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ACM REFINERY AND SMELTER SITE
CASCADE COUNTY, MONTANA
REMEDIAL INVESTIGATION/FEASIBILITY STUDY SUPPORT

BLACK EAGLE RAILROAD BED SUBSURFACE INVESTIGATION FINAL DATA SUMMARY REPORT

REVISION 0

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CONTENTS

Tables

Figures

APPENDICES

A	Boring Logs
B	Photos
C	Field Notes
D	Chains of Custody
E	Analytical Results and Case Narratives
F	Modified Analysis Requests for Quotations
G	Data Verification/Validation

1.0 INTRODUCTION

1.1 Purpose and General Objectives

This Black Eagle Railroad Bed Subsurface Investigation Data Summary Report (DSR) presents the results of the Great Falls Railroad Bed Subsurface Investigation which was conducted in December 2010 in the community of Black Eagle, Montana. This drilling and soil sampling project was located immediately west of the Former Great Falls Refinery Site, as shown on Figure 1. All work described in this DSR was undertaken by Pacific Western Technologies, Ltd. (PWT), as a subcontractor to the U.S. Environmental Protection Agency (EPA).

Based on the review of previous surface soil sampling data, the intent of this subsurface characterization soil sampling was to further characterize the extent of arsenic, cadmium, copper, lead and zinc (metals) contamination within the Black Eagle Railroad Bed. Sampling was conducted at 19 locations to delineate the subsurface extent and concentration range of metals present along the railroad bed. The sample results presented in this DSR will support decisions with respect to future remedial actions for this railroad bed. Site-specific action levels have not been established at this time, so this DSR does not make a determination as to which samples or what total volume of soil is contaminated. However, samples which are characteristically hazardous in accordance with the results of the toxicity characteristic leaching procedure (TCLP) have been identified.

2.0 SITE BACKGROUND

2.1 Site Location

The Black Eagle Railroad Bed is a rail spur leading from the main Burlington Northern rail line to the Former Great Falls Refinery Site in the community of Black Eagle, Montana. Black Eagle is an unincorporated community located north of the Missouri River and north of the City of Great Falls, Montana. The primary railroad bed originates outside the western boundary of the former smelter site near the Black Eagle Community Center, and runs west through the community of Black Eagle to Highway 87, spanning a distance of approximately 2,500 lineal feet. A secondary railroad siding exists along the south side of Art Higgins Memorial Park, and extends for a distance of approximately 1,500 feet. These railroad beds are shown on Figure 1. The railroad beds sampled under this project are located on several properties involving different ownership because the railroad right-of way has been abandoned.

2.2 Site History

The railroad involved with this project was constructed in 1892 as a spur of the St. Paul, Minneapolis & Manitoba Railway Company's right-of-way. Typical for the time frame when this railroad was constructed, the upper ballast material consisted of smelter slag, referred to on the field boring logs as "waste."

The portion of the railroad bed within the fenced Former Great Falls Refinery Site has been completely obliterated by reclamation activities over the past 20 years. The remaining portion of the primary railroad bed is evident approximately 1,000 feet west of the Former Great Falls Refinery Site and extends approximately 2,500 feet to the Highway 87 underpass. Figure 2 is a cross section of the drilling and sampling locations along this railroad bed. A secondary spur of this railroad line comprises an additional 1,500 feet adjacent to the railroad bed to the south. Boreholes located along this former secondary spur are depicted in cross section on Figure 3.

2.3 Previous Railroad Bed Sample Collection Efforts

Following a citizen's complaint to the Montana Department of Environmental Quality (DEQ) Enforcement Division in 1997, the Montana Power Company collected samples from the abandoned railroad bed near 110 14th Street in Black Eagle, Montana. Montana Power Company personnel collected three 0- to 4-inch depth composite samples (composites consisting of 4 subsamples) from the railroad bed materials. The samples were analyzed for total metals as well as total petroleum hydrocarbons (TPH). Results are summarized below:

Metal or Metalloid	Concentration Range (milligrams per kilogram (mg/kg))
Arsenic	83 – 440
Barium	90 – 270
Cadmium	16 – 140
Chromium	8 – 16
Lead	830 – 4,200
Mercury	11 – 50
Selenium	Non-detect
Silver	Non-detect – 31
TPH	41 – 2,130

During December 2001, the DEQ Enforcement Division received a complaint from a citizen stating that the railroad grade near his home was contaminated with heavy metals. The home is located at 121 11th Street in Black Eagle, Montana. The DEQ Enforcement Division collected two 5-point composite samples from the railroad bed where 14th Street intersects the railroad grade. The samples were analyzed for total metals and total extractable hydrocarbons (TEH). Results are summarized below:

Metal or Metalloid	Concentration Range (mg/kg)
Aluminum	6,880 – 7,970
Arsenic	152 – 205
Barium	117 – 147
Calcium	4,320 – 10,200
Chromium	12 – 15
Copper	1,200 – 2,630
Iron	37,700 – 44,400
Lead	2,490 – 4,430
Magnesium	1,260 – 1,820
Nickel	14 – 16
TEH	250

The railroad bed was sampled again as part of an Expanded Site Inspection conducted by the EPA in April 2003. Three separate samples of railroad bed materials were collected during this investigation and analyzed for total metals. Results of this sampling effort are presented and discussed in the *Final Analytical Results Report for Expanded Site Inspection, Anaconda Minerals Company, Great Falls Refinery*, (EPA, 2004). The exact depth at which these railroad bed samples were collected is unknown; however, the report does indicate that all samples were collected at depths no greater than 2 feet below ground surface. Metals detected in samples of the railroad bed materials at greater than three times their respective background soil concentrations (as stated in EPA, 2004) are as follows:

Metal or Metalloid	Concentration Range (mg/kg)
Arsenic	37.2 – 445
Cadmium	3.9U – 582
Chromium	7.1 – 14.8
Copper	346 – 2,920
Iron	24,800 – 31,700
Lead	541 – 7,200
Mercury	0.64J – 3.0 J
Silver	4.1J – 61.5
Sodium	449 – 3,920
Zinc	5,090 – 54,200

(Note: U indicates non-detect at sample quantitation limit; J indicates estimated concentration)

In March, 2006, Atlantic Richfield Company (ARCO) conducted a surface soil investigation of the Great Falls Railroad Bed (ARCO 2006). The purpose of the railroad bed investigation was to further characterize the extent of arsenic, cadmium, copper, lead, and zinc metals contamination in surface soils along and across the Great Falls Railroad Bed. The soil samples were collected from depths of 0 to 2 inches and the results are summarized below:

Metal or Metalloid	Concentration Range (mg/kg)
Arsenic	7.5U – 445
Cadmium	3.9U – 582
Copper	13.9U – 3,500
Lead	8.2U – 5,760

Zinc	11.9U – 80,200

(Note: U indicates non-detect at sample quantitation limit)
Based on the results of these investigations, the EPA determined that more extensive investigation of the railroad beds was warranted.

3.0 SAMPLE COLLECTION

3.1 Data Quality Objectives

The Data Quality Objectives (DQOs) process (EPA, 2000a) is an iterative, strategic planning approach designed to ensure that the type, quality, and quantity of environmental data used in decision-making are appropriate for the intended application. Once established, the DQOs are used to develop a scientific and resource-effective data collection design. DQOs are also used after data collection to evaluate how well the collected data meets the objectives of an investigation.

The DQO process specifies project decisions, the data quality required to support these decisions, specific data types needed, data collection requirements, and analytical techniques necessary to generate the specified data quality. The process also ensures that the resources required to generate the data are justified. This investigation had four primary DQOs, as summarized below:

DQO 1 – Problem Statement:
To what extent do concentrations of metals in railroad bed subsurface soils indicate that contamination exists along the length of the railroad bed in the neighborhood of Black Eagle?

Problem Scope:
Boreholes spaced along the centerline of the Black Eagle Railroad Bed, and biased towards areas of higher foot-traffic

Data Types:

- Borehole lithology observed and recorded during drilling and sampling activities
- Soil samples collected at 1-foot vertical intervals from the surface to 2 feet below "waste" or smelter slag, as visually identified in the field. Deeper samples collected on 2-foot intervals vertical from 2 feet below the bottom of waste to the bottom of the borehole.
- Total metals analysis conducted by an approved CLP laboratory
- Surveyed borehole locations

Boundaries:

Spatial:	Railroad bed existing outside of the western boundary of the Former Great Falls Refinery Site near the Black Eagle Community Center, and running west to the Highway 87 underpass, spanning a distance of approximately 4,000 lineal feet
Temporal:	One time grab samples collected between December 13 and December 16, 2010

Decision Statement:

IF	Sample results indicate that metals contamination along the railroad bed is continuous;

THEN Report findings and consider future step-out investigations along the length of the railroad beds.

DQO 2 – Problem Statement:
To what extent do concentrations of metals in railroad bed subsurface soils indicate that contamination exists below the surface within the railroad bed?

Problem Scope:
Boreholes drilled from the surface of the Black Eagle Railroad Bed to approximately 2 feet into underlying native material.

Data Types:
- Borehole lithology observed and recorded during drilling and sampling activities
- Soil samples collected at 1-foot vertical intervals from the surface to 2 feet below "waste" or smelter slag, as visually identified in the field. Deeper samples collected on 2-foot vertical intervals from 2 feet below the bottom of waste to the bottom of the borehole.
- Total metals analysis conducted by an approved CLP laboratory
- Surveyed borehole locations

Boundaries:
Spatial: From the surface of the Black Eagle Railroad Bed to 2 feet below the native soil horizon
Temporal: One time grab samples collected between December 13 and December 16, 2010

Decision Statement:
IF Sample results indicate that metals contamination exists beneath the surface soil materials in the railroad bed;
THEN Report findings and consider depth sampling in future step-out drilling in the railroad bed.

DQO 3 – Problem Statement:
To what extent do concentrations of metals in railroad grade subsurface soils indicate that contamination is moving or has the potential to move down through the soil column into native soils?

Problem Scope:
Boreholes drilled from the surface of the Black Eagle Railroad Bed to approximately 2 feet into native material.

Data Types:
- Borehole lithology observed and recorded during drilling and sampling activities
- Soil samples collected in a 2-foot vertical interval below the railroad grade material into native soil.
- Total metals analysis conducted by an approved CLP laboratory
- Surveyed borehole locations

Boundaries:

Spatial:	From the bottom of the Black Eagle Railroad Bed to 2 feet below the native soil horizon
Temporal:	One time grab samples collected between December 13 and December 16, 2010

Decision Statement:

IF	Sample results indicate that metals contamination extends into native soil materials beneath the railroad bed;
THEN	Report findings and consider future step-out investigations perpendicular to the railroad beds.

DQO 4 – Problem Statement:
To what extent do concentrations of metals in railroad bed subsurface soils indicate that the material in the railroad bed is characteristically hazardous?

Problem Scope:
Splits of samples which had at least one detected analyte concentration, as determined by total metals analysis, greater than: 100 mg/kg for arsenic; 2,000 mg/kg for barium; 20 mg/kg for cadmium; 100 mg/kg for chromium; 100 mg/kg for lead; 4 mg/kg for mercury; 20 mg/kg for selenium; or 100 mg/kg for silver.

Data Types:

- Total metals analysis conducted by an approved CLP laboratory to determine if “trigger” concentrations were exceeded in total metals analytes results
- TCLP analysis conducted by an approved CLP laboratory on identified samples

Boundaries:

Spatial:	Not applicable
Temporal:	One time grab samples collected between December 13 and December 16, 2010

Decision Statement:

IF	TCLP results exceed one of the following: 5 micrograms per liter (ug/L) for arsenic; 100 ug/L for barium; 1 ug/L for cadmium; 5 ug/L for chromium; 5 ug/L for lead; 0.2 ug/L for mercury; 1 ug/L for selenium; or 5 ug/L- for silver;
THEN	Indentify sample as failing TCLP and document results.

3.2 Data Collection Design and Rationale

The sampling approach described below was developed and implemented in the field to address the four DQOs detailed above.

Boring locations were spaced at intervals along the Railroad Bed, as identified in the field during a joint site visit by PWT, EPA, and MDEQ on December 8, 2010; the average distance between boreholes was 220 feet. Samples were collected from continuous core intervals advanced through the railroad grade and no more than 2 feet into the native soil materials. Direct push technology was used to advance boreholes and to collect representative samples of the subsurface for determination of the concentration of metals throughout the subsurface. Sample intervals were 1-foot intervals from the surface to 2 feet below "waste" or smelter slag, as visually identified in the field. Subsequent samples were collected on 2-foot intervals from 2 feet below the bottom of waste to the bottom of the borehole. Field personnel logged and documented soil lithologies observed in each boring on field boring log forms (Appendix A), and in field notes (Appendix C). Photographs of site conditions and sampling locations are included in Appendix B. Surveyed borehole locations are presented in Table 1. Cross sections of both railroad beds are identified on Figure 1, and are presented on Figures 2 and 3. These cross sections show both sample intervals and the general borehole lithologies identified in the field.

The Black Eagle Railroad Bed Subsurface Sampling and Analysis Plan (SAP), (PWT 2010) called for five percent field duplicates for Quality Assurance/Quality Control (QA/QC). A total of 170 soil samples (160 investigative samples and 10 field duplicate samples) were analyzed by a qualified CLP laboratory for the following metals:

CLP Metals and Metalloids

Aluminum	Cobalt	Potassium
Antimony	Copper	Selenium
Arsenic	Iron	Silver
Barium	Lead	Sodium
Beryllium	Magnesium	Thallium
Cadmium	Manganese	Vanadium
Calcium	Mercury	Zinc
Chromium	Nickel	

The primary contaminants of concern are arsenic, cadmium, copper, lead, mercury and zinc; concentrations of these metals by borehole are presented in Table 2.

In addition, splits of 68 soil samples (62 investigative samples and 6 field duplicate samples) with metal concentrations above predetermined trigger levels were analyzed using the TCLP by a qualified laboratory for the following metals:

TCLP Metals

Arsenic	Chromium	Selenium
Barium	Lead	Silver
Cadmium	Mercury	

TCLP analytical results are presented in Table 3. Trigger levels were set at concentrations above 100 mg/kg for arsenic, 2,000 mg/kg for barium, 20 mg/kg for cadmium, 100 mg/kg for chromium, 100 mg/kg for lead, 4 mg/kg for mercury, 20 mg/kg for selenium, or 100 mg/kg for silver. These trigger levels represent the smallest concentration of a given metal which could potentially cause the sample to be characteristically hazardous by the TCLP, if one hundred percent of that metal in the sample was leachable.

3.3 Scope of Project

Drilling and soil sampling were conducted along the Great Falls Railroad Bed between the Black Eagle Community Center and Highway 87 from December 13, 2010 through December 16, 2010. The length of railroad bed is approximately 4,000 lineal feet and includes two railroad spurs that exist south of the main residential area in Black Eagle. A total of 19 soil borings were completed and 170 samples were obtained from the Great Falls Railroad Bed. Boring locations were identified in the field during a joint site visit by PWT, EPA, and the Montana DEQ on December 8, 2010, and the intervals between locations along the Railroad Bed varied from 81 to 424 feet; the average distance between boreholes was 220 feet.

Sampling was conducted to identify whether, and to what extent, contamination exists vertically from the surface of the railroad beds to the upper part of the underlying native soil horizon, and whether, and to what extent, contamination exists laterally over the full extent of the railroad beds. Sampling was also intended to help determine whether such contamination, if found, causes the material to exhibit characteristically hazardous behavior.

3.4 Description of Activities

Boreholes were advanced using direct push methods from the surface of the Railroad Bed, terminating two feet into the native soils underlying the Railroad Bed. The total depths of these holes were between 2.2 and 28 feet, averaging12.8 feet deep. In accordance with the SAP, borings were drilled along the centerline of the railroad bed, except where the surface has been improved as a paved trail. Along the asphalt trail portion of the railroad bed, boreholes were offset to the edge of the asphalt. Continuous core samples were collected from the boreholes at each sample location and soil samples were prepared from the appropriate intervals for submittal to the analytical laboratory to determine the concentration of metals in the subsurface. PWT personnel logged and documented in field notes and on appropriate forms the sample intervals and soil lithologies observed in the borehole materials.

The boreholes were refilled after sampling was completed, and topped off with bentonite hole-plug as necessary. The surface area around each hole was photographed and the borehole location surveyed. In addition to soil sampling, data collection included recording soil lithologies observed in each borehole.

All 170 soil samples were analyzed by CLP methods for total metals, and splits of 68 samples which exceeded pre-determined limits for any metal were further analyzed by TCLP for the RCRA 8 metals suite.

3.5 Deviations from the Sampling and Analysis Plan (SAP)

Sampling was conducted in general accordance with Standard Operating Procedures (SOPs) G-4, G-6 and SS-1 as modified and presented in the SAP. However, the I-Chem 300-series Superanalyzed™ sample bottles which were delivered to the site for the sampling round were narrow mouth water sampling bottles, instead of the correct wide mouth bottles for soil sampling. After discussion with the analytical laboratory and with the principal decision makers onsite (Mr. Charles Coleman of the EPA and Mr. John Brown of the MDEQ), the decision was made to collect samples from the shallow "waste" interval of each boring into the I-Chem™ bottles, and to collect the remainder of the soil samples in Ziplock® freezer bags.

CLP chain-of-custody (COC) forms assign to each sample a unique CLP sample identification (ID), as well as showing the client sample ID (listed as Station Location on the COC), the sample collection date and time, and additional information about each sample. Three samples collected from borehole BER-BH18 on December 16, 2010 were incorrectly identified in the client sample IDs on the COC as being from borehole BER-BH19. Based upon the documentation in the field notes and the field boring logs, and a comparison of sample collection times with drilling times at each of these borings, the client sample IDs have been corrected.

One sample interval from BER-BH08 was incorrectly recorded in the client sample ID on the COC. Based upon the documentation in the field boring log and on the field notes, the correct sample interval was verified, and the client sample ID corrected. Seven client sample IDs were translated incorrectly from the COCs into the laboratory sample management system. These typographical errors were corrected after the CLP sample IDs were used to positively identify each sample. None of these typographical errors compromised sample integrity because the identity, collection time, and collection location of every sample is known and documented.

4.0 DATA SUMMARY

4.1 Spatial Distribution of Total Metal Concentrations in Soil

Site-specific action levels have not been established at this time, so this DSR does not make a determination as to which samples or what total volume of soil is contaminated. However, samples which are characteristically hazardous in accordance with the results of the TCLP have been identified.

Data was collected along the centerline of the railroad beds from the surface to 2 feet below the native soil horizon to determine the lateral and vertical distribution of metals in soil. In 18 of 19 borehole locations, at least two sample intervals were found to contain metals at concentrations which triggered a TCLP analysis. Borehole BER-BH18 did not have any samples which triggered TCLP analysis. Arsenic was seen most frequently to have concentrations high enough to trigger further analysis (47 times), exceeding the pre-determined trigger level nearly twice as often as either cadmium (25 times), or lead (23 times). Only two samples had mercury concentrations above 4 mg/kg, which triggered a TCLP analysis. No TCLP analyses were triggered due to the total metal concentration of barium, chromium, selenium or silver in the samples.

The highest observed concentrations of all contaminants were found between the ground surface and 5 feet below ground surface, in and immediately below the interval of identified smelter slag in each boring. However, in some cases arsenic concentrations were high enough to trigger TCLP analysis up to 10 feet below ground surface. In a few locations, samples containing native material yielded total metal concentrations which triggered TCLP analysis.

Metal concentrations in soil, as determined by total metals analysis, indicate that contamination at levels with the potential to be characteristically hazardous extends laterally to the boundaries of this investigation. Future subsurface sampling activities should look beyond the lateral boundaries of this study, both to the west beyond Highway 87, and to the east onto the smelter site as far as the former railroad bed can be identified, to determine the full extent of metal contamination along the railroad bed in the neighborhood of Black Eagle.

The vertical extent of metals concentrations in soil which have the potential to be characteristically hazardous is predominantly limited to the upper 5 feet of the railroad beds, but extends deeper in isolated locations. Native soil below the elevated railroad beds does contain metal concentrations with the potential to be characteristically hazardous in isolated locations.

4.2 Toxicity Characteristic Leaching Procedure Results

The TCLP analysis was performed on 62 selected samples to determine if the material in the railroad beds is characteristically hazardous (Table 3). This information was considered necessary for guiding potential remedial decision making in the future. As previously noted, trigger levels were set at concentrations above 100 mg/kg for arsenic, 2,000 mg/kg for barium, 20 mg/kg for cadmium, 100 mg/kg for chromium, 100 mg/kg for lead, 4 mg/kg for mercury, 20 mg/kg for selenium, or 100 mg/kg for silver. These trigger levels represent the smallest concentration of a given metal (as determined by total metals analysis) which could potentially cause the sample to be characteristically hazardous by the TCLP, if one hundred percent of that metal in the sample was leachable. Sixty of the 62 samples which were analyzed by TCLP exceeded the TCLP limit for cadmium, indicating that these sample intervals represent areas of characteristically hazardous material contained within the railroad beds. Forty-six samples exceeded the TCLP limit for arsenic, and 44 samples exceeded the TCLP limit for lead. TCLP results for selenium and silver were either non-detect, or estimated below the reporting limit, for all 62 samples, indicating that these metals are not found in the Black Eagle railroad beds at concentrations with the potential to be characteristically hazardous. Although barium concentrations in soil did not trigger any TCLP analyses, samples tested due to exceedances in other metal concentrations failed TCLP for barium in 28 of the 62 samples.

The concentration of mercury in two near-surface samples (Table 2), as determined by total metals analysis, was high enough to trigger TCLP analysis. In both of these samples, arsenic, cadmium, and lead were also above the pre-determined TCLP trigger levels. The TCLP results for mercury were non-detect, indicating that mercury likely will not be a primary contaminant of concern as the project moves forward. However, both these samples were determined to be characteristically hazardous due to the TCLP concentrations of arsenic, barium, cadmium, and lead.

5.0 DATA QUALITY ASSESSMENT

The objective of the data assessment process is to determine whether the analytical results are acceptable for use in making decisions for the project. As a component of the data assessment process, the analytical data were evaluated against the data quality indicators of precision, accuracy, representativeness, completeness, and comparability (PARCC). An evaluation of each data quality indicator follows.

Precision

Precision is the measure of mutual agreement among measurements. Field precision was evaluated by calculating relative percent difference (RPD) values from the positive field duplicate results. One field duplicate was collected for every 17 investigative samples, a frequency slightly exceeding the required 5% called out in the SAP (PWT 2010).

In accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (EPA 2010), precision limits were set at RPD less than or equal to 35% at levels above two times the contract required detection limit (CRDL). Table 4 presents the results for field duplicate pairs and the calculated RPD for each analyte detected above two times the CRDL. RPD was calculated as follows:

$$RPD = \frac{|x - y|}{\frac{(x + y)}{2}} \times 100$$

Where:

x = investigative sample result
y = duplicate sample result

RPD exceeded precision limits in 17.5% of the calculations. Lack of duplicate precision for some field and laboratory duplicates could indicate a non-homogenous distribution of the elements of concern within the sample that might be mitigated by further processing of the raw samples before analysis. RPDs in detected, non-estimated results ranged from a minimum of 0.6% to a maximum of 130%. The mean RPD was 19.5% and the median RPD was 9.8%. In general, lower RPDs were observed for samples collected in imported fill materials than in those samples collected from the smelter slag.

Close examination of the comparison of field duplicate pairs with RPDs over 35% indicates that lack of precision in analytical results does not impede the use of these results to determine whether a sample contains metals at concentrations above the pre-determined trigger levels. For example, chromium results for samples BER-BH04-2.6:3.6 and BER-BH04-2.6:3.6D were 7.3 mg/kg and 3.7 mg/kg, respectively. This resulted in a calculated RPD of 65.5%. However, these results are still conclusive in their determination that the quantity of chromium in the sample was less than 100 mg/kg, and TCLP analysis was not necessary to determine if the material was characteristically hazardous due to chromium contamination.

The data collected under this sampling program is precise enough to determine whether soils within the Black Eagle railroad beds are characteristically hazardous.

Accuracy

Accuracy is the agreement of measured values with an accepted reference value. Accuracy is evaluated by examining the recoveries obtained for spiked target analytes in standard and natural matrix spiked samples. Because accuracy is primarily determined using laboratory quality control information which was examined during the data verification and validation process, the accuracy of the data collected under this sampling program is discussed in detail in Section 6.0 of this report.

Representativeness
Representativeness refers to the selection and application of sampling locations, sampling protocols, and analytical methods such that the results are representative of the media being sampled and the conditions being measured. As described in the SAP (PWT 2010), borehole locations were selected in the field to be representative of the railroad beds; and at each borehole, samples were collected over intervals designed to be representative of observed field conditions in that location.

In accordance with the SAP (PWT 2010), samples were analyzed by analytical methods prescribed by the EPA at an approved laboratory participating in the CLP program. Total metals analysis was completed in accordance with standard CLP protocols. The TCLP analysis was modified to allow the laboratory to check total metal results against the pre-determined trigger levels and then run the TCLP test without additional instruction from EPA or PWT. Copies of the TCLP Modified Analysis Requests for Quotation, prepared by the CLP Coordinator, are included as Appendix F of this DSR.

An evaluation of QC blanks (trip blanks, field blanks, and rinse blanks) is typically completed as part of the data quality assessment. However, in accordance with modifications to the CFRSSI QAPP requested by ARCO in March of 1996 and approved by EPA, no external contamination equipment blank samples were submitted. Laboratory method blanks measure potential contamination from laboratory sources such as glassware, reagents, preservatives, and laboratory water. In accordance with contract requirements, the laboratory prepared and analyzed preparation, initial, and continuing calibration blanks. No preparation or calibration blanks contained analytes above the CRDL. However, low levels in some of the blanks required qualifying low-level results as not detected at the reporting level. Additional details regarding laboratory quality control results are included in Section 6.0.

Because the program was designed to provide characterization level information about the railroad beds, and the sampling and analysis program was implemented as described in the SAP (PWT 2010), the data are judged to be representative.

Completeness
Completeness is a comparison of the amount of valid data obtained from a sampling program compared to the amount of data expected and needed to meet the project goals. Valid analytical data are those that have been identified as usable (i.e., not rejected).

There were only limited instances in the field where desired samples could not be collected due to poor recovery (insufficient sample volume), or no recovery over the desired sample interval. Despite these exceptions, sample collection under this program is judged to be complete because locations of poor or no recovery were isolated, and the preponderance of samples were collected at the spacing and over the intervals called out in the SAP (PWT 2010).

While some data were rejected due to problems with laboratory method blanks or sensitivity issues, over 95% of the results from all analyses were usable. Looking only at the primary contaminants of concern, the amount of valid data is upward of 98%. Although the SAP (PWT 2010) did not identify a specific data-completeness goal for the project, 95% is typically considered acceptable for this type of investigation. Additional detail concerning data validation and verification is contained in Section 6.0 of this report.

Comparability

Comparability refers to the confidence with which one data set can be evaluated relative to another. Prior to beginning this investigation, it was determined that comparability with data previously collected by ARCO would increase the usability of any new data obtained for the project. Therefore, the field QA program for this investigation was designed to incorporate many of the field QA procedures developed in the following: *Clark Fork River Superfund Site Investigation* (CFRSSI) *SOP G-4, Field Logbook/Photographs* (ARCO, 1992a); *CFRSSI SOP SS-I, Sample Collection from Soil Borings, Excavations, and Hand Dug Pits* (pages SS-1.1 and SS-1.2 only). These SOPs were modified to be appropriate to the proposed work and then followed in the field; copies of the SOPs and specific modifications were included in the SAP (PWT 2010). Consistent procedures for the reporting and management of the data generated were also followed throughout the project. All data, with the exception of rejected results, are considered comparable.

6.0 DATA VERIFICATION AND VALIDATION

Data validation and verification were completed in accordance with the EPA 2010 Functional Guidelines (EPA, 2010) by a PWT Chemist. Results were validated for approximately 12% of the 170 soil samples, and for approximately 5% of the sample delivery groups (SDGs). The analytical laboratory performed validation (Stage 2B Validation Electronic) on all analytical results; however, examination of the lab qualifiers revealed that the software program used was not up-to-date with the EPA 2010 Functional Guidelines. PWT completed 100% verification (Stage 2B Validation Manual) for all samples for the primary analytes of interest (arsenic, cadmium, chromium, lead, mercury, and zinc) in soil, and for the TCLP analysis of RCRA 8 metals. Validation (Stage 3 Validation Manual) was completed for randomly selected SDG MH37F1 which contained TCLP results for 20 samples. Detailed results from the data verification and validation are presented in Appendix G, and summarized below. The validation qualifiers which appear with the results presented in Tables 2 and 3 of this DSR capture the implications of laboratory QC sample results and apply them to the appropriate individual investigative samples or entire SDGs in accordance with the Functional Guidelines.

Samples were analyzed in SDGs for totals metals by the CLP inorganic methodology that included 15 to 25 samples from vertical sampling in each borehole. Samples for quality control were chosen randomly by the laboratory in the total metals SDGs. Each sample with measured total metals concentrations in excess of pre-determined trigger levels were extracted by the TCLP and analyzed to determine if the sample was characteristically hazardous.

Despite the random selection of samples for method quality studies, the majority of the packages analyzed for total metals had outside-of-method-limit qualifications for several elements concerning matrix spike additions, duplicate precision, and serial dilution. The laboratory's Form I equivalents and package narratives in Appendix F include all identified quality control deviations. These non-compliance issues are summarized in the independent PWT validation qualifiers attached to the summary results. Many of the results for elements of concern are qualified as estimated, summarizing the application of the EPA Functional Guidelines for verifying inorganic data. These qualifiers relate to the difficulty encountered in analyzing this sample matrix and appear to be independent of the method performance of the laboratory. Unless specific matrices are identified in the samples and proven independent of the actual quality control sample chosen, the Functional Guidelines require qualification of all samples in a package for the non-compliance of the single, independently chosen, sample used for quality control.

Lack of duplicate precision for some field and laboratory duplicates might indicate a non-homogenous nature for the distribution of the elements of concern in the samples, which might be mitigated by further processing of the raw samples before analysis. Further study of the standard and natural matrix spiked samples with the magnitude of the elements of concern might clarify causes of the matrix interferences and at what levels this might be of importance. The post-digestion spike studies indicate that most elements of concern are not subject to matrix effects when higher levels of spikes are added after digestion, suggesting that high level samples may not be influenced by matrix interference to the same extent as low-level samples. Matrix effects of the samples are also demonstrated in the data from TCLP analyses, but not to the extent seen with the total metal analyses.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The analytical data collected during this investigation were of sufficient quality to meet the DQOs of this study. However, if future investigations require a higher level of precision or accuracy in the quantitation of metals contamination in soil, adjustments to the procedures for sample collection and preparation may be necessary, as may be possible modifications to the contract requirements for the analytical laboratory.

The analytical data collected during this investigation suggests that metals contamination does exist in the Black Eagle railroad beds at concentrations high enough to cause the material to be classified as characteristically hazardous. This contamination extends laterally beyond the limits of the study at both ends of the railroad beds investigated. This contamination is not limited to the surface or near surface soils, and in some cases extends down into the native soil horizon below the railroad beds.

Future step-out characterization sampling should be considered to determine the lateral and vertical extents of contamination within the Black Eagle railroad beds.

8.0 RECORDS AND REPORTS

The analytical data collected during this investigation have been uploaded to the EPA Scribe Database and will also reside in a database maintained by PWT. Analytical laboratory data deliverables and original field documentation will be maintained at the PWT office location in accordance with PWT's RAC2 contract requirements.

9.0 REFERENCES

Atlantic Richfield Company (ARCO). 1992a. "*Clark Fork River Superfund Site Investigation, Standard Operating Procedures*." September 1992.

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