

Appendix D.

**REMOVAL ACTION
SAMPLING AND ANALYSIS
PLAN**

**Cleveland Mill Site
Grant County, New Mexico**

Prepared for:

**Bayard Mining Corporation
Mining Remedial Recovery Company
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1. INTRODUCTION..... 1

 1.1 Background.....1

 1.2 Purpose and Objectives.....1

 1.3 Scope of Work.....2

 1.4 Document Organization.....3

2. FIELD SAMPLING PLAN 4

 2.1 Air Quality Program.....4

 2.1.1 Objective.....4

 2.1.2 Sampling Locations and Frequency.....4

 2.1.3 Field Procedures and Standard Operating
 Procedures.....5

 2.1.4 Analysis.....5

 2.2 Soil Sampling Program.....5

 2.2.1 Objective.....5

 2.2.2 Sampling Locations and Frequency.....5

 2.2.3 Deciding Whether the Cleveland Mill Site
 Meets Cleanup Levels.....10

 2.2.4 Standard Operating Procedures.....11

 2.2.5 Analysis.....11

 2.2.6 Conclusions.....11

 2.3 Groundwater Sampling Program.....12

 2.3.1 Objective.....12

 2.3.2 Sampling Locations and Frequency.....12

 2.3.3 Field Procedures and Standard Operating
 Procedures.....12

 2.3.4 Analysis.....13

 2.4 Surface Water Sampling Program.....13

 2.4.1 Objective.....13

2.4.2 Sampling Locations and Frequency..... 13
2.4.3 Field Procedures and Standard Operating
Procedures 13
2.4.4 Analysis..... 14
2.5 General..... 14
2.5.1 Sample Identification 14
2.5.2 Analysis..... 14
2.5.3 Sample Handling and Documentation..... 16
2.5.4 Equipment Decontamination..... 16
REFERENCES 16

List of Tables

Table 1. Removal Action Cleanup Levels for Soil and Groundwater..... 2
Table 2. Sampling Objectives. 3
Table 3. Cleveland Mill Area Solid Material Sampling Subunits..... 6
Table 4. Maximum Number of Samples Needed to Verify Cleanup..... 9
Table 5. Solid Material Sample Analytical and Container Requirements... 16
Table 6. Water Sample Analytical and Container Requirements. 16

List of Figures

Figure 1. Cleveland Mill Site Map.

List of Plates

- Plate 1. Air Monitoring Locations.
- Plate 2. Approximate Soil Sampling Locations.
- Plate 3. Groundwater Monitoring Locations.
- Plate 4. Surface Water Monitoring Locations.

List of Attachments

Attachment 1. Standard Operating Procedure for High Volume Air Sampling.

Attachment 2. Standard Operating Procedure for Soil Sampling.

Attachment 3. Standard Operating Procedure for Groundwater Sampling.

Attachment 4. Standard Operating Procedure for Water Level Measurements.

Attachment 5. Standard Operating Procedure for Surface Water Sampling.

Attachment 6. Standard Operating Procedure for Air, Water and Soil Analytical Techniques.

Attachment 7. Standard Operating Procedure for Sample Handling and Documentation.

Attachment 8. Standard Operating Procedure for Equipment Decontamination.

1. INTRODUCTION

The Removal Action Sampling and Analysis Plan (SAP) describes the field sampling and analytical activities for the Cleveland Mill site. The SAP was prepared in accordance with several EPA documents (EPA, 1987, 1988, 1989 and 1990).

1.1 Background

The Cleveland Mill site is located in the Pinos Altos Mining District, approximately five miles north of Silver City, in Grant County, New Mexico (Figure 1). The Cleveland Mill site includes approximately four acres, on which are located building foundations (including the mill foundations), various roads, a water storage reservoir, and materials discarded during mining and ore processing operations. The Cleveland Mill site also includes approximately 14 acres in and along the creekbed of Little Walnut Creek. The Cleveland Mill site contains approximately 70,900 cubic yards of tailings, cobbled ore, and various sediments (hereafter referred to as the "Cleveland Mill material") resulting from the former mining and milling operations (Figure 1).

A detailed site description and discussion of previous investigations can be found in the Record of Decision (ROD) (EPA, 1993) and the Removal Action Work Plan for Cleveland Mill site.

1.2 Purpose and Objectives

The purposes of the sampling and analysis program are:

- to monitor air quality for airborne particulates to establish that the removal action has been carried out in an appropriate manner;
- to obtain solid material sample data that can be used to verify that the soil cleanup levels set forth in Table 1 for the Cleveland Mill site are met;
- to monitor groundwater quality; and
- to monitor surface water quality.

The cleanup levels for the metals in the soil medium and the groundwater, which are taken from the ROD, are presented in Table 1.

Table 1. Removal Action Cleanup Levels for Soil and Groundwater.

Parameter	Soil	Groundwater
	ppm	mg/L
Arsenic	30	0.05
Beryllium	4	0.004
Cadmium	140	0.05
Copper		1.0
Lead	500	0.005*
Mercury		0.002
Silver		0.05*
Zinc	82,000	5

NOTE: All groundwater cleanup levels are federal maximum contaminant levels (MCLs) except as noted:
 * = New Mexico Water Quality Control Commission standards.

1.3 Scope of Work

This SAP describes the planned site-specific sampling, analysis, and monitoring tasks, which consist of:

- sample types,
- locations and frequency,
- sampling procedures and equipment,
- sample handling and documentation,
- equipment decontamination procedures,
- analytical requirements, and
- reporting.

The Quality Assurance Project Plan (QAPP, Appendix E of the Removal Action Work Plan) describes the policies, organization, objectives, functional activities, and specific Quality Assurance (QA) and Quality Control (QC) procedures that will be used to ensure the validity of the field sampling activities and analytical data generated during the project.

Together, the SAP, QAPP and Removal Action Work Plan comprise the primary management tools which will be used to guide the project and ensure its successful completion. Sampling objectives are summarized in Table 2.

Table 2. Sampling Objectives.

Sampling Objectives	Data Collection Activities	General Analytical Strategy	Data Uses
1. Airborne particulates-Monitor potential personal exposure to and off site transport of airborne metal compounds during removal action.	Air sampling and real-time monitoring of total suspended particulates.	Inorganic chemical analysis	Evaluate airborne particulates and determine dust-control operations.
2. Solid material-Verify removal of material and attainment of cleanup levels.	Surface soil sampling	Geochemical analysis	Removal verification
3. Groundwater-Monitor groundwater quality.	Monitor well sampling	Chemical and water quality parameters	Monitor changes in groundwater quality
4. Surface Water-Monitor the change in surface water quality.	Surface water sampling	Chemical and water quality parameters	Monitor changes in surface water quality

1.4 Document Organization

The SAP is composed of the following parts:

- Field Sampling Plan, and
- Quality Assurance Project Plan (Appendix E, Removal Action Work Plan).

Standard Operating Procedures (SOPs) for sample collection, handling, documentation, analytical techniques and equipment decontamination have been developed. The following SOPs are applicable to this project and are provided as a set of attachments to the SAP:

1. High Volume Air Sampling;
2. Soil Sampling;
3. Groundwater Sampling;
4. Water Level Measurements;
5. Surface Water Sampling and Flow Measurements;
6. Air, Water and Soil Analytical Techniques;
7. Sample Handling and Documentation; and
8. Equipment Decontamination.

2. FIELD SAMPLING PLAN

The scope of work set out in the SAP consists of:

- air sampling;
- solid material sampling;
- groundwater sampling; and
- surface water sampling.

The field sampling plan for each medium is presented in separate sections below.

2.1 Air Quality Program

2.1.1 Objective

The objective of the air quality sampling program is to accurately monitor potential exposure to and migration of airborne metal compounds during the removal action. The monitoring results will be used to establish and, if necessary, modify the levels of protection for on site workers and the dust control operations during the removal action.

2.1.2 Sampling Locations and Frequency

Three total suspended particulate (TSP) high volume (hi-vol) air samplers will be utilized to monitor airborne dust levels being transported from the Cleveland Mill site and three real-time aerosol monitors (personal DataRAMs) will be used to determine dust control operations and confirm appropriate levels of personal protection during various tasks which may generate greater than expected air emissions. The TSP air monitoring equipment will be placed at approximately 5 to 6 feet off the ground level on the first and second (upgradient) sediment control structures in Little Walnut Creek and at the sediment control structure downgradient of the Cleveland Mine as illustrated in Plate 1, Air Monitoring Locations. The personal DataRAMs will be placed inside one cab of the excavating or loading equipment, and at each of the working areas (i.e. the disposal cell area and the mill area during the loading of the tailings). Semi-permanent stable and weatherproof stations have been constructed for personal DataRAM monitoring at the disposal cell and mill area, based on prevailing wind directions. However, the exact locations for air monitoring will be modified in the field on a daily basis by the Project Manager if variation in daily wind direction warrants this change. Temporary tripod setups for the monitoring instruments are available for this purpose, and the locations used will be documented. Two wind socks will be used to determine the daily wind directions. It has been established that site personnel working in and around activities that generate greater than expected air emissions will wear respirators as required by 29 C.F.R. §1910.134.

Hydrogen Sulfide (H₂S) will also be monitored during excavation and bulk sampling activities. Personnel working in areas where Cleveland Mill material is being excavated (loader and bulldozer operators as well as anyone conducting sampling) will wear colorimetric badges which monitor and warn of H₂S levels well below the exposure ceiling.

Background air sampling will occur for two days prior to the beginning of earthwork activity at the site. Additional air sampling will begin three days prior to commencement of the Cleveland Mill material excavation and removal activities and terminate five days after the cessation of these activities. Air monitoring will be

performed daily during the first week of Cleveland Mill material excavation and removal activities. After the first week, air monitoring will be conducted approximately one day per six days of working time. The sampling frequency will be reviewed and may be revised by EPA/NMED.

2.1.3 Field Procedures and Standard Operating Procedures

To provide defensible data, air monitoring stations will be sited in accordance with the Standard Operating Procedure for High Volume Air Sampling (Attachment 1), which references the applicable portions of the Code of Federal Regulations (40 CFR Part 58). The air samplers will be operated for the duration of the work day.

2.1.4 Analysis

TSP sample filters will be submitted for CLP RAS analysis of arsenic, beryllium, cadmium, copper, lead, and zinc using modified Method 3050--Acid digestion of sediments, sludges, and soils as described in Attachment 6, Standard Operating Procedure for Air, Water and Soil Analytical Techniques. Hydrogen Sulfide (H₂S) will also be monitored during excavation, drilling and bulk sampling activities involving Cleveland Mill material. At least two personnel working in areas where active excavation is occurring and the PM will wear colorimetric badges which monitors and warn of H₂S levels as described in Attachment 6, Standard Operating Procedure for Air, Water and Soil Analytical Techniques.

2.2 Soil Sampling Program

2.2.1 Objective

The purpose of the soil (including stream sediment) sampling program is to confirm the removal of Cleveland Mill material with metals concentrations above the cleanup levels. The data collected during soil sampling program will determine the concentrations of metals of concern in the remaining solid phase material and be used to statistically verify removal of the Cleveland Mill material.

In the event that the Cleveland Mill material or naturally occurring unconsolidated material are excavated to bedrock, bedrock outcrops will not be sampled and no excavation of bedrock will occur. Soil replacement and reclamation will not be performed in excavated areas in which tailings are removed to bedrock. Areas which are excavated to clean soil will be sampled for nutrient analyses and, if necessary, covered with up to 6 inches of random fill and revegetated for reclamation. Soil replacement and reclamation will not be performed in the stream areas where tailings have been excavated.

2.2.2 Sampling Locations and Frequency

Soil sample locations and frequency have been determined for Little Walnut Creek streambed and the Cleveland Mill area. Sampling locations and frequency for Little Walnut Creek sediment are based on a longitudinal profile, whereas sampling at the Cleveland Mill area is based on stratified sampling protocol from EPA 230/02-89-042 entitled "Methods for Evaluating the Attainment of Cleanup Standards. Volume I. Soils and Solid Media".

2.2.2.1 Little Walnut Creek Streambed

During the RI, the creekbed was divided into approximately 1,000 foot segments and a stream sediment sampling transect was established at each segment. To verify the removal of tailings material in the stream, composite samples will be collected from sampling transects every 250 feet from the mill area to the Hughes' sediment control structure. One composite sample per transect will be obtained by collecting

soil every 5 feet perpendicular to stream flow with a maximum of 5 samples per transect. In the case where the stream is greater than 25 feet across, the samples will be collected such that there is equal spacing between each sample along the transect. In the event that bedrock only is exposed at a sample location, no sample will be collected.

2.2.2.2 Cleveland Mill Area

The sampling locations for the four acres surrounding the mill foundations and main tailings piles were determined by utilizing the protocol described in EPA 230/02-89-042. Three sampling styles are available: random sampling, stratified sampling and systematic sampling. Stratified random sampling is the method by which the removal action will be evaluated. Stratified sampling is appropriate because the statistical evaluation will be improved by dividing the site into the subunits listed above which provide a more homogeneous strata. The four acre sample area will be divided into a series of subunits based on the location and material designation.

Specifically, seven subunits have been selected. Each of these subunits offers more precise estimates of metals levels, and allows for potential follow-up excavation to focus directly on affected subunits. Each individual subunit is identified Table 3 along with its approximate surface area and estimated volume.

Table 3. Cleveland Mill Area Solid Material Sampling Subunits.

Subunit	Approximate Area (ft ²)	Volume (yd ³)	Proportion of Volume*
East Tailings	35,000	11,000	0.155
West Tailings	45,000	19,000	0.268
Cobbed Ore Pile	8,750	15,000	0.211
Western Hillside Piles	12,000	2,500	0.035
Dust Piles	10,000	900	0.013
Mine Spoils	20,000	15,000	0.211
Roadbed Soils	30,000	1,500	0.021
TOTALS	160,750	64,900	0.914

* Calculations to determine the proportion of volume contributed by each subunit include the volume of tailings to be removed from Little Walnut Creek (6,000 yds³) in the total volume of material (70,900 yds³).

Chapter 7 in EPA 230/02-89-042 describes how to calculate the number of samples needed for each subunit to verify that 95% of the soil at the site has concentrations below the cleanup levels.

There are three basic steps involved in the stratified sampling protocol:

- determine the required sample size for each subunit;

- within each subunit, identify the locations from which the soil units are to be selected, collect the physical samples, and send the sampled material to the laboratory for analysis; and
- perform appropriate statistical analysis and, on the basis of the results, decide whether the site has attained the cleanup levels.

Although the exact number of soil samples to be collected to verify compliance with the cleanup levels at the Cleveland Mill site is dependent on the amount of area which has been excavated to bedrock, the sample areas for the main portion of the Cleveland Mill site, around the mill foundations are a maximum and are calculated below and presented in Table 4, Maximum Number of Samples Needed to Verify Cleanup.

2.2.2.2.1 Sample Size Determination

According to EPA 230/02-89-042, the equation to use for computing the sample size for subunit h is:

$$n_{hd} = P_0 (1 - P_0) * \left\{ \sum W_h \sqrt{C_h} \right\} * \left\{ z_{1-\alpha} + z_{1-\beta} / P_0 - P_1 \right\}^2 * W_h / \sqrt{C_h}$$

Each of the terms in this expression are defined and described in the table below:

Variable	Definition
h	As a subscript, indicates a value for a subunit within the sample area rather than for the entire sample area.
n_{hd}	The target sample size for the cleanup evaluation calculation.
n_h	The actual sample size (should ideally be equal to N_{hd}).
W_h	Proportion of the volume of soil in the sample area which is in subunit h.
C_h	Cost of collecting, processing, and analyzing one additional soil sample, on a relative scale.
C_s	The cleanup level relevant to the sample area and the metal being tested.
P	The "true" but unknown proportion of the sample area with metal concentrations greater than the cleanup level.
P_h	The "true" but unknown proportion of subunit h with metal concentrations greater than the cleanup level.
P_0	The criterion for defining whether the sample area meets the cleanup level. According to the attainment objectives, the sample area attains the cleanup level if the proportion of the sample area with metal concentrations greater than the cleanup level is less than P_0 , (i.e., the sample area is clean if $P > P_0$).
α	The desired false positive rate for the statistical test to be used. The false positive rate for the statistical procedure is the probability that the sample area will be declared to be clean when it is actually dirty.

P_1	The value of P under the alternative hypothesis for which a specified false negative rate is to be controlled. Think of P_1 as the value less than P_0 ($P_1 < P_0$) that designates a very clean area that must, with great certainty, be designated clean by the statistical test.
β	The false negative rate for the statistical procedure is the probability that the sample area will be declared to be dirty when it is actually clean and the true mean is P_1 . The desired sample size n_d is selected so that the statistical procedure has a false negative rate of β at P_1 .
y_{hi}	The scored concentration data where $y_{hi} = 1$ if the measured concentration is greater than the cleanup level and 0 otherwise.

The following assumptions have been made:

- the costs of sampling for each subunit are assumed to be equal, therefore $C_h = 1$ for all subunits;
- because data are not available to provide an estimate of P_h , P_h is set equal to P_0 for all subunits.

For this sampling procedure, EPA requires that less than 5 percent of the soil ($P_0 = .05$) can have concentrations over the cleanup levels (with a confidence of 95 percent, $\alpha = .05$). The false negative rate for the test has been chosen to conclude that the site is clean with a confidence of 80 percent ($\beta = .20$) at an overall contamination proportion of 2 percent ($P_1 = .02$). Using Table A.2 from EPA 230/02-89-042, $z_{1-\alpha} = 1.645$ and $z_{1-\beta} = 0.842$.

Note that all variables except W_h , the proportion of the volume of soil in the total study area contained in subunit h , are constant for all subunits. The maximum number of samples required for each subunit is dependent on its relative size to assure 95 percent confidence that less than 5 percent of the soil has concentrations greater than the cleanup levels are reported in Table 4.

Table 4. Maximum Number of Samples Needed to Verify Cleanup.

Subunit	Maximum Number of Samples to assure 95% Confidence*
East Tailings	51
West Tailings	88
Cobbed Ore Pile	69
Western Hillside Piles	12
Dust Piles	4
Mine Spoils	69
Roadbed Soils	7
TOTALS	300

* Assumes that excavation for all areas will not extend to bedrock. Actual sample numbers may be less depending on bedrock outcrops.

The collection locations for these samples must be located randomly within the subunit by randomly selecting a range of (X,Y) coordinates within each section.

2.2.2.2.2 Random Selection of Samples in a Subunit

Following the procedure found in Chapter 5 of EPA 230/02-89-042, the first step in the random selection of samples is to obtain a detailed map of the boundaries of the entire site with the clearly defined subunits. A separate rectangular grid is drawn around each of the subunits and the origin is defined in each grid, typically in the lower left hand corner. The grid must encompass the entire subunit area, and depending on the shape of the subunit, the rectangular shape of the grid will most likely exceed the sample area. The X and Y coordinates of each grid must be specified according to the size of the area and to what distances sample locations can be easily measured. With an overall area of 4.0 acres, it may be only reasonable to identify a location within 5-10 m. The minimum and maximum coordinate ranges within each grid are identified as X_{min} to X_{max} and Y_{min} to Y_{max} .

For each subunit, random (X,Y) coordinates will be generated using the steps and formulas below until the required number of samples have been identified.

1. Generate a set of coordinates (X,Y) using the following equations:

$$X = X_{min} + (X_{max} - X_{min}) * RND$$

$$Y = Y_{min} + (Y_{max} - Y_{min}) * RND$$

RND is the next unused random number between 0 and 1 in a sequence of random numbers generated by hand-held calculator.

2. If generated (X,Y) coordinates within the grid lie outside the sample area, return to step 1 to generate another random coordinate; otherwise go to step 3.
3. Define (X_i,Y_i) using the following steps:
 - Round X to the nearest unit that can be located easily in the field; set this equal to X_i
 - Round Y to the nearest unit that can be located easily in the field; set this equal to Y_i
4. Continue to generate the next random coordinate until the sample size requirement has been filled.

2.2.2.2.3 Field Procedures for Determining Exact Sampling Locations

Difficulties may arise in the field when attempting to sample at the random locations. This may be caused by the natural existence of steep slopes, vegetation, boulders, etc. which may inhibit sampling at the exact predetermined location. In this case, the procedure to move from the location identified from the reference points (which is unattainable) to the final sample collection point will be to choose a random distance to go in the X and Y direction (i.e. 10 steps) and take the sample at this point.

2.2.3 Deciding Whether the Cleveland Mill Site Meets Cleanup Levels

2.2.3.1 Little Walnut Creek

To determine whether Little Walnut Creek meets the cleanup levels after sampling and analyses are complete, the data will be examined individually and longitudinally. If a section fails the cleanup levels, that area will be re-examined and, if appropriate, re-excavated, re-sampled and re-evaluated.

2.2.3.2 Cleveland Mill Area

The data will be evaluated to determine whether the site meets the cleanup levels after sampling and analyses are complete. The results will be statistically evaluated by the strata evaluation approach outlined in EPA 230/02-89-042 and below.

The statistical evaluation to be used designates each soil sample measurement as either equal to or above the cleanup level C_s and coded as "1", or below C_s and coded as "0". The determination of whether the site meets the cleanup levels depends on the proportion of samples that are above the cleanup levels. If the proportion of 1's are high, additional removal of material may be necessary. Similarly, if the proportion of 0's is sufficiently large, the site will be declared clean. The proportion of samples which fall above or below the cleanup levels, C_s , is then used to calculate the upper limit of the predefined confidence interval which is then compared to P_0 . To calculate the upper limit of the confidence interval ($P_{U\alpha}$) the equation is used below:

$$P_{U\alpha} = P_{st} + Z_{1-\alpha} + S_{pn}$$

To evaluate,

If $P_{U\alpha} < P_0$ (.05 in this case), conclude that the site meets the cleanup levels.

If $P_{U\alpha} > P_0$ (.05), conclude that the site does not meet the cleanup levels.

Each of the terms required to perform the evaluation is presented below. The standard error, s_{ps} , is a measure of the variability (or precision) of a sample estimate and is used to establish confidence intervals around the actual population proportion.

$$s_{ps} = \sqrt{\sum_{h=1}^7 W_h^2 [p_h(1-p_h) / n_h]}$$

The estimated overall proportion of soil units, p_{st} , that have chemical concentrations exceeding C_c is given by the formula:

$$p_{st} = \sum_{h=1}^7 W_h p_h$$

where p_h is the sample proportion of units in subunit h that have chemical concentrations exceeding C_c , and is determined using the equation below:

$$p_h = \sum_{i=1}^n y_{hi} / n_h$$

where y_{hi} is the scored concentration data in subunit h where $y_{hi} = 1$ if the measured concentration is greater than the cleanup level and 0 otherwise, and n_h is the total number of samples in subunit h .

2.2.4 Standard Operating Procedures

Surface soil samples, including stream sediment samples, will be collected from the top four inches of exposed unconsolidated material to a maximum depth of four inches below ground surface (bgs) using disposable plastic spoons. Bedrock outcrops will not be sampled. All samples will be placed into appropriate sample containers with proper sample designation markings. Surface soil sampling procedures will be in accordance with Attachment 2, Standard Operating Procedure for Soil Sampling.

2.2.5 Analysis

Soil samples will be submitted for CLP analysis (limited to arsenic, beryllium, cadmium, lead and zinc) by Method 3050/6010 as described in Table 2. The procedure for Method 3050/6010 is described in Attachment 6, Standard Operating Procedure for Air, Water and Soil Analytical Techniques. It is expected that there will be approximately 14 days between a sampling event and delivery to the project team of the analytical results; another 5 days will be required to validate the data. For QC purposes, 10 percent of the samples will be submitted for duplicate laboratory analysis, 10 percent of the samples will be analyzed for the full suite of TAL metals and approximately 20 percent of the samples will be collected in splits for analysis by EPA. The frequency and analyte list will be reviewed and may be revised by EPA/NMED and the Settling Defendants. All sampling results will be copied to the EPA Project Manager.

2.2.6 Conclusions

This stratified random sampling plan for the Cleveland Mill site proposes that a maximum of 300 soil/sediment samples be taken randomly over seven subunits derived from the 4.0 acre total site area to

ensure a 95 percent confidence that less than 5 percent of the soil/sediment exceeds the cleanup levels. Additionally, composite sediment samples will be collected from Little Walnut Creek every 250 feet from the Cleveland Mill area to the Hughes' sediment control structure. The number of actual samples to be taken may be less in the event that excavation is to bedrock. The samples will be used to statistically evaluate if a subunit meets the cleanup levels. If exceedances occur, the testing can be used to identify locations within the subunit which will need to undergo further evaluation and, if appropriate, excavation in order to meet cleanup levels.

2.3 Groundwater Sampling Program

2.3.1 Objective

Based on the metals concentrations detected in groundwater during the RI, groundwater quality samples will be analyzed for the cleanup metals listed in Table 1, Removal Action Cleanup Levels for Soil and Groundwater. In general, for ground water samples collected during the RI, dissolved metal concentrations were detected at approximately 95% of total metal concentrations; therefore, all groundwater samples will be field filtered and analyzed for dissolved metals. Field parameters will include temperature, pH, and electrical conductivity. Analytical methods for water samples are presented in Attachment 6, Standard Operating Procedure for Air, Water and Soil Analytical Techniques.

2.3.2 Sampling Locations and Frequency

Groundwater sampling will be performed on two monitoring wells near the Cleveland Mill disposal cell, and the residential wells at the Hughes property and the Hood property. Proposed groundwater monitoring well locations are presented in Plate 3, Groundwater Monitoring Locations. For QC purposes, 10 percent of the samples will be submitted for duplicate laboratory analysis, 10 percent of the samples will be analyzed for the full suite of TAL metals and approximately 20 percent of the samples will be collected in splits for analysis by EPA. The frequency and analyte list will be reviewed and may be revised by EPA/NMED and the Settling Defendants.

Prior to commencement of activities at the Cleveland Mill site, a base-line water quality data set was collected for each existing monitoring well and are in Attachment 1 of the Removal Action Work Plan. Following the removal action, each of the two monitoring wells (97MW-04 and 97MW-05) and the two residential wells will be sampled on a quarterly basis for a period of five years. In addition, a replacement for well MW-1 will be constructed at the toe of the mill tailings area when tailings removal is completed, and this well will be included in the five year monitoring program.

2.3.3 Field Procedures and Standard Operating Procedures

Groundwater sampling will be performed in accordance with Attachment 3, Standard Operating Procedure for Groundwater Sampling. Water level measurements will be collected as described in Attachment 4, Standard Operating Procedure for Water Level Measurements.

2.3.4 Analysis

Based on the metals concentrations detected in monitoring well water during the RI, groundwater quality samples will be analyzed for dissolved arsenic, beryllium, cadmium, copper, lead, mercury, silver and zinc. Field parameters will include temperature, pH and electrical conductivity. In addition, 10 percent of the samples will be analyzed for the full suite of TAL metals. The frequency and analyte list will be reviewed and may be revised by EPA/NMED and the Settling Defendants.

It is expected that there will be approximately 14 days between a sampling event and delivery to the project team of the analytical results; another 5 days will be required to validate the data. Analytical methods for water samples are presented in Attachment 6, Standard Operating Procedure for Air, Water and Soil Analytical Techniques.

2.4 Surface Water Sampling Program

2.4.1 Objective

The objective of the surface water sampling program is to document the change in the water quality of the mill valley tributary and Little Walnut Creek as a result of the removal action.

2.4.2 Sampling Locations and Frequency

Surface water sampling will be performed at five locations: in the mill valley tributary to Little Walnut Creek at the toe of the tailings area, at the Gypsum Spring, at the first sediment control structure, at the sediment control structure furthest downstream, and in Picnic Creek after the confluence with Little Walnut Creek. Proposed surface water monitoring locations are presented in Plate 4, Surface Water Monitoring Locations.

Prior to commencement of activities, a base-line surface water quality data set was collected for each sampling location and the results are provided in Attachment 1 of the Removal Action Work Plan. Following completion of the removal activities, each of the sampling locations will be sampled on a quarterly basis for a period of five years. For QC purposes, 10 percent of the samples will be submitted for duplicate laboratory analysis, 10 percent of the samples will be analyzed for the full suite of TAL metals and approximately 20 percent of the samples will be collected in splits for analysis by EPA. The frequency and analyte list will be reviewed and may be revised by EPA/NMED and the Settling Defendants.

2.4.3 Field Procedures and Standard Operating Procedures

Surface water sampling will be performed in accordance with Attachment 5, Standard Operating Procedure for Surface Water Sampling. Based on the metals concentrations detected in surface water during the RI, surface water quality samples will be analyzed for the cleanup metals listed in Table 1, Removal Action Cleanup Levels for Soil and Groundwater. Surface water samples will be field filtered and analyzed for dissolved metals. Field parameters will include temperature, pH, and electrical conductivity. Analytical methods for water samples are presented in Attachment 6, Standard Operating Procedure for Air, Water and Soil Analytical Techniques.

2.4.4 Analysis

Based on the metals concentrations detected in monitoring well water during the RI, surface water quality samples will be analyzed for dissolved arsenic, beryllium, cadmium, copper, lead, mercury, silver and zinc. Field parameters will include temperature, pH and electrical conductivity. It is expected that there will be approximately 14 days between a sampling event and delivery of the analytical results to the project team; another 5 days will be required to validate the data. Analytical methods for water samples are presented in Attachment 6, Standard Operating Procedure for Air, Water and Soil Analytical Techniques.

2.5 General

2.5.1 Sample Identification

The Project Manager will assign unique sample numbers to each sample. The sample numbers will be based on an alphanumeric code. The sample numbers will be organized according to the various sample matrices (e.g., air, creek sediment, soil). The code will begin with CMRA for Cleveland Mill Removal Action, followed by a description of the sample matrix (e.g., A = air, CS = creek sediment, S = soil) and a three digit number identifying the sequential series (i.e., 001).

Example: CMRACS001, Sample number one, sample matrix creek sediment, collected at the Cleveland Mill site during the removal action.

Laboratory CLP traffic reports, chain-of-custody forms, packing lists, and sample tags will be used to ensure that the integrity of the samples is maintained during collection, storage, and analysis. All sample control and chain-of-custody procedures will follow the CLP users guide (EPA, 1988). Examples of the forms and paperwork and a complete description of sample identification, handling and documentation is presented in Attachment 7, Standard Operating Procedure for Sample Handling and Documentation.

2.5.2 Analysis

Samples collected to monitor air quality, to confirm the removal of Cleveland Mill material, to establish baseline water quality, and to monitor water quality will be analyzed by EPA Contract Laboratory Program (CLP) protocol in an EPA approved laboratory. Analytical, preservation, and sample container requirements, and the expected number of samples for each sample medium are summarized in Table 4, Table 5, and Table 6. The analyte list and corresponding analytical methods are presented in Attachment 6, Standard Operating Procedure for Air, Water and Soil Analytical Techniques. All analytical procedures will follow the CLP User's Guide (EPA, 1988).

Table 5. Solid Material Sample Analytical and Container Requirements.

PARAMETER	METHOD	CONTAINER Type/Size	PRESERVATIVE	HOLDING TIME
Total arsenic, beryllium, cadmium, lead and zinc	CLP RAS	1-8 oz. wide mouth glass jar	None	6 months
Total aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium and zinc*	CLP RAS	1-8 oz. wide mouth glass jar	None	6 months

* = Analyte list for 20% of samples. May be reviewed and revised by EPA/NMED and Settling Defendants.

Table 6. Water Sample Analytical and Container Requirements.

PARAMETER	METHOD	CONTAINER Type/Size	PRESERVATIVE	HOLDING TIME
Dissolved Metals	CLP RAS	One 1-L wide mouth container	HNO ₃ , pH<2	6 months
Major Anions	CLP SAS	One 1-L wide mouth container	NaOH, pH>12	14 days

CLP RAS = EPA's Contract Laboratory Program Routine Analytical Services analysis for Target Analyte List of Inorganic Constituents.

CLP SAS = EPA's Contract Laboratory Program Special Analytical Services analysis for major anions.

NOTE: All water samples will be measured in the field for conductivity, pH, and temperature.

2.5.3 Sample Handling and Documentation

Samples collected during the removal action will be analyzed through a CLP laboratory. Analytical requirements are summarized in the above tables, along with the respective analytical methods, containers, preservatives, and holding times. A complete description of the sample handling and documentation protocol is presented in Attachment 7, Standard Operating Procedure for Sample Handling and Documentation. CLP traffic reports, chain-of-custody forms, packing lists, and sample tags will be used to ensure that the integrity of the samples is maintained during collection, storage, and analysis.

2.5.4 Equipment Decontamination

When necessary, expendable sampling and personal protective equipment will be used. When non-expendable equipment is used, decontamination will be performed in the decontamination area and will consist of an initial wash in Alconox detergent solution, followed by a clean water rinse, and two distilled water rinses. The equipment decontamination procedure is described in Attachment 8, Standard Operating

Procedure for Equipment Decontamination. In summary, the equipment decontamination procedure will be as follows:

1. wash equipment with high pressure water rinse and wire or plastic brush, if necessary;
2. wash equipment with Alconox and tap water;
3. rinse with tap water; and
4. double rinse with distilled water.

Rinsate from the decontamination process will be used in dust suppression operations.

REFERENCES

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STANDARD OPERATING PROCEDURE

Groundwater Sampling

Prepared for:

Bayard Mining Corporation
Mining Remedial Recovery Company
Viacom International Inc.

August 27, 1997
SOP NUMBER: SOP-GWS021



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1. PURPOSE..... 1

2. MATERIALS REQUIRED 1

3. PROCEDURE 3

 3.1 Decontaminate Equipment.....3

 3.2 Instrument Calibration.....3

 3.3 Evacuate Well.....3

 3.4 Obtain Water Samples.....4

 3.5 Filtering Samples5

4. QUALITY ASSURANCE..... 6

 4.1 Rinsate Samples.....6

 4.2 Duplicate Samples6

 4.3 Field Blanks.....6

 4.4 Matrix Spikes.....7

 4.5 Sample Handling.....7

5. REPORTING 7

 5.1 Field Sampling Data.....7

 5.2 Field Notes.....7

 5.3 Well Volume Calculations.....8

1. PURPOSE

The purpose of this document is to define the standard procedure for collecting groundwater samples from wells. This procedure gives descriptions of equipment, field procedures and QA/QC procedures necessary to collect groundwater samples from wells. The sample locations and frequency of collection are specified in the main report.

2. MATERIALS REQUIRED

Sample bottles with preservatives will be obtained from the analytical laboratory. Several extra sample bottles should be obtained in case of breakage or other problems.

Equipment that may be used during well purging is listed below:

- well keys,
- electronic water level probe,
- assorted tools (knife, screwdriver, etc.),
- PVC or Teflon bailer (bottom filling),
- PVC hand pump,
- nylon rope or twine,
- bailer tripod,
- trilock pumps,
- PVC pump discharge hose,
- gas-powered electric generator,
- stainless steel submersible pump,
- thermometer,
- pH meter (with automatic temperature compensation),
- specific conductance meter,
- dissolved oxygen meter,
- plastic squeeze bottle filled with distilled water,
- polyethylene or glass container (for field parameter measurements),

- chemical-free paper towels or Kimwipes,
- calculator,
- field notebook,
- waterproof pen,
- holding tank for storing purge water (except for EPA wells),
- plastic sheeting (for placing around well), and
- appropriate health and safety equipment.

Equipment used during well sampling consists of:

- electronic water level measurement probe,
- PVC, Teflon, or stainless steel bailers (bottom filling),
- stainless steel submersible pump,
- PVC pump discharge hose,
- electric generator,
- nylon rope or twine,
- bailer tripod,
- trilock pumps,
- thermometer,
- pH meter (with automatic temperature compensation),
- specific conductance meter,
- dissolved oxygen meter,
- plastic squeeze bottle filled with distilled water,
- sample bottles,
- dedicated jug for holding sample for filtering,
- cooler with ice,
- polyethylene or glass jar for field measurement samples, and
- sample labels.

Equipment used during sample filtration includes:

- disposable filterware with 0.45-micron filter,
- hand pump or peristaltic pump, and
- tygon tubing (2- to 4-ft lengths).

Equipment used during decontamination is as follows:

- alconox soap (or equivalent),

- potable tap water,
- distilled water,
- decontamination buckets/pails,
- large sponges,
- plastic brushes, and
- garden-type sprayer filled with distilled water.

3. PROCEDURE

This section gives the step-by-step procedures for collecting samples in the field. Observations made during sample collection should be recorded in the field notebook as specified in the Section 5 of this SOP.

3.1 Decontaminate Equipment

Before any evacuation or sampling begins, all well probes, bailers, and other sampling devices must be decontaminated. If dedicated equipment is used, it should be rinsed with distilled water. Dedicated downhole pumps will not be decontaminated. Mobile decontamination supplies will be provided so that equipment can be decontaminated in the field. Each piece of evacuation and/or sampling equipment must be decontaminated before sampling operations and between each well. The decontamination solutions must be replaced with clean solutions between each well. Used solutions will be placed in the container with evacuated well water for disposal. A discussion of equipment and personnel decontamination is contained in the SOP DEC047, Decontamination, and in the Health and Safety Plan.

3.2 Instrument Calibration

Electronic equipment used during sampling includes a pH meter, a temperature probe, a conductivity meter, a dissolved oxygen (DO) meter, and a water level measurement probe. Before going into the field, the sampler shall verify that all of these are operating properly. The pH, DO, and conductivity meters require calibration prior to use every day and must be recalibrated if they have been turned off. Calibration times and readings will be recorded in a notebook to be kept by the field sampler. Specific instructions for calibrating the instruments are given in the instrument operation manuals.

3.3 Evacuate Well

The purpose of well purging is to remove stagnant water from the well and obtain representative water from the geologic formation being sampled while minimizing disturbance to the collected samples. Before a sample is taken, the well will be purged until a minimum of three borehole volumes have been removed and/or field parameters have stabilized or until the well is pumped or bailed dry. All wells shall be purged on the same day that samples are taken. Evacuated well water will be used in dust suppression operations as described in the SAP.

Before well purging begins, the following procedures are to be performed at each well:

- Note the condition of the outer well casing, concrete well pad, protective posts (if present), and any other unusual conditions of the area around the well.
- Place clean plastic sheeting around the well.
- Open the well.
- Note the condition of the inner well cap and casing.
- Measure (to nearest 0.01 foot) and record depth of static water level from the measuring point on the well casing and indicate time. Record what the measuring point is (i.e., notch on north side, top of PVC well casing).
- Measure and record total depth of well from the same measuring point on the casing.
- Calculate volume of water in the well casing in gallons based on feet of water and well bore diameter. (See Section 5 of this SOP.)
- From the above calculation, calculate the three borehole volumes to be evacuated.
- Obtain an initial sample (which is not retained) from the bailer or purge pump for field measurements (temperature, DO, conductivity, and pH measurements) and observations of water quality.
- Evacuate three borehole volumes of water with a bailer or pump; collect water for later disposal. Take temperature, DO, specific conductance, and pH measurements periodically, at least after evacuation of each well volume to confirm that the water chemistry has stabilized. Generally, pH values within 0.1 pH unit among 3 consecutive readings indicate good stability of the water chemistry. If the chemistry is not stable, continue purging, measuring pH, DO, and specific conductance after each one-half well volume.
- When evacuating a well using a pump, the pump intake should be placed as follows:
 - for low recovery wells (wells which can be pumped dry), place pump intake at bottom of screened interval;
 - for high recovery wells (little drawdown with pumping), place pump at top of screened interval.
- If the well is bailed or pumped dry during evacuation, it can be assumed that the purpose of removing 3 borehole volumes of water has been accomplished, that is, removing all stagnant water which had prolonged contact with the well-casing or air. If recovery is very slow, samples may be obtained as soon as sufficient water is available.

3.4 Obtain Water Samples

Obtain samples for chemical analysis within two hours after purging is completed. For slow recovering wells, the sample must be collected immediately after a sufficient volume is available. The water quality

samples must be taken from within the well screen interval. The following sampling procedure is to be used at each well:

1. Assemble decontaminated sampling equipment. If bailers are used, new nylon rope will be used for each well for each sampling event. Assemble the filtering apparatus.
2. Make sure that sample labels have been filled out for each well.
3. Lower the bailer slowly and gently into contact with the water in the well. Lower the bailer to the same depth in the well each time, within the screened interval. If submersible or bladder pumps are utilized to collect samples, start the pump and fill a composite sample container (e.g. a 2-1/2 gallon plastic cubitainer).
4. From the cubitainer, fill the sample bottles in accordance with the following procedure:
 - a) Slowly pour an unfiltered portion into the sample container for field parameter (pH, specific conductance, temperature) analyses and perform the in-field analyses and record.
 - b) Shake the cubitainer vigorously so that all sediment is suspended.
 - c) Immediately fill all sample bottles for analyses of "total" constituents, starting with metals and cyanide analyses.
 - d) Then, use the remainder of the sample for analyses that require field filtration (See Section 3.5 of this SOP).
 - e) Place samples on ice in a cooler.
5. Record time of sampling.
6. Replace and lock well cap.
7. Complete field documentation.

3.5 Filtering Samples

Samples for metals analyses will be filtered during the field sampling event by using a disposable filter apparatus and peristaltic or hand vacuum pump. The following procedure is to be used for filtering:

- Assemble filter device according to manufacturer's instructions.
- Filter sample either by pouring sample in the top portion of filter unit or pumping through an in-line filter using a peristaltic pump.
- Transfer filtered sample to appropriate preserved sample bottles.
- Place the used filter membrane in a Ziplock bag for disposal with the personal protective equipment (see SOP DEC047).
- Flush and decontaminate any reusable filtering equipment with distilled water.

4. QUALITY ASSURANCE

The well sampling order will be dependent on expected levels of contamination in each well, if known, and will be determined prior to sampling. In general, sample the least contaminated well first, the most contaminated well last. Quality assurance/quality control (QA/QC) samples will be collected during groundwater sampling.

QA/QC samples are designed to help identify potential sources of sample contamination and evaluate potential error introduced by sample collection and handling. All QA/QC samples are labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses.

4.1 Rinsate Samples

An equipment rinsate sample of sampling equipment is intended to check if decontamination procedures have been effective. For the well sampling operation, a rinsate sample will be collected from the decontaminated sampling equipment (bailer) or filter equipment before it is used to obtain the sample. Distilled water will be rinsed over the decontaminated sampling apparatus and transferred to the sample bottles. The sample parameters that are being analyzed in the groundwater samples will be analyzed in the rinsate samples. The rinsate sample is assigned a QA/QC sample identification number, stored in an iced cooler, and shipped to the laboratory on the day it is collected. One rinsate sample will be collected for every 10 water samples.

4.2 Duplicate Samples

Duplicate samples are samples collected side-by-side to check for the natural sample variance and the consistency of field techniques and laboratory analysis. For the groundwater sampling a duplicate sample will be collected at the same time as the initial sample. The initial sample bottles for total metals and cyanide analyses will be filled first, then the duplicate sample bottles for total metals and cyanide and so on until all necessary sample bottle for both the initial sample and the duplicate sample have been filled. The duplicate groundwater sample will be handled in the same manner as the primary sample. The duplicate sample will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory on the day it is collected. One duplicate sample will be collected for every 10 water samples.

4.3 Field Blanks

Field blanks check for contamination of samples due to factors at the well site. For a field blank, a metals sample bottle is taken empty to the field and filled at the well site with organic-free distilled water at the time the well is sampled. The sample will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory with the other samples. One field blank will be collected for every 10 water samples.

4.4 Matrix Spikes

Matrix spikes are used to determine long-term precision and accuracy of the analytical method on various matrices. For this procedure duplicate samples are collected at a well and spiking is done by the laboratory. Samples are labeled as matrix spikes for the laboratory. It is useful to collect both the matrix spike and duplicate at the same well. One matrix spike and one duplicate will be taken for every 20 water samples.

4.5 Sample Handling

Sample containers and preservatives are specified in SOP SAM005, Sample Handling, Documentation and Analysis. Samples will be labeled and handled as described in SOP SAM005. The parameters for analysis are also specified in the SAP.

5. REPORTING

5.1 Field Sampling Data

Field sampling data for groundwater samples will be noted in the field notebook at each sampling location. If items do not apply to a specific location, the item will be labeled as not applicable (NA). The data include the following:

- well number,
- date and time of sampling,
- person performing sampling,
- volume of water evacuated before sampling,
- conductivity, temperature, DO, and pH during evacuation (note number of well volumes),
- time samples are obtained,
- number of samples taken,
- sample identification number,
- preservation of sample,
- record of any QC samples from site, and
- any irregularities of problems which may have a bearing on sampling quality.

5.2 Field Notes

Field notes shall be kept in a bound field book. The following information will be recorded using waterproof ink:

- names of personnel,

- weather conditions,
- date and time of sampling,
- location and well number,
- condition of the well,
- decontamination information,
- initial static water level and total well depth,
- calculations (e.g., calculation of evacuated volume),
- analytes of interest, and
- calibration information.

5.3 Well Volume Calculations

One of the following equations shall be used to calculate the volume of water to be removed during well evacuation dependent on the borehole diameter:

For 2-inch borehole:

$$\begin{aligned}\text{Evacuation Volume [gal]} &= (\text{Total Depth [ft]} - \text{Water Level Depth [ft]}) \times 0.1632 \text{ gal/ft} \\ &= 1 \text{ borehole volume [gal]}\end{aligned}$$

For 4-inch borehole:

$$\begin{aligned}\text{Evacuation Volume [gal]} &= (\text{Total Depth [ft]} - \text{Water Level Depth [ft]}) \times 0.6528 \text{ gal/ft} \\ &= 1 \text{ borehole volume [gal]}\end{aligned}$$

For 6-inch borehole:

$$\begin{aligned}\text{Evacuation Volume [gal]} &= (\text{Total Depth [ft]} - \text{Water Level Depth [ft]}) \times 1.4688 \text{ gal/ft} \\ &= 1 \text{ borehole volume [gal]}\end{aligned}$$

Multiply one borehole volume by three (3) to obtain the minimum volume of water to be removed before sampling.

Attachment 4.

STANDARD OPERATING PROCEDURE

Water Level Measurements

Prepared for:

Bayard Mining Corporation
Mining Remedial Recovery Company
Viacom International Inc.

August 27, 1997
SOP NUMBER: SOP-GWM002



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1. PURPOSE..... 1

2. MATERIALS REQUIRED 1

3. PROCEDURE 1

4. CALIBRATION..... 2

5. QUALITY ASSURANCE..... 2

6. REPORTING 2

7. DISCUSSION..... 3

List of Tables

Table 1. Field Data Sheet for Water Level Measurement 4

1. PURPOSE

The purpose of this document is to define the standard procedure for measuring the depth to water in groundwater wells, using an electric sounder. This SOP includes standard procedures for measuring water levels in wells.

2. MATERIALS REQUIRED

The following materials are needed:

1. electric water level indicator capable of producing measurements to a precision of 0.01 ft;
2. steel measuring tape, calibrated in 0.01 ft;
3. keys to the wells locks;
4. map showing well locations and numbers. (If possible, obtain well completion and elevation data);
5. field log book;
6. bucket and brush for equipment decontamination;
7. plastic sheets (ground cover);
8. garden-type sprayer filled with distilled water; and
9. appropriate health and safety equipment (i.e., rubber gloves, safety glasses).

3. PROCEDURE

The following procedure assumes that a Sinco electric sounder will be used, however, most sounders operate in a similar manner.

1. Remove protective well covers.
2. Visually determine location of measuring point (MP) and compare to written description of MP. Measure the height of the MP above the top of surface (pad). Record the height of the MP above the ground surface in a field book or on a field data sheet (Table 1). Record electric sounder number in field book.
3. Turn meter on and depress test button. (A beep should be audible and the light should be on.)
4. Lower decontaminated sensor (probe) into well, being careful not to unreel the cable too quickly. (See SOP-DEC047 for decontamination procedures.)
5. Stop lowering the cable when the water sensor signals that the water table has been encountered.
6. Once the signal of water is activated, set the reel on a plastic sheet or the well pad and then gently raise the sensor until the signal stops. Slowly lower the cable again until the signal again sounds.

Repeat this procedure until the exact point at which the signal starts is obtained. This point can be marked with a finger or thumb nail which is in contact with the MP.

7. Pull a short portion of the cable out of the well and using a steel pocket tape measure, measure the length of cable between the closest depth marker and the mark held by your thumb or finger. If an engineer's tape is used, record the length of cable to the nearest 0.01 ft. If a standard inch/foot tape is used, record the length of cable to the nearest 1/8 inch. For water level sounders which are pre-marked to the nearest 0.01 of a foot, read the depth directly. In all cases, record the exact measurement as read from the cable and/or tape. Do not perform any calculations or rounding before recording value. See field data sheet, attached, for critical recording parameters.
8. After recording the depth, repeat the measurement to confirm the depth.
9. Turn the meter off and reel up cable.
10. Decontaminate probe and cable according to SOP-DEC047.
11. Replace inner and outer protective caps. Be sure to lock outer cover, replacing old lock if necessary.

4. CALIBRATION

The length of the water level measurement probe cord should be calibrated at least once per year or more often as needed to ensure the desired accuracy. The calibration check consists of laying out 100 ft of steel tape next to 100 ft increments of the probe cord. Note any measurement discrepancies between the two at 2-ft intervals. The probe cord shall be rechecked if there is a possibility it could have been stretched or damaged during water level measurements.

The procedures followed during any calibration and verification of equipment shall be documented in the field notebook along with any calculations. If a correction is required, the probe will be tagged to indicate the correction. Record the actual measured value and the corrected value. Also record the probe number during use and calibration procedures.

5. QUALITY ASSURANCE

Recording the probe number prior to any field use is essential in maintaining QA. This number can be cross-checked with any past and future calibrations to assure the quality of the probe operation. The quality of actual field measurements is assured by repeat measurements at each location.

6. REPORTING

All data collected in the field as a result of measuring water levels will be recorded in the field book. An example of a field data sheet to record water level measurements is presented as Table 1. This data must include well number, height and description of the measuring point, probe number, field personnel, date, time, and depth to water (as actually measured).

7. DISCUSSION

Additional comments:

1. Secure permission to measure water levels from private property or well owners, if necessary.
2. Test equipment prior to departing for field. Are the batteries fresh? Does the sensor work when probe is immersed in water?
3. Examine cable to determine how cable length is measured (ie., is the reference mark above or below the reference number).
4. Record gauge model and serial number in field book or on log sheet.
5. If you replace an old padlock, be sure to provide the well owner with a tagged key.
6. **DO NOT DROP ANYTHING DOWN THE WELL!** Report any equipment lost down the well immediately!
7. Report any damaged, blocked or otherwise deficient wells to the project manager for repair or closure.

Table 1. Field Data Sheet for Water Level Measurement

Instrument Number: _____ Date: _____
 Sampler's Name: _____ Project No.: _____
 Project Name: _____

Location	Date/ Time	Measurement Point Elevation (MSL)	Depth to Water	Depth of Well	Water Elevation* (MSL)	Sampler's Initials
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* Water elevation = measurement point elevation - Depth to water.

This elevation should be checked in the field to see that it is reasonable and that the subtraction was performed correctly. If there is a discrepancy, measure again.

Note: BE SURE TO DECONTAMINATE THE PROBE BETWEEN WELLS

Attachment 5.

STANDARD OPERATING
PROCEDURE

Surface Water Sampling

Prepared for:

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Mining Remedial Recovery Company
Viacom International Inc.

August 27, 1997
SOP NUMBER: SOP-SWS010



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1. PURPOSE..... 1

2. MATERIALS REQUIRED 1

3. PROCEDURE..... 2

 3.1 Decontamination Equipment3

 3.2 Instrument Calibration3

 3.3 Obtaining Water Samples - Small
 Streams3

 3.4 Filtering Samples5

 3.5 Field Quality Assurance/Quality Control
 Samples5

 3.6 Flow Rate6

4. SAMPLE HANDLING 6

5. DOCUMENTATION 6

 5.1 Field Sampling Data.....6

 5.2 Field Notes.....7

List of Tables

Table 1. Collection Methods and Devices Based on Stream Dimensions. .2

1. PURPOSE

The purpose of this document is to define the standard procedure for collecting surface water samples. This Standard Operating Procedure (SOP) serves as a supplement to the Quality Assurance Project Plan (QAPP) and the Sampling and Analysis Plan (SAP). This procedure gives descriptions of equipment, field procedures, and QA/QC procedures necessary to collect surface water samples. The sample locations and frequency of collection are specified in the SAP.

This procedure is intended to be used together with the SAP and several other SOPs. Sample identification, labeling, handling, and chain-of-custody procedures are described in SOP SAM005. SOP SAM005 also includes the listing of sample containers, preservatives, and holding times applicable to samples collected using this SOP. SOP DEC047 describes decontamination procedures which are also applicable to this SOP.

2. MATERIALS REQUIRED

Sample bottles will be obtained from the analytical laboratory. Several extra sample bottles will be obtained in case of breakage or other problems.

Equipment used during surface water sample collection:

- pH meter (with automatic temperature compensation)
- Specific conductance meter
- Dissolved oxygen meter
- Thermometer
- Sample bottles
- Dedicated jug for holding sample for filtering
- Cooler with ice
- DH-48 depth-integrated sampler, or equivalent
- Portable barometer
- Polyethylene or glass jar for field measurement samples
- Pocket calculator
- Steel measuring tape
- Pole (with clamp to hold sample collection container)
- Glass or polyethylene sample collection container
- Plastic squeeze bottle filled with deionized or distilled water

- Plastic sheeting
- Appropriate health and safety equipment

Equipment used during sample filtration and splitting:

- Disposable filterware with 0.45 micron filter
- Hand pump or peristaltic pump
- Tygon tubing
- USGS churn splitter

Equipment used during decontamination:

- Alconox soap (or equivalent)
- Potable tap water
- Deionized or distilled water
- Large sponges
- Decontamination buckets/pails
- Several "spray" or "squirt" bottles

3. PROCEDURE

This section discusses the criteria for the selection of sampling methods and equipment. The selection of sampling methods and equipment is based on sample type, flow conditions, and data quality objectives stated in the field sampling plan. Selection of sampling methods and equipment based on flow condition is described in Table 1.

Table 1. Collection Methods and Devices Based on Stream Dimensions.

Stream Width	Stream Depth	Method	Device(s)
<3 ft	<1 ft	Grab from center of stream	Beaker or dipper/churn splitter
3 - 5 ft	approx. 1 ft	Horizontal composite	Beaker or dipper/ churn splitter
>5 ft	>1 ft	Horizontal/ Vertical composite integrated or EWI Method	DH-48 depth- sampler/churn splitter
Any width	Too deep to Grab	composite (>2 ft) with extension rods	extension from shore-rod/churn splitter

- If depth is less than 1 foot and the stream is less than 3 feet wide, collect samples from the center of flow. Use a dipper or a breaker to collect samples into the churn splitter. Distribute the sample water from the churn splitter into the sample bottles.
- If depth is about 1 foot in depth and the stream is 3 to 5 feet wide, use the horizontal areal composite method: Collect aliquots of sample from 3 stations spaced evenly across the stream. Combine these in the churn splitter.
- If depth averages greater than 1 foot and the stream is at least 5 feet wide, use the EWI method of sampling (described below) for dissolved chemical constituents unless the stream is too deep to wade. The DH-48 sampler is to be used to collect a sample for this method.

This section gives the step-by-step procedures for collecting samples in the field. Observations made during sample collection should be recorded in the field notebook and field data sheet as specified below.

Samples will be collected from the same cross section of the stream as that which is to be used for the flow measurement, if stream flow is measured. Always collect samples prior to making flow measurements. Stand downstream of the water to be sampled.

3.1 Decontamination Equipment

Before any sampling begins, and between samples, all sample collection equipment must be decontaminated. If dedicated equipment is used, it should be rinsed with deionized water. Mobile decontamination supplies must be provided so that equipment can be decontaminated in the field. The decontamination solutions shall be replaced with clean solutions between each decontamination operation (i.e., between each sample location). Used solutions will be placed in a container for disposal as specified on the SAP. A discussion of equipment and personnel decontamination are contained in DEC047 and in the Site Health and Safety Plan.

3.2 Instrument Calibration

Electronic equipment used during sampling includes a pH meter with temperature scale, a dissolved-oxygen (DO) meter and a specific conductance meter. Before going into the field, the sampler must verify that all of these are operating properly. The pH and conductivity meters require calibration prior to use every day and must be recalibrated if they have been turned off. Calibration time and appropriate readings will be recorded in the field notebook. Calibrations should be performed according to instrument operations manuals.

3.3 Obtaining Water Samples - Small Streams

The following procedures are to be used to collect surface water samples in streams less than 3 - 5 feet wide and 1 foot deep.

1. Assemble all necessary sample collection and filtering equipment.

2. Make sure that the sample labels have been filled out for the sampling location. Assemble bottles for filling.
3. Rinse the pole and water collection container with clean water.
4.
 - a) When sampling in a stream, the sample will be taken from a point in the middle part of the main stream flow. Reach out with the sampling apparatus and gently lower the container into the water. Care should be taken to avoid collecting items floating in the water and to avoid disturbing any sediment during sample collection. After the container is filled, carefully lift it out of the water and empty it into the appropriate sample bottles as described in 5 below. Repeat the process at the sampling location until all of the bottles have been filled. Be sure that the sampling apparatus is returned to the same location each time sample is collected.
 - b) If an area composite sample is to be collected from the sampling areas, use the following technique. At each area, the appropriate quantity of sample (one-third of the sample if there are three areas) will be collected. Reach out with the sampling apparatus and gently lower the container into the water taking care to avoid disturbing any sediment. Care should also be taken to avoid collecting items floating in the water. After the container is filled, carefully lift it out of the water and fill the sample bottles to the appropriate level (one-third, etc.) in the order given in 5 below. For each composite sampling area, be sure the sampling apparatus is returned to the same area each time additional sample is collected. Repeat the process until all of the sample has been collected. Cap the sample bottles before proceeding to the next compositing location.
5. Bottle filling order:
 - a) Slowly pour a portion into the preserved sample bottles for total metals and cyanide analyses first. Cap quickly.
 - b) Slowly pour a portion of the sample into the unpreserved dedicated jug for analyses requiring field filtering. If at a stream location, filter the sample and transfer it to the preserved sample bottles and cap quickly. If the sample is being composited, wait until all the locations have been sampled and then proceed with filtering. See below for field filtration.
 - c) Slowly pour a portion of the sample into the sample bottles for all other analyses and cap quickly.
 - d) Slowly pour an unfiltered portion into the sample container for field parameters, obtain field parameters measurements and record. For composited samples, field parameters will be measured from a portion of the unpreserved composite taken for filtering.
 - e) Place samples on ice in a cooler.
6. Rinse sample collection and field analysis equipment with deionized water after sample collection is complete at each station.

7. Record time of sampling and barometric pressure and complete field documentation.

3.4 Filtering Samples

Samples for metals analyses will be filtered during the field sampling event by using a disposable filter apparatus and peristaltic or hand vacuum pump. Filtered samples will be collected according to the following procedure:

- Assemble filter device according to manufacturer's instructions.
- Filter sample either by pouring sample in the top portion of filter unit or pumping it through an in-line filter using a peristaltic pump.
- Transfer filtered sample to appropriate preservative-containing sample bottles.
- Place the used filter membrane in a ziplock bag for disposal with the personal protective equipment (see SOP DEC047).
- Flush and decontaminate any reusable filtering equipment with deionized or distilled water.

3.5 Field Quality Assurance/Quality Control Samples

Quality assurance/quality control (QA/QC) samples will be collected during surface water sampling.

QA/QC samples are designed to help identify potential sources of sample contamination and evaluate potential error introduced by sample collection and handling. All QA/QC samples are labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses.

Rinsate Samples: A decontamination rinsate sample of sampling equipment is intended to check if decontamination procedures have been effective. For the surface water sampling operation, a rinsate sample will be collected from the decontaminated sampling or filter equipment before it is used to obtain the sample. Deionized water will be rinsed over a decontaminated sampling apparatus and transferred to the sample bottles. The same parameters that are being analyzed in the water samples will be analyzed in the rinsate samples. The rinsate sample is assigned a QA/QC sample identification number, stored in an iced cooler, and shipped to the laboratory on the day it is collected. One rinsate sample will be collected for every 10 water samples.

Duplicate Samples: Duplicate samples are samples collected side-by-side to check for the natural sample variance and the consistency of field techniques and laboratory analysis. For the surface water sampling a duplicate sample will be collected at the same time as the initial sample. The initial sample bottles for total metals and cyanide analyses will be filled first, then the duplicate sample bottles for total metals and cyanide analyses and so on until all necessary sample bottles for both the initial sample and the duplicate sample have been filled. The duplicate sample will be handled in the same manner as the primary sample. The duplicate surface water sample will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory on the day it is collected. One duplicate sample will be collected for approximately every 10 water samples.

Field Blanks: Field blanks check for contamination of samples due to factors at the sampling site. For a field blank, a metals sample bottle is taken empty to the field and filled at the sampling site with organic-free deionized water at the time the surface water sample is collected. The sample will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory with the other samples. One field blank will be collected for approximately every 10 water samples.

Matrix Spikes: Matrix spikes are used to determine long-term precision and accuracy of the analytical method on various matrices. For this procedure duplicate samples are collected at a sampling site and spiking is done by the lab. Samples are labeled as matrix spikes for the lab. It is useful to collect both the matrix spike and duplicate at the same sampling site. One matrix spike and one duplicate will be taken for approximately every 10 water samples.

3.6 Flow Rate

After collecting surface water samples, the surface water flow rate will be measured to ascertain the surface water flow conditions at the time of sample collection. The surface water flow rate should be measured and recorded according to the procedures described in SOP SWM009.

4. SAMPLE HANDLING

Sample containers and preservatives are specified in SOP SAM005 Sample Handling, Documentation, and Analysis. Samples will be labeled and handled as described in SOP SAM005. The parameters for analysis are specified in the SAP.

5. DOCUMENTATION

5.1 Field Sampling Data

The following field sampling data will be collected at each sample location. Items not applicable to the sampling will be labeled as not applicable(NA). The data includes the following:

- Sampling location
- Date and time of sampling
- Person performing sampling
- Conductivity, temperature, and pH during sampling
- Color (describe), Odor (describe), Turbidity (Y/N)
- Sample identification number
- Number of samples taken
- Preservation of samples
- Record of any QC samples from site

- Any irregularities or problems which may have a bearing on sampling quality.

5.2 Field Notes

Field notes will also be kept during sampling activity. The following information will be recorded in the bound field notebook using waterproof ink:

- names of personnel,
- weather conditions,
- barometric pressure,
- date and time of sampling,
- location and sample station number,
- times that procedures and measurements are completed,
- decontamination times,
- calibration information, and
- calculations (e.g., calculation of flow rate).