# NORTH FORK OF CLEAR CREEK PROJECT
# RESTORATION OF ABANDONED MINE SITES

# FINAL REPORT

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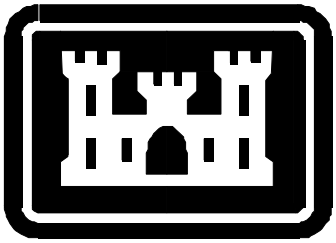

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## TABLE OF CONTENTS



## TABLES



## FIGURES

## APPENDICES



## ATTACHMENTS

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ASTM | American Standard Testing Materials |
| $^{o}C$ | Degrees Celsius |
| CDMG | Colorado Division of Minerals and Geology |
| CDQAR | Chemical Data Quality Assessment Report |
| CENWO | Corps of Engineers, Omaha District |
| COC | Chain-of-Custody |
| DQOs | Data Quality Objectives |
| DUP | Duplicate |
| ECB | Environmental Chemistry Branch |
| EPA | Environmental Protection Agency |
| FSP | Field Sampling Plan |
| Ft | Foot/Feet |
| GPS | Global Positioning System |
| IDW | Investigative Derived Waste |
| Kg | Kilogram |
| L | Liter |
| LIMS | Laboratory Information Management System |
| MDL | Method Detection Limit |
| MRL | Method Reporting Limit |
| µg/L | Micrograms per Liter |
| mg/kg | Milligrams per kilogram |
| mg/L | Milligrams per Liter |
| mg | Milligram |
| Min | Minute |
| mL | Milliliters |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| N/A | Not Applicable |
| ND | non-detect |
| ppb | Parts per Billion (measured in water as µg/L) |
| QA | Quality Assurance |
| QC | Quality Control |
| RAMS | Restoration of Abandoned Mine Sites |
| RPD | Relative Percent Difference |
| SSHP | Site Safety Health Plan |
| SOP | Standard Operating Procedure |
| SSA | Site-Specific Addendum |
| U.S. | United States |
| USACE | U.S. Army Corps of Engineers |
| USBR | U.S. Bureau of Reclamation |
| USFS | U.S. Forest Service |
| WRDA | Water Resource Development Act |

# 1 INTRODUCTION

The U.S. Army Corps of Engineers (USACE) has been provided authority for Restoration of Abandoned Mine Sites (RAMS) through the Water Resource Development Act (WRDA) 1999 Section 560. The RAMS program is a regionally focused and stakeholder responsive program for the restoration of abandoned and inactive non-coal mines where water resources (ecosystem/habitat) have been degraded by past mining practices. This authority is intended to allow the USACE to provide support to agencies that manage lands impacted by past mining. The USACE coordinated in advance to obtain stakeholder buy-in on all work proposed to be performed by Corps Districts to ensure that the proposed work is supportive of the stakeholders' efforts in the area.

The USACE Omaha District is working in coordination with the Colorado Division of Minerals and Geology (CDMG) and the Bureau of Reclamation (USBR) on the North Fork of Clear Creek RAMS Project. The CDMG and USBR identified the data needs for this drainage. The USACE obtained the necessary right-of-entry (ROE) to the identified locations. Individuals from the USACE Omaha District and USACE Albuquerque District performed the fieldwork from September 9 through September13, 2002.

The purpose of this report is to submit documentation of the field activities and analytical results to the CDMG, the primary data user. This report includes the methods and procedures used for collecting surface soil and sediment samples, data quality review, the field forms, and site photos. This report does not include any interpretations or conclusions based on this data.

# 2 PROJECT INFORMATION

## 2.1 Site Description

The North Fork of Clear Creek drainage basin encompasses approximately 90% of Gilpin County in north-central Colorado near Central City, Colorado. Gilpin County is one of the most intensely mined counties in Colorado, particularly from Central City south to the county line. Three major tributaries to the North Fork of Clear Creek drain this heavily mined area, which are Chase Gulch, Nevada/Gregory Gulch, and Russell Gulch. Within these three drainages, there are an estimated 2,000 mine waste piles.

The North Fork of Clear Creek is within the Clear Creek Superfund study area. Superfund characterization activities within this basin have focused on mine drainages. Very few of the mine waste rock and mill tailing piles have been characterized in Gilpin County. The numerous waste rock and mill tailing piles contain acid forming materials (e.g. pyrite, chalcopyrite, etc.) and contain high levels of leachable zinc, copper, manganese, lead, and iron.

## 2.2 Project Objectives

The primary objective of this field investigation is to collect and provide surface soil and sediment data to the CDMG and USBR to support their respective investigations for the North Fork of Clear Creek drainage. This data may eventually be used by the CDMG and/or the USBR in order to determine metals loading from various mine waste pile sites to the North Fork of Clear Creek drainage.

The goal of this initial phase is to identify potential contaminant sources throughout a watershed. A site visit was conducted on 23 July 2002 to perform a cursory survey of project area to identify and prioritize waste piles. Due to the vast number of waste piles, but with limited investigative funds and right-of-entry (ROE) access agreements with the landowners, only 27 of the 43 highest priority waste piles identified in the Site Specific Addendum (SSA) of the Work Plan were sampled. In addition, four sediment sample locations from Chase Gulch were collected for data to ascertain if run-off from the waste piles has impacted the Chase Gulch drainage.

# 3 FIELD INVESTIGATION

## 3.1 Field Investigation Activities

A single round of sediment and surface soil samples were collected in accordance with the approved Work Plans. Sampling locations are shown on Figure 3-1 and listed in Table 3-1.

The following Standard Operating Procedures (SOPs) identified in the Site-Specific Addendum (SSA) to the RAMS Work Plan were adhered to during the course of this field investigation: A1 (Surface Soil/Rock Sampling Equipment and Procedures); A4 Soil/Rock Homogenization Equipment and Procedures, A7 (Investigative Derived Waste Procedures); A12 (Equipment Decontamination Procedures); A13 (Sample Handling, Documentation, and Tracking Procedures); and A14 (Field Documentation).

## 3.2 Surface Soil Samples

A total of twenty-seven (27) field samples and four duplicate samples of surface soil were collected from seventeen sampling locations from Chase Gulch (CHG-2 through CHG-11, CHG-13 through CHG-16, CHG-18, CHG-20, and CHG-21) and ten sampling locations from the lower Gregory Gulch (LGG-22, LGG-25 through LGG-27, LGG-31 through LGG-34, LGG-36, and LGG-37). Duplicate samples were collected from sampling locations CHG-8, CHG-11, LGG-26, and LGG-37. A visual reconnaissance was performed on each of the sampled waste piles. The latitude/longitude, approximate distance from a defined drainage channel, degree of erosion, volumetric measurements, presence and approximate size of vegetation kill zone, presence of vegetation on the waste piles, texture of waste pile, degree of cementation of the waste pile, and equipment access description were documented. This information is documented on the data sheets in Appendix B. The coordinates and sample identification numbers are listed in Table 3-1.

All surface soil samples were submitted to the USACE Environmental Chemistry Branch (ECB) Laboratory for total metals of the soil and leachable metals, pH, acidity, and conductivity from the water leachate of the soil.

## 3.3 Sediment Samples

A total of four field samples and one duplicate sample were collected of the creek sediment in Chase Gulch. A composite sample was collected from the banks or the sediment immediately adjacent to the creek. All sediment samples were submitted to the USACE Environmental Chemistry Branch (ECB) Laboratory for total metals of the sediment and leachable metals, pH, acidity, and conductivity from the water leachate of the sediment.

## 3.4 Sample Identification Scheme

The sample ID scheme presented in SOP A13 was modified to the following designation.

**UU-VVV/VVV02-XXXX-ZZ**

where:

**UU** = Project designation was replaced with **CO** (for Colorado RAMS)
**VVV/VVV** = Designation of sampling area location was replaced with

- **NCC/LGG** for North Fork of Clear Creek- Lower Gregory Gulch
- **NCC/CHG** for North Fork of Clear Creek -Chase Gulch

**02** = Year of sampling
**XXXX** = **SS** (surface soil) or **SD** (sediment sample) plus the two-digit sample location number
**ZZ** = 2 Character Designation for Samples, where:

01 = Normal Field Sample
02 = QC Duplicate

**Examples:**
A surface soil sample from location #11 collected from Chase Gulch of the North Fork of Clear Creek site is:

CO-NCC/CHG02-SS11-01

The QC duplicate sample has the sample designation of:

CO-NCC/NGG02-SS11-02

### 3.5 Surveying

Sampling location coordinates listed in the Table 3-1 were based on the approximate center of all the sub-sampling locations as obtained from a hand-held Global Positioning System (GPS) device. These measurements were recorded on the Field Data Sheets (Appendix B) in longitude and latitude. The device has an approximate accuracy of plus-or-minus 25 to 75 feet. Since some piles were quite extensive and given the accuracy of the hand-held GPS device, the survey coordinates given for a particular mine waste pile may not correlate to the U.S. Geological Survey Map (USGS) quadrangle map (Figure 3-1).

The physical dimensions for the size of the mine waste piles were visually estimated or were measured by pacing the distances. This data was recorded on the Field Data Sheets (Appendix B).

# Table 3-1

| ID NO. | WASTE PILE NAME | DRAINAGE | LATITUDE | LONGITUDE |
|---|---|---|---|---|
| CHG-2 | Two Sisters | Chase Gulch | N39º 48’ 32.7” | W105º 31’ 29.1” |
| CHG-3 | Ellery | Chase Gulch | N39º 48’ 22.2” | W105º 30’ 43.0” |
| CHG-4 | Belden Tunnel | Chase Gulch | N39º 48’ 27.3” | W105º 30’ 43.4” |
| CHG-5 | Allie | Chase Gulch | N39º 48’ 23.8” | W105º 30’ 43.7” |
| CHG-6 | Sans Souci | Chase Gulch | N39º 48’ 28.9” | W105º 30’ 37.1” |
| CHG-7 | Castle Rock | Chase Gulch | N39º 48’ 27.8” | W105º 30’ 46.8” |
| CHG-8 | Lower Centennial | Chase Gulch | N39º 48’ 24.3” | W105º 30’ 28.4” |
| CHG-9 | Advance Tunnel | Chase Gulch | N39º 48’ 33.1” | W105º 30’ 50.5” |
| CHG-10 | Hayseed Tunnel | Chase Gulch | N39º 48’ 40.7” | W105º 30’ 56.3” |
| CHG-11 | Tucker | Chase Gulch | N39º 48’ 42.6” | W105º 30’ 56.7” |
| CHG-13 | Centre Tunnel | Chase Gulch | N39º 48’ 26.5” | W105º 30’ 30.2” |
| CHG-14 | Upper Centennial | Chase Gulch | N39º 48’ 22.9” | W105º 30’ 33.3” |
| CHG-15 | Robert Emmet | Chase Gulch | N39º 48’ 27.7” | W105º 30’ 21.1” |
| CHG-16 | Virginia Discovery | Chase Gulch | N39º 48’ 33.1” | W105º 30’ 29.3” |
| CHG-18 | Bates | Chase Gulch | N39º 48’ 7.2” | W105º 30’ 59.3” |
| CHG-20 | Bonanza Tunnel | Chase Gulch | N39º 48’ 20.0” | W105º 30’ 14.7” |
| CHG-21 | Aetna | Chase Gulch | N39º 48’ 18.6” | W105º 30’ 16.0” |
| LGG-22 | Boston | Gregory Gulch | N39º 47’ 58.1” | W105º 30’ 39.5” |
| LGG-25 | Humboldt | Gregory Gulch | N39º 48’ 12.7” | W105º 30’ 6.4” |
| LGG-26 | Winnebago | Gregory Gulch | N39º 48’ 14.1” | W105º 30’ 50.8” |
| LGG-27 | Hunter-Gold Extension | Gregory Gulch | N39º 47’ 48.7” | W105º 30’ 38.5” |
| LGG-31 | Next President | Gregory Gulch | N39º 47’ 56.8” | W105º 30’ 12.2” |
| LGG-32 | Hartford | Gregory Gulch | N39º 47’ 57.0” | W105º 30’ 16.4” |
| LGG-33 | Maine-Hamlet | Gregory Gulch | N39º 47’ 54.9” | W105º 30’ 34.4” |
| LGG-34 | Vasa-Leavitt | Gregory Gulch | N39º 47’ 59.7” | W105º 30’ 23.6” |
| LGG-36 | O.K. (Epizootic) | Gregory Gulch | N39º 47’ 54.1” | W105º 30’ 36.3” |
| LGG-37 | German | Gregory Gulch | N39º 47’ 52.8” | W105º 30’ 32.7” |
| | SEDIMENT SAMPLES | | | |
| SD-1 | Upstream of Tucker | Chase Gulch | N39º 48’ 43.6” | W105º 30’ 58.7” |
| SD-2 | Downstream of Hayseed | Chase Gulch | N39º 48’ 36.7” | W105º 30’ 54.1” |
| SD-3 | Downstream of Centennial | Chase Gulch | N39º 48’ 25.0” | W105º 30’ 27.0” |
| SD-4 | Downstream of Bonanza | Chase Gulch | N39º 48’ 18.8” | W105º 30’ 15.0” |

# 4 LABORATORY ANALYTICAL RESULTS

## 4.1 Data Quality Objectives

The Data Quality Objectives for this project are those presented in the RAMS Final Work Plan dated July 2002. The criteria in order to attain these objectives are given in the RAMS Final Work Plan and/or presented in this section. The Method Detection Limit (MDL), Method Reporting Limit (MRL), and QC criteria that will meet the data objectives for metals are given in Tables 6-5 and 6-6 of the RAMS Final Work Plan. The MDL, MRL, and QC criteria that will meet the data objectives for conductivity, pH, and acidity are given in Table 6-7 of the RAMS Final Work Plan.

## 4.2 Laboratory Analytical Sample Requirements

All surface soil and sediment samples were submitted to a laboratory for analysis for total metals for soil samples and analysis for metals, conductivity, pH, and acidity of the water leachate from the soil.

Laboratory analytical sample requirements are given in the following table:

**TABLE 4-1: LABORATORY ANALYTICAL SAMPLE REQUIREMENTS**

| Parameter | Field | Quality Control Duplicate | Total |
|---|---|---|---|
| Soil Samples | | | |
| Surface soil ** | 27 | 4 | 31 |
| Sediment ** | 4 | 1 | 5 |
| Water Leachate Samples* | | | |
| Surface soil | 27 | 4 | 31 |
| Sediment | 4 | 1 | 5 |

* The water leachate sample was derived by leaching the soil sample.
** Metals include Al, As, Ca, Cd, Cr, Cu, Fe, Pb, Mg, Mn, K, Ag, and Zn.

## 4.3 Sample Containers, Preservation and Holding Times

Sample container, preservation, and holding time requirements are given in the following table:

**TABLE 4-2: SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES FOR COMPOSITE SOIL SAMPLES**

| Parameter | Container | Maximum Holding Times | |
|---|---|---|---|
| | | Digestion | Analysis |
| **Composite Soil Sample*** | | | |
| Metals[1] | 1 x 8 ox Glass | 6 months (Mercury – 28 days) | 6 months (Mercury – 28 days) |
| **Water Leachate**** | | | |
| Leachate Metals[1] | | 6 months (Mercury – 28 days) | 6 months (Mercury – 28 days) |
| Leachate pH | | | ASAP*** |
| Leachate Acidity | | | ASAP*** |
| Conductivity | | | ASAP*** |

* One 8 oz jar obtained in the field from each area is sufficient for all analyses.
** The water leachate process is performed in the laboratory by the method described in the Site Specific Work Plan..
*** ASAP in this instance means as soon as possible after leachate is obtained.
[1] Al, As, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, K, Ag, Zn

## 4.4 Sample Labeling and Shipment

Immediately after sample collection, the samples were preserved as noted above, labeled, and placed into a cooler. Labeling was performed as specified in the SSA to the RAMS Work Plan. The Laboratory Identification Management System (LIMS) number was **LIMS # 6695.** The samples were stored in a secured place until shipped in a cooler with the appropriate chain-of-custody forms sealed and shipped by overnight delivery to the USACE ECB Laboratory located in Omaha, Nebraska.

## 4.5 Sample Analysis

All samples were held at the ECB Laboratory and analyzed in the same sample analytical batch**.** The following analytical methods were used for the field samples and appropriate required quality control samples for this site:

| Parameter | Method | Matrix |
|---|---|---|
| Metals | EPA Method 3050/6010B | Soil |
| | | |
| Water Leachate** | | |
| Metals | EPA Method 3010/6010B | aqueous leachate |
| pH | USDA 8C | aqueous leachate |
| Acidity | EPA 305.1 | aqueous leachate |
| Conductivity | 9050A | aqueous leachate |

** The water leachate process is performed in the laboratory as is described in the Site Specific Work Plan.

## 4.6 Analytical Results

The analytical results for this project are provided in Tables 1 and 2 of the CDQAR. These tables include the MRL, the analytical results with units specified, and any data qualifiers. Data qualifiers are defined on the table and are described in the Chemical Data Quality Assessment Report (CDQAR), which is included as an attachment to this document (Attachment 1).

# 5 QUALITY CONTROL REVIEW

Quality control review consists of an evaluation of the field and analytical procedures and a review of the data to ensure that the appropriate QC compliance was met.

## 5.1 Field Quality Control

The project team reviewed all field documentation (e.g. field data sheets, chain-of-custody forms, etc.) for completeness. A review of the placement or coordinates of the sample was performed to ensure that this correlates to sample nomenclature. Placement and frequency of the quality control samples were reviewed to ensure compliance to set criteria.

## 5.2 Laboratory Quality Control

Laboratory Quality Control is provided in the CDQAR, which is included as an attachment to this document (Attachment 1).

## 5.3 Data Validation

Data validation information is provided in the CDQAR, which is included as an attachment to this document (Attachment 1).

## 5.4 Data Quality Summary

The CDQAR presents, in specific terms, the quality control practices utilized to achieve the goals of the site investigation at North Fork of Clear Creek, Colorado. Samples were also collected and analyzed in accordance with ASTM and EPA methods and laboratory specific QA/QC procedures were used. These procedures were followed to generate high quality data.

The quality issues addressed in the CDQAR do not impact the usability of the data. The required qualifications have been applied to the data in Table 2 of the CDQAR. The reviewed data are usable and are suitable for addressing the overall objectives of this investigation.

# 6 SUMMARY

The project was executed in accordance with the RAMS Work Plan and the Site Specific Addendum for North Fork of Clear Creek in Colorado. Samples were also collected and analyzed in accordance with ASTM and EPA methods and laboratory specific QA/QC procedures were used. These procedures were followed to generate high quality data. The minor quality issues addressed in the CDQAR do not impact the usability of the data. The reviewed data are usable and are suitable for addressing the overall objectives of this investigation.

# FIGURE 3-1

| ident | Name | Drainage | Type |
|---|---|---|---|
| 2 | Two Sisters | Chase Gulch | waste pile |
| 3 | Ellery | Chase Gulch | waste pile |
| 4 | Belden Tunnel | Chase Gulch | waste pile |
| 5 | Allie | Chase Gulch | waste pile |
| 6 | Sans Souci | Chase Gulch | waste pile |
| 7 | Castle Rock | Chase Gulch | waste pile |
| 8 | Lower Centennial | Chase Gulch | waste pile |
| 9 | Advance Tunnel | Chase Gulch | waste pile |
| 10 | Hayseed Tunnel | Chase Gulch | waste pile |
| 11 | Tucker | Chase Gulch | waste pile |
| 13 | Centre Tunnel | Chase Gulch | waste pile |
| 14 | Upper Centennial | Chase Gulch | waste pile |
| 15 | Robert Emmet | Chase Gulch | waste pile |
| 16 | Virginia Discovery | Chase Gulch | waste pile |
| 18 | Bates | Chase Gulch | waste pile |
| 20 | Bonanza Tunnel | Chase Gulch | waste pile |
| 21 | Aetna | Chase Gulch | waste pile |
| 22 | Boston | Gregory Gulch | waste pile |
| 25 | Humboldt | Gregory Gulch | waste pile |
| 26 | Winnebago | Gregory Gulch | waste pile |
| 27 | Hunter-Gold Extensio | Gregory Gulch | waste pile |
| 31 | Next President | Gregory Gulch | waste pile |
| 32 | Hartford | Gregory Gulch | waste pile |
| 33 | Maine-Hamlet | Gregory Gulch | waste pile |
| 34 | Vasa-Leavitt | Gregory Gulch | waste pile |
| 36 | OK (Epizootic) | Gregory Gulch | waste pile |
| 37 | German | Gregory Gulch | waste pile |
| SD-1 | SD-1 | Chase Gulch | sed sample |
| SD-2 | SD-2 | Chase Gulch | sed sample |
| SD-3 | SD-3 | Chase Gulch | sed sample |

**Legend**

- Sediment Samples
- Waste Piles
- 12 Section Number

T3S R73W

T3S R72W

**CLEAR CREEK**
**SEDIMENT SAMPLES and WASTE PILE LOCATIONS**
SCALE 1:12,000

1000 0 1000 2000 Feet

# APPENDIX A

# PHOTOGRAPHS OF MINE WASTE PILES

Site Number 2:  Two Sisters

Site Number 3:  Ellery

Site Number 4: Belden Tunnel

Site Number 5:  Allie

Site Number 6:  Sans Souci

Site Number 7:  Castle Rock

Site Number 8:  Lower Centennial

Site Number 9: Advance Tunnel

Site Number 10:  Hayseed Tunnel

Site Number 11:  Tucker

Site Number 13:  Centre Tunnel

Site Number 14:  Upper Centennial

Site Number 15:  Robert Emmet

Site Number 16:  Virginia Discovery

Site Number 18:  Bates

Site Number 20:  Bonanza Tunnel

Site Number 21:  Aetna

Site Number 22:  Boston

Site Number 25:  Humboldt

Site Number 26:  Winnebago

Site Number 27:  Hunter-Gold Extension

Site Number 31:  Next President

Site Number 32:  Hartford

Site Number 33:  Maine-Hamlet

Site Number 34:  Vasa-Leavitt

Site Number 36:  O.K. (Epizootic)

Site Number 37:  German

# APPENDIX B

# FIELD DATA SHEETS

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #2 Two Sisters

Drainage Chase

Latitude N39° 48 ' 32.7 "

Average of 20 Readings

Longitude W105° 31 ' 29.1 "

---

Mineralogy (1= present, 2= abundant)

Pyrite

Sphalerite 1

Chalcopyrite

Galena

Other, (specify)

Country Rock 1

Secondary Sulfides 1

---

Approximate Distance from Drainage Channel > 500'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1 -2 (some)

Average top width 75'

Average top length 25' (short width)

Average bottom width 50'

Average bottom length 80'

Average height 30'

Estimated Volume

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 100' x 20'

Vegetation on Pile (Y or N) N

Texture (fine, coarse) fine w/ cobbles

Equipment Access (describe) Easy

---

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal X

Cementation Uncemented

Cap-in-place

Amend and Revegetate X

---

Comments

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #3 Ellery  Drainage Chase

Latitude N39° 48 ' 22.2 "  Average of 10 Readings

Longitude W105° 30 ' 43.0 "

---

Mineralogy (1= present, 2= abundant)  Pyrite

Sphalerite 1  Chalcopyrite

Galena  Other, (specify)

Country Rock 1 (flanks)  Secondary Sulfides 1

---

Approximate Distance from Drainage Channel > 500'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 2

Average top width 10'  Average top length 30'

Average bottom width 50'  Average bottom length 50'

Average height 40'  Estimated Volume

Vegetation Kill Zone Present (Y or N) Y  Approximate Size (l x w) 50' x 100'

Vegetation on Pile (Y or N) N (few trees)  Texture (fine, coarse) coarse w/ some fines

Equipment Access (describe) Old rail grade or road leads to mine

---

Reclamation Measures (check if feasible)  Run-on Diversion X

Removal  Cementation Little

Cap-in-place  Amend and Revegetate X

---

Comments

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #4 Beldin Tunnel  Drainage Chase

Latitude N39° 48 ' 27.3 "  Average of 14 Readings

Longitude W105° 30 ' 43.4 "

---

Mineralogy (1= present, 2= abundant)  Pyrite

Sphalerite  Chalcopyrite 1

Galena  Other, (specify)

Country Rock 1  Secondary Sulfides 2

---

Approximate Distance from Drainage Channel 0'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width 50'  Average top length 240'

Average bottom width 75'  Average bottom length 300'

Average height 15'  Estimated Volume

Vegetation Kill Zone Present (Y or N) Y  Approximate Size (l x w) 75' x 3'

Vegetation on Pile (Y or N) N (yellow areas) Y (country rock)  Texture (fine, coarse) Boulders, cobbles, w/ gravel

Equipment Access (describe) Cross Chase Creek to access/ thick vegetation

---

Reclamation Measures (check if feasible)  Run-on Diversion X

Removal  Cementation Little

Cap-in-place  Amend and Revegetate X

---

Comments

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #5 Allie  Drainage Chase

Latitude N39° 48 ' 23.8 "  Average of 8 Readings

Longitude W105° 30 ' 43.7 "

---

Mineralogy (1= present, 2= abundant)  Pyrite

Sphalerite 1  Chalcopyrite 1 (minor)

Galena  Other, (specify)

Country Rock  Secondary Sulfides 1

---

Approximate Distance from Drainage Channel > 300'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width 20'  Average top length 25'

Average bottom width 25'  Average bottom length 50'

Average height 30'  Estimated Volume

Vegetation Kill Zone Present (Y or N) N  Approximate Size (l x w) None below pile

Vegetation on Pile (Y or N) N  Texture (fine, coarse) fine w/ some cobbles

Equipment Access (describe) Hard to access though a trail leads to mine

---

Reclamation Measures (check if feasible)  Run-on Diversion X

Removal  Cementation None

Cap-in-place  Amend and Revegetate X

---

Comments

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #6 Sans Souci  Drainage Chase

Latitude N39° 48 ' 28.9 "  Average of 12 Readings

Longitude W105° 30 ' 37.1 "

---

Mineralogy (1= present, 2= abundant)  Pyrite

Sphalerite 1  Chalcopyrite

Galena  Other, (specify)

Country Rock  Secondary Sulfides 2

---

Approximate Distance from Drainage Channel 0'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3

Average top width 25'  Average top length 120'

Average bottom width 100'  Average bottom length 320'

Average height 90'  Estimated Volume

Vegetation Kill Zone Present (Y or N) Y  Approximate Size (l x w)

Vegetation on Pile (Y or N) N  Texture (fine, coarse) fine sand w/ cobbles

Equipment Access (describe) Base - no problem, Top - sleep slopes

---

Reclamation Measures (check if feasible)  Run-on Diversion X

Removal  Cementation

Cap-in-place  Amend and Revegetate X

---

Comments Greenish rock - malachite? Some biotite, some pinkish rock also.

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #7 Castle Rock  Drainage Chase

Latitude N39° 48 ' 27.8 "  Average of 12 Readings

Longitude W105° 30 ' 46.8 "

---

Mineralogy (1= present, 2= abundant)  Pyrite

Sphalerite 1  Chalcopyrite 1

Galena  Other, (specify)

Country Rock 2  Secondary Sulfides 1

---

Approximate Distance from Drainage Channel 225'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width 15'  Average top length 60'

Average bottom width 90'  Average bottom length 90'

Average height 100'  Estimated Volume

Vegetation Kill Zone Present (Y or N) Y*  Approximate Size (l x w)

Vegetation on Pile (Y or N) Y  Texture (fine, coarse) coarse

Equipment Access (describe) Hard to access - steep slopes- steep slopes for equipment

---

Reclamation Measures (check if feasible)  Run-on Diversion X

Removal  Cementation Some natural cementation

Cap-in-place  Amend and Revegetate

---

Comments *Rubble zone – killing zone

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #8 Lower Centennial  Drainage Chase

Latitude N39° 48 ' 24.3 "  Average of 12 Readings

Longitude W105° 30 ' 28.4 "

---

Mineralogy (1= present, 2= abundant)  Pyrite

Sphalerite 1  Chalcopyrite 1

Galena  Other, (specify)

Country Rock 1 (flanks)  Secondary Sulfides

---

Approximate Distance from Drainage Channel 0 - 2'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep)

Average top width 2'  Average top length 50'

Average bottom width 10'  Average bottom length 150'

Average height 15'  Estimated Volume

Vegetation Kill Zone Present (Y or N) Y (to creek)  Approximate Size (l x w) 2' x 150'

Vegetation on Pile (Y or N) N  Texture (fine, coarse) medium coarse

Equipment Access (describe) Near road but must cross Chase Creek

---

Reclamation Measures (check if feasible)  Run-on Diversion X

Removal X  Cementation Little

Cap-in-place X  Amend and Revegetate X

---

Comments Tires in gully between piles. Duplicate sample.

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #9 Advance Tunnel  Drainage Chase

Latitude N39° 48 ' 33.1 "  Average of 12 Readings

Longitude W105° 30 ' 50.5 "

---

Mineralogy (1= present, 2= abundant)  Pyrite

Sphalerite 2  Chalcopyrite 1

Galena  Other, (specify)

Country Rock 1  Secondary Sulfides 2

---

Approximate Distance from Drainage Channel 75'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 2

Average top width 30'  Average top length 200'

Average bottom width 75'  Average bottom length 225'

Average height 15'  Estimated Volume

Vegetation Kill Zone Present (Y or N) N  Approximate Size (l x w)

Vegetation on Pile (Y or N) N (very little)  Texture (fine, coarse) med-coarse to med-fine

Equipment Access (describe) Access to base, steep slopes

---

Reclamation Measures (check if feasible)  Run-on Diversion X

Removal X  Cementation Little

Cap-in-place X  Amend and Revegetate X

---

Comments

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #10 Hayseed  Drainage Chase

Latitude N39° 48 ' 40.7 "  Average of 12 Readings

Longitude W105° 30 ' 56.3 "

---

Mineralogy (1= present, 2= abundant)  Pyrite 1

Sphalerite 2  Chalcopyrite 1

Galena 1  Other, (specify)

Country Rock 2  Secondary Sulfides 2

---

Approximate Distance from Drainage Channel 3

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width 25'  Average top length 50'

Average bottom width 50'  Average bottom length 75'

Average height 15'  Estimated Volume

Vegetation Kill Zone Present (Y or N) N  Approximate Size (l x w)

Vegetation on Pile (Y or N) N (very little)  Texture (fine, coarse) fine

Equipment Access (describe) Easy access

---

Reclamation Measures (check if feasible)  Run-on Diversion X

Removal X  Cementation None

Cap-in-place  Amend and Revegetate X

---

Comments

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #11 Tucker  Drainage Chase

Latitude N39° 48 ' 42.6 "  Average of 12 Readings

Longitude W105° 30 ' 56.7 "

---

Mineralogy (1= present, 2= abundant)  Pyrite

Sphalerite 2  Chalcopyrite 1

Galena 1  Other, (specify)

Country Rock 2  Secondary Sulfides 1

---

Approximate Distance from Drainage Channel 75'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width 90'  Average top length 150'

Average bottom width 200'  Average bottom length 200'

Average height 50'  Estimated Volume

Vegetation Kill Zone Present (Y or N) N  Approximate Size (l x w)

Vegetation on Pile (Y or N) Y  Texture (fine, coarse) coarse

Equipment Access (describe) Relatively accessible

---

Reclamation Measures (check if feasible)  Run-on Diversion X

Removal X  Cementation Very little

Cap-in-place  Amend and Revegetate X

---

Comments Duplicate sample

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #13 Centre

Drainage Chase

Latitude N39° 48 ' 26.5 "

Average of 10 Readings

Longitude W105° 30 ' 30.2 "

---

Mineralogy (1= present, 2= abundant)

Pyrite

Sphalerite 1

Chalcopyrite 1

Galena

Other, (specify)

Country Rock 1

Secondary Sulfides 2

---

Approximate Distance from Drainage Channel A = 15', B = 0'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width A = 5', B = 10'

Average top length A = 15', B = 75'

Average bottom width A = 10', B = 50'

Average bottom length A = 20', B = 100'

Average height A = 12', B = 12'

Estimated Volume

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) A = 15' x 25'<br>B = In creek

Vegetation on Pile (Y or N) N

Texture (fine, coarse) fine

Equipment Access (describe) Cross creek from road

---

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal X

Cementation Little

Cap-in-place X

Amend and Revegetate X

---

Comments Two piles: A - one from shaft, B - next to creek

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #14 Upper Centennial

Drainage Chase

Latitude N39° 48 ' 22.9 "

Average of 10 Readings

Longitude W105° 30 ' 33.3 "

---

Mineralogy (1= present, 2= abundant)

Pyrite

Sphalerite 1

Chalcopyrite 1

Galena

Other, (specify)

Country Rock 1 (very little)

Secondary Sulfides 2

---

Approximate Distance from Drainage Channel > 500'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3

Average top width 45'

Average top length 25'

Average bottom width 55'

Average bottom length 150'

Average height 80'

Estimated Volume

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 150' x 50' (runs into lower piles)

Vegetation on Pile (Y or N) N

Texture (fine, coarse) Mostly fine w/ some coarse country rock

Equipment Access (describe) Road access to top - very steep slopes

---

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal

Cementation little

Cap-in-place

Amend and Revegetate X

---

Comments

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #15 Robert Emmet  Drainage Chase

Latitude N39° 48 ' 27.7 "  Average of 10 Readings

Longitude W105° 30 ' 21.1 "

---

Mineralogy (1= present, 2= abundant)  Pyrite

Sphalerite 1  Chalcopyrite 1

Galena  Other, (specify) bricks

Country Rock 1  Secondary Sulfides 1

---

Approximate Distance from Drainage Channel > 1000'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width 25'  Average top length 200'

Average bottom width 80'  Average bottom length 225'

Average height 50'  Estimated Volume

Vegetation Kill Zone Present (Y or N) Y  Approximate Size (l x w) 250' x 100'

Vegetation on Pile (Y or N) N (except country rock)  Texture (fine, coarse)

Equipment Access (describe) Very steep but trail is present

---

Reclamation Measures (check if feasible)  Run-on Diversion X

Removal  Cementation Loosely cemented

Cap-in-place  Amend and Revegetate X

---

Comments Some red minerals

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #16 Virginia Discovery  Drainage Chase

Latitude N39° 48 ' 33.1 "  Average of 10 Readings

Longitude W105° 30 ' 29.3 "

---

Mineralogy (1= present, 2= abundant)  Pyrite 1 (very minor)

Sphalerite 1  Chalcopyrite 1

Galena  Other, (specify)

Country Rock  Secondary Sulfides 2

---

Approximate Distance from Drainage Channel

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3

Average top width 25'  Average top length 200'

Average bottom width 25'  Average bottom length 250'

Average height 40'  Estimated Volume

Vegetation Kill Zone Present (Y or N) Y  Approximate Size (l x w) 250' x 100'

Vegetation on Pile (Y or N) N  Texture (fine, coarse) fine to medium

Equipment Access (describe) Very steep - old trail leads to mine

---

Reclamation Measures (check if feasible)  Run-on Diversion X

Removal  Cementation Loose - little

Cap-in-place  Amend and Revegetate X

---

Comments Red minerals, pyrite

Sample - Red rock, chalcopyrite w/ pyrite

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #18 Bates

Drainage Chase

Latitude N39° 48 ' 7.2 "

Average of 6 Readings

Longitude W105° 29 ' 59.3 "

---

Mineralogy (1= present, 2= abundant)

Pyrite

Sphalerite 1

Chalcopyrite 1

Galena

Other, (specify)

Country Rock

Secondary Sulfides 1

---

Approximate Distance from Drainage Channel > 1000'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width 20'

Average top length 20'

Average bottom width 30'

Average bottom length 30'

Average height 10'

Estimated Volume

Vegetation Kill Zone Present (Y or N) N

Approximate Size (l x w) 50' x 100'

Vegetation on Pile (Y or N) Y (few trees)

Texture (fine, coarse) medium coarse

Equipment Access (describe) Very easy access

---

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal X

Cementation Little

Cap-in-place X

Amend and Revegetate X

---

Comments

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #20 Bonanza  Drainage Chase

Latitude N39° 48 ' 20.0 "  Average of 15 Readings

Longitude W105° 30 ' 14.7 "

---

Mineralogy (1= present, 2= abundant)  Pyrite 1 (minor)

Sphalerite 1  Chalcopyrite 1

Galena  Other, (specify)

Country Rock  Secondary Sulfides 2

---

Approximate Distance from Drainage Channel 50'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 2

Average top width 30'  Average top length 750'

Average bottom width 75'  Average bottom length 1000'

Average height 50'  Estimated Volume

Vegetation Kill Zone Present (Y or N) Y  Approximate Size (l x w) 600' x 25' (to road)

Vegetation on Pile (Y or N) N  Texture (fine, coarse) fine

Equipment Access (describe) Access easy except steep slopes

---

Reclamation Measures (check if feasible)  Run-on Diversion X

Removal  Cementation Some cementation

Cap-in-place X  Amend and Revegetate X

---

Comments

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #21 Aetna  Drainage Chase

Latitude N39° 48 ' 18.6 "  Average of 8 Readings

Longitude W105° 30 ' 16.0 "

---

Mineralogy (1= present, 2= abundant)  Pyrite

Sphalerite 1  Chalcopyrite 1

Galena  Other, (specify)

Country Rock 1  Secondary Sulfides 1

---

Approximate Distance from Drainage Channel 50'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width 25'  Average top length 50'

Average bottom width 10'  Average bottom length 75'

Average height 20'  Estimated Volume

Vegetation Kill Zone Present (Y or N) Y  Approximate Size (l x w) 100' x 30'

Vegetation on Pile (Y or N) N (few trees)  Texture (fine, coarse) fine

Equipment Access (describe) Cross creek from road

---

Reclamation Measures (check if feasible)  Run-on Diversion X

Removal  Cementation little

Cap-in-place  Amend and Revegetate X

---

Comments Tunnel weeping water

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #22 Boston  Drainage Gregory

Latitude N39° 47 ' 58.1 "  Average of 10 Readings

Longitude W105° 30 ' 39.5 "

---

Mineralogy (1= present, 2= abundant)  Pyrite 1

Sphalerite 1  Chalcopyrite 1

Galena  Other, (specify)

Country Rock  Secondary Sulfides 2

---

Approximate Distance from Drainage Channel

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep)

Average top width 15'  Average top length 500'

Average bottom width 200'  Average bottom length 1000'

Average height 100'  Estimated Volume

Vegetation Kill Zone Present (Y or N) Y  Approximate Size (l x w) 1000' x 50' (street/bldgs)

Vegetation on Pile (Y or N) N  Texture (fine, coarse) mostly fine w/ coarse

Equipment Access (describe) Hard access from top. Bottom from street.

---

Reclamation Measures (check if feasible)  Run-on Diversion X

Removal  Cementation little

Cap-in-place  Amend and Revegetate X

---

Comments

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #25 Humboldt  Drainage Gregory

Latitude N39° 48 ' 12.7 "  Average of 10 Readings

Longitude W105° 31 ' 6.4 "

---

Mineralogy (1= present, 2= abundant)  Pyrite

Sphalerite 1  Chalcopyrite 1

Galena  Other, (specify)

Country Rock  Secondary Sulfides 2

---

Approximate Distance from Drainage Channel > 300'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 2

Average top width 25'  Average top length 50'

Average bottom width 25'  Average bottom length 75'

Average height 20'  Estimated Volume

Vegetation Kill Zone Present (Y or N) Y  Approximate Size (l x w) 100' x 75'

Vegetation on Pile (Y or N) N  Texture (fine, coarse) fine

Equipment Access (describe) Easy access from road

---

Reclamation Measures (check if feasible)  Run-on Diversion X

Removal X  Cementation Some surface crust

Cap-in-place X  Amend and Revegetate X

---

Comments

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #26 Winnebago  Drainage Gregory

Latitude N39° 48 ' 14.1 "  Average of 10 Readings

Longitude W105° 30 ' 50.8 "

---

Mineralogy (1= present, 2= abundant)  Pyrite

Sphalerite 1  Chalcopyrite 1

Galena  Other, (specify)

Country Rock  Secondary Sulfides 1

---

Approximate Distance from Drainage Channel

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3 ( one gully 4)

Average top width 100'  Average top length 150'

Average bottom width 100'  Average bottom length 200'

Average height 50'  Estimated Volume

Vegetation Kill Zone Present (Y or N) Y  Approximate Size (l x w) 200' x 75'

Vegetation on Pile (Y or N) N (some trees)  Texture (fine, coarse) coarse

Equipment Access (describe) Accessible by roads

---

Reclamation Measures (check if feasible)  Run-on Diversion X

Removal  Cementation

Cap-in-place X  Amend and Revegetate X

---

Comments Duplicate sample

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #27 Hunter-Gold

Drainage Gregory

Latitude N39° 47 ' 48.7 "

Average of 12 Readings

Longitude W105° 30 ' 38.5 "

---

Mineralogy (1= present, 2= abundant)

Pyrite

Sphalerite 1

Chalcopyrite 1

Galena

Other, (specify)

Country Rock 1

Secondary Sulfides 1

---

Approximate Distance from Drainage Channel > 200'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width 10'

Average top length 30'

Average bottom width 10'

Average bottom length 50'

Average height 6'

Estimated Volume

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 75' x 20'

Vegetation on Pile (Y or N) N

Texture (fine, coarse) coarse w/ some fine

Equipment Access (describe) Easy

---

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal X

Cementation Some cement

Cap-in-place X

Amend and Revegetate X

---

Comments

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #31 Next President  Drainage Gregory

Latitude N39° 47 ' 56.8 "  Average of 10 Readings

Longitude W105° 30 ' 12.2 "

---

Mineralogy (1= present, 2= abundant)  Pyrite 1

Sphalerite 1  Chalcopyrite 2

Galena  Other, (specify)

Country Rock 1  Secondary Sulfides 1

---

Approximate Distance from Drainage Channel 100' (gulch)

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3

Average top width 25'  Average top length 200'

Average bottom width 100'  Average bottom length 300'

Average height 50'  Estimated Volume

Vegetation Kill Zone Present (Y or N) Y  Approximate Size (l x w) 1000' x 100'

Vegetation on Pile (Y or N) N  Texture (fine, coarse) mostly fine

Equipment Access (describe) Road cut to site

---

Reclamation Measures (check if feasible)  Run-on Diversion X

Removal  Cementation

Cap-in-place  Amend and Revegetate X

---

Comments

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #32 Hartford

Drainage Gregory

Latitude N39° 47 ' 57.0 "

Average of 10 Readings

Longitude W105° 30 ' 16.4 "

---

Mineralogy (1= present, 2= abundant)

Pyrite

Sphalerite 1

Chalcopyrite 1

Galena

Other, (specify)

Country Rock

Secondary Sulfides 2

---

Approximate Distance from Drainage Channel 90' (to gulch)

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3

Average top width 30'

Average top length 75'

Average bottom width 50'

Average bottom length 100'

Average height 25'

Estimated Volume

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 125' x 90' (to gulch)

Vegetation on Pile (Y or N) N

Texture (fine, coarse) fine

Equipment Access (describe) Road access

---

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal

Cementation some cement

Cap-in-place

Amend and Revegetate X

---

Comments

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #33 Mainc Hamlet

Drainage Gregory

Latitude N39° 47 ' 54.9 "

Average of 9 Readings

Longitude W105° 30 ' 34.4 "

---

Mineralogy (1= present, 2= abundant)

Pyrite

Sphalerite 1

Chalcopyrite

Galena

Other, (specify)

Country Rock

Secondary Sulfides 1

---

Approximate Distance from Drainage Channel 0

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3

Average top width 15'

Average top length 20'

Average bottom width 50'

Average bottom length 100'

Average height 30'

Estimated Volume

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 75' x 100' (to Harveys)

Vegetation on Pile (Y or N) N

Texture (fine, coarse) fine

Equipment Access (describe) Steep ridges from Epizodic, old trail on right flank looking downgrade

---

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal

Cementation little

Cap-in-place

Amend and Revegetate X

---

Comments

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #34 Vasa - Levant

Drainage Gregory

Latitude N39° 47 ' 59.7 "

Average of 10 Readings

Longitude W105° 30 ' 23.6 "

---

Mineralogy (1= present, 2= abundant)

Pyrite

Sphalerite 1

Chalcopyrite 1

Galena

Other, (specify)

Country Rock 1 (on flanks)

Secondary Sulfides 2

---

Approximate Distance from Drainage Channel 50'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3

Average top width 50'

Average top length 1000'

Average bottom width 100'

Average bottom length 1200'

Average height 50'

Estimated Volume

Vegetation Kill Zone Present (Y or N) N

Approximate Size (l x w) (1200' x ?) highway cuts off toe

Vegetation on Pile (Y or N) N

Texture (fine, coarse) mostly fine w/ coarse

Equipment Access (describe) Toe - easy from highway. Top - difficult.

---

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal

Cementation

Cap-in-place

Amend and Revegetate X

---

Comments

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #36 OK (Epizodic) Drainage Gregory

Latitude N39° 47 ' 54.1 " Average of 9 Readings

Longitude W105° 30 ' 36.3 "

---

Mineralogy (1= present, 2= abundant) Pyrite

Sphalerite 1 Chalcopyrite 1 (minor)

Galena Other, (specify)

Country Rock 1 Secondary Sulfides 2

---

Approximate Distance from Drainage Channel 75'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3

Average top width 50' Average top length 50'

Average bottom width 75' Average bottom length 100'

Average height 30' Estimated Volume

Vegetation Kill Zone Present (Y or N) Y Approximate Size (l x w) 125' x 50'

Vegetation on Pile (Y or N) N Texture (fine, coarse) fine (some boulders)

Equipment Access (describe) Very steep - old access road on right flank looking down slope

---

Reclamation Measures (check if feasible) Run-on Diversion X

Removal Cementation little

Cap-in-place Amend and Revegetate X

---

Comments Some malachite - green, Some red - cinnabar?

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #37 German  Drainage Gregory

Latitude N39° 47 ' 52.8 "  Average of 12 Readings

Longitude W105° 30 ' 32.7 "

---

Mineralogy (1= present, 2= abundant)  Pyrite 1

Sphalerite 1  Chalcopyrite

Galena 1  Other, (specify)

Country Rock  Secondary Sulfides 2

---

Approximate Distance from Drainage Channel 75'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3

Average top width 25'  Average top length 75'

Average bottom width 100'  Average bottom length 200'

Average height 100'  Estimated Volume

Vegetation Kill Zone Present (Y or N) Y  Approximate Size (l x w) 250' x 75'

Vegetation on Pile (Y or N) N  Texture (fine, coarse) fine to medium fine

Equipment Access (describe) To top by old road (trees are in road)

---

Reclamation Measures (check if feasible)  Run-on Diversion X

Removal  Cementation little

Cap-in-place  Amend and Revegetate X

---

Comments Pyrite

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site SD-1 Drainage Chase

Latitude N39° 48 ' 43.6 " Average of 3 Readings

Longitude W105° 30 ' 58.7 "

---

Mineralogy (1= present, 2= abundant) Pyrite _____

Sphalerite _____ Chalcopyrite _____

Galena _____ Other, (specify) _____

Country Rock _____ Secondary Sulfides _____

---

Approximate Distance from Drainage Channel _____

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) _____

Average top width _____ Average top length _____

Average bottom width _____ Average bottom length _____

Average height _____ Estimated Volume _____

Vegetation Kill Zone Present (Y or N) _____ Approximate Size (l x w) _____

Vegetation on Pile (Y or N) _____ Texture (fine, coarse) _____

Equipment Access (describe) _____

---

Reclamation Measures (check if feasible) Run-on Diversion _____

Removal _____ Cementation _____

Cap-in-place _____ Amend and Revegetate _____

---

Comments Upstream of Tucker

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site SD-02 Drainage Chase

Latitude N39° 48 ' 36.7 " Average of 3 Readings

Longitude W105° 30 ' 54.1 "

---

Mineralogy (1= present, 2= abundant) Pyrite _____

Sphalerite _____ Chalcopyrite _____

Galena _____ Other, (specify) _____

Country Rock _____ Secondary Sulfides _____

---

Approximate Distance from Drainage Channel 0'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) _____

Average top width _____ Average top length _____

Average bottom width _____ Average bottom length _____

Average height _____ Estimated Volume _____

Vegetation Kill Zone Present (Y or N) _____ Approximate Size (l x w) _____

Vegetation on Pile (Y or N) _____ Texture (fine, coarse) _____

Equipment Access (describe) _____

---

Reclamation Measures (check if feasible) Run-on Diversion _____

Removal _____ Cementation _____

Cap-in-place _____ Amend and Revegetate _____

---

Comments From the stream bed, down stream of Hayseed

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site SD-3 Drainage Chase

Latitude N39° 48 ' 25.0 " Average of 5 Readings

Longitude W105° 30 ' 27.0 "

---

Mineralogy (1= present, 2= abundant) Pyrite

Sphalerite Chalcopyrite

Galena Other, (specify)

Country Rock Secondary Sulfides

---

Approximate Distance from Drainage Channel

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep)

Average top width Average top length

Average bottom width Average bottom length

Average height Estimated Volume

Vegetation Kill Zone Present (Y or N) Approximate Size (l x w)

Vegetation on Pile (Y or N) Texture (fine, coarse)

Equipment Access (describe)

---

Reclamation Measures (check if feasible) Run-on Diversion

Removal Cementation

Cap-in-place Amend and Revegetate

---

Comments

## NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site SD-4 Drainage Chase

Latitude N39° 48 ' 18.8 " Average of 10 Readings

Longitude W105° 30 ' 15.0 "

---

Mineralogy (1= present, 2= abundant) Pyrite

Sphalerite Chalcopyrite

Galena Other, (specify)

Country Rock Secondary Sulfides

---

Approximate Distance from Drainage Channel

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep)

Average top width Average top length

Average bottom width Average bottom length

Average height Estimated Volume

Vegetation Kill Zone Present (Y or N) Approximate Size (l x w)

Vegetation on Pile (Y or N) Texture (fine, coarse)

Equipment Access (describe)

---

Reclamation Measures (check if feasible) Run-on Diversion

Removal Cementation

Cap-in-place Amend and Revegetate

---

Comments Next to creek: where a drainage from the Bonanza drains into creek.

QC/QA

# ATTACHMENT 1

# CHEMICAL DATA QUALITY ASSESSMENT REPORT (CDQAR) FOR SURFACE SOIL SAMPLES NORTH FORK OF CLEAR CREEK, COLORADO

OMAHA DISTRICT
U.S. ARMY
CORPS OF ENGINEERS

# Chemical Data Quality Assessment Report (CDQAR)

For

Soil Samples Obtained at

# North Fork of Clear Creek, Colorado

**April 2003**

## TABLE OF CONTENTS

LIST OF TABLES



LIST OF APPENDICES

# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ABA | Acid Base Accounting |
| ADP | Analytical Data Package |
| ASTM | American Standard Testing Materials |
| $^{o}C$ | Degrees Celsius |
| CDMG | Colorado Division of Minerals and Geology |
| CDQAR | Chemical Data Quality Assessment Report |
| CENWO | Corps of Engineers, Omaha District |
| COC | Chain-of-Custody |
| DQCR | Daily Quality Control Report |
| DQOs | Data Quality Objectives |
| DUP | Duplicate |
| eV | Electron volt |
| ECB | Environmental Chemistry Branch |
| EPA | Environmental Protection Agency |
| FSP | Field Sampling Plan |
| Ft | Foot/Feet |
| GPS | Global Positioning System |
| HSA | Hollow Stem Auger |
| I.D. | Inner Diameter |
| IDW | Investigative Derived Waste |
| Kg | Kilogram |
| L | Liter |
| LCS | Laboratory Control Sample |
| LCSD | Laboratory Control Sample Duplicate |
| LIMS | Laboratory Information Management System |
| MDL | Method Detection Limit |
| MRL | Method Reporting Limit |
| µg/L | Micrograms per Liter |
| mg/kg | Milligrams per kilogram |
| mg/L | Milligrams per Liter |
| mg | Milligram |
| Min | Minute |
| mL | Milliliters |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| MW | Monitoring Well |
| N/A | Not Applicable |
| ND | non-detect |
| NPDES | National Pollutant Discharge Elimination System |
| O.D. | Outer Diameter |
| PID | Photoionization Detector |
| ppb | Parts per Billion (measured in water as µg/L) |

| | |
|---|---|
| QA | Quality Assurance |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |
| RAMS | Restoration of Abandoned Mine Sites |
| RPD | Relative Percent Difference |
| SSHP | Site Safety Health Plan |
| SOP | Standard Operating Procedure |
| SSA | Site-Specific Addendum |
| TMDL | Total Maximum Daily Load |
| U.S. | United States |
| USACE | U.S. Army Corps of Engineers |
| USBR | U.S. Bureau of Reclamation |
| USDA | U.S. Department of Agriculture |
| USFS | U.S. Forest Service |
| WRDA | Water Resource Development Act |

# 1 INTRODUCTION

## 1.1 QUALITY CONTROL SUMMARY

This Chemical Data Quality Assessment Report (CDQAR) describes the operations and procedures followed by USACE to conduct the investigation of soil and sediment samples obtained from the abandoned mine area of North Fork of Clear Creek, Colorado. Field work was performed by USACE Omaha and Albuquerque Districts. Analytical services were provided by a US Army Corps of Engineers laboratory, the Environmental Chemistry Branch Laboratory located in Omaha, Nebraska.

The field and sample analyses were performed in accordance with the general Site Work Plan for the Restoration of Abandoned Mines prepared by U.S. Army Corps of Engineers, Omaha District, Omaha, Nebraska, July 2002 and the Site Specific Work Plan for the North Fork of Clear Creek, Colorado, August 2002.

This CDQAR includes a summary of the quality assurance (QA) and quality control (QC) procedures and an evaluation of data quality and data usability with respect to Data Quality Objectives (DQOs) established for this field investigation.

## 1.2 REPORT ORGANIZATION

Section 2 of this report provides a discussion of project objectives. Procedures employed to control and evaluate the quality of sample collection, transportation, storage, and analysis are presented in Section 3. Section 4 discusses data evaluation, and the results of QC evaluations are in Section 5. Conclusions and recommendations are presented in Section 6.

# 2 PROJECT DESCRIPTION

## 2.1 PROJECT PURPOSE

The primary objective of this field investigation is to collect and provide surface soil and sediment data to the CDMG and USBR to support their respective investigations for the North Fork of Clear Creek drainage. This data may eventually be used by the CDMG and/or the USBR in order to determine metals loading from various mine waste pile sites to the North Fork of Clear Creek drainage.

## 2.2 ANALYTICAL SERVICES

The Environmental Chemistry Branch (ECB) laboratory provided analytical services for total metals of the soil/sediment samples and total metals, pH, acidity and conductivity of the water leachate from the soil/sediment samples. Laboratory address is given below:

US Army Corps of Engineers
Environmental Chemistry Branch (ECB) Laboratory
420 South 18th Street
Omaha, NE 68102

ECB Laboratory reported all non-detect results as "u". The non-detect values are given in the data tables as 'u' less than the Method Detection limits (MDL). The MDL is the minimum concentration of a substance that can be measured and reported with 99 per cent confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. The reporting limit (RL) is determined by the laboratory and takes into account impacts from sample matrix, sample preparation, and instrument limitations. The RL represents the concentration at which the laboratory can both determine the presence of an analyte and accurately quantify the amount present. The laboratory reported detections below the RL and higher than the MDL with a "J" laboratory qualifier, which indicates a greater degree of uncertainty associated with the quantitative result. The J qualified values are considered valid and useable. Reporting limits may increase for an individual environmental sample due to high concentrations of target analytes, matrix effects, or other interferences.

## 2.3 DATA QUALITY OBJECTIVES

The DQOs for this site are based on the objective of the investigation, which is to collect soil data of sufficient quality so that the data users can assess the effects of former mine operations at this area and then evaluate the need for any additional response action.

### 2.3.1 Data Collected

The data collected at the North Fork of Clear Creek were from samples obtained from soil/sediment samples and sent to the labs given above.

**Field Measurements (Field Screening Data)**
No field screening of samples were performed.

**Off-Site Analysis (Definitive Level Data)**
Definitive level data was collected from twenty-seven (27) soil sample locations and four (4) sediment sample locations. The total number of soil samples analyzed was 31 soil samples (27 primary samples plus four QC samples) and five sediment samples (four primary samples and one QC sample). All samples were analyzed for total metals. The water leachate derived from these same soil samples was also analyzed for total leachable metals, pH, acidity, and conductivity. The metals suite is: Al, As, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, K, Ag, Zn. Sections 3.0 and 4.0 give the field and laboratory quality control procedures and the result of the quality control process is given in Section 5.0. The data quality objectives for this data are to ensure that the data adheres to criteria in Sections 3.0, 4.0, and 5.0.

# 3 FIELD QUALITY CONTROL PROCEDURES

## 3.1 PROJECT PLANNING

The field investigation was conducted as described in the Site Specific Work Plan for the North Fork of Clear Creek, Colorado, 29 August 2002. The plan was written by CENWO to ensure the quality of data derived from the investigation. The plan provides a discussion of the project work scope and general procedures to be followed for field and laboratory activities.

## 3.2 DOCUMENTED FIELD ACTIVITIES

This section summarizes the equipment, procedures, and methods undertaken to ensure quality of the sample collection activities. Investigation activities and QC procedures were recorded and documented in the field using appropriate field forms. Prior to sample collection, as well as between sample locations, field equipment was decontaminated.

### 3.2.1 Soil/Sediment Samples

A total twenty-seven (27) soil samples and four (4) sediment samples were collected by CENWO personnel between 9 –13 September 2002 and were sent off site for analysis.

### 3.2.2 Management of Investigation Derived Waste (IDW)

IDW was handled as described in the Site Specific Work Plan for the North Fork of Clear Creek, Colorado, August 2002.

### 3.2.3 Decontamination Procedures

The field instruments were decontaminated in the field as described in the Standard Operating Procedures.

### 3.2.4 Other Documentation and Reporting of Field Activities

All field activities were thoroughly documented in indelible ink using the following forms:

- Field Data Sheets
- Chain of Custody Record
- Sample Labels

Field personnel initiated Chain of Custody (COC) documentation as samples were collected and selected for laboratory analysis. Sample custody was maintained from sample collection through the completion of the laboratory analysis.

### 3.2.5 Sample Labeling, Handling, and Shipping

All documentation, handling, and shipping employed for this field effort were in concurrence with the procedures described in the Work Plan.

Labeled samples were placed in sealed Ziploc brand bags and packed in waterproof plastic ice chests with sufficient packaging material placed around and between the sample jars. Sample containers and holding times used for this project are shown in Table 3-1.

Every cooler contained a COC form, prepared in triplicate, which identified all of the sample containers, analytical requirements, time and date sampled, preservatives, and other pertinent field data. Samples were shipped by an overnight courier to ECB Laboratory to enable analysis within holding times. Upon receipt in the laboratory, the Sample Custodian opened the shipping containers, compared the contents with the COC record, ensured that the document control information was accurate and complete, and dated the form. A Sample Receipt Form was also used by the laboratory to log in samples and document their integrity upon arrival. These forms are provided in the Analytical Data Packages.

## 3.3 FIELD QUALITY CONTROL SAMPLES

Duplicate samples were collected for this field effort as follows: four soil samples and one sediment sample. The results of the field QC samples and their impact on data quality are discussed in Section 4.

**Table 3-1**
**SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES**
**FOR COMPOSITE SOIL SAMPLES**

| Parameter | Container | Maximum Holding Times | |
|---|---|---|---|
| | | **Digestion** | **Analysis** |
| **Composite Soil Sample*** | | | |
| Metals[1] | 1 x 8 ox Glass | 6 months (Mercury – 28 days) | 6 months (Mercury – 28 days) |
| | | | |
| **Water Leachate**** | | | |
| Leachate Metals[1] | | 6 months (Mercury – 28 days) | 6 months (Mercury – 28 days) |
| Leachate pH | | | ASAP*** |
| Leachate Acidity | | | ASAP*** |
| Conductivity | | | ASAP*** |

* One 8 oz jar obtained in the field from each area is sufficient for all analyses.

** The water leachate process is performed in the laboratory by the method described in the Site Specific Work Plan..

*** ASAP in this instance means as soon as possible after leachate is obtained.

[1] Al, As, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, K, Ag, Zn

# 4 EVALUATION OF DATA QUALITY

The laboratory analytical data was reviewed and verified by ECB Laboratory and then evaluated by the CENWO project chemist for compliance with project objectives.

The following section is a description of the laboratory review procedures used to ensure data quality and the project chemists' assessment of project deliverables. Data usability was determined by comparing the project DQOs against the quality of the final analytical results.

## 4.1 LABORATORY QUALITY CONTROL SAMPLES

This section provides a description of laboratory QC samples: laboratory control samples, method blanks, and surrogate spike samples (organic analyses only), and matrix spike/matrix spike duplicate.

### 4.1.1 Laboratory Control Samples (LCS)

The laboratory analyzed a spike blank sample in duplicate to evaluate the precision and accuracy within an analytical batch. The nomenclature for these samples is a laboratory control sample (LCS). LCS sample pairs consisted of analyte-free water that was spiked with selected target compounds. LCS results are included in the QC section of each laboratory's data package, which are included in the Analytical Data Packages.

### 4.1.2 Method Blank Analyses

A laboratory method blank is a contaminant free matrix sample (e.g. a method blank is often a volume of distilled water carried through the entire analytical scheme) that is subjected to the same analytical procedures as the field samples. The method blank is used in all analyses to verify that the determined concentrations do not reflect contamination. One method blank is performed with every batch of samples (approximately 20 samples). If consistent high blank values are observed, laboratory glassware and reagents are checked for contamination and the analysis is halted until the system is brought under control.

### 4.1.3 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

The laboratory analyzed a spiked environmental sample and duplicate to evaluate the performance of the method as applied to a particular project matrix. A MS is an environmental sample in which known concentrations of certain target analytes have been added before sample manipulation from the preparation, and determinative procedures have been implemented. The results of the MS are evaluated in conjunction with other QC information to determine if the effect of the matrix can bias the analysis.

## 4.2 LABORATORY DATA VALIDATION ACTIVITIES

All analytical data generated by ECB Lab was checked for completeness and evaluated for overall quality prior to final report generation as outlined in the Quality Assurance Program Plan (QAPP) and specified in each laboratory's Standard Operating Procedures (SOPs). This process consisted of data generation and reduction plus three levels of documented review. Each step of the review process involved evaluation of data quality based on QC data results and the professional judgement of the reviewer(s). All reviews were documented by the reviewer's signature and the date reviewed.

The analyst who generated the raw analytical data performed the first level review. Primary emphasis of the review was on correctness and completeness of the data set. All data were generated and reduced following method-specific SOPs. Each analyst reviewed the quality of the work based on the guidelines established in the SOP. The first review ensured that:

- Sample preparation and analysis information was correct and complete;
- The appropriate SOPs had been followed;
- QC parameters were within method control limits; and
- Documentation was complete

The second level review was structured so that all calibration data and QC sample results were reviewed and 10 percent of the analytical results were confirmed against the bench and instrument sheets. This shall include a complete review of instrument data scans to ensure accurate peaks and retention time, and correct peak integrations have been performed. If no problems were found with the data package, the review was considered complete. If any problems were found with the data package, an additional 10 percent of the samples were checked to the bench sheet. The process was continued for each batch until no errors were found or until each data package was reviewed in its entirety. All second level reviews were performed by a laboratory supervisor, data review specialist, or QA officer to ensure that:

- Calibration data were appropriate to the method and completely documented;
- QC samples were within established guidelines;
- Qualitative identification of sample components was correct;
- Quantitative values were calculated correctly;
- Documentation was complete and correct;
- The data were ready for final reporting; and;
- The data package was complete and ready for data archive.

An important element of the second review was the documentation of any errors identified and corrected during the review process.

Before the final report was released, a third review was performed to check each data package for completeness and to ensure that the data met the overall objectives of the project. The laboratory Program Administrator, as stated in the QAPP, did this review. The review was performed to ensure that:

- Target analyte lists were complete as specified in the sampling and analysis plan;
- Data package checklist items were present;
- Case narratives accurately documented analytical conditions;
- All non-conformances were addressed and closed.

The Analytical Data Packages (ADPs) contain the following:

- Cover page, identifying project and remarks
- Summary and discussion of method QC and shipping and/or chain-of-custody errors

- Sample receipt information including copies of Cooler Receipt Forms
- Chain-of-Custody (COC) information including copies of COCs
- Analytical Test Results

As part of the review process, both contract laboratories applied data qualifiers to specific results to indicate usability and/or special analytical conditions. The following qualifiers were used to flag data:

| | |
|---|---|
| B | The compound was also observed in the method blank. |
| J | Estimated concentration below the Reporting Limit. |
| u | The compound was not detected. |
| M | Reporting limit higher than normal due to matrix interferences. |
| D | Derived from a dilution of extract. |

All investigative and QC sample summary results have been submitted in the Analytical Data Packages. A summary of laboratory quality control issues is found in the data package. The data package as obtained from the laboratory is attached as Appendix B.

## 4.3 CENWO PROJECT CHEMIST QUALITY EVALUATION

In addition to the internal validation conducted by ECB Lab, the CENWO project chemist performed data validation of the data set. This included an evaluation and validation of samples based on:

- Initial sample inspection and COC documentation;
- Holding Times;
- Field Duplicate Analyses;
- Laboratory Control Samples;
- Method Blank Analyses;
- Matrix Spike/Matrix Spike Duplicate recoveries;
- Precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters as they apply to this CDQAR; and
- An overall assessment of data compared to the project DQOs.

The CENWO project chemist received data from the laboratory in hard copy format. The USACE Guidance for the Review of Performance-Based Definitive Chemical Data was used to perform the review and validation of the data.

The first step in evaluating and validating the data was to group the samples according to analytical batch or work group. A table was generated which show all analytical batches (project samples and laboratory QC samples). The batches are shown on Table 4-1. After analytical batching, the batches were reviewed to ensure that the proper QC (type and frequency) was analyzed according to the QAPP for each batch. Next, sample duplicate frequency was evaluated for compliance with the QAPP. Chain-of-custody forms and Cooler Receipt Forms were then reviewed. Any problems found were documented and the impact on sample results was determined and explained.

Holding times were evaluated for compliance with extraction and analysis holding time requirements. Matrix spike recoveries were evaluated for all samples. MS/MSD results were re-calculated on at least one sample per batch. Data qualifier flags were applied as appropriate. Surrogate spike recoveries were evaluated for all samples and surrogate recoveries were re-calculated on at least one sample per batch.

Next, LCS results were reviewed for all samples. LCS recoveries were re-calculated on one sample per batch. Relative Percent Differences (RPDs) for MS/MSD and LCS/LCSD pair calculations were verified for all batches. The 5X and 10X rule (as discussed in the Functional Guidelines for the Evaluation of Chemical Data) was used for evaluation of method blank results. The completeness percentage for surrogates, LCS, MS/MSD and holding times was then calculated.

A summary of the data review/validation results is given in section 5.

As discussed previously, data qualifier flags were applied to out-of-control data as appropriate. The following qualifiers were used to indicate data usability:

u: The analyte was not detected relative to the method reporting limit.

UN: The result is reported as a tentative non-detection. There is uncertainty with whether or not the non-detection is valid at the stated method reporting limit.

X: The data is tentatively rejected because project-specific data quality objectives have not been met or have not been demonstrated.

J: The target analyte is positively identified but the quantitative result is an estimate and the direction of bias is unknown. The flag indicates a significant quantitative (rather than a qualitative) uncertainty exists.

J-: The target analyte is present but the reported concentration is an estimated value that is believed to be biased low. (i.e. the actual concentration in the environmental sample believed to be higher than the reported concentration)

J+: The target analyte is present but the reported concentration is an estimated value that is believed to be biased high. (i.e. the actual concentration in the environmental sample is believed to be lower than the reported concentration)

R: Data is rejected due to the serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified. The data is not useable.

Daily Quality Control Reports and COC documentation were compared against laboratory reports to check conformity of sample identification numbers. Analytical results were compared

to daily activity logs to identify sampling procedures/activities that may have impacted data quality.

## Table 4-1 Analytical Batches

**North Fork Clear Creek, Colorado**

| Batch | Analyses | Sample ID |
|---|---|---|
| WG11258 | Metals (soil) | CO-NCC-CHG02-SS11 |
| | | CO-NCC-CHG02-SS10 |
| | | CO-NCC-CHG02-SS11 dup |
| | | CO-NCC-CHG02-SS09 |
| | | CO-NCC-CHG02-SD-01 |
| | | CO-NCC-CHG02-SD02 |
| | | CO-NCC-CHG02-SS07 |
| | | CO-NCC-CHG02-SS06 |
| | | CO-NCC-CHG02-SS04 |
| | | CO-NCC-CHG02-SS16 |
| | | CO-NCC-CHG02-SS15 |
| | | CO-NCC-CHG02-SS02 |
| | | CO-NCC-CHG02-SS08 |
| | | CO-NCC-CHG02-SS08 dup |
| | | CO-NCC-CHG02-SD-03 |
| | | CO-NCC-CHG02-SS14 |
| | | CO-NCC-CHG02-SD-04 |
| | | CO-NCC-CHG02-SS-03 |
| | | Method Blank |
| | | Laboratory Matrix Duplicate |
| | | Matrix Spike (MS)/Matrix Spike Duplicate (MSD) |
| | | Laboratory Control Sample (LCS) |
| WG11267 | Metals (soil) | CO-NCC-CHG02-SS14 |
| | | CO-NCC-CHG02-SD04 |
| | | CO-NCC-CHG02-SS03 |
| | | CO-NCC-CHG02-SS13 |
| | | CO-NCC-CHG02-SS20 |
| | | CO-NCC-CHG02-SS21 |
| | | CO-NCC-LGG02-SS25 |
| | | CO-NCC-LGG02-SS26 |
| | | CO-NCC-LGG02-SS26 dup |
| | | CO-NCC-CHG02-SS05 |
| | | CO-NCC-CHG02-SD04 dup |
| | | CO-NCC-CHG02-SS18 |
| | | CO-NCC-LGG02-SS27 |
| | | CO-NCC-LGG02-SS33 |
| | | Method Blank |
| | | Laboratory Matrix Duplicate |
| | | MS/MSD |
| | | LCS |

| Batch | Analyses | Sample ID |
|---|---|---|
| WG11268 | Metals (soil) | CO-NCC-LGG02-SS37 |
| | | CO-NCC-LGG02-SS37 dup |
| | | CO-NCC-LGG02-SS36 |
| | | CO-NCC-LGG02-SS22 |
| | | CO-NCC-LGG02-SS34 |
| | | CO-NCC-LGG02-SS31 |
| | | CO-NCC-LGG02-SS32 |
| | | Method Blank |
| | | Laboratory Matrix Duplicate |
| | | MS/MSD |
| | | LCS |
| WG11333 | Metals (water leachate) | CO-NCC-CHG02-SS11 |
| | | CO-NCC-CHG02-SS10 |
| | | CO-NCC-CHG02-SS11 dup |
| | | CO-NCC-CHG02-SS09 |
| | | CO-NCC-CHG02-SD-01 |
| | | CO-NCC-CHG02-SD02 |
| | | CO-NCC-CHG02-SS07 |
| | | CO-NCC-CHG02-SS06 |
| | | CO-NCC-CHG02-SS04 |
| | | CO-NCC-CHG02-SS16 |
| | | CO-NCC-CHG02-SS15 |
| | | CO-NCC-CHG02-SS02 |
| | | CO-NCC-CHG02-SS08 |
| | | CO-NCC-CHG02-SS08 dup |
| | | CO-NCC-CHG02-SD-03 |
| | | CO-NCC-CHG02-SS14 |
| | | CO-NCC-CHG02-SD-04 |
| | | CO-NCC-CHG02-SS-03 |
| | | Method Blank |
| | | Laboratory Matrix Duplicate |
| | | MS/MSD |
| | | LCS |
| WG11334 | Metals (water leachate) | CO-NCC-CHG02-SS13 |
| | | CO-NCC-CHG02-SS20 |
| | | CO-NCC-CHG02-SS21 |
| | | CO-NCC-LGG02-SS25 |
| | | CO-NCC-LGG02-SS26 |
| | | CO-NCC-LGG02-SS26 dup |
| | | CO-NCC-CHG02-SS05 |
| | | CO-NCC-CHG02-SD04 dup |
| | | CO-NCC-CHG02-SS18 |
| | | CO-NCC-LGG02-SS27 |
| | | CO-NCC-LGG02-SS33 |

| Batch | Analyses | Sample ID |
|---|---|---|
| | | CO-NCC-LGG02-SS37 |
| | | CO-NCC-LGG02-SS37 dup |
| | | CO-NCC-LGG02-SS36 |
| | | CO-NCC-LGG02-SS22 |
| | | CO-NCC-LGG02-SS34 |
| | | CO-NCC-LGG02-SS31 |
| | | CO-NCC-LGG02-SS32 |
| | | Method Blank |
| | | Laboratory Matrix Duplicate |
| | | MS/MSD |
| | | LCS |
| M020912 | Water Leachate Conductivity | CO-NCC-CHG02-SS11 |
| | | CO-NCC-CHG02-SS10 |
| | | CO-NCC-CHG02-SS11 dup |
| | | CO-NCC-CHG02-SS09 |
| | | CO-NCC-CHG02-SD-01 |
| | | CO-NCC-CHG02-SD02 |
| | | CO-NCC-CHG02-SS07 |
| | | CO-NCC-CHG02-SS06 |
| | | CO-NCC-CHG02-SS04 |
| | | CO-NCC-CHD02-SS16 |
| | | CO-NCC-CHG02-SS15 |
| | | CO-NCC-CHG02-SS02 |
| | | CO-NCC-CHG02-SS08 |
| | | CO-NCC-CHG02-SS08 dup |
| | | CO-NCC-CHG02-SD-03 |
| | | Method Blank |
| | | Laboratory Matrix Duplicate |
| | | LCS |
| M020922 | Water Leachate Conductivity | CO-NCC-CHG02-SS14 |
| | | CO-NCC-CHG02-SD04 |
| | | CO-NCC-CHG02-SS03 |
| | | CO-NCC-CHG02-SS13 |
| | | CO-NCC-CHG02-SS20 |
| | | CO-NCC-CHG02-SS21 |
| | | CO-NCC-CHG02-SS25 |
| | | CO-NCC-CHG02-SS26 |
| | | CO-NCC-CHG02-SS26 dup |
| | | CO-NCC-CHG02-SS05 |
| | | CO-NCC-CHG02-SD04 dup |
| | | CO-NCC-CHG02-SS18 |
| | | CO-NCC-LGG02-SS27 |
| | | CO-NCC-LGG02-SS33 |
| | | CO-NCC-LGG02-SS37 |

| Batch | Analyses | Sample ID |
|---|---|---|
| | | CO-NCC-LGG02-SS37 dup |
| | | CO-NCC-LGG02-SS36 |
| | | CO-NCC-LGG02-SS22 |
| | | CO-NCC-LGG02-SS34 |
| | | CO-NCC-LGG02-SS31 |
| | | CO-NCC-LGG02-SS32 |
| | | Method Blank |
| | | Laboratory Matrix Duplicate |
| | | LCS/LCSD |
| M020912 | Water Leachate pH | CO-NCC-CHG02-SS11 |
| | | CO-NCC-CHG02-SS10 |
| | | CO-NCC-CHG02-SS11 dup |
| | | CO-NCC-CHG02-SS09 |
| | | CO-NCC-CHG02-SD-01 |
| | | CO-NCC-CHG02-SD02 |
| | | CO-NCC-CHG02-SS07 |
| | | CO-NCC-CHG02-SS06 |
| | | CO-NCC-CHG02-SS04 |
| | | CO-NCC-CHG02-SS16 |
| | | CO-NCC-CHG02-SS15 |
| | | CO-NCC-CHG02-SS02 |
| | | CO-NCC-CHG02-SS08 |
| | | CO-NCC-CHG02-SS08 dup |
| | | CO-NCC-CHG02-SD-03 |
| | | pH = 4.0 |
| | | PH = 7.0 |
| M020922 | Water Leachate pH | CO-NCC-CHG02-SS14 |
| | | CO-NCC-CHG02-SD04 |
| | | CO-NCC-CHG02-SS03 |
| | | CO-NCC-CHG02-SS13 |
| | | CO-NCC-CHG02-SS20 |
| | | CO-NCC-CHG02-SS21 |
| | | CO-NCC-LGG02-SS25 |
| | | CO-NCC-LGG02-SS26 |
| | | CO-NCC-LGG02-SS26 dup |
| | | CO-NCC-CHG02-SS05 |
| | | CO-NCC-CHG02-SD04 |
| | | CO-NCC-CHG02-SS18 |
| | | CO-NCC-LGG02-SS27 |
| | | CO-NCC-LGG02-SS33 |
| | | CO-NCC-LGG02-SS37 |
| | | CO-NCC-LGG02-SS37 dup |
| | | CO-NCC-LGG02-SS36 |
| | | CO-NCC-LGG02-SS22 |

| Batch | Analyses | Sample ID |
|---|---|---|
| | | CO-NCC-LGG02-SS34 |
| | | CO-NCC-LGG02-SS31 |
| | | CO-NCC-LGG02-SS32 |
| | | pH = 4.0 |
| | | pH = 7 |

# 5 RESULTS OF QUALITY CONTROL ACTIVITIES AND ANALYSES

Field QC activities consisted of collecting appropriate field QC samples (field duplicates, trip blanks), daily communication between the CENWO field team and ECB Lab, and consistent interaction between the CENWO field team and CENWO Technical Manager.

## 5.1 FIELD QC PROCEDURES AND FIELD QC ANALYSES

### 5.1.1 Documentation of Field Quality Procedures

Daily Reports and Daily Quality Control Reports (DQCRs) were completed to summarize daily investigation procedures and document QC activities. These reports summarize samples collected, environmental conditions, instrument problems, and any non-routine situations that may have impacted sample integrity. These reports were reviewed concurrently with the COC forms and the analytical results from the laboratories to identify potential sampling anomalies or confirm sample identifications. The DQCR reports show collection procedures were adequate to ensure data results met project objectives.

### 5.1.2 Field Duplicate Analyses

Field duplicate samples were collected as indicated in Table 4-1, and also one sample in each batch for metals was run in duplicate for precision for the batch can be determined. Relative percent difference (RPD) of each analyte was within compliance so no qualification was required for the metals results because of precision for the soils and soils leachate. Field duplicates were analyzed for five sets of samples for conductivity, pH, and acidity and the RPDs were within criteria, so no qualifications were applied.

## 5.2 LABORATORY QC PROCEDURES AND LABORATORY QC ANALYSES

The USACE project chemist conducted a review of laboratory QC procedures. All issues identified, and their respective solutions are discussed below and required qualifications are given in section 5.

### 5.2.1 Initial Sample Inspection and COC Documentation

ECB Laboratory inspected all shipping containers and compared the contents with the appropriate COC documentation. Information from the sample check-in procedures was recorded on the Cooler Receipt Form. This form was used to document that samples listed on the COC forms agreed with samples contained in the coolers, COC forms were filled out properly, samples were not broken, custody seals were intact, and cooler temperatures were less than or equal to $4^{o}$C. These forms are included in the Analytical Data Packages. No problems or deficiencies were found with the sample shipments or COC documentation.

### 5.2.2 Holding Times

Samples were delivered daily by the overnight courier to ECB Laboratory to ensure all analyses were completed within the required holding times. Part of the CENWO chemist evaluation included reviewing sample extraction and analysis dates to ensure holding times were met. Based on CENWO's review of the laboratory data, all samples were extracted and analyzed within the required holding times.

### 5.2.3 Method Blank Analyses

Method blanks were analyzed to assess existence and magnitude of contamination problems and measure the representativeness of the analytical process. Blanks reflect the amount of contamination introduced into the environmental samples during sample collection, transfer from the site to the laboratory or analysis. In particular, method blanks reflect laboratory contamination from both the determinative and preparatory method. At least one method blank must be reported for each preparation batch of samples. All blanks were clean except in the following:

Analytical Batch:

WG11258: Cu = 1.0 mg/Kg
Zn = 2.0 mg/Kg

No qualification since the sample values for these metals were greater than 10 times the blank contamination.

WG11267: Cu = 2.6 mg/Kg
Zn = 2.2 mg/Kg

No qualification since the sample values for these metals were greater than 10 times the blank contamination.

WG111268: Zn = 0.6J mg/Kg

No qualification since the sample values for these metals were greater than 10 times the blank contamination.

### 5.2.4 Laboratory Control Samples

Laboratory control samples are evaluated to assess overall method performance and are the primary indicators of laboratory performance. Laboratory control samples are method blanks which are typically spiked with all target analytes of interest. The percent recovery is used as a measure of accuracy and bias. The relative percent difference (RPD) for duplicate LCS recoveries is normally used as a measure of precision. When both a laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) are processed for a batch of samples, there is no significant physical distinction between the LCS and the LCSD. Both the LCS and the LCSD must satisfy the same recovery acceptance criteria. At least one LCS must be reported with each batch of samples. Multiple LCSs may be required to evaluate method precision. For example, a laboratory control sample and a laboratory control sample duplicate (LCSD) may be analyzed to provide information on the precision of the analytical method. The generation of control chart limits for precision via the analysis of LCS/LCSD pairs is an effective means to measure method precision. LCS and LCSD results are included in the QC section of the laboratory's data package. No qualifications were applied due to the LCS. The recoveries were with set criteria for all metals and conductivity results.

### 5.2.5 Surrogate Recovery

Surrogates are organic compounds, which are similar in chemical composition to the analytes of interest. Surrogates are spiked into environmental and batch QC samples prior to sample preparation and analysis. Surrogate recoveries for environmental samples are used to evaluate matrix interference on a sample-specific basis. High or low surrogate recoveries indicate problems in instrument performance, extraction procedures, or severe matrix effects. Samples for metals analysis are not spiked with surrogate analytes. No surrogate is added to samples for conductivity analysis.

### 5.2.6 MS/MSD Recovery

Matrix Spike (MS) and matrix spike duplicate (MSD) results are examined to evaluate the impact of matrix effects on overall analytical performance. A matrix spike is a representative environmental sample that is spiked with target analytes of interest prior to being taken through the entire analytical process in order to evaluate analytical bias for an actual matrix. A matrix duplicate is a collocated or a homogenized sample that is processed through the entire analytical procedure in order to evaluate overall precision for an actual matrix.

It should be noted that MS recovery failure and poor precision may arise because of (i) poor sampling technique, (ii) inadequate homogenization, or (iii) from matrix effects associated with the preparatory or determinative portion of an analytical method. Matrix interferences may be "positive" or "negative" in nature. Results of MS/MSD analyses are included in the Analytical Data Packages.

Metals: One set of MS/MSD samples were analyzed for each metals analytical batch. Analytical batches WG11258, WG11267, and WG11268 had recoveries and/or RPD values our of criteria.

WG11258 and WG11268: Aluminum and Zinc MS recoveries were each high, but the % recovery determination would be hard due to high initial sample concentration. The MS/MSD RPD was generally acceptable. All other quality control indicators were acceptable for these batches. No qualifications were applied to the data in these batches.

WG11267: Lead has erratic MS recoveries for this analytical batch. It may be due to high initial samples concentrations of lead. All other quality control indicators were acceptable for this batch. No qualifications were applied to the data in this batch.

### 5.2.7 Completeness of Data Packages

The CENWO Chemist reviewed the data package and confirmed the completeness of the data package. All the planned sampling activities were executed and all the laboratory analyses were performed.

## 5.3 PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS AND COMPARABILITY (PARCC)

DQOs and their corresponding measurement indicators were specified in the Sampling and Analysis Plan. To achieve the project DQOs, specific PARCC goals are established for laboratory and field sampling procedures. These PARCC parameters are the measurement tools for determining the usability of generated data.

Precision and accuracy goals were based on knowledge of each analytical measurement system. For this CDQAR, precision was measured using the RPD between two replicated sample analyses. The precision evaluation encompassed laboratory precision (LCS samples), and combined field/laboratory precision (MS/MSD samples).

Accuracy was measured using the percent recovery of surrogates, MS/MSD samples, and LCS sample pairs. Spike recoveries form field samples and laboratory QC samples are compared to established control limits to determine a laboratory's ability to accurately determine both qualitative and quantitative results.

Representativeness is the degree to which the data accurately and precisely portrayed the environmental conditions being studied. For the site investigation, sampling procedures and sample locations were selected to bias samples in areas of potential places of contamination. All sampling was conducted using known approved field procedures to minimize variability.

Completeness refers to the amount of valid data obtainable from a measurement system compared to the expected amount of data. The SAP established a completeness goal of 90 percent for laboratory QC requirements. This goal was attained by the data for this project.

## 5.4 DATA TABLES

The qualified data is given in Appendix A.

## 5.5 ANALYTICAL DATA PACKAGE

Data Sheets as Obtained from Environmental Chemistry Laboratory will be given upon request as hard copy of the Analytical Data Package.

# 6 CONCLUSIONS

This CDQAR presents, in specific terms, the quality control practices utilized to achieve the goals of the site investigation at North Fork of Clear Creek, Colorado. The analytical program for this project conformed to the CENWO General Chemistry SOS and the General Geology SOS. Samples were also collected and analyzed in accordance with ASTM and EPA methods and laboratory specific QA/QC procedures were used. These procedures were followed to generate high quality data.

The quality issues addressed in Section 5 of this report do not impact the usability of the data. The required qualifications have been applied to the data in Appendix A, Table 1, and 2. The reviewed data are usable and are suitable for addressing the overall objective of this investigation.

# Appendix A

Table 1

# Soil Sample Analysis

| Sample | MDL | CO-NCC/CHG02-SS11 | | | CO-NCC/CHG02-SS10 | | | CO-NCC/CHG02-SS11 dup | | | CO-NCC/CHG02-SS09 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Collected** | | **09/09/02** | **RL** | **Qual** | **09/09/02** | **RL** | **Qual** | **09/09/02** | **RL** | **Qual** | **09/09/02** | **RL** | **Qual** |
| Silver | 0.2 | 8.65 | 1 | | 23.7 | 1 | | 7.33 | 1 | | 7.12 | 1 | |
| Arsnic | 0.6 | 49.6 | 3 | | 22 | 3 | | 38.1 | 3 | | 9.8 | 3 | |
| Aluminum | 6 | 4300 | 18 | | 3100 | 18 | | 5080 | 18 | | 2470 | 18 | |
| Calcium | 20 | 3210 | 60 | | 1170 | 60 | | 4010 | 60 | | 387 | 60 | |
| Cadmium | 0.1 | 7.81 | 0.5 | | 44.9 | 0.5 | | 14.3 | 0.5 | | 0.507 | 0.5 | |
| Chromium | 0.4 | 4.69 | 2 | | 2.47 | 2 | | 7.15 | 2 | | 1.4 | 2 | J |
| Copper | 0.4 | 174 | 2 | B | 271 | 2 | B | 160 | 2 | B | 13.7 | 2 | B |
| Iron | 8 | 32200 | 24 | | 24000 | 24 | | 31200 | 24 | | 18200 | 24 | |
| Potassium | 20 | 3660 | 60 | | 3850 | 60 | | 3620 | 60 | | 3610 | 60 | |
| Magnesium | 8 | 2160 | 24 | | 1180 | 24 | | 2450 | 24 | | 442 | 24 | |
| Manganese | 0.2 | 1020 | 0.8 | | 1040 | 0.8 | | 899 | 0.8 | | 497 | 0.8 | |
| Lead | 0.4 | 3960 | 8 | | 20900 | 4 | | 2770 | 4 | | 401 | 2 | |
| Zinic | 0.6 | 2230 | 8 | B | 9070 | 4 | B | 3550 | 4 | B | 274 | 2 | B |

MDl = method detection limit RL = reporting limit units = mg/kg

B = analyte detected in method blank J = estimate u = non detect less than MDL

Table 1 (cont)

# Soil Sample Analysis

| Sample | MDL | CO-NCC/CHG02-SD01 | | | CO-NCC/CHG02-SD02 | | | CO-NCC/CHG02-SS07 | | | CO-NCC/CHG02-SS06 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Collected** | | **09/09/02** | **RL** | **Qual** | **09/09/02** | **RL** | **Qual** | **09/09/02** | **RL** | **Qual** | **09/09/02** | **RL** | **Qual** |
| Silver | 0.2 | < .2 | 1 | u | 1.01 | 1 | | 7.24 | 1 | | 7.02 | 1 | |
| Arsnic | 0.6 | 10 | 3 | | 15 | 3 | | 11 | 3 | | 13 | 3 | |
| Aluminum | 6 | 4530 | 18 | | 6240 | 18 | | 6370 | 18 | | 2360 | 18 | |
| Calcium | 20 | 1730 | 60 | | 1940 | 60 | | 5940 | 60 | | 2020 | 60 | |
| Cadmium | 0.1 | < .1 | 0.5 | u | 1.21 | 0.5 | | 19.8 | 0.5 | | 0.34 | 0.5 | J |
| Chromium | 0.4 | 31.6 | 2 | | 24 | 2 | | 24.2 | 2 | | 8.24 | 2 | |
| Copper | 0.4 | 32.4 | 2 | B | 38.7 | 2 | B | 127 | 2 | B | 41.6 | 2 | B |
| Iron | 8 | 24000 | 24 | | 18900 | 24 | | 59100 | 96 | | 28300 | 24 | |
| Potassium | 20 | 1920 | 60 | | 2450 | 60 | | 3390 | 60 | | 3340 | 60 | |
| Magnesium | 8 | 1430 | 24 | | 2310 | 24 | | 3960 | 24 | | 345 | 24 | |
| Manganese | 0.2 | 929 | 0.8 | | 847 | 0.8 | | 1950 | 3.2 | | 304 | 0.8 | |
| Lead | 0.4 | 81.9 | 2 | | 133 | 2 | | 4270 | 8 | | 3670 | 8 | |
| Zinic | 0.6 | 226 | 2 | B | 384 | 2 | B | 4020 | 8 | B | 446 | 2 | B |

MDl = method detection limit RL = reporting limit units = mg/kg

B = analyte detected in method blank J = estimate u = non detect less than MDL

Table 1 (cont)

# Soil Sample Analysis

| Sample | MDL | CO-NCC/CHG02-SS04 | | | CO-NCC/CHG02-SS16 | | | CO-NCC/CHG02-SS15 | | | CO-NCC/CHG02-SS02 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Collected** | | **9/10/02** | **RL** | **Qual** | **9/10/02** | **RL** | **Qual** | **9/10/02** | **RL** | **Qual** | **9/10/02** | **RL** | **Qual** |
| Silver | 0.2 | 1.87 | 1 | | 5.18 | 1 | | 2.51 | 1 | | 4.67 | 1 | |
| Arsnic | 0.6 | 9.9 | 3 | | 15 | 3 | | 9.8 | 3 | | 18 | 3 | |
| Aluminum | 6 | 4660 | 18 | | 2170 | 18 | | 5890 | 18 | | 6260 | 18 | |
| Calcium | 20 | 583 | 60 | | 162 | 60 | | 2340 | 60 | | 2070 | 60 | |
| Cadmium | 0.1 | < .1 | 0.5 | u | 1.82 | 0.5 | | 1.51 | 0.5 | | 4.41 | 0.5 | |
| Chromium | 0.4 | 5.53 | 2 | | 2.27 | 2 | | 8.46 | 2 | | 5.4 | 2 | |
| Copper | 0.4 | 140 | 2 | B | 72.5 | 2 | B | 65.7 | 2 | B | 94.4 | 2 | B |
| Iron | 8 | 33000 | 24 | | 16100 | 24 | | 29600 | 24 | | 26900 | 24 | |
| Potassium | 20 | 4030 | 60 | | 2980 | 60 | | 3470 | 60 | | 3770 | 60 | |
| Magnesium | 8 | 1600 | 24 | | 241 | 24 | | 2630 | 24 | | 2850 | 24 | |
| Manganese | 0.2 | 559 | 0.8 | | 63.3 | 0.8 | | 456 | 0.8 | | 972 | 0.8 | |
| Lead | 0.4 | 1040 | 2 | | 4120 | 8 | | 425 | 2 | | 4190 | 8 | |
| Zinic | 0.6 | 258 | 2 | B | 599 | 2 | B | 513 | 2 | B | 1380 | 8 | B |

MDl = method detection limit RL = reporting limit units = mg/kg

B = analyte detected in method blank J = estimate u = non detect less than MDL

Table 1 (cont)

# Soil Sample Analysis

| Sample | MDL | CO-NCC/CHG02-SS08 | | | CO-NCC/CHG02-SS08 dup | | | CO-NCC/CHG02-SD03 | | | CO-NCC/CHG02-SS05 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Collected** | | **9/10/02** | **RL** | **Qual** | **9/10/02** | **RL** | **Qual** | **9/10/02** | **RL** | **Qual** | **9/10/02** | **RL** | **Qual** |
| Silver | 0.2 | 1.56 | 1 | | 4.45 | 1 | | 2.16 | 1 | | 2.7 | 1 | |
| Arsnic | 0.6 | 9.3 | 3 | | 18 | 3 | | 14 | 3 | | 4.9 | 3 | |
| Aluminum | 6 | 5470 | 18 | | 5210 | 18 | | 9760 | 18 | | 5910 | 18 | |
| Calcium | 20 | 898 | 60 | | 756 | 60 | | 1940 | 60 | | 810 | 60 | |
| Cadmium | 0.1 | < .1 | 0.5 | u | 8.77 | 0.5 | | 1.43 | 0.5 | | 1.2 | 0.5 | |
| Chromium | 0.4 | 13.6 | 2 | | 10.8 | 2 | | 31.9 | 2 | | 38.6 | 2 | |
| Copper | 0.4 | 91.3 | 2 | B | 329 | 2 | B | 54.9 | 2 | B | 152 | 2 | B |
| Iron | 8 | 27600 | 24 | | 28900 | 24 | | 22100 | 24 | | 11800 | 24 | |
| Potassium | 20 | 3950 | 60 | | 3890 | 60 | | 4010 | 60 | | 3300 | 60 | |
| Magnesium | 8 | 2210 | 24 | | 1980 | 24 | | 4170 | 24 | | 2470 | 24 | |
| Manganese | 0.2 | 522 | 0.8 | | 351 | 0.8 | | 738 | 0.8 | | 290 | 0.8 | |
| Lead | 0.4 | 291 | 2 | | 341 | 2 | | 151 | 2 | | 373 | 2 | |
| Zinic | 0.6 | 248 | 2 | B | 1440 | 2 | B | 574 | 2 | B | 223 | 2 | B |

MDl = method detection limit RL = reporting limit units = mg/kg

B = analyte detected in method blank J = estimate u = non detect less than MDL

Table 1 (cont)

# Soil Sample Analysis

| Sample | MDL | CO-NCC/CHG02-SS14 | | | CO-NCC/CHG02-SD04 | | | CO-NCC/CHG02-SS03 | | | COCC/CHG02-SS13 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Collected** | | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** |
| Silver | 0.2 | 3.77 | 1 | | 1.13 | 1 | | 8.3 | 1 | | 2.37 | 1 | |
| Arsnic | 0.6 | 25 | 3 | | 11 | 3 | | 9.5 | 3 | | 13 | 3 | |
| Aluminum | 6 | 3180 | 18 | | 4720 | 18 | | 2400 | 18 | | 2730 | 18 | |
| Calcium | 20 | 1170 | 60 | | 1180 | 60 | | 65.1 | 60 | | 221 | 60 | |
| Cadmium | 0.1 | 0.32 | 0.5 | J | 3.1 | 0.5 | | 0.42 | 0.5 | J | 0.14 | 0.5 | J |
| Chromium | 0.4 | 2.56 | 2 | | 13 | 2 | | 1.1 | 2 | J | 1.2 | 2 | J |
| Copper | 0.4 | 96.1 | 2 | B | 42.3 | 2 | B | 49.9 | 2 | B | 30.4 | 2 | B |
| Iron | 8 | 37400 | 24 | | 16500 | 24 | | 13300 | 24 | | 28700 | 24 | |
| Potassium | 20 | 3800 | 60 | | 2520 | 60 | | 2890 | 60 | | 3920 | 60 | |
| Magnesium | 8 | 796 | 24 | | 1950 | 24 | | 291 | 24 | | 570 | 24 | |
| Manganese | 0.2 | 265 | 0.8 | | 352 | 0.8 | | 38.1 | 0.8 | | 150 | 0.8 | |
| Lead | 0.4 | 588 | 2 | | 338 | 2 | | 392 | 2 | | 172 | 2 | |
| Zinic | 0.6 | 277 | 2 | B | 697 | 2 | B | 125 | 2 | B | 198 | 2 | B |

MDl = method detection limit RL = reporting limit units = mg/kg

B = analyte detected in method blank J = estimate u = non detect less than MDL

Table 1 (cont)

# Soil Sample Analysis

| Sample | MDL | CO-NCC/CHG02-SS20 | | | CO-NCC/CHG02-SS21 | | | CO-NCC/LGG02-SS25 | | | CO-NCC/LGG02-SS26 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Collected** | | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** |
| Silver | 0.2 | 6.31 | 1 | | 1.36 | 1 | | 4.24 | 1 | | 0.89 | 1 | J |
| Arsnic | 0.6 | 41 | 3 | | 31.5 | 3 | | 24 | 3 | | 12 | 3 | |
| Aluminum | 6 | 3750 | 18 | | 6050 | 18 | | 2450 | 18 | | 3830 | 18 | |
| Calcium | 20 | 3910 | 60 | | 3550 | 60 | | 567 | 60 | | 236 | 60 | |
| Cadmium | 0.1 | 6.29 | 0.5 | | < .1 | 0.5 | u | 0.34 | 0.5 | J | < .1 | 0.5 | u |
| Chromium | 0.4 | 5.1 | 2 | | 2.28 | 2 | | 4.27 | 2 | | 4.18 | 2 | |
| Copper | 0.4 | 70.2 | 2 | B | 25.2 | 2 | B | 212 | 2 | B | 42.4 | 2 | B |
| Iron | 8 | 44700 | 24 | | 52600 | 48 | | 36500 | 24 | | 18600 | 24 | |
| Potassium | 20 | 4400 | 60 | | 4770 | 60 | | 3960 | 60 | | 2550 | 60 | |
| Magnesium | 8 | 1510 | 24 | | 2640 | 24 | | 578 | 24 | | 892 | 24 | |
| Manganese | 0.2 | 389 | 0.8 | | 351 | 0.8 | | 467 | 0.8 | | 163 | 0.8 | |
| Lead | 0.4 | 4430 | 8 | | 923 | 2 | | 637 | 2 | | 207 | 2 | |
| Zinic | 0.6 | 1430 | 8 | B | 336 | 2 | B | 186 | 2 | B | 95.1 | 2 | B |

MDl = method detection limit RL = reporting limit units = mg/kg

B = analyte detected in method blank J = estimate u = non detect less than MDL

Table 1 (cont)

# Soil Sample Analysis

| Sample | MDL | CO-NCC/LGG02-SS26 | | | CO-NCC/CHG02-SD04 | | | CO-NCC/CHG02-SS18 | | | CO-NCC/LGG02-SS27 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Collected** | | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** |
| Silver | 0.2 | 0.82 | 1 | J | 0.64 | 1 | J | 1.7 | 1 | | 4.2 | 1 | |
| Arsnic | 0.6 | 8.3 | 3 | | 8.1 | 3 | | 19 | 3 | | 28 | 3 | |
| Aluminum | 6 | 4170 | 18 | | 3540 | 18 | | 4720 | 18 | | 2400 | 18 | |
| Calcium | 20 | 221 | 60 | | 842 | 60 | | 653 | 60 | | 366 | 60 | |
| Cadmium | 0.1 | < .1 | 0.5 | u | 1.37 | 0.5 | | 0.49 | 0.5 | J | < .1 | 0.5 | u |
| Chromium | 0.4 | 4.38 | 2 | | 8.52 | 2 | | 3.94 | 2 | | 5.43 | 2 | |
| Copper | 0.4 | 100 | 2 | B | 52.7 | 2 | B | 46.2 | 2 | B | 294 | 2 | B |
| Iron | 8 | 18400 | 24 | | 13700 | 24 | | 17500 | 24 | | 18100 | 24 | |
| Potassium | 20 | 2480 | 60 | | 2030 | 60 | | 3150 | 60 | | 2250 | 60 | |
| Magnesium | 8 | 904 | 24 | | 1310 | 24 | | 1780 | 24 | | 805 | 24 | |
| Manganese | 0.2 | 158 | 0.8 | | 265 | 0.8 | | 317 | 0.8 | | 38.1 | 0.8 | |
| Lead | 0.4 | 148 | 2 | | 202 | 2 | | 403 | 2 | | 190 | 2 | |
| Zinic | 0.6 | 97.2 | 2 | B | 379 | 2 | B | 168 | 2 | B | 22.4 | 2 | B |

MDl = method detection limit RL = reporting limit units = mg/kg

B = analyte detected in method blank J = estimate u = non detect less than MDL

Table 1 (cont)

# Soil Sample Analysis

| Sample | MDL | CO-NCC/LGG02-SS33 | | | CO-NCC/LGG02-SS37 | | | CO-NCC/LGG02-SS37 dup | | | CO-NCC/LGG02-SS36 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Collected** | | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** |
| Silver | 0.2 | 7.86 | 1 | | 5.77 | 1 | | 5.66 | 1 | | 8.28 | 1 | |
| Arsnic | 0.6 | 42.7 | 3 | | 60.3 | 3 | | 43.1 | 3 | | 39.7 | 3 | |
| Aluminum | 6 | 5520 | 18 | | 3070 | 18 | | 2930 | 18 | | 3220 | 18 | |
| Calcium | 20 | 1150 | 60 | | 122 | 60 | | 147 | 60 | | 283 | 60 | |
| Cadmium | 0.1 | < .1 | 0.5 | u | < .1 | 0.5 | u | < .1 | 0.5 | u | < .1 | 0.5 | u |
| Chromium | 0.4 | 9.95 | 2 | | 4.33 | 2 | | 4.36 | 2 | | 3.58 | 2 | |
| Copper | 0.4 | 118 | 2 | B | 241 | 2 | | 194 | 2 | | 786 | 2 | |
| Iron | 8 | 49500 | 48 | | 36500 | 24 | | 32100 | 24 | | 25800 | 24 | |
| Potassium | 20 | 3980 | 60 | | 4210 | 60 | | 3850 | 60 | | 3500 | 60 | |
| Magnesium | 8 | 2100 | 24 | | 823 | 24 | | 742 | 24 | | 658 | 24 | |
| Manganese | 0.2 | 172 | 0.8 | | 37.7 | 0.8 | | 33.4 | 0.8 | | 39.2 | 0.8 | |
| Lead | 0.4 | 659 | 2 | | 134 | 2 | | 122 | 2 | | 245 | 2 | |
| Zinic | 0.6 | 108 | 2 | B | 13.4 | 2 | B | 19 | 2 | B | 39 | 2 | B |

MDl = method detection limit RL = reporting limit units = mg/kg

B = analyte detected in method blank J = estimate u = non detect less than MDL

Table 1 (cont)

# Soil Sample Analysis

| Sample | MDL | CO-NCC/LGG02-SS22 | | | CO-NCC/LGG02-SS34 | | | CO-NCC/LGG02-SS31 | | | CO-NCC/LGG02-SS32 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Collected** | | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** |
| Silver | 0.2 | 2.38 | 1 | | 3.2 | 1 | | 4.6 | 1 | | 5.31 | 1 | |
| Arsnic | 0.6 | 17 | 3 | | 36.9 | 3 | | 30.2 | 3 | | 38 | 3 | |
| Aluminum | 6 | 3920 | 18 | | 2910 | 18 | | 2390 | 18 | | 2370 | 18 | |
| Calcium | 20 | 329 | 60 | | 398 | 60 | | 510 | 60 | | 408 | 60 | |
| Cadmium | 0.1 | < .1 | 0.5 | u | < .1 | 0.5 | u | < .1 | 0.5 | u | < .1 | 0.5 | u |
| Chromium | 0.4 | 5.42 | 2 | | 2.68 | 2 | | 2.52 | 2 | | 1.2 | 2 | J |
| Copper | 0.4 | 66.2 | 2 | | 75.8 | 2 | | 310 | 2 | | 102 | 2 | |
| Iron | 8 | 24600 | 24 | | 38600 | 24 | | 27000 | 24 | | 26500 | 24 | |
| Potassium | 20 | 3380 | 60 | | 2880 | 60 | | 3190 | 60 | | 3180 | 60 | |
| Magnesium | 8 | 671 | 24 | | 591 | 24 | | 367 | 24 | | 385 | 24 | |
| Manganese | 0.2 | 63.3 | 0.8 | | 47.8 | 0.8 | | 55.7 | 0.8 | | 35.5 | 0.8 | |
| Lead | 0.4 | 474 | 2 | | 166 | 2 | | 326 | 2 | | 214 | 2 | |
| Zinic | 0.6 | 63 | 2 | B | 114 | 2 | B | 65.6 | 2 | B | 38.5 | 2 | B |

MDl = method detection limit RL = reporting limit units = mg/kg

B = analyte detected in method blank J = estimate u = non detect less than MDL

**Table 2**

# Water Leachate Sample Analysis

| Sample ug/l | MDL | CO-NCC/CHG02-SS11 | | | CO-NCC/CHG02-SS10 | | | CO-NCC/CHG02-SS11dup | | | CO-NCC/CHG02-SS09 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Collected** | | **09/09/02** | **RL** | **Qual** | **09/09/02** | **RL** | **Qual** | **09/09/02** | **RL** | **Qual** | **09/09/02** | **RL** | **Qual** |
| Aluminum | 30 | < 30 | 90 | u | < 30 | 90 | u | < 30 | 90 | u | 5440 | 90 | |
| Arsenic | 3 | < 3 | 15 | u | < 3 | 15 | u | < 3 | 15 | u | 7.8 | 15 | J |
| Cadmium | 0.5 | 66.1 | 2.5 | | 1620 | 2.5 | | 83.7 | 2.5 | | 83.7 | 2.5 | |
| Calcium | 100 | 190000 | 300 | | 90500 | 300 | | 168000 | 300 | | 50800 | 300 | |
| Chromium | 2 | < 2 | 10 | u | 2.1 | 10 | J | < 2 | 10 | u | 3.2 | 10 | J |
| Copper | 2 | 2.5 | 10 | J | 81.5 | 10 | | < 2 | 10 | u | 63.3 | 10 | |
| Iron | 40 | < 40 | 120 | u | < 40 | 120 | u | < 40 | 120 | u | 243 | 120 | |
| Lead | 2 | < 2 | 10 | u | 71.7 | 10 | | < 2 | 10 | u | 307 | 10 | |
| Magnesium | 40 | 54100 | 120 | | 60100 | 120 | | 51100 | 120 | | 30700 | 120 | |
| Manganese | 1 | 2540 | 4 | | 23800 | 40 | | 3880 | 4 | | 24200 | 20 | |
| Potassium | 100 | 4490 | 300 | | 5460 | 300 | | 4230 | 300 | | 1950 | 300 | |
| Silver | 1 | < 1 | 5 | u | < 1 | 5 | u | < 1 | 5 | u | < 1 | 5 | u |
| Zinc | 3 | 7640 | 20 | | 221000 | 100 | | 10800 | 20 | | 15300 | 50 | |
| Conductivity umho/cm | | 1310 | | | 1720 | | | 1340 | | | 831 | | |
| pH | | 6.71 | | | 6.34 | | | 6.57 | | | 4.79 | | |
| Acid Concentration mole/l | | $1.95 \times 10^{-7}$ | | | $4.57 \times 10^{-7}$ | | | $2.69 \times 10^{-7}$ | | | $1.62 \times 10^{-5}$ | | |
| Acidity mg/l | | 95 | | | 550 | | | 32 | | | 84 | | |

MDL = method detection limit RL = reporting limit

B = analyte detedted in method blank J = estimate u = nondetect less than MDL

Table 2 (cont)

# Water Leachate Sample Analysis

| Sample | MDL | CO-NCC/CHG02-SD01 | | | CO-NCC/CHG02-SD02 | | | CO-NCC/CHG02-SS07 | | | CO-NCC/CHG02-SS06 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Collected** | | **09/09/02** | **RL** | **Qual** | **09/09/02** | **RL** | **Qual** | **09/09/02** | **RL** | **Qual** | **09/09/02** | **RL** | **Qual** |
| Aluminum | 30 | 735 | 90 | | 1880 | 90 | | < 30 | 90 | u | 80400 | 90 | |
| Arsenic | 3 | < 3 | 15 | u | < 3 | 15 | u | < 3 | 15 | u | 29.4 | 15 | |
| Cadmium | 0.5 | < .5 | 2.5 | u | < .5 | 2.5 | u | 3.08 | 2.5 | | 155 | 2.5 | |
| Calcium | 100 | 2620 | 300 | | 12500 | 300 | | 74400 | 300 | | 210000 | 300 | |
| Chromium | 2 | < 2 | 10 | u | 3.2 | 10 | J | < 2 | 10 | u | 153 | 10 | |
| Copper | 2 | < 2 | 10 | u | 4.9 | 10 | J | < 2 | 10 | u | 717 | 10 | |
| Iron | 40 | 820 | 120 | | 1690 | 120 | | < 40 | 120 | u | 168000 | 120 | |
| Lead | 2 | 5.4 | 10 | J | 13.6 | 10 | | < 2 | 10 | u | 1370 | 10 | |
| Magnesium | 40 | 760 | 120 | | 2910 | 120 | | 40900 | 120 | | 22400 | 120 | |
| Manganese | 1 | 27.1 | 4 | | 23.5 | 4 | | 252 | 4 | | 18000 | 20 | |
| Potassium | 100 | 741 | 300 | | 741 | 300 | | 2420 | 300 | | 1550 | 300 | |
| Silver | 1 | < 1 | 5 | u | < 1 | 5 | u | < 1 | 5 | u | < 1 | 5 | u |
| Zinc | 3 | 105 | 10 | | 98.9 | 10 | | 44 | 10 | | 31500 | 50 | |
| Conductivity umho/cm | | 49.1 | | | 132 | | | 820 | | | 3490 | | |
| pH | | 7.25 | | | 7.5 | | | 7.84 | | | 2.45 | | |
| Acid Concentration mole/l | | $5.62 \times 10^{-8}$ | | | $3.16 \times 10^{-8}$ | | | $1.45 \times 10^{-8}$ | | | $3.55 \times 10^{-3}$ | | |
| Acidity mg/l | | <20 | | | <20 | | | <20 | | | 1630 | | |

MDL = method detection limit RL = reporting limit

B = analyte detedted in method blank J = estimate u = nondetect less than MDL

Table 2 (cont)

# Water Leachate Sample Analysis

| Sample | MDL | CO-NCC/CHG02-SS04 | | | CO-NCC/CHG02-SS16 | | | CO-NCC/CHG02-SS15 | | | CO-NCC/CHG02-SS02 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Collected** | | **09/10/02** | **RL** | **Qual** | **09/10/02** | **RL** | **Qual** | **09/10/02** | **RL** | **Qual** | **09/10/02** | **RL** | **Qual** |
| Aluminum | 30 | < 30 | 90 | u | 812 | 90 | | < 30 | 90 | u | < 30 | 90 | u |
| Arsenic | 3 | < 3 | 15 | u | < 3 | 15 | u | < 3 | 15 | u | < 3 | 15 | u |
| Cadmium | 0.5 | 0.7 | 2.5 | J | 63 | 2.5 | | 5.78 | 2.5 | | 128 | 2.5 | |
| Calcium | 100 | 4570 | 300 | | 14700 | 300 | | 38000 | 300 | | 23800 | 300 | |
| Chromium | 2 | < 2 | 10 | u | < 2 | 10 | u | < 2 | 10 | u | < 2 | 10 | u |
| Copper | 2 | < 2 | 10 | u | 180 | 10 | | < 2 | 10 | u | 6.7 | 10 | J |
| Iron | 40 | 94 | 120 | J | < 40 | 120 | u | 43 | 120 | J | 56 | 120 | J |
| Lead | 2 | 2.4 | 10 | J | 1460 | 10 | | < 2 | 10 | u | 29.3 | 10 | |
| Magnesium | 40 | 2500 | 120 | | 2540 | 120 | | 8070 | 120 | | 10200 | 120 | |
| Manganese | 1 | 782 | 4 | | 2270 | 4 | | 1410 | 4 | | 4490 | 4 | |
| Potassium | 100 | 1290 | 300 | | 7000 | 300 | | 2520 | 300 | | 5060 | 300 | |
| Silver | 1 | < 1 | 5 | u | < 1 | 5 | u | < 1 | 5 | u | < 1 | 5 | u |
| Zinc | 3 | 52.6 | 10 | | 11400 | 20 | | 1180 | 10 | | 16600 | 30 | |
| Conductivity umho/cm | | 104 | | | 312 | | | 349 | | | 355 | | |
| pH | | 6.64 | | | 4.03 | | | 6.5 | | | 6.05 | | |
| Acid Concentration mole/l | | $2.30 \times 10^{-7}$ | | | $9.33 \times 10^{-5}$ | | | $3.16 \times 10^{-7}$ | | | $8.91 \times 10^{-7}$ | | |
| Acidity mg/l | | <20 | | | 47 | | | <20 | | | 41 | | |

MDL = method detection limit RL = reporting limit

B = analyte detedted in method blank J = estimate u = nondetect less than MDL

Table 2 (cont)

# Water Leachate Sample Analysis

| Sample | MDL | CO-NCC/CHG02-SS08 | | | CO-NCC/CHG02-SS08 dup | | | CO-NCC/CHG02-SD03 | | | CO-NCC/CHG02-SS14 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Collected** | | **09/10/02** | **RL** | **Qual** | **09/10/02** | **RL** | **Qual** | **09/10/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** |
| Aluminum | 30 | 166 | 90 | | 132 | 90 | | 3210 | 90 | | 2390 | 90 | |
| Arsenic | 3 | < 3 | 15 | u | < 3 | 15 | u | < 3 | 15 | | < 3 | 15 | u |
| Cadmium | 0.5 | 1.7 | 2.5 | J | 2.54 | 2.5 | | < .5 | 2.5 | | 29.7 | 2.5 | |
| Calcium | 100 | 6110 | 300 | | 6720 | 300 | | 7060 | 300 | | 80000 | 300 | |
| Chromium | 2 | < 2 | 10 | u | < 2 | 10 | u | 4.9 | 10 | | < 2 | 10 | u |
| Copper | 2 | 2.1 | 10 | J | 2.3 | 10 | J | 8.7 | 10 | | 69.4 | 10 | |
| Iron | 40 | 406 | 120 | | 217 | 120 | | 2680 | 120 | | < 40 | 120 | u |
| Lead | 2 | 6.5 | 10 | J | 2.8 | 10 | J | 24.1 | 10 | | 29.9 | 10 | |
| Magnesium | 40 | 2040 | 120 | | 2220 | 120 | | 2150 | 120 | | 13000 | 120 | |
| Manganese | 1 | 851 | 4 | | 968 | 4 | | 52.6 | 4 | | 6630 | 8 | |
| Potassium | 100 | 4130 | 300 | | 3950 | 300 | | 782 | 300 | | 3630 | 300 | |
| Silver | 1 | < 1 | 5 | u | < 1 | 5 | u | < 1 | 5 | | < 1 | 5 | u |
| Zinc | 3 | 379 | 10 | | 537 | 10 | | 106 | 10 | | 8040 | 20 | |
| Conductivity umho/cm | | 125 | | | 126 | | | 89.1 | | | 706 | | |
| pH | | 6.69 | | | 6.66 | | | 7.31 | | | 6.21 | | |
| Acid Concentration mole/l | | $2.04 \times 10^{-7}$ | | | $2.19 \times 10^{-7}$ | | | $4.99 \times 10^{-8}$ | | | $6.17 \times 10^{-7}$ | | |
| Acidity mg/l | | <20 | | | <20 | | | <20 | | | 46 | | |

MDL = method detection limit RL = reporting limit

B = analyte detedted in method blank J = estimate u = nondetect less than MDL

Table 2 (cont)

# Water Leachate Sample Analysis

| Sample | MDL | CO-NCC/CHG02-SD04 | | | CO-NCC/CHG02-SS03 | | | CO-NCC/CHG02-SS13 | | | CO-NCC/CHG02-SS20 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Collected** | | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** |
| Aluminum | 30 | 66 | 90 | J | 1270 | 90 | | 22300 | 90 | | 41200 | 90 | |
| Arsenic | 3 | < 3 | 15 | u | < 3 | 15 | u | < 3 | 15 | u | 5.3 | 15 | J |
| Cadmium | 0.5 | 30.7 | 2.5 | | < .5 | 2.5 | u | 59 | 2.5 | | 925 | 2.5 | |
| Calcium | 100 | 19600 | 300 | | 1150 | 300 | | 39900 | 300 | | 280000 | 300 | |
| Chromium | 2 | < 2 | 10 | u | < 2 | 10 | u | 3.5 | 10 | J | 13.1 | 10 | |
| Copper | 2 | < 2 | 10 | u | 8.2 | 10 | J | 669 | 10 | | 1040 | 10 | |
| Iron | 40 | 368 | 120 | | 2850 | 120 | | 1040 | 120 | | 3590 | 120 | |
| Lead | 2 | 16.4 | 10 | | 117 | 10 | | 14.6 | 10 | | 399 | 10 | |
| Magnesium | 40 | 4010 | 120 | | 239 | 120 | | 12900 | 120 | | 79500 | 120 | |
| Manganese | 1 | 3190 | 4 | | 43 | 4 | | 14100 | 12 | | 42300 | 20 | |
| Potassium | 100 | 1970 | 300 | | 1610 | 300 | | 2310 | 300 | | 1540 | 300 | |
| Silver | 1 | < 1 | 5 | u | 1.4 | 5 | J | < 1 | 5 | u | < 1 | 5 | u |
| Zinc | 3 | 6040 | 20 | | 52.9 | 10 | | 12700 | 30 | | 87100 | 50 | |
| Conductivity umho/cm | | 226 | | | 47.1 | | | 1090 | | | 3260 | | |
| pH | | 6.39 | | | 6.8 | | | 2.91 | | | 3.16 | | |
| Acid Concentration mole/l | | $4.07 \times 10^{-7}$ | | | $1.59 \times 10^{-7}$ | | | $1.23 \times 10^{-3}$ | | | $7.24 \times 10^{-7}$ | | |
| Acidity mg/l | | 22 | | | <20 | | | 245 | | | 337 | | |

MDL = method detection limit RL = reporting limit

B = analyte detedted in method blank J = estimate u = nondetect less than MDL

Table 2 (cont)

# Water Leachate Sample Analysis

| Sample | MDL | CO-NCC/CHG02-SS21 | | | CO-NCC/LGG02-SS25 | | | CO-NCC/LGG02-SS26 | | | CO-NCC/LGG02-SS26 dup | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Collected** | | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** | **09/11/02** | **RL** | **Qual** |
| Aluminum | 30 | 58 | 90 | J | 5430 | 90 | | 1150 | 90 | | 1140 | 90 | |
| Arsenic | 3 | < 3 | 15 | u | < 3 | 15 | u | < 3 | 15 | u | < 3 | 15 | u |
| Cadmium | 0.5 | 0.86 | 2.5 | J | 88.5 | 2.5 | | 11.2 | 2.5 | | 11.6 | 2.5 | |
| Calcium | 100 | 13600 | 300 | | 78900 | 300 | | 15300 | 300 | | 15300 | 300 | |
| Chromium | 2 | < 2 | 10 | u | 2.2 | 10 | J | < 2 | 10 | u | < 2 | 10 | u |
| Copper | 2 | < 2 | 10 | u | 1800 | 10 | | 115 | 10 | | 118 | 10 | |
| Iron | 40 | 373 | 120 | | 110 | 120 | J | < 40 | 120 | u | < 40 | 120 | u |
| Lead | 2 | 10 | 10 | | 14.2 | 10 | | < 2 | 10 | u | 2.8 | 10 | J |
| Magnesium | 40 | 1180 | 120 | | 37400 | 120 | | 4930 | 120 | | 5250 | 120 | |
| Manganese | 1 | 509 | 4 | | 29400 | 20 | | 4660 | 4 | | 4920 | 4 | |
| Potassium | 100 | 2730 | 300 | | 1920 | 300 | | 2340 | 300 | | 2350 | 300 | |
| Silver | 1 | < 1 | 5 | u | < 1 | 5 | u | < 1 | 5 | u | < 1 | 5 | u |
| Zinc | 3 | 253 | 10 | | 9640 | 50 | | 2140 | 10 | | 2250 | 10 | |
| Conductivity umho/cm | | 151 | | | 989 | | | 244 | | | 247 | | |
| pH | | 6.74 | | | 3.57 | | | 4.44 | | | 4.33 | | |
| Acid Concentration mole/l | | $1.82 \times 10^{-7}$ | | | $2.69 \times 10^{-4}$ | | | $3.63 \times 10^{-5}$ | | | $4.68 \times 10^{-5}$ | | |
| Acidity mg/l | | <20 | | | 100 | | | 24 | | | 31 | | |

MDL = method detection limit RL = reporting limit

B = analyte detedted in method blank J = estimate u = nondetect less than MDL

Table 2 (cont)

# Water Leachate Sample Analysis

| Sample | MDL | CO-NCC/CHG02-SS05 | | | CO-NCC/CHG02-SD04 dup | | | CO-NCC/CHG02-SS18 | | | CO-NCC/LGG02-SS27 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Collected** | | **09/11/02** | **RL** | **Qual** | **09/12/02** | **RL** | **Qual** | **09/12/02** | **RL** | **Qual** | **09/12/02** | **RL** | **Qual** |
| Aluminum | 30 | 3580 | 90 | | < 30 | 90 | u | 1290 | 90 | | 82200 | 90 | |
| Arsenic | 3 | < 3 | 15 | u | < 3 | 15 | u | 6.4 | 15 | J | 369 | 15 | |
| Cadmium | 0.5 | < .5 | 2.5 | u | 33.6 | 2.5 | | < .5 | 2.5 | u | < .5 | 2.5 | u |
| Calcium | 100 | 821 | 300 | | 20400 | 300 | | 2370 | 300 | | 21100 | 300 | |
| Chromium | 2 | 15.2 | 10 | | < 2 | 10 | u | < 2 | 10 | u | 50.8 | 10 | |
| Copper | 2 | 45.2 | 10 | | < 2 | 10 | u | 6.3 | 10 | J | 12300 | 30 | |
| Iron | 40 | 2970 | 120 | | 257 | 120 | | 3610 | 120 | | 328000 | 360 | |
| Lead | 2 | 33.8 | 10 | | 9.3 | 10 | J | 199 | 10 | | < 2 | 10 | u |
| Magnesium | 40 | 386 | 120 | | 4190 | 120 | | 415 | 120 | | 14900 | 120 | |
| Manganese | 1 | 34.3 | 4 | | 3200 | 4 | | 163 | 4 | | 1780 | 4 | |
| Potassium | 100 | 1000 | 300 | | 1830 | 300 | | 1160 | 300 | | 1540 | 300 | |
| Silver | 1 | 1.6 | 5 | J | < 1 | 5 | u | < 1 | 5 | u | < 1 | 5 | u |
| Zinc | 3 | 117 | 10 | | 6220 | 20 | | 61.6 | 10 | | 2400 | 10 | |
| Conductivity umho/cm | | 36.8 | | | 233 | | | 53.5 | | | 2710 | | |
| pH | | 6.95 | | | 6.29 | | | 6.75 | | | 2.35 | | |
| Acid Concentration mole/l | | $1.12 \times 10^{-7}$ | | | $5.13 \times 10^{-7}$ | | | $1.78 \times 10^{-7}$ | | | $4.47 \times 10^{-3}$ | | |
| Acidity mg/l | | <20 | | | 26 | | | <20 | | | 1270 | | |

MDL = method detection limit RL = reporting limit

B = analyte detedted in method blank J = estimate u = nondetect less than MDL

Table 2 (cont)

# Water Leachate Sample Analysis

| Sample | MDL | CO-NCC/LGG02-SS33 | | | CO-NCC/LGG02-SS37 | | | CO-NCC/LGG02-SS37dup | | | CO-NCC/LGG02-SS36 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Collected** | | **09/12/02** | **RL** | **Qual** | **09/12/02** | **RL** | **Qual** | **09/12/02** | **RL** | **Qual** | **09/12/02** | **RL** | **Qual** |
| Aluminum | 30 | 54900 | 90 | | 35600 | 90 | | 37100 | 90 | | 6580 | 90 | |
| Arsenic | 3 | < 3 | 15 | u | < 3 | 15 | u | < 3 | 15 | u | < 3 | 15 | u |
| Cadmium | 0.5 | 14.2 | 2.5 | | 1.1 | 2.5 | J | 1 | 2.5 | J | 7.08 | 2.5 | |
| Calcium | 100 | 66600 | 300 | | 17500 | 300 | | 19500 | 300 | | 28800 | 300 | |
| Chromium | 2 | 48.6 | 10 | | 24.9 | 10 | | 26.3 | 10 | | 3.4 | 10 | J |
| Copper | 2 | 2280 | 10 | | 9960 | 30 | | 10100 | 30 | | 2420 | 10 | |
| Iron | 40 | 35800 | 120 | | 42900 | 120 | | 48500 | 120 | | 1430 | 120 | |
| Lead | 2 | 22.7 | 10 | | < 2 | 10 | u | 9.6 | 10 | J | < 2 | 10 | u |
| Magnesium | 40 | 16600 | 120 | | 5480 | 120 | | 5800 | 120 | | 3290 | 120 | |
| Manganese | 1 | 8230 | 8 | | 921 | 4 | | 967 | 4 | | 759 | 4 | |
| Potassium | 100 | 1720 | 300 | | 2000 | 300 | | 2040 | 300 | | 1370 | 300 | |
| Silver | 1 | < 1 | 5 | u | < 1 | 5 | u | < 1 | 5 | u | < 1 | 5 | u |
| Zinc | 3 | 3230 | 10 | | 1190 | 10 | | 1210 | 10 | | 1620 | 10 | |
| Conductivity umho/cm | | 1730 | | | 1610 | | | 1730 | | | 581 | | |
| pH | | 2.66 | | | 2.48 | | | 2.41 | | | 3.04 | | |
| Acid Concentration mole/l | | $2.19 \times 10^{-3}$ | | | $3.31 \times 10^{-3}$ | | | $3.89 \times 10^{-3}$ | | | $9.12 \times 10^{-4}$ | | |
| Acidity mg/l | | 616 | | | 512 | | | 551 | | | 100 | | |

MDL = method detection limit RL = reporting limit

B = analyte detedted in method blank J = estimate u = nondetect less than MDL

Table 2 (cont)

# Water Leachate Sample Analysis

| Sample | MDL | CO-NCC/LGG02-SS22 | | | CO-NCC/LGG02-SS34 | | | CO-NCC/LGG02-SS31 | | | CO-NCC/LGG02-SS32 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Collected** | | **09/12/02** | **RL** | **Qual** | **09/12/02** | **RL** | **Qual** | **09/12/02** | **RL** | **Qual** | **09/12/02** | **RL** | **Qual** |
| Aluminum | 30 | 43300 | 90 | | 75100 | 90 | | 106000 | 90 | | 154000 | 90 | |
| Arsenic | 3 | < 3 | 15 | u | 92.1 | 15 | | 265 | 15 | | 2380 | 15 | |
| Cadmium | 0.5 | 13.8 | 2.5 | | < .5 | 2.5 | u | < .5 | 2.5 | u | 6.59 | 2.5 | |
| Calcium | 100 | 60500 | 300 | | 67400 | 300 | | 61300 | 300 | | 36300 | 300 | |
| Chromium | 2 | 31.8 | 10 | | 39.3 | 10 | | 57.2 | 10 | | 70.4 | 10 | |
| Copper | 2 | 2120 | 10 | | 3180 | 10 | | 14900 | 50 | | 10800 | 100 | |
| Iron | 40 | 56200 | 120 | | 422000 | 360 | | 592000 | 600 | | 1140000 | 1200 | |
| Lead | 2 | 82.9 | 10 | | 30 | 10 | | < 2 | 10 | u | 67.6 | 10 | |
| Magnesium | 40 | 12400 | 120 | | 14500 | 120 | | 20000 | 120 | | 20500 | 120 | |
| Manganese | 1 | 3190 | 4 | | 2770 | 4 | | 7290 | 20 | | 6370 | 40 | |
| Potassium | 100 | 1710 | 300 | | 1530 | 300 | | 1240 | 300 | | 1520 | 300 | |
| Silver | 1 | < 1 | 5 | u | < 1 | 5 | u | < 1 | 5 | u | < 1 | 5 | u |
| Zinc | 3 | 3610 | 10 | | 2970 | 10 | | 3850 | 10 | | 6510 | 100 | |
| Conductivity umho/cm | | 1930 | | | 3020 | | | 3520 | | | 5040 | | |
| pH | | 2.4 | | | 2.21 | | | 2.25 | | | 2.6 | | |
| Acid Concentration mole/l | | $3.98 \times 10^{-3}$ | | | $6.17 \times 10^{-3}$ | | | $5.62 \times 10^{-3}$ | | | $2.51 \times 10^{-3}$ | | |
| Acidity mg/l | | 587 | | | 1790 | | | 2690 | | | 5030 | | |

MDL = method detection limit RL = reporting limit

B = analyte detedted in method blank J = estimate u = nondetect less than MDL