OMAHA DISTRICT
U.S. ARMY
CORPS OF ENGINEERS

Chemical Data Quality Assessment Report (CDQAR)

For

Surface Water, Mine Waste, and Creek Sediment Samples
Obtained at

Ironton Park/Calhoon Property
Colorado

November 2002

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ABBREVIATIONS

ADP	Analytical Data Package
ASTM	American Standard Testing Materials
°C	Degrees Celsius
CDQAR	Chemical Data Quality Assessment Report
CENWO	Corps of Engineers, Omaha District
COC	Chain-of-Custody
ECB	Environmental Chemistry Branch Laboratory
DQCR	Daily Quality Control Report
DQOs	Data Quality Objectives
DUP	Duplicate
eV	Electron volt
EPA	Environmental Protection Agency
FSP	Field Sampling Plan
Ft	Foot/Feet
I.D.	Inner Diameter
IDW	Investigative Derived Waste
Kg	Kilogram
LRL	Laboratory Reporting Limit
L	Liter
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LIMS	Laboratory Information Management System
MDL	Method Detection Limit
mg/kg	Milligrams per kilogram
mg/L	Milligrams per Liter
mg	Milligram
Min	Minute
ml	Milliliters
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MSL	Mean Sea Level
MW	Monitoring Well
N/A	Not Applicable
ND	non-detect
PID	Photoionization Detector
ppb	Parts per Billion (measured in water as ug/L)
SQL	Sample Quantitation Limit
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation Recovery Act
RPD	Relative Percent Difference

SSHP	Site Safety Health Plan
SOP	Standard Operating Procedure
ug/L	Micrograms per Liter
U.S.	United States
USACE	United States Army Corps of Engineers

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 the surface water, mine waste, and sediment samples obtained from the Ironton Park/Calhoon Property, Colorado. Field work was performed by USACE Omaha District and USFS Grand Mesa Uncompaghre Gunnison (GMUG) National Forest personnel. Analytical services were provided by a US Army Corps of Engineers laboratory, the Environmental Chemistry Branch (ECB) Laboratory, located in Omaha, Nebraska.

The field and sample analyses was 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 Ironton Park/Calhoon Property areas, 19 to 22 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 purpose of this investigation is to sample surface water, mine waste, and sediment from the Ironton Park/Calhoon Property, Colorado to determine the impact of mine wastes to the area.

2.2 ANALYTICAL SERVICES

The ECB laboratory provided the analytical services for this project. The Environmental Chemistry Branch (ECB) laboratory provided analytical services for total and dissolved metals, sulfate, Alkalinity, and chloride. Field measurements of pH, specific conductance, temperature and turbidity were obtained with a Horiba U-10 water quality probe. 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 MDL as sample detection limit and RL as sample quantitation limit or laboratory reporting limit. For this report they can be used interchangeably. 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 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 surface water, mine waste, and sediment data to assess effect of former mine operations at this area, to determine if there is a threat posed to human health and the environment, and to evaluate the need for any additional response action.

2.3.1 Data Collected

The data collected at the Ironton Park/Calhoon Property site were from samples obtained from surface water, mine waste, and sediment. The data collected included both field

measurements (field screening data) and off-site analysis of samples (definitive data).

2.3.1.1 **Field Measurements (Field Screening Data)**

A Oriba U-10 was used to measure water quality parameters in the field. The Oriba U-10 measured pH, temperature, conductivity, and flow rate. Measurements were recorded in the field logbook.

2.3.1.2 **Off-Site Analysis (Definitive Level Data)**

Definitive level data was obtained from sixteen (16) surface water samples, three (3) mine waste samples, and fourteen (14) creek sediment samples. The water samples were analyzed for total and dissolved metals, cyanide and water quality parameters, the mine waste samples were analyzed for metals and SPLP metals, and the sediment samples were analyzed for metals. Sections 3 and 4 give the field and laboratory quality control procedures and the result of the quality control process is given in section 5. The data quality objectives for this data is to ensure that the data adheres criteria in sections 3, 4, and 5.

3 FIELD QUALITY CONTROL PROCEDURES

3.1 PROJECT PLANNING

The field investigation was conducted as described in the Site Specific Work Plan for the Ironton Park/Calhoon Property, 12 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 insure quality 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 Samples Obtained

The samples were obtained by CENWO personnel from August 19 through August 21, 2002.

3.2.1.1 **Surface Water Samples.** Sixteen (16) surface water samples and one QC duplicate were obtained and sent to the laboratory and analyzed for the following:

Target Constituent	Analytical Method
Metals	
Antimony, dissolved	EPA M200.8 ICP-Trace
Arsenic, dissolved	EPA M200.8 ICP-Trace
Cadmium, dissolved	EPA M200.8 ICP-Trace
Chromium, dissolved	EPA M200.8 ICP-Trace
Copper, dissolved	EPA M200.8 ICP-Trace
Iron, total	EPA M200.7 ICP
Lead, dissolved	EPA M200.8 ICP-Trace
Manganese, dissolved	EPA M200.7 ICP
Mercury, dissolved	EPA M200.8 ICP-Trace
Nickel, dissolved	EPA M200.8 ICP-Trace
Selenium, dissolved	EPA M200.8 ICP-Trace
Silver, dissolved	EPA M200.8 ICP-Trace
Zinc, dissolved	EPA M200.8 ICP-Trace
Chloride	EPA M325.2
Cyanide, free	EPA M335.3
Sulfate	EPA M375.3
Hardness as $CaCO_3$	EPA SM2340B
Residue, Filterable (TDS) @ 18°C	EPA M160.1
pH	EPA M150.1

Target Constituent	Analytical Method
Conductivity @ 25°C	EPA M120.1

3.2.1.2 **Mine Waste Samples.** Three (3) mine waste surface rock/soil samples and one QC duplicate were obtained and analyzed for the following:

Target Constituent	Analytical Method
Total Metals (total digestion)	EPA 3051
Antimony	EPA 6010, ICP
Arsenic	EPA 6010, ICP
Cadmium	EPA 6010, ICP
Copper	EPA 6010, ICP
Lead	EPA 6010, ICP
Manganese	EPA 6010, ICP
Mercury	EPA 7470, CVAA
Nickel	EPA 6010, ICP
Selenium	EPA 6010, ICP
Silver	EPA 6010, ICP
Zinc	EPA 6010, ICP
SPLP Extraction	EPA 1312 – West
Antimony	EPA 1312/200.7, ICP
Arsenic	EPA 1312/200.7, ICP
Cadmium	EPA 1312/200.7, ICP
Copper	EPA 1312/200.7, ICP
Lead	EPA 1312/200.7, ICP
Manganese	EPA 1312/200.7, ICP
Mercury	EPA 1312/245.1, CVAA
Nickel	EPA 1312/200.7, ICP
Selenium	EPA 1312/200.7, ICP
Silver	EPA 1312/200.7, ICP
Zinc	EPA 1312/200.7, ICP

3.2.1.3 **Sediment Samples.** Fourteen (14) sediment samples and one QC duplicate were obtained and analyzed for the following:

Target Constituent	Analytical Method
Total Metals (total digestion)	EPA 3051
Antimony	EPA 6010, ICP
Arsenic	EPA 6010, ICP
Cadmium	EPA 6010, ICP

Target Constituent	Analytical Method
Copper	EPA 6010, ICP
Lead	EPA 6010, ICP
Manganese	EPA 6010, ICP
Mercury	EPA 7470, CVAA
Nickel	EPA 6010, ICP
Selenium	EPA 6010, ICP
Silver	EPA 6010, ICP
Zinc	EPA 6010, ICP

3.2.2 Management of Investigation Derived Waste (IDW)

No IDW was generated for this project except for disposable gloves, plastic cups and other disposable sampling equipment which was disposed of in a dumpster.

3.2.3 Decontamination Procedures

The field instrument was 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 Notebook
- Chain of Custody Record
- Daily Quality Control Report (DQCR)

CENWO 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

The sampling team performed sample collection, sample labeling, and sample shipping. Samples were collected in the appropriate sample containers provided by ECB Laboratory. The sample containers were identified with waterproof labels and all writing was completed in indelible ink.

Labeled samples were placed in sealed Ziplock brand bags and packed in waterproof plastic ice chests with sufficient packaging material placed around and between the sample jars. Ice was double bagged and placed on the bottom of the cooler, and around the sample containers, and on top of the sample containers to achieve and maintain preservation at 4 degrees Celsius from the time of collection until receipt by the laboratory. Sample containers, preservatives, 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 analyzed at the rate of one every analytical batch. The results of the field QC samples and their impact on data quality are discussed in Section 4.0.

Table 1a

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES FOR SURFACE WATER SAMPLES

Parameter	Container	Preservation	Maximum Holding Times	
			Extraction	Analysis
Metals*	500 ml			6 months
(dissolved/total)	plastic			Hg 28 days
Chloride	1 liter plastic			28 days
Sulfate				28 days
Hardness as $CaCO_3$				28 days
pH				24 hrs
Conductivity @ 25^0C				28 days
Residue, Filterable (TDS) @ 18^0C				7 days
Cyanide, free	500 ml plastic	NaOH to pH >12		14 days

- Dissolved metals: Sb, As, Cd, Cr, Cu, Pb, Mn, Hg, Ni, Se, Ag, Zn. Total metals: Fe. One sample can be sent in for metals, but it must be written on the COC and sample label that an aliquot for total Fe must be removed before filtering.

Table 1b

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES FOR MINE WASTE SAMPLES

Parameter	Container	Preservation	Maximum Holding Times	
			Extraction	Analysis
Metals* **	1 x 8 oz glass	-		6 months
				Hg 28 days
Metals (SPLP)* **		-		6 months
				Hg 28 days

* Metals: Sb, As, Cd, Cu, Pb, Mn, Hg, Ni, Se, Ag, Zn.

** One sample can be sent in for metals and SPLP Extraction metals, but it must be written on the COC and sample label that part of the soil must be used for the SPLP Extraction.

Table 1c

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES FOR SEDIMENT SAMPLES

Parameter	Container	Preservation	Maximum Holding Times	
			Extraction	Analysis
Metals*	8 oz glass	-		6 months
				Hg 28 days

* Metals: Sb, As, Cd, Cu, Pb, Mn, Hg, Ni, Se, Ag, Zn.

The soil metal samples may be batched (held on site) before shipping, but should be sent to the laboratory at least once a week. The sample/samples will be analyzed and the sensitivity and quality control samples acceptance criteria will meet that set by the Environmental Chemistry Branch Laboratory criteria and/or as per the Draft General Work Plan, Restoration of Abandoned Mine Sites, June 2002.

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, matrix spike/matrix spike duplicate, and surrogate spike samples if required.

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 which 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 Surrogate Spike Analyses

An organic surrogate compounds is spiked into all investigative samples for explosives analyses. The surrogate is compared to QC limits to evaluate the matrix effect of each sample and monitor the overall system performance. Low surrogate recoveries are indicative of problems in instrument performance, extraction procedures, or severe matrix effects. Samples which have a surrogate recovery above the laboratory control limits typically do not demonstrate performance problems unless the recoveries are high enough to indicate double spiking of surrogate compounds or extremely low internal standard recoveries.

4.1.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

The laboratory analyzed a spiked environmental sample and duplicate to evaluate the precision and accuracy within an analytical batch. The MS is used to assess the performance of the method as applied to a particular project matrix. A MS is an environmental sample of which known concentrations of certain target analytes have been added before sample manipulation from the preparation, cleanup, and determinative procedures have been implemented. The

results of the MS are evaluated in conjunction with other QC information to determine the effect of the matrix on the bias of 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 first level review was performed by the analyst who generated the raw analytical data. 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. This review was done by the laboratory Program Administrator, as stated in the QAPP. 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.

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;
- Surrogate 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 are 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 nondetection. 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
Ironton Park/Calhoon Property, Colorado

Batch	Analyses	Sample ID
WG11088	Metals (Surface water (dissolved))	CO-IPCP-SW22 (diss)
		CO-IPCP-SW34 (diss)
		CO-IPCP-SW33 (diss)
		CO-IPCP-SW32 (diss)
		CO-IPCP-SW24 (diss)
		CO-IPCP-SW28 (diss)
		CO-IPCP-SW25 (diss)
		CO-IPCP-SW31 (diss)
		CO-IPCP-SW31-02 dup (diss)
		CO-IPCP-SW19 (diss)
		CO-IPCP-SW20 (diss)
		CO-IPCP-SW10 (diss)
		CO-IPCP-SW09 (diss)
		CO-IPCP-SW07 (diss)
		CO-IPCP-SW06 (diss)
		Method Blank
		Laboratory Matrix Duplicate
		Matrix Spike (MS)/Matrix Spike Duplicate (MSD)
		Laboratory Control Sample (LCS)
WG11194	Mercury (surface water (dissolved))	CO-IPCP-SW22 (diss)
		CO-IPCP-SW34 (diss)
		CO-IPCP-SW33 (diss)
		CO-IPCP-SW32 (diss)
		CO-IPCP-SW24 (diss)
		CO-IPCP-SW28 (diss)
		CO-IPCP-SW25 (diss)
		CO-IPCP-SW31 (diss)
		CO-IPCP-SW31-02 dup (diss)
		CO-IPCP-SW19 (diss)
		CO-IPCP-SW20 (diss)
		CO-IPCP-SW10 (diss)
		CO-IPCP-SW09 (diss)
		CO-IPCP-SW07 (diss)
		CO-IPCP-SW06 (diss)
		CO-IPCP-SW05 (diss)
		CO-IPCP-SW01 (diss)
		Method Blank
		Laboratory Matrix Duplicate

Batch	Analyses	Sample ID
		MS/MSD
		LCS
WG11100	Metals (surface water (dissolved))	CO-IPCP-SW05 (diss)
		CO-IPCP-SW01 (diss)
		Method Blank
		Laboratory Matrix Duplicate
		MD/MSD
		LCS
WG11087	Iron & hardness (surface water (total)	CO-IPCP-SW22
		CO-IPCP-SW34
		CO-IPCP-SW33
		CO-IPCP-SW32
		CO-IPCP-SW24
		CO-IPCP-SW28
		CO-IPCP-SW25
		CO-IPCP-SW31
		CO-IPCP-SW31-02 dup
		CO-IPCP-SW19
		CO-IPCP-SW20
		CO-IPCP-SW10
		CO-IPCP-SW09
		CO-IPCP-SW07
		CO-IPCP-SW06
		CO-IPCP-SW05
		CO-IPCP-SW01
		Method Blank
		Laboratory Matrix Duplicate
		MS/MSD
		LCS
WG11101	Iron & hardness (surface water (total)	CO-IPCP-SW05
		CO-IPCP-01
		Method Blank
		Laboratory Matrix Duplicate
		MS/MSD
		LCS
020826-1 Continental	Cyanide (surface water (total)	CO-IPCP-SW22
		CO-IPCP-SW34
		CO-IPCP-SW33
		CO-IPCP-SW32

Batch	Analyses	Sample ID
		CO-IPCP-SW24
		CO-IPCP-SW28
		CO-IPCP-SW25
		CO-IPCP-SW31
		CO-IPCP-SW31 dup
		CO-IPCP-SW19
		CO-IPCP-SW20
		CO-IPCP-SW10
		CO-IPCP-SW09
		CO-IPCP-SW07
		CO-IPCP-SW06
		CO-IPCP-SW05
		CO-IPCP-SW01
		Method Blank
		MS/MSD
		LCS/LCSD
WG11128	Chloride (surface water (total))	CO-IPCP-SW22
		CO-IPCP-SW34
		CO-IPCP-SW33
		CO-IPCP-SW32
		CO-IPCP-SW24
		CO-IPCP-SW28
		CO-IPCP-SW25
		CO-IPCP-SW31
		CO-IPCP-SW31 dup
		CO-IPCP-SW19
		CO-IPCP-SW20
		CO-IPCP-SW10
		CO-IPCP-SW09
		CO-IPCP-SW07
		CO-IPCP-SW06
		CO-IPCP-SW05
		CO-IPCP-SW01
		Method Blank
		Lab Matrix Dup
		MS/MSD
		LCS
WG11133	Sulfate (surface water (total))	CO-IPCP-SW22
		CO-IPCP-SW34
		CO-IPCP-SW33
		CO-IPCP-SW32
		CO-IPCP-SW24

Batch	Analyses	Sample ID
		CO-IPCP-SW28
		CO-IPCP-SW25
		CO-IPCP-SW31
		CO-IPCP-SW31-02 dup
		CO-IPCP-SW19
		CO-IPCP-SW20
		CO-IPCP-SW10
		CO-IPCP-SW09
		CO-IPCP-SW07
		CO-IPCP-SW06
		CO-IPCP-SW05
		CO-IPCP-SW01
		Method Blank
		Lab Matrix Dup
		MS/MSD
		LCS
M020820	Water pH	CO-IPCP-SW22
		CO-IPCP-SW34
		CO-IPCP-SW33
		CO-IPCP-SW32
		CO-IPCP-SW24
		CO-IPCP-SW28
		CO-IPCP-SW25
		CO-IPCP-SW31
		CO-IPCP-SW31-02 dup
		CO-IPCP-SW19
		CO-IPCP-SW20
		CO-IPCP-SW10
		CO-IPCP-SW09
		CO-IPCP-SW07
		CO-IPCP-SW06
		CO-IPCP-SW05
		CO-IPCP-SW01
		Standard pH =4.0
		Standard pH =7.0
WG11098	Total Dissolved Solids (TDS)	CO-IPCP-SW22
		CO-IPCP-SW34
		CO-IPCP-SW33
		CO-IPCP-SW32
		CO-IPCP-SW24
		CO-IPCP-SW28
		CO-IPCP-SW25

Batch	Analyses	Sample ID
		CO-IPCP-SW31
		CO-IPCP-SW31-02 dup
		CO-IPCP-SW19
		CO-IPCP-SW20
		CO-IPCP-SW10
		CO-IPCP-SW09
		CO-IPCP-SW07
		CO-IPCP-SW06
		CO-IPCP-SW05
		CO-IPCP-SW01
		Method Blank
		Lab Matrix Dup
		Standard
M020820	Conductivity (surface water)	CO-IPCP-SW22
		CO-IPCP-SW34
		CO-IPCP-SW33
		CO-IPCP-SW32
		CO-IPCP-SW24
		CO-IPCP-SW28
		CO-IPCP-SW25
		CO-IPCP-SW31
		CO-IPCP-SW31-02 dup
		CO-IPCP-SW19
		CO-IPCP-SW20
		CO-IPCP-SW10
		CO-IPCP-SW09
		CO-IPCP-SW07
		CO-IPCP-SW06
		CO-IPCP-SW05
		CO-IPCP-SW01
		Method Blank
		Standard
WG11171	Metals (SPLP) from mine waste soil sample	C0-IPCP-WR23
		CO-IPCP-WR17
		CO-IPCP-WR17-02 DUP
		CO-IPCP-WR18
		Method Blank
		Lab matrix duplicate
		MS/MSD
		LCS

Batch	Analyses	Sample ID
WG11195	Mercury (SPLP) from mine waste soil sample	C0-IPCP-WR23
		CO-IPCP-WR17
		CO-IPCP-WR17-02 DUP
		CO-IPCP-WR18
		Method Blank
		Lab matrix duplicate
		MS/MSD
		LCS
WG11136	Metals (sediment)	CO-IPCP-SD26
		CO-IPCP-SD27
		CO-IPCP-SD30
		CO-IPCP-SD29
		CO-IPCP-SD35
		CO-IPCP-SD13
		CO-IPCP-SD14
		CO-IPCP-SD15
		CO-IPCP-SD16
		CO-IPCP-SD11
		CO-IPCP-SD02
		Method Blank
		Lab Matrix Dup
		MS/MSD
		LCS
WG11159	Mercury (sediment)	CO-IPCP-SD26
		CO-IPCP-SD27
		CO-IPCP-SD30
		CO-IPCP-SD29
		CO-IPCP-SD35
		CO-IPCP-SD13
		CO-IPCP-SD14
		CO-IPCP-SD15
		CO-IPCP-SD16
		CO-IPCP-SD11
		CO-IPCP-SD02
		Method Blank
		Lab Matrix Dup
		MS/MSD
		LCS
WG11169	Metals (sediment and mine waste)	CO-IPCP-SD02
		CO-IPCP-SD03

Batch	Analyses	Sample ID
		CO-IPCP-SD08
		CP-IPCP-WR23
		CO-IPCP-WR17
		CO-IPCP-WR17-02 dup
		CO-IPCP0WR18
		CO-IPCP-SD12
		Method Blank
		Lab Matrix Dup
		MS/MSD
		LCS
WG11127	Mercury (sediment and mine waste)	CO-IPCP-SD02
		CO-IPCP-SD03
		CO-IPCP-SD08
		CP-IPCP-WR23
		CO-IPCP-WR17
		CO-IPCP-WR17-02 dup
		CO-IPCP0WR18
		CO-IPCP-SD12
		Method Blank
		Lab Matrix Dup
		MS/MSD
		LCS

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 which may have impacted sample integrity. These reports were reviewed concurrently with the COC forms and the analytical results from the laboratory 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 during the sampling event to evaluate sampling and laboratory precision. Duplicate samples were obtained for the surface water, mine waste, and sediment samples, (see Table 4-1 for the QC duplicate samples obtained). These QC duplicate samples were analyzed for the analyses given in Table 3-1. No qualification was applied to the data due to field duplicates.

5.2 LABORATORY QC PROCEDURES AND LABORATORY QC ANALYSES

A review of laboratory QC procedures was conducted by the USACE project chemist. All issues identified and their respective solutions are discussed below. The required criteria are given in the General Work Plan for the Restoration of Abandoned Mines prepared by U.S. Army Corps of Engineers, Omaha District, Omaha, Nebraska, July 2002.

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°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. The method blank results are included in the quality section of the laboratory's analytical data package. All blanks were clean except in the following:

Analytical Batch: WG11136. The method blank contained Lead at 0.6 J, Selenium at 0.8 J and Zinc at 0.9 J mg/kg. The lead and zinc results were not qualified since all values are greater than 5 times the blank results. All Selenium values less than 5 times the blank value were qualified estimate "J". These values are also qualified "J" estimate since they are detected below the reporting limits of 4 mg/kg.

Analytical Batch: WG11169. The method blank contained Zinc at 0.9 J, mg/kg. All samples in this batch contained Zinc values much greater than 5 times the blank value so no qualification was applied.

Analytical Batch: WG11088. The method blank contained Arsenic at 4 J ug/L. All sample results were non detect except for sample IPCP-SW31, which was qualified "J" estimate.

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 analytical data package.

Metals: An LCS was analyzed with each metals analytical batch. The % recovery was compared to set criteria for each analyte. The LCS % recoveries were all within set criteria so no qualifications were applied to metals results.
Cyanide: An LCS and LCD was analyzed as part of the cyanide quality control to determine precision and accuracy. The % recoveries and RPD results met set criteria so no qualification was applied to the cyanide results.

Water Quality Parameters: The LCS samples for all analytical batches were within criteria so no qualifications were applied.

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 cyanide 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 which 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 which 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.

Water Samples: All water samples that were analyzed for metals and water quality parameters had the batch MS/MSD within criteria so no qualifications were applied.

Metals: One set of MS/MSD samples was analyzed for each metals analytical batch for soil/mine waste. Analytical batches WG11136 and WG11169 had Antimony recovery of 29 and 25 per cent. MS and MSD % recoveries should not be used alone for qualification but should be used along with the LCS recovery. Since the Antimony LCS recoveries are within set criteria this indicates that the process can analyze properly for Antimony. The low MS and MSD % recovery for Antimony may indicate a matrix interference or improper digestion (see Table 5-1). For this reason the Antimony samples will be qualified as "J-" as bias low for detect and qualified as "UJ" for non detect samples.

Table 5-1 OUT OF CONTROL MATRIX SPIKE/MATRIX SPIKE DUPLICATE SAMPLE ANALYSIS Soil Metal Samples

Batch	Analyte	Sample Result ug/l	MS Spike Concn ug/l	MSD Spike Concn ug/l	MS Percent Recovery	MSD Percent Recovery	QC Limits	RPD (%)	RPD Limit
WG11169	Antimony	u	100	100	25	25	80-120	0	25
WG11136	Antimony	u	100	100	29	28	80-120	1	25

5.2.7 Quality Control for pH analyses

Quality control for pH analysis consists of standardization of the pH meter using standard solutions of pH 4 and pH 7. The pH instrument was standardized using this method.

5.2.8 Conductivity Quality Control

A standard and blank sample were run to calibrate the conductivity instrument. No qualification was applied to the conductivity results.

5.2.9 Total Dissolved Solids

A blank and laboratory duplicate were run as quality control for the TDS. No qualifications were required.

5.2.10 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 Analytical Data Tables

The qualified data is given in Appendix A.

5.5 Analytical Data package

Data sheets as obtained from the Environmental Chemistry laboratory will be given upon request as a 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 Ironton Park/Calhoon Property, CO. The analytical program for this project conformed with 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. The reviewed data are usable and are suitable for addressing the overall objective of this investigation.

Appendix A

Table 1, Analytical Results
Ironton Road/Calhoon Property, Surface Water Samples (ug/L)

Sample		IPCP-SW22			IPCP-SW34			IPCP-SW33			IPCP-SW32			IPCP-SW24			IPCP-SW28		
Samples (Dissolved)																			
Date Collected	MDL	8/19/02	RL	Q	8/19/02	RL	Q	8/19/02	RL	Q	8/19/02	RL	Q	8/19/02	RL	Q	8/19/02	RL	Q
Antimony	6.	<6	20	u	<6	20	u	<6	20	u	<6	20	u	<6	20	u	<6	20	u
Arsenic	3	<3	15	u	<3	15	u	<3	15	u	< 3	15	u	<3	15	u	<3	15	u
Cadmium	0.5	4.6	2.5		<0.5	2.5	u	<0.5	2.5	u	<0.5	2.5	u	<0.5	2.5	u	<0.5	2.5	u
Chromium	2	2	10		<2	10	u	<2	10	u	<2	10	u	<2	10	u	<2	10	u
Copper	2	661	10		<2	10	u	<2	10	u	<2	10	u	<2	10	u	<2	10	u
Iron	40	3220	120		<40	120	u	<40	120	u	50	120	J	1450	120		5400	120	
Lead	2	44	10		<2	10	u	<2	10	u	<2	10	u	<2	10	u	3	10	J
Manganese	1	1790	4		29	4		12	4		368	4		468	4		636	4	
Nickel	3	27	10		<3	10	u	<3	10	u	<3	10	u	<3	10	u	4	10	J
Selenium	4	<4	20		<4	20	u	<4	20	u	<4	20	u	<4	20	u	<4	20	u
Silver	1	<1	5		<1	5	u	<1	5	u	<1	5	u	<1	5	u	<1	5	u
Zinc	3	1370	10		4	10	J	<3	10	u	13	10		60	10		117	10	
Mercury	0.02	<0.02	0.1	u	<0.02	0.1	u	<0.02	0.1	u	<0.02	0.1	u	<0.02	0.1	u	<0.02	0.1	u
Samples (Total)																			
Iron	40	17300	120		80	120	J	220	120		330	120		1810	120		6470	120	
Hardness	0.04	346	1.2		273	1.2		273	1.2		268	1.2		122	1.2		271	1.2	
Cyanide*		<10 (a)	10	u	<10	10	u	<10	10	u	<10	10	u	<10	10	u	<10	10	u
Conductivity		1070			618			618			611			309			750		
Chloride	1	1	5	J	<1	5	u	<1	5	u	<1	5	u	<1	5	u	<1	5	u
Sulfate	6	530	100	D	290	60	D	290	60	D	290	60	D	110	20		340	80	D
Total Dissolved Solids (TDS)	5	720	10		410	10		430	10		430	10		210	10		540	10	
pH		3.48			8.62			9.12			7.66			6.65			3.75		

Table 1 (cont) Analytical Results
Ironton Road/Calhoon Property, Surface Water Samples (ug/L)

Sample		IPCP-SW25			IPCP-SW31			IPCP-SW31 dup			IPCP-SW19			IPCP-SW20			IPCP-SW10		
Samples (Dissolved)																			
Date Collected	MDL	8/19/02	RL	Q	8/19/02	RL	Q	8/19/02	RL	Q	8/19/02	RL	Q	8/19/02	RL	Q	8/19/02	RL	Q
Antimony	6.	<6	20	u	<6	20	u	<6	20	u	<6	20	u	<6	20	u	<6	20	u
Arsenic	3	<3	15	u	4	15	JB	<3	15	u	<3	15	u	< 3	15	u	<3	15	u
Cadmium	0.5	<0.5	2.5	u	<0.5	2.5	u	<0.5	2.5	u	2	2.5	J	0.6	2.5	J	6	2.5	
Chromium	2	<2	10	u	<2	10	u	<2	10	u	<2	10	u	<2	10	u	5	10	J
Copper	2	<2	10	u	<2	10	u	<2	10	u	276	10		3	10	J	946	10	
Iron	40	<40	120	u	5450	120		5450	120	u	1500	120	u	60	120	J	7300	120	
Lead	2	<2	10	u	<2	10	u	3	10	J	96	10		<2	10	u	67	10	u
Manganese	1	5.9	4		537	4		542	4		2130	4		1150	4		1960	4	
Nickel	3	<3	10	u	9	10	J	9	10	J	5	10	J	<3	10	u	37	10	
Selenium	4	<4	20	u	<4	20	u	<4	20	u	<4	20	u	<4	20	u	<4	20	u
Silver	1	<1	5	u	<1	5	u	<1	5	u	2	5	J	<1	5	u	<1	5	u
Zinc	3	<3	10	u	209	10		221	10		689	10	u	20	10		1690	10	
Mercury	0.02	<0.02	0.1	u	<0.02	0.1	u	<0.02	0.1	u	<0.02	0.1	u	<0.02	0.1	u	<0.02	0.1	u
Samples (Total)																			
Iron	40	190	120		5410	120		5450	120		1480	120		1760	120		31500	120	
Hardness	0.04	101	1.2		93.8	1.2		94.6	1.2		108	1.2		508	1.2		368	1.2	
Cyanide*		<10	10	u	<10	10	u	<10	10	u	<10	10	u	<10	10	u	<10 (a)	10	u
Conductivity		244			444			456			620			1010			1280		
Chloride	1	<1	5	u	<1	5	u	<1	5	u	<1	5	u	<1	5	u	<1	5	u
Sulfate	6	66	20		180	20		180	20		180	20		500	120	D	600	120	D
Total Dissolved Solids (TDS)	5	150	10		270	10		280	10		250	10		720	10		820	10	
pH		8.12			3.66			3.66			3.25			8.19			3.22		

Table 1 (cont) Analytical Results
Ironton Road/Calhoon Property, Surface Water Samples (ug/L)

Sample		IPCP-SW09			IPCP-SW07			IPCP-SW06			IPCP-SW05			IPCP-SW01		
Samples (Dissolved)																
Date Collected	MDL	8/19/02	RL	Q	8/19/02	RL	Q	8/19/02	RL	Q	8/20/02	RL	Q	8/19/02	RL	Q
Antimony	6.	<6	20	u	<6	20	u	<6	20	u	<6	20	u	<6	20	u
Arsenic	3	<3	15	u	<3	15	u	<3	15	u	<3	15	u	<3	15	u
Cadmium	0.5	8.5	2.5		5.9	2.5		<0.5	2.5	u	<0.5	2.5	u	8.4	2.5	
Chromium	2	<2	10	u	4	10	J	<2	10	u	<2	10	u	8	10	J
Copper	2	125	10		994	10		5	10	J	<2	10	u	1300	10	
Iron	40	330	120		7760	120		60	120	J	70	120	J	19100	120	
Lead	2	<2	10	u	68	10		<2	10	u	<2	10	u	81	10	
Manganese	1	5030	4		1900	4		558	4		601	4		2340	4	
Nickel	3	26	10		37	10	u	<3	10	u	<3	10	u	52	10	
Selenium	4	<4	20	u	<4	20		4	20	J	<4	20	u	<4	20	u
Silver	1	<1	5	u	<1	5	u	<1	5	u	<1	5	u	<1	5	u
Zinc	3	2660	10		1670	10		56	10		62	10		2240	10	
Mercury	0.02	<0.02	0.1	u	<0.02	0.1	u	<0.02	0.1	u	<0.02	0.1	u	<0.02	0.1	u
Samples (Total)																
Iron	40	360	120		32400	120		2200	120		4500	120		61200	120	
Hardness	0.04	449	1.2		370	1.2		455	1.2		462	1.2		316	1.2	
Cyanide*		<10	10	u	<10 (a)	10	u	<10	10	u	<10	10	u	<10 (a)	10	u
Conductivity		1030			1290			940			942			1380		
Chloride	1	<1	5	u	1	5	J	<1	5	u	<1	5	u	1	5	J
Sulfate	6	560	120	D	620	120	D	490	120	D	480	100	D	660	100	D
Total Dissolved Solids (TDS)	5	780	10		840	10		700	10		710	10		910	10	
pH		4.23			3.18			6.76			6.75			3.05		

Table 1 (cont) Analytical Results
Ironton Road/Calhoon Property, Mine Waste Soil Samples (mg/kg)

Sample		IPCP-SD26			IPCP-SD27			IPCP-SD30			IPCP-SD29			IPCP-SD35			IPCP-SD13		
Date Collected	MDL	8/20/02	RL	Q	8/20/02	RL	Q	8/20/02	RL	Q	8/20/02	RL	Q	8/20/02	RL	Q	8/20/02	RL	Q
Antimony	1	<1	4	u J-	2	4	J-	<1	4	uJ-	<1	4	J-	<1	4	uJ-	28	4	J-
Arsenic	0.6	4.9	3		2	3	J	3	3	J	3.4	3		2	3	J	176	3	
Cadmium	0.1	0.5	0.5	J	<0.1	0.5	J	<0.1	0.5	u	<0.1	0.5	J	0.1	0.5	J	0.2	0.5	J
Copper	0.4	15	2		7.4	2		9.6	2		7	2		6.8	2		1870	2	
Lead	0.4	46	2	B	13	2	B	5.8	2	B	15	2	B	6.8	2	B	8210	2	B
Manganese	0.2	489	0.8		42.7	0.8		42.2	0.8		151	0.8		370	0.8		80.3	0.8	
Nickel	0.6	5.7	2		2.3	2		8.4	2		6.5	2		2.7	2		11	2	
Selenium	0.8	1	4	JB	<0.8	4	u	4.3	4	JB	<0.8	4	u	13	4	B	19	4	B
Silver	0.2	<0.2	1	u	<0.2	1	u	<0.2	1	u	<0.2	1	u	<0.2	1	u	226	1	
Zinc	0.6	172	2	B	342	2	B	57	2	B	131	2	B	50.2	2	B	1840	20	B
Mercury	0.002	0.064	0.01		0.02	0.01		0.06	0.01		0.036	0.01		0.036	0.01		0.292	0.01	

Table 1 (cont) Analytical Results
Ironton Road/Calhoon Property, Mine Waste Soil Samples (mg/kg)

Sample		IPCP-SD14			IPCP-SD15			IPCP-SD16			IPCP-SD11			IPCP-SD02			IPCP-SD02-02		
Date Collected	MDL	8/20/02	RL	Q	8/20/02	RL	Q	8/20/02	RL	Q	8/20/02	RL	Q	8/20/02	RL	Q	8/20/02	RL	Q
Antimony	1	64.3	4	J-	12	4	J-	10	4	J-	8.3	4	J-	1	4	J-	<1	4	uJ-
Arsenic	0.6	823	3		128	3		165	3		126	3		148	3		156	3	
Cadmium	0.1	<0.1	0..5	u	0.97	0.5		<0.1	05	J	0.7	0.5		<0.1	0.5	J	0.2	0.5	J
Copper	0.4	2980	20		828	2		438	2		689	2		57.4	2		50.9	2	
Lead	0.4	25900	20	B	4080	2	B	3850	20	B	3060	2	B	685	2	B	734	2	
Manganese	0.2	217	0.8		608	0.8		251	0.8		7560	0.8		823	0.8		857	0.8	
Nickel	0.6	4.8	2		5.5	2		2.1	2		9.4	2		1	2	J	1	2	J
Selenium	0.8	27	4	u	4	4	JB	15	4	B	7.1	4	B	1	4	JB	2	4	J
Silver	0.2	189	1		79.8	1		124	1		43.3	1		5.4	1		5.7	1	
Zinc	0.6	725	2		467	20	B	249	2	B	1040	2	B	137	2	B	130	2	B
Mercury	0.002	0.039	0.1		0.071	0.01		0.08	0.01		0.089	0.01		0.05	0.01		0.05	0.01	

Table 1 (cont) Analytical Results
Ironton Road/Calhoon Property, Mine Waste Soil Samples (mg/kg)

Sample		IPCP-SD03			IPCP-SD08			IPCP-SD12			
Date Collected	MDL	8/20/02	RL	Q	8/20/02	RL	Q	8/20/02	RL	Q	
Antimony	1	<1	4	uJ-	2	4	J-	10	4	J-	
Arsenic	0.6	20	3		109	3		190	3		
Cadmium	0.1	0.5	0.5	J	0.78	0.5		1.7	0.5		
Copper	0.4	644	2		314	2		946	2		
Lead	0.4	358	2		619	2		5930	8		
Manganese	0.2	314	0.8		315	0.8		1790	3.2		
Nickel	0.6	3.1	2		3	2		6.6	2		
Selenium	0.8	<0.8	4	u	3	4	J	17	4		
Silver	0.2	0.7	1	J	7.9	1		127	1		
Zinc	0.6	154	2	B	385	2	B	956	2	B	
Mercury	0.002	0.08	0.01		0.15	0.01		0.2	0.01		

Table 1 (cont) Analytical Results
Ironton Road/Calhoon Property, Mine Waste Soil Samples (mg/kg)

Sample		IPCP-WR23			IPCP-WR17			IPCP-WR17 (dup)			IPCP-WR18			
Date Collected	MDL	8/20/02	RL	Q	8/21/02	RL	Q	8/21/02	RL	Q	8/21/02	RL	Q	
Antimony	1	< 1	4		3	4	J	2	4	J	10	4		
Arsenic	0.6	6.5	3		40.4	3		34.7	3		302	3		
Cadmium	0.1	< 0.1	0.5		3.8	0.5		3.3	0.5		<0.1	0.5		
Copper	0.4	37.9	2		2010	8		1820	8		1030	2		
Lead	0.4	808	2		5860	8		5570	8		1080	2		
Manganese	0.2	289	0.8		2330	3.2		2800	3.2		41.5	0.8		
Nickel	0.6	2.3	2		19	2		16	2		15	2		
Selenium	0.8	2	4	J	10	4		12	4		16	4		
Silver	0.2	9	1		97.4	1		86	1		243	1		
Zinc	0.6	72.6	2	B	1950	8	B	1700	8	B	356	2	B	
Mercury	0.002	0.13	0.01		0.23	0.01		0.24	0.01		0.06	0.01		

Table 1 (cont) Analytical Results

Tronton Road/Calhoon Property, Mine Waste (SPLP) Samples (mg/L)

Sample		IPCP-WR23 SPLP			IPCP-WR17			IPCP-WR17 (dup)			IPCP-WR18			
Date Collected	MDL	8/20/02	RL	Q	8/21/02	RL	Q	8/21/02	RL	Q	8/21/02	RL	Q	
Antimony	0.04	<0.04	0.12		<0.04	0.12		<0.04	0.12		<0.04	0.12		
Arsenic	0.006	<0.006	0.03		<0.006	0.03		<0.006	0.03		0.032	0.03		
Cadmium	0.001	<0.001	0.005		0.02	0.005		0.02	0.005		<0.001	0.005		
Copper	0.005	<0.001	0.02		4.0	0.02		4.22	0.02		0.57	0.02		
Lead	0.01	<0.01	0.05		0.37	0.05		1.58	0.05		3.8	0.05		
Manganese	0.002	0.07	0.008		6.24	0.008		5.59	0.008		0.1	0.008		
Nickel	0.006	<0.006	0.04		0.04	0.04		0.04	0.04		<0.006	0.04		
Selenium	0.01	<0.01	0.05		<0.01	0.05		<0.01	0.05		<0.01	0.05		
Silver	0.002	<0.002	0.01		<0.002	0.01		0.002	0.01	J	0.002	0.01		
Zinc	0.006	0.06	0.02		4.0	0.02		4.1	0.02		0.2	0.02		
Mercury	0.0004	<0.0004	0.002		<0.0004	0.002		<0.0004	0.002		<0.0004	0.002		

In Table 1, the following definitions apply:

* = Non detect values were reported as less than the reporting limit

u = non detect up to MDL

J = estimate values due to analyte detected between MDl and RL or data qualification.

J- = estimate values with low bias.

B = Contamination was detected in the analytical blank. Results that were not qualified because of the blank contamination will retain the B.

D = dilution

(a) = pH may not be greater than 12