URS

REPORT
SUPPLEMENTAL REMEDIAL INVESTIGATION/FEASIBILITY STUDY
PEND OREILLE MINE TDF-1 AND TDF-2
METALINE FALLS, WASHINGTON

PREPARED FOR:
TECK WASHINGTON INCORPORATED

URS JOB NO. 36298248
June 3, 2010

URS

June 3, 2010

Mr. Kevin Dunn
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Subject: Report
Supplemental Remedial Investigation/Feasibility Study
Pend Oreille Mine TDF-1 and TDF-2
Metaline Falls, Washington
URS Job No.: 36298248

Dear Mr. Dunn,

URS Corporation (URS) is pleased to present this supplemental remedial investigation/feasibility study (RI/FS) at the Teck Washington Incorporated (TAI) Pend Oreille Mine Tailings Disposal Facilities (TDF) #1 and #2. The site is located along the Pend Oreille River, north of Metaline Falls, Washington. This report is based on our October 22, 2009 proposal. URS has prepared this report to supplement the draft RI/FS prepared by Golder Associates Inc., submitted to Teck Cominco Washington Incorporated on October 10, 2006 with comments provided by The Washington State Department of Ecology (Ecology) in 2007, responses to Ecology's comments by Golder and Associates Inc. on January 7, 2008 and additional comments submitted by Ecology on September 16, 2009.

It is the intent of this document to supplement the draft RI/FS by addressing Ecology comments, providing additional information where necessary, and to combine all RI/FS-related documents into one bound source. We trust this report provides you with the information you require. Should you have questions regarding the information presented in this report or need further assistance, please contact us.

Sincerely,
URS Corporation

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INTRODUCTION TO THE SUPPLEMENTAL RI/FS

Teck Washington Incorporated (Teck) is conducting a remedial investigation/feasibility study (RI/FS) to select remedial alternatives for closure of the historic Pend Oreille Mine tailings disposal facilities (TDF) #1 and #2 (TDF-1 and TDF-2). The site is located along the Pend Oreille River, north of Metaline Falls, Washington as shown on Vicinity Map, Figure 1. The RI/FS is being conducted under Agreed Order No. 2585 between Teck and the Washington State Department of Ecology (Ecology). A draft "Remedial Investigation/Feasibility Study Report for the Pend Oreille Mine Tailing Disposal Facilities TDF-1 and TDF-2, Metaline Falls, Washington" was prepared for Teck by Golder Associates Inc. (Golder) and submitted to Ecology on October 10, 2006. The draft RI/FS is presented as Attachment A. Ecology provided comments on the draft RI/FS to Teck and Golder responded to the comments in a letter dated January 7, 2008.

In February 2008, URS began assisting Teck with finalization of the draft RI/FS by responding to several Ecology comments related to characterization of groundwater flow and conditions beneath the site. As part of this effort, URS developed a hydrogeologic conceptual site model (CSM) for the site. The CSM is presented in Attachment B, *Pend Oreille Mine TDF-1 and TDF-2 Hydrogeology Data Review Memorandum*. Based on the CSM, URS installed three groundwater monitoring wells; coordinated surveying and sampled new and existing wells; prepared *Supplemental Monitoring Well Installation and Groundwater Monitoring Report* dated February 24, 2009 (Attachment C); and *Groundwater Monitoring Report*, *Pend Oreille Mine TDF-1 and TDF-2* dated January 28, 2010 (Attachment D). In a cooperative process between URS, Ecology, and Teck, the initial comments, responses, and results of the supplemental hydrogeological investigation were evaluated and a revised set of comments were provided by Ecology in a letter to Teck dated September 16, 2009.

Teck authorized URS to create an amended RI/FS (this document) that addresses Ecology's comments using the draft RI/FS and initial responses to comments prepared by Golder. The objective of amending the draft RI/FS is to prepare a final document that meets the substantive requirements of Washington Administrative Code (WAC) 173-340-350, Remedial Investigation and Feasibility Study, while not recreating the studies conducted during the during preparation of the draft RI/FS. URS completed the following tasks during preparation of the amended RI/FS:

- Conducted an abbreviated data validation of remedial investigation (RI) analytical data to identify if the data can be relied upon by URS.

- Conducted a review of the risk assessment (RA) sections of the draft RI/FS to evaluate whether the EPA-level site-specific RA prepared by Golder Associates can be simplified using Ecology Model Toxics Control Act RA procedures preferred by Ecology.

- Reviewed the geotechnical engineering sections of the RI/FS, specifically the slope stability calculations/methodology used to support the FS alternatives. During completion of this task, URS identified that alternatives presented in the draft RI/FS included regrading the impoundment dam of TDF-1 to a 2.5H:1V slope, which might be overly conservative and costly. Consequently an additional study was conducted to develop a least-cost but technically feasible, safe and acceptable concept for permanently stabilizing the outer slope of TDF-1. Attachment E, *TDF-1 Slope Stabilization Concept Development of Amended RI/FS Report*, presents findings of this assessment.

- Task 4. Respond to Ecology's revised comment list and prepared this Amended RI/FS.

This document including revised and new tables, in combination with the draft RI/FS, original comments from Ecology, responses to Ecology comments by Golder dated January 7, 2008, comments to specific responses from Ecology dated September 16, 2009, and supplemental hydrogeological, chemical, and geotechnical studies are intended to comprise a complete RI/FS for TDF-1 and -2 at the Pend Oreille Mine. The supplemental documents are provided in Attachments A through E of this Supplemental document, respectively.

The amended RI/FS document that follows is intended to be used with the draft RI/FS. Applicable sections that have been modified to address Ecology comments are replaced or amended as described in bolded italic text. Sections that are unchanged are noted as unchanged.

RI/FS SUPPLEMENT

1.0 INTRODUCTION

1.1 Purpose of the RI/FS *is changed to read*

The purpose for the RI is to collect, develop and evaluate sufficient information regarding the Teck Cominco American Incorporated tailings facilities TDF-1 and TDF-2 (collectively designated as the Site), to determine their metal content, stability and potential releases of metals to the environment. The data collected during the RI will supplement the existing Site information that is presented in Sections 2 and 4 to complete the RI/FS. An assessment of risks to human and ecological receptors at the Site is conducted as part of the RI to determine if cleanup actions are needed at the Site. The information obtained during the RI supports the FS to evaluate appropriate cleanup actions in accordance with MTCA. ***Ecology will review the alternatives presented in the FS and select a cleanup action that is protective of human health and the environment. Ecology's selected alternative may not be the alternative selected in the FS and may be a combination of alternatives presented in the FS.*** Completing the RI/FS will effectively satisfy the Agreed Order between Ecology and Teck Cominco American Incorporated.

1.2 RI/FS Objectives *is changed to read*

The general objective for an RI/FS is to adequately understand the nature and extent of environmental risks from TDF-1 and TDF-2 to select an appropriate remediation for the Site. The specific objectives of the remedial investigation for this Site were documented in the Site RIFS Work Plan (Golder 2005) and include:

1. An assessment of historical uses and operations at the Site and surrounding area;
2. An evaluation of previous investigations and remediation conducted at the Site;
3. A classification of the characteristics of the Tailings materials in TDF-I and TDF-2;
4. An assessment of the potential for revegetation of the surface of TDF-1 and TDF-2;
5. A characterization of the groundwater and surface water/sediment quality emanating from TDF-1 and TDF-2;
6. Evaluation of the TDF-1 stability; and,
7. An assessment of human and ecological risks from the tailings facilities and potential impact to adjacent habitat areas.

The RI determines the nature and extent of metal ***contaminants of concern (COC and COPC, used interchangeably throughout this document)*** to Site soil and groundwater, and to develop a conceptual Site model for exposure that identifies potential human health and/or environmental risks associated with the Site. Completion of the RI will provide the necessary data to support the FS, which is principally an evaluation of appropriate remedial alternatives for Site cleanup. This helps ensure selection of a remedy that meets regulatory requirements and is protective of human health and the environment.

The FS is conducted according to the MTCA cleanup regulations, specifically WAC 173-340-350 and 360. It comprehensively evaluates likely remediation alternatives, and proposes a remedial alternative that provides the most practical and achievable results for the Teck Cominco American Incorporated tailings facilities. The remedy selected from the FS will need to be effective for the protection of human health and the environment, achievable in a practical manner and implementable within a reasonable time frame.

To meet the standards set fourth by WAC 173-340-360, the selected remedy also will:

- ***Comply with cleanup standards;***
- ***Comply with applicable state and federal laws;***
- ***Provide for compliance monitoring;***
- ***Use a permanent solution to the maximum extent possible; and***
- ***Consider public concerns***

1.3 Report Organization *is changed to read*

This RI/FS Report has been structured to facilitate a clear understanding of all the elements to be conducted during the RI and FS. This report is organized as follows:

- **Section 1 - Introduction**: This section briefly states the purpose and objectives of the Pend Oreille Mine TDF-1 and TDF-2 RI/FS, and outlines the organization of the RI/FS Report.

- **Section 2 – Site Background Summary**: This section describes the Site including proper facility name, legal description, address, property lines, property history, and review of previous environmental investigations.

- **Section 3 – Site Remedial Investigation:** This section describes the activities and provides the results of the RI investigation.

- **Section 4 – Site Conditions and Nature and Extent of *COC*:** This section describes the Site physical and biological setting including Site topography, local and regional geology, hydrogeology, ecology, area meteorology, and demographics. The results of the previous investigations and this RI are used to determine affected areas and *COC*.

- **Section 5 – Human and Ecological Risk Assessment:** This section identifies potential exposure pathways and evaluates human and ecological health risks at the Site.

- **Section 6 – Cleanup Action Objectives and *Remedial Technology Screening*:** This section presents remedial action objectives and screens applicable remedial technologies.

- **Section 7 – Cleanup Action Alternative Development:** From the retained technologies, this section develops and describes remedial action alternatives that are appropriate for this Site.

- **Section 8 – Cleanup Alternatives Evaluation:** This section estimates cost and evaluates each alternative in accordance with MTCA.

- **Section 9 – References**: This section includes citations for the references used to prepare this RI/FSS Report.

- **Appendices –** Appendices provide:

  A. Laboratory analytical reports;

  B. ***TDF-1 and TDF-2*** Test pit logs;

  C. ***Site*** Borehole and well construction diagrams;

  D. ***Hydraulic pump test analysis;***

E. ***Vegetation and off-site soil sample inventory*;**

F. ***Site wildlife survey;***

G. TDF-1 stability analysis;

H. ***Human lead blood concentration model runs (EPA IEUBK Model)***

I. Applicable, relevant ***or*** appropriate requirements (ARARs); and

J. Cleanup Alternative Cost Estimates.

2.0 SITE BACKGROUND SUMMARY

This section is unchanged

2.1 Site Location

This section is unchanged

2.2 Property History *is changed to read*

The current Pend Oreille Mine is in the Metaline mining district. Ownership of the mine dates back to 1904 when L.P. Larsen began prospecting in the area. In 1906 the Pend Oreille Mines & Metals Company was incorporated. The early mining in the area began on the west side of the Pend Oreille River where ore bodies were exposed above the river level. ***In about 1952, underground mining began at the location of the current Pend Oreille Mine on the east side of the Pend Oreille River.*** The Pend Oreille Mine was owned and operated by the Pend Oreille Mines & Metals Company until 1974, when the Bunker Hill Company acquired the property and operations. The Bunker Hill Company operated the mine and mill until September 1977, when Pintlar Corporation acquired the property through bankruptcy proceedings. During 1977, the mine and mill were closed ***and*** in 1990 ownership of the mine, mill and 13,000 acres of contiguous mineral property were transferred to Resource Finance Corporation. In 1996, Cominco American Incorporated acquired the property including the mine and mill complex from Resource Finance Corporation. When Cominco American Incorporated merged with Teck Incorporated in 2001, Teck Cominco American Incorporated took ownership of the mine, mill and property. Teck Cominco American Incorporated, in addition to the land obtained with the merger, leased additional contiguous surface lands (including mineral rights) and reopened the mine and mill for production in 2004. The mine and mill are currently operational on privately owned land and is operated by Teck Washington Incorporated.

2.3 Description of Adjacent Properties

This section is unchanged

2.4 TDF-I and TDF-2

This section is unchanged

2.4.1 TDF -1

This section is unchanged

2.4.2 TDF -2

This section is unchanged

2.5 Previous Environmental Investigations

This section is unchanged

3.0 SITE REMEDIAL INVESTIGATION

This section is unchanged

3.1 TDF-1 and TDF-2 Tailings Characterization

This section is unchanged

3.1.1 Sampling Activities and Methods

This section is unchanged

3.1.2 Analytical Results

This section is unchanged

3.1.2.1 Total Metal Content *is changed to read*

All test pit composite samples were analyzed for Total Metal Content of ***COC*** including arsenic, barium. cadmium, copper. lead, mercury, selenium, and zinc, as well as TCLP testing for cadmium and lead. The composite samples represent the entire test pit column. ***Revised*** Table 3-1 summarizes the analytical results for the Total Metal Content analyses. ***Each result is compared to the applicable MTCA Method A Unrestricted Land Use and Industrial Land Use soil cleanup level, if available. When MTCA Method A values are not available, MTCA Method B and C soil direct contact values along with the lowest terrestrial ecological screening value presented in MTCA Table 749-3 are used to screen the metal in Revised Table 3-1.*** The screening values are ***further*** developed in Section 4 of this report.

The tailings material in TDF-l and TDF-2 contains several metals at concentrations above screening values as shown on ***Revised*** Table 3-1. ***Cadmium and lead are above screening values for Unrestricted Land Use; arsenic is slightly above in two samples but neither sample is twice the cleanup level and the frequency of exceedance is about 10%.*** Metal content in TDF-l and TDF-2 that are above ecological risk screening values include ***barium (in two samples from TDF-2), copper (in one sample from TDF-1 and one from TDF-2),*** and zinc. Selenium is the only ***COC*** analyzed that is below the laboratory detection limit of 4.0 mg/kg for all tailings composite samples.

3.1.2.2 TCLP Results

This section is unchanged

3.1.2.3 Surface Agronomic Characteristics

This section is unchanged

3.2 Hydrogeologic Characterization *Section 3.2 and applicable subsections are supplemented by the report "Supplemental Monitoring Well Installation and Groundwater Monitoring, Pend Oreille Mine TDF-1 and TDF-2", URS 2009 (Attachment C) and Supplemental Groundwater Monitoring Report (Attachment D), and is changed to read*

The hydrogeologic study of the Site focused on the groundwater above the Ledbetter Slate. The Ledbetter Slate is hundreds of feet thick and is an aquitard for groundwater vertical flow. Glaciofluvial deposits mantle the Ledbetter Slate, but can be over a hundred feet in thickness, Groundwater was encountered within the glaciofluvial deposits and within tailings materials. TDF-I has five existing piezometers that were sampled during the RI (see Figure 3-2). Three monitoring wells (MW-201, MW-202, and MW-203) were installed on TDF-2 (see Figure 3-2), but only two wells (MW-203 and MW-201) encountered groundwater. The third well, MW-202, extended below the TDF-2 tailings material to the Ledbetter Slate, but groundwater did not exist above the slate during the two RI sampling periods. Initial drilling efforts for MW-201 had drilling refusal using a hollow stem auger drill rig before encountering groundwater. The location of these boreholes designated BH-201(A) and BH-201(B) are also shown in Figure 3-2.

Groundwater was further investigated as seep water below TDF-1 ***and TDF-2***. The Ledbetter Slate is near surface and the steep topography results in groundwater being near surface and accessible through a drive tube. Seeps represent groundwater down-gradient of TDF-1 above the Ledbetter Slate. The groundwater seeps that were identified in the field along the western and northern perimeter of TDF-1 were sampled and analyzed for metal content.

Two additional boreholes (designated LSB-1 and LSB-2) were drilled north of TDF- 1 and TDF-2 to further investigate the groundwater conditions and elevation of the Ledbetter Slate (see Figure 3-2). ***(Sentence Deleted)***

Additionally, hydraulic tests were performed in the monitoring wells in TDF-2 and the piezometers in TDF-1 in order to characterize the hydrogeologic conditions of the uppermost saturated zone within or below the tailings material in TDF-1 and TDF-2.

3.2.1 Geologic Borehole Logging and Installation of Monitoring Wells

This section is unchanged

3.2.1.1 Drilling Procedures and Geologic Logging Results

This section is unchanged

3.2.1.2 Monitoring Well Construction Details and Geodetic Survey Results *is changed to read*

The TDF-2 monitoring well borings were advanced to a depth of approximately 8- to 10-feet below the top of the shallow groundwater table encountered beneath the tailings material in TDF-2. Upon reaching total depth of the borings, a monitoring well was completed with 2-inch diameter, schedule-40 PVC well screen and casing in accordance with Golder's Technical Procedures and Washington State Well Construction Regulations (WAC 173-1601) referenced in the SAP (Golder 2005). A schematic installation diagram for the monitoring wells is shown in Figure 3-3. All monitoring wells were completed with protective steel well monuments with lockable lids and developed appropriately, ***except MW-202 which was dry at the time of well installation and RI monitoring periods***. Installation details for the monitoring wells on TDF-2, existing piezometers on TDF-1, and investigation boreholes are presented in Table 3-4 and are illustrated in Appendix C.

3.2.2 Groundwater Hydraulic Testing Procedures and Results

This section is unchanged

3.2.2.1 Slug Testing

This section is unchanged

3.2.2.2 Pump Testing

This section is unchanged

3.2.3 Groundwater Sampling

This section is unchanged

3.2.3.1 Sampling Activities and Methods

This section is unchanged

3.2.3.2 Analytical Results *this section is supplemented by "Supplemental Monitoring Well Installation and Groundwater Monitoring, Pend Oreille Mine TDF-1 and TDF-2", URS 2009 (Attachment C) and Supplemental Groundwater Monitoring Report (Attachment D*

3.2.4 Groundwater Seep and Culvert Discharge Sampling

This section is unchanged

3.2.4.1 Sampling Activities and Methods

This section is unchanged

3.2.4.2 Analytical Results

This section is unchanged

3.3 Surface Water and Sediment Characterization

This section is unchanged

3.3.1 Surface Water

This section is unchanged

3.3.1.1 Sampling Activities and Methods *is changed to read*

Creek surface water sampling locations were established at sections of the creeks where less turbulent flows were observed in order to obtain representative surface water samples with the least amount of suspended materials present. Each surface water sample was collected from a cross-section of the surface water channel at each creek sampling location. ***The creek flows were measured with a graduated 5-gallon bucket with known volumes and timed with a stop watch. A location on each creek was selected that had a natural weir or drop-off that would facilitate flow measurement. Some locations for flow measurement were modified by dredging as needed to improve creek flow capture in the graduated bucket.*** All surface water samples were filtered through 0.45-micron in-line filters, and select surface waters were also analyzed for total metals to compare the differences between unfiltered and filtered samples regarding metal content of the surface water systems. Surface water sample collection activities were conducted in accordance with strict QA protocols and procedures specified in the relevant technical procedures referenced in the QAPP (Golder 2005). The surface water sampling locations are described in more detail below:

Creek #1 was sampled at one up-gradient location (C1-1) and one down-gradient location (C1-2) (see Figure 3-5). Creek #1 did not have a continuous flow throughout the length of the channel adjacent to the tailings facilities during both sampling periods, although the creek is constrained to a well-defined deep drainage channel. During the August 2005 sampling event, Creek #1 was dry at the up-gradient sampling location, but had a steady flow (~5 gpm) of surface water emanating within the channel at the down-gradient sampling location. During the May 2006 sampling event, Creek #1 had flowing surface water conditions at both the up-gradient and down-gradient sampling locations; however, the surface water system in this channel was discontinuous throughout the length of the channel.

Creek #2 was sampled at one up-stream location (C2-1) and one down-stream location (C2-2) (see Figure 3-5). Creek #2 was observed to have a continuous flow throughout the length of the channel system during both sampling periods, and is constrained to a well-defined narrow drainage channel. Creek #2 flow was estimated to be approximately the same at the up stream and down-stream stations, about 60 gpm and 15 gpm, respectively, for the August 2005 and May 2006 sampling periods. Creek #2 starts at the toe of TDF-1 at the discharge point of the North and South Diversion Ditches constructed around TDF-1 and the outflow of the TDF-1 decant structure. The up-gradient sample location C2-1 was located just below the confluence of these discharges from and around TDF-1. The down-stream C2-2 sample location was near the discharge of Creek #2 to the Pend Oreille River.

The standing surface water in the wetland on top of TDF-1 was sampled in the western portion (designated W1-1) and the eastern portion (designated W1-2) of the wetland as shown on Figure 3-5 (Note: these samples are not the same as the seep samples Wl-S1 and W1-S2 that are groundwater seeps emanating up-gradient of TDF-1 and discharge to the south diversion ditch). During both sampling events, both wetland sampling locations were observed to be continuously submerged by water nearly 10 inches deep. Surface water was observed to be flowing from the TDF-1 wetland area approximately 50 feet though a narrow channel (8 - 10 inches deep) at a rate of about 2 - 3 gpm and discharging into the active decant tower in TDF-1.

3.3.1.2 Analytical Results *is changed to read*

All surface water samples were analyzed for dissolved metals including silver, arsenic, barium, calcium, cadmium, chromium, copper, iron, magnesium, manganese, mercury, lead, selenium, and zinc, as well as chloride, sulfate and alkalinity. In addition, selected surface water samples were analyzed for total metals for comparison with the dissolved metal content. The field measured water quality parameters are presented in Table 3-6. Table 3-10 summarizes the laboratory analytical results for the surface water samples for both sampling periods.

None of the Site ***COCs*** were found to be above human or aquatic ecological health-based screening levels in the analytical results of filtered surface water samples. The only exception is the surface water sample C1-2 from Creek #1 obtained during the May 2006 sampling period, where cadmium (0.53 µg/L) slightly exceeded the Federal Water Quality Criteria of 0.44 µg/L (Washington Water Quality Criteria is 1.9 µg/L). Creek #1 does not drain TDF-1 or TDF-2 and cannot receive groundwater because of the Ledbetter Slate ridge separating the tailing disposal facilities from Creek #1 (see Section 4.1.8). Therefore, this exceedance during the May 2006 sampling event is believed to be caused by other sources or natural background.

The water quality standards presented in Table 3-10 are based on dissolved metal content ***with the exception of selenium and mercury.*** Total metal content in surface water samples was analyzed for comparison with dissolved metal content ***in Creek #2, downstream near the outfall area***. Table 3-10 shows that the unfiltered sample collected ***(C2-2)*** in Spring 2006 has a higher content of cadmium, copper, iron, lead and zinc than that found in the filtered sample for the C2-2 collected during that sampling period. Therefore, total metal content in the unfiltered surface water sample is considered to be representative of the amount of metals being carried in the surface water system by the sediment load at that specific time. ***Concentrations of selenium and mercury in the unfiltered samples remained below detections limits.***

3.3.2 Sediments

This section is unchanged

3.3.2.1 Sampling Activities and Methods

This section is unchanged

3.3.2.2 Analytical Results *is changed to read*

All creek and seep sediment samples were analyzed for total metals including arsenic, barium, cadmium, copper, lead, mercury, selenium, and zinc. ***Revised*** Table 3-11 summarizes the analytical results for the creek sediment samples for both sampling periods. ***Revised Table 3-11 also presents MTCA Human Unrestricted and Industrial Land Use Soil Cleanup Levels, Proposed Washington State Fresh Water Sediment Criteria, and Consensus Based Freshwater Sediment Probably Effects Concentrations (PECS) and Threshold Effects Concentrations (TECS). Arsenic, barium, copper, selenium, and mercury exceeded criteria at several locations. Cadmium, lead, and zinc exceeded one or more sediment criteria at most sampling locations.***

3.4 Vegetation Characterization

This section is unchanged

3.4.1 Vegetation and Perimeter Soil Sampling

This section is unchanged

3.4.2 Field Sampling Procedures

This section is unchanged

3.4.3 Analytical Chemistry and Results

This section is unchanged

3.5 Wildlife Surveys

This section is unchanged

3.5.1 Wildlife Survey Methods

This section is unchanged

3.5.2 Results

This section is unchanged

3.6 TDF-1 Piezometer Water Level Monitoring

This section is unchanged

3.6.1 Sampling Activities and Methods

This section is unchanged

3.6.2 Results

This section is unchanged

4.0 SITE CONDITIONS AND NATURE AND EXTENT OF *COC*

This section is unchanged

4.1 Physical and Biological Setting

This section is unchanged

4.1.2 Climate

This section is unchanged

4.1.3 Soils *is changed to read*

Soils near the Site are derived from the weathering of glacial till, colluvium, and glaciofluvial and Glaciolacustrine sediments (Soil Conservation Service, 1992). Podzols are common at elevations above

3,600 feet and Brunisols are present in the lower elevations along the valley slopes and in the valleys ***(Ecology 2000). Brunisols are similar to Inceptisols in the US Soil Taxonomy system.***

The Soil Conservation Service (SCS) mapped the soils in the vicinity of the Pend Oreille Mine to be the Bonner-Orwig-Kanisku and the Cusick-Martella-Anglen general units. The map of soils types/units are shown in Figure 4-1. Table 4-1 identifies each soil type and general characteristics on depth, drainage, erosion potential and topsoil suitability. The soils in the area are described by the SCS as deep, moderately to well-drained soils formed in glacial outwash or glacial lake sediments that often have a mixture of glacial material and volcanic ash.

4.1.4 Tailings Agronomic Soil Characteristics *is changed to read*

The results were compared to several criteria for evaluating soil, including:

- Ecological Indicator Soil Concentrations (mg/kg) for Protection of Terrestrial Plants and Animals (WAC 173-340-900 Table 749-3);

- Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision (Efroymsen, et.al., 1997); and

- Various guidelines for evaluating nutrient and agronomic status of soils in the Western US., including (OSM 1999, WDEQ 1999, NMMMD (no date) and Follett, et.al., (1991).

It is important to note that the evaluation criteria are guidelines, not mandatory criteria. The appropriate metal concentration in a soil is a function of numerous factors, including soil texture, organic matter content, pH, oxidation reduction potential (ORP), and relative abundance of carbonates, iron and manganese hydrous oxides, etc. Likewise, most nutrient guidelines are based on research for agricultural crops. The limited research related to nutrient level of soils for native species indicates that native species have lower nutrient requirements.

Nutrient Status

The tailings are deficient in the essential macronutrients, nitrogen, phosphorus, and potassium. Average macronutrients concentrations in the samples are: available nitrogen (N) <1 ppm, available phosphorus (P) <1 ppm and available potassium (K) 16 ppm. Generally, soil test levels of 10 to 20 ppm N, >11 ppm P, and > 60 ppm K are considered adequate to support native vegetation.

Average soil reaction, measured as pH, was reported as approximately 7.5. This value is normal for Western U.S. soils and native vegetation. Organic matter for the samples averages about 2.8%, which is considered adequate for establishing native vegetation in the Western U.S., and similar to the average organic matter content reported for native soils in the area (Soil Conservation Service 1992).

Metals

The laboratory results indicate that total cadmium, lead, and zinc are present in concentrations considered potentially phytotoxic (Efroymsen, et.al., 1997) on both TDF-1 and TDF-2. Total copper on TDF-2 exceeds potentially phytotoxic concentrations. As stated earlier, the phytotoxicity of a given metal concentration in a soil is a function of numerous factors, including soil texture, organic matter content, pH, ORP, and the abundance of carbonates, iron and manganese hydrous oxides, etc. These factors all influence the partitioning of the metal into insoluble and soluble components. Insoluble compounds are not available to plants. The available research indicates that, particularly for arsenic, total concentration is not a good indicator of phytotoxicity. Therefore, the samples were also analyzed using an ammonium-bicarbonate DTPA extractant (AB-DTPA). AB-DTPA is designed to mimic the chemistry in the vicinity of a plant root, and provide an estimate of the plant-available portion of the total soil metal pool. The results are presented in Table 3-3. The results indicate that plant available zinc and lead exceed the concentration generally considered phytotoxic on both areas, and copper exceeds plant-available concentrations on TDF-2. There are insufficient data in the literature to determine a potentially phytotoxic plant-available concentration for cadmium.

In general, total and plant available metal concentrations are higher on TDF-2 than TDF-1. Furthermore, the southern part of TDF-2 (Test Pits -T15, -T16 and -T17) has higher copper (total and plant-available) concentrations than the northern portion (Test Pits 13 and 14). It is of particular interest that there is little or stressed vegetation on the southern portion of TDF-2. The plant-available copper concentration on the southern portion of TDF-2 exceeds the potentially phytotoxic level, while it is below the potentially phytotoxic level on the lower part of TDF-2 and all of TDF-1.

Although the agronomic analyses results in general indicate that the tailings are a poor plant growth medium due to lack of nutrients and elevated metals, vegetation has established to varying degrees on most of the tailings. As stated above, the benchmark values for the metals presented above are guidelines above which phytotoxic effects may occur. However, the effect is a function of numerous other soil factors that can increase or reduce the impact on vegetation. The presence of organic matter, slightly alkaline pH and presence of carbonates in the tailings are all factors that reduce the availability of metals and mitigate the impact to vegetation. Despite the elevated soil metal concentration, few symptoms of metal toxicity were observed in the vegetation on the tailings. In addition, plant tissue samples were analyzed (Section 3.5) for metals. The results indicated that the metals of concern were not present in plant tissue at concentrations that are generally considered toxic to plants. The one exception was zinc, which was reported in the black cottonwood at levels well above the 400 ppm concentration generally considered to be toxic (Kabata-Pendias and Pendias, 2002), but the cottonwood trees appeared to be healthy on TDF-1.

In summary, the comparative analytical soil results and field observations of the plants indicate that TDF-1 and the north part of TDF-2 are not phytotoxic. The elevated copper levels and poor coverage and stressed vegetation on the south part of TDF-2 indicate that the area is phytotoxic.

4.1.5 Vegetation

This section is unchanged

4.1.6 Wildlife

This section is unchanged

4.1.6.1 Habitat

This section is unchanged

4.1.6.2 Endangered, Threatened, Sensitive and other Priority Species *is changed to read*

There are several amphibian, bird, ***fish*** and mammal species of concern that may use the Site or surrounding area. There are several wildlife species of concern (***Revised*** Table 4-3) identified by their status by Federal and Washington State agencies. Several of the animals of concern listed on are not expected to live on or in the vicinity of the Site because of elevation or habitat types, but could be an infrequent transient visitor.

4.1.7 Geology

This section is unchanged

4.1.7.1 Regional Geology

This section is unchanged

4.1.7.2 Mineralization

This section is unchanged

4.1.8 Site Geology

This section is unchanged

4.1.9 Site Hydrology and Hydrogeology

This section is unchanged

4.1.9.1 Hydrology

This section is unchanged

4.1.9.2 Hydrogeology *This section is supplemented by the Pend Oreille Mine TDF-1 and TDF-2 Hydrogeology Data Review Memorandum dated May 8, 2008 (Attachment B) and Supplemental Monitoring Well Installation and Groundwater Monitoring Report, Pend Oreille Mine TDF-1 and TDF-2 dated February 24, 2009 (Attachment C)*

4.1.10 TDF-1 Stability *This section is supplemented by the TDF-1 Slope Stabilization Concept Development for Amended RI/FS Report, Pend Oreille Mine TDF-1 and TDF-2, URS Corporation, December 28, 2009 (Attachment E)*

4.2 Human Ecological Risk Screening Levels

This section is unchanged

4.2.1 Human Risk Screening Levels *is changed by the following*

Table 4.4 is revised to show Washington State Background Concentrations for arsenic, barium, and selenium.

4.2.2 Ecological Screening Levels *is changed to read*

Potentially applicable risk-based concentrations for ecological receptors were identified for soil/sediment (Table 4-6) and surface water (Table 4-7) from Federal and Washington State established criteria for ecological protection***. For screening purposes sediment COC concentrations were compared to the soil clean-up standards and proposed sediment guidelines for Washington State (Ecology 2003). In addition, Freshwater sediment concentrations were also compared to consensus based Probable Effects Concentrations (PECs) and Threshold Effects Concentrations (TECs) (MacDonald et al, 2000). The PECs and TECs are commonly used as screening levels by the USEPA***. Each Federal and State applicable criterion is identified in the tables. Washington accepted background concentrations and standard PQLs are also included on the tables, since screening levels or cleanup levels cannot be below background or analytical PQLs. The RI/FS uses the clean-up goal as the screening concentration rather than a more conservative toxicity threshold value used in the more detailed Ecological Risk Assessment (ERA) that involve multiple iterations. Interpretation of results using the MTCA criteria in some cases relies on more detailed analyses of recent Federal summaries, in particular for:

- Lead in soils for mammalian receptors;
- Cadmium in soils for avian and mammalian receptors

4.3 Extent of Potential Risks from Metal COC *This section is amended by Supplemental Monitoring Well Installation and Groundwater Monitoring Report, Pend Oreille Mine TDF-1 and TDF-2 dated February 24, 2009 (Attachment C) and Groundwater Monitoring Report, Pend Oreille Mine TDF-1 and TDF-2 dated January 28, 2010 (Attachment E), and is changed to read*

The extent of ***COC*** above human and ecological screening levels by media is defined herein by the presence and levels of constituents above screening goals (Table 4-8). Based on the information discussed in this subsection, Site investigations have adequately defined the extent of metals to proceed with this RI/FS Report. Other analyzed parameters were not detected above human or ecological screening levels and these compounds are not considered further. The ***COC*** and associated media that have concentrations above human or ecological screening levels (Table 4-8 ***and Supplemental Table 4-8***) are considered in the risk assessment in Section 5.

<u>Human Screening level Exceedances</u>

The only ***COC*** that are above any human health risk levels are;

- Lead in TDF-1 and TDF-2 tailings materials;
- Lead in Creek #2, TDF-1 Wetland***, Unnamed Ditch, and Seeps #4 and #7*** sediments
- Lead in the Seep #4 water during the May 2006 period; and
- Secondary drinking water criteria for zinc, iron, manganese and sulfate in groundwater and seep water.

The upper 95% confidence level ($UCL_{95\%}$) of the mean lead concentrations in tailings are above the MTCA levels of 250 mg/kg for unrestricted land use in both TDF-1 and TDF-2. The lead MTCA level of 1000 mg/kg for industrial land use is not exceeded for tailings in TDF-1 and TDF-2, when the $UCL_{95\%}$ is calculated using all the laboratory analytical results for TDF-2 tailings (both the test pit and agronomic sample analyses). The $UCL_{95\%}$ for a normally and lognormally distributed TDF-2 tailings sample set is 958 mg/kg and 995 mg/kg, respectively, with both the test pit tailings and agronomic tailing analytical results used together in the statistical calculation. Because the UCLs are very similar for test pit soil and the agronomic soil metal concentrations from TDF-1 tailings, combining the results was not warranted.

Except for lead, ***COC*** concentrations in all Site sediments are below MTCA ***direct human contact*** levels for unrestricted land use. Site sediments have lead concentrations greater than the MTCA Method A level of 250 mg/kg for unrestricted use in Creek #2, TDF-1 Wetland, ***Unnamed Ditch, and Seeps #4 and #7 however detected concentrations are*** less than the MTCA Method A level of 1000 mg/kg for industrial land use. The sediments within TDF-1 Wetland actually consist of mainly TDF-1 tailings and have similar ***COC*** concentrations.

The only exceedance of a human health based Primary Drinking Water Standard or ***cleanup level in the project area*** was for lead in one sample from Seep #4 during the May sampling period. The Federal and State Drinking Water ***cleanup level*** for lead is 15 µg/L. The May 2006 water sample from Seep #4 had a lead concentration of 26.2 µg/L, but the August 2005 corresponding seep water sample was below the human health-based standard at 9.5 µg/L. ***One surface water sample from Creek #1 contained a concentration of cadmium above Federal Drinking Water criteria; this sample is assumed to be off-site.***

All other media investigated at and surrounding TDF-1 and TDF-2 have concentrations below human health screening levels for unrestricted use.

Ecological Screening Exceedances

The measured ***COC*** concentrations in soil/sediments, surface and seep waters and Site vegetation samples (see Table 3-12) were compared to the screening levels presented in Tables 4-6 and 4-7 following the MTCA guidelines. The tailings (TDF-l and TDF-2) exceeded screening levels for ***barium,*** cadmium, ***copper (one sample),*** lead, and zinc (Table 4-8). In addition, the sediments from creeks and the wetland on TDF-1 as well as the soils on the fringe of the TDF-l wetland exceeded screening concentrations for selenium ***(in addition to those metals mentioned above)***. Except for cadmium in the Creek #1, which was selected to provide reference concentrations and is not associated with the Site, there were no exceedances of water quality parameters Cfable 4-8).

4.4 Nature of Metal COC *this section is changed to read*

The ***COC*** were identified in the RI/FS Work Plan (Golder, 2005) and mainly include the metals: arsenic, cadmium, copper, lead, selenium, mercury, and zinc. ***Arsenic exceeded the MTCA Method A Unrestricted Soil Cleanup Level in three locations. Two locations are from test pits installed into TDF-1 tailings materials; these samples only slightly exceeded the MTCA Method A Unrestricted soil cleanup levels. The third location was near the collapsed decant tower; this detection appears to be an outlier possibly associated with wood treatment chemicals associated with the collapsed decant tower structure. Because the portions of the site where these samples were collected will be addressed as part of the overall remedial action, arsenic is not carried forward as a COC.*** Barium and copper are not considered to be ***COC*** for this RI/FS, because their concentrations in Site media are either below accepted State of Washington background levels (copper) or do not exceed human and ecological screening levels for plants, avian or mammalian potential receptors ***(barium)***. Cadmium, lead, mercury, selenium, and zinc have been detected in one or more Site media above Washington State background levels and human or ecological risk-based screening levels. These metals remain ***COC*** and their chemical properties and environmental fate processes are discussed below.

4.4.1 Metal COC *the following subsection is changed to read (the remaining subsections are unchanged)*

Cadmium

Cadmium is a relatively mobile metal that is transported in the aqueous environment in solution as a hydrated cation or as an inorganic or organic compound. A typical ambient cadmium concentration range reported for soils in North America is 0.01 to 0.7 mg/kg (Lindsay, 1979); Dragun (1988) reports a range from 0.01 to 45 milligrams per kilogram (mg/kg). Ecology considers background cadmium concentrations for soils in the State of Washington to be 1.0 mg/kg (Ecology 1994).

Cadmium is often present in soils and waters as the divalent cation (Lindsay, 1979). In solution, cadmium is primarily the divalent cation or an oxide. Cadmium hydroxides, [$CdOH^+$ and $Cd(OH)_2$] are important secondary species at pH values greater than 7.5 (Lindsay, 1979). Cadmium solubility is largely affected by pH, *but* ***the ionic state of cadmium is nearly unaffected by water REDOX conditions*****.** Cadmium is generally more soluble at lower pH and therefore is more mobile as pH decreases. The typical range of aqueous solubility for cadmium is approximately 0.1 to 1.0 milligrams per liter (mg/L).

The limits on cadmium solubility depend on the presence of inorganic or organic ligands. In most cases, organic substances (i.e., humic substances) can account for the majority of cadmium complexes. The second most important complexing ligand is probably carbonate followed by hydroxide. Cadmium sulfate minerals are generally highly soluble and are unlikely to form in soils.

However, under reducing conditions, in the presence of sulfide, insoluble sulfide precipitates could form (USEPA, 1979). Sorption of cadmium by clays and organic matter, co-precipitation with hydrous iron, aluminum and manganese oxides, and isomorphous substitution in carbonate minerals are all mechanisms for the removal of cadmium from natural waters.

4.4.2 Environmental Fate Processes *is changed to read*

The ***COC*** are metal elements, which are not subject to degradation. The ***COC*** originate in the tailings materials and are capable of migration either through erosion via: water-borne or airborne mechanisms or by becoming dissolved in contacting water and migrating with the movement of water. The erosion or dam slope failure of tailings could potentially release solid materials downslope in an uncontrolled manner.

Airborne releases of tailings do not appear to be operative at the Site. The surface of the TDF-1 and TDF-2 has developed a crust and layers of lichen that minimizes the potential for fugitive dust emissions. If airborne fugitive dust emissions had occurred or are occurring at the Site, elevated ***COC*** concentrations would be expected in surface soils adjacent to the tailings facilities. Animal pathways from the tailings facilities should represent impacts to adjacent soils from both fugitive dust emissions and animal tracking tailings material. Soil samples obtained along animal pathways adjacent to the tailings facilities are either at accepted Washington State background concentrations (Ecology 1994) or are below risk screening levels. Since low ***COC*** concentrations were observed in animal pathways soils, there is no evidence that ***natural*** airborne fugitive emissions from the tailings facilities have or are operative to impact surrounding soils to unacceptable levels. ***There is potential for fugitive dust to be generated by trespassers or recreational site users. Therefore, to protect human health risks, the inhalation pathway was evaluated during the risk assessment.***

Groundwater dissolution or leaching of metals does not appear to be sufficiently operative at the Site based on observed concentrations of COC in downgradient monitoring wells. Observed concentrations of retained metals (cadmium, mercury, lead, and zinc) in tailings soil were evaluated using the MTCA

Fixed Parameter Three Phase Partitioning Model (WAC 173-340-747[4], Equation 747-1) for unsaturated soil using a dilution factor (DF) of 20 and for saturated soil using a dilution factor of 1. This model is used to predict soil concentrations protective of groundwater (soil to groundwater pathway). For unsaturated soils, only cadmium is predicted to be present in tailings groundwater when the observed UCL concentration of cadmium in tailings soil is used in the model; cadmium is not observed in downgradient groundwater at a concentration exceeding human health criteria. For saturated soil, cadmium, mercury, lead, and zinc are predicted to cause an exceedance of the human health criteria in groundwater when the observed UCL concentrations in tailings are used in the model. Because downgradient concentrations of these contaminants in groundwater are less than cleanup criteria, it does not appear that significant releases of metals to groundwater are occurring and the model does not appear effective in predicting releases of these contaminants to groundwater at this site. The following presents results of Equation 747-1 for Site COC:

COC	***Soil Concentration Protective of Groundwater (mg/kg) Dilution Factor of 20***	***Soil Concentration Protective of Groundwater (mg/kg) Dilution Factor of 1***
Cadmium	***0.69***	***0.03***
Mercury	***2.09***	***0.10***
Lead	***3000***	***150***
Zinc	***5971***	***299***

Metals dissolved in water are subjected to several physical processes including advection, dispersion, and molecular diffusion. Advection is the migration of a substance due to the bulk movement of water. Advection tends to move chemicals in the direction of flow. Hydrodynamic dispersion, which consists of both mechanical dispersion and molecular diffusion, dilutes concentrations primarily in the direction of flow. Mechanical dispersion of ground water plumes is caused primarily by the movement of ground water around the soil particles that are in the flow path. These particles divert the forward motion of ground water and tend to disperse substances. Molecular diffusion, caused by intermolecular collisions, also causes chemicals to dilute in ground water. Therefore, as ***COC*** migrate, these physical processes, in combination with the chemical and biological processes, retard and dilute ***COC*** concentrations in water along the infiltration and ground water pathways.

Infiltrating rainwater comes into contact with soil containing ***COC*** at the Site. For pathways activated by contact of water with soil containing ***COC*** (e.g., overland runoff and infiltration), the migration rate is controlled by the availability of water, the time of contact between the water and the constituents, the rate of evaporation, the permeability and wetting characteristics of soil and the vadose zone, and the solubility of the ***COC.*** The relative partitioning of ***COC*** between the dissolved and particulate phases is controlled by a complex combination of precipitation, dissolution, and sorption reactions.

Sorption is an important process affecting metals migration for infiltrating rainwater and ground water. Sorption can be thought of as an equilibrium-partitioning process between the soil and water.

5.0 HUMAN AND ECOLOGICAL RISK ASSESSMENT

This section is unchanged

5.1 Identification of Site Areas for the Risk Assessment

This section is unchanged

5.2 Human Health Risk Assessment (HRRA)

This section is unchanged

5.2.1 Exposure Evaluation

This section is unchanged

5.2.1.1 Potential Human Health Receptors *is changed to read*

The Site is currently an inactive portion of the operational Pend Oreille Mine. The area surrounding the Site is also within the boundary of the Pend Oreille Mine and is mainly undisturbed, composed of native soil coves, rock outcrops, and vegetation. There are no residences or schools on or immediately adjacent to the Site; however, there are several single-family homes within a mile of the Site ***and the Metaline Falls Golf Course is located near TDF-2 approximately 200 yards to the east. TDF-2 and the golf course are separated by the forest vegetation typical of the area. Road*** access to the Site is controlled by locked gates at road entrances.

The following receptors may be exposed to Site ***COC*** and were included as potential receptors in the human health CSM:

- Current and future on-Site trespassers/recreational visitors ***including golfers***;
- Current and future off-Site residents;
- Future on-Site industrial/construction workers; and
- Future on-Site residents

5.2.1.2 Potential Human Health Exposure Pathways

This section is unchanged

5.2.1.2.1 Groundwater Pathway *This section is amended by the report "Supplemental Monitoring Well Installation and Groundwater Monitoring, Pend Oreille Mine TDF-1 and TDF-2", URS 2009, Attachment C and "Groundwater Monitoring Report, Pend Oreille Mine TDF-1 and TDF-2", URS 2010, Attachment D.*

5.2.1.2.2 Surface Water Pathway *is changed to read*

The most beneficial use of surface water at the site is assumed to be for future drinking water. Surface water data collected at the Site indicate that ***COC*** concentrations are below conservative human health risk screening levels in Creek #2. It was assumed that Creek #1 and #2 could become a drinking water source in the future, but that the Site waters in TDF-1 Wetland and seeps would not be used as a drinking water source. Humans were assumed to become exposed to TDF-1 Wetland and Site seep waters through incidental ingestion rather than as a primary drinking water source.

Surface water in Creek #1 and Creek #2 has ***COC*** concentrations below human health-based screening levels (see Table 4-5) and is not considered to pose any risk to humans. Creek #1 does not drain the Site, and should not become impacted in the future. Creek #2 drains the Site and represents surface water migrating from the Site. Creek #2 surface water is acceptable for use as a drinking water source for future on-Site residents because its water quality meets MCLs. The surface water pathway to off-Site human receptors is not complete and will not be assessed for potential risks. Given the amount of time the present conditions at the Site have existed and the water quality of groundwater and diversion ditch water discharging to Creek #2, it is highly unlikely that this surface water pathway would result in different exposures in the future. Creek #2 water, therefore, is not included in the HHRA for the current or future human receptors.

5.2.1.2.3 Air Pathway

This section is unchanged

5.2.1.2.4 Soil and Sediment Pathway

This section is unchanged

5.2.2 Risk Evaluation

This section is unchanged

5.2.2.1 Selection of Site Media and COC *this section is amended by the reports "Supplemental Monitoring Well Installation and Groundwater Monitoring, Pend Oreille Mine TDF-1 and TDF-2", URS Corporation, February 24, 2009, Attachment C, and "Groundwater Monitoring Report, Pend Oreille Mine TDF-1 and TDF-2" URS Corporation, January 28, 2010, Attachment D.*

5.2.2.2 Reasonable Maximum Exposure Assessment

This section is unchanged

5.2.3 Uncertainty Assessment *is changed to read*

In reviewing the results of this risk characterization, it should be emphasized that the potential risks estimated in this analysis are based on a series of conservative assumptions regarding exposure and toxicity. For example, although the true exposure area at the Site is the entire Site area, risks were evaluated for discrete exposure points within the Site area, assuming that exposures only occurred at each of the areas, rather than across the entire Site. ***To address uncertainties in evaluating risk in the risk assessment, a conservative approach was taken.*** Trespassers/future recreational visitors would be expected to use the entire Site rather than spend all their visits and time in one specific area. Since The HHRA also used the maximum concentration of the sediments and waters from different seep and wetland locations and human exposure would be to the maximum concentration for the entire exposure duration is physically impossible and results in a very conservative calculated risk.

Risks to humans from inhalation and dermal contact may be overestimated. Inhalation reference concentrations (RfCs) were not available for the inorganic analytes evaluated in the HHRA. Therefore, dust inhalation non-cancer risks were conservatively estimated using oral RfDs. However, dust inhalation exposures are negligible compared to ingestion exposures. Similarly, dermal exposure to soil was evaluated in the risk characterization using the suggested MTCA (WAC 173-340-740 and745) estimate of

0.2 times the oral RfD for the corresponding inhalation RfD. Both of these approaches are conservative and likely overestimate the true risks at the Site. ***In addition, it is noted that the data set is limited and contains uncertainty however an attempt to account for the limits of the data were made by utilizing the lognormal UCLs to maintain a conservative approach.***

5.3 Ecological Risk Assessment (ERA) *is changed to read*

In accordance with MTCA, terrestrial ecological risk was evaluated to determine whether terrestrial ecologic receptors are exposed to contaminated soil at a level with the potential to cause significant adverse effects. The site does not qualify for an exclusion from a terrestrial ecological evaluation because soil contaminated with hazardous substances is present above the point of compliance (15 feet depth) and soil contaminated with hazardous substances is not covered by physical barriers (although institutional controls will likely be utilized during the remedy). The site does not qualify for the simplified terrestrial ecological evaluation under MTCA because wetlands in the vicinity of the site are used by the Columbia Spotted Frog, a wildlife species classified by the Washington state as a priority species (see Section 3.5.1). Therefore, a site-specific terrestrial ecological evaluation was conducted at the site for the mammalian predator, avian predator, and mammalian herbivore. Table 4-9, Site-Specific Terrestrial Ecological Risk Evaluation, presents estimated wildlife exposure estimates under the site-specific evaluation.

Plant and soil biota risk was compared to values presented in Ecological Indicator Soil Concentrations (mg/kg) for Protection of Terrestrial Plants and Animals, MTCA Table 749-3. Wildlife risk was developed using Wildlife Exposure Model for Site-Specific Evaluations, MTCA Table 749-4 (new table), as described above. Table 4-6, Potentially Applicable Terrestrial Ecological Health Screening Levels for Soils and Sediments, presents proposed ecological soil and sediment screening criteria of the site-specific terrestrial ecological evaluation.

To evaluate whether significant adverse effects are likely, based on the conservative results of site-specific terrestrial ecological evaluation, an Ecological Risk Assessment (ERA) was conducted. The ERA evaluates potentially complete exposure pathways between the ***COC*** and valued ecological receptors at the Site. Information concerning potential receptors and exposure pathways, including chemical sources and chemical constituent release mechanisms, are integrated into an ecological CSM (Figure 5-2). The potential sources presented in the CSM represent the suspected sources of chemical releases at the Site and are identified on the basis of history and previous investigations.

5.3.1 Exposure Evaluation *is changed to read*

An initial screening level assessment for all ***COC*** was undertaken by comparing the concentrations of ***COC*** at the Site in various media to relevant screening criteria. The measured ***COC*** concentrations in soil/sediments (see Tables 3-1, 3-3, 3-11, 3-13, and 3-14) and surface waters (see Table 3-9 and 3-10) were compared to the MTCA wildlife cleanup standards. No comprehensive screening values are available for fresh water sediments. Therefore, sediments were screened using a combination of the Washington State proposed freshwater sediment guidelines (Ecology 2003), ***Washington State background concentrations, MTCA human health-based soil cleanup standards, PECS and TECS. Based on this screening, arsenic, barium, copper and mercury*** were dropped from further consideration in the ERA. ***Note that while these metals are present at the site at concentrations exceeding some screening criteria, these metals are generally not present at concentrations significantly above background or human health-based criteria.***

For the more in-depth analyses of the ***COC*** carried forward in the ERA, generally accepted practices to estimate risks to wildlife were followed. Because most measurements of ***COC*** concentrations in various media (water, soil, sediment, or food items) were limited to a few samples, the 95-percentile of the UCL of the mean based on the appropriate distributions for the data was used. Calculated exposure values were based on default assumptions (i.e., 100% bioavailability, continuous exposure to maximum concentration of media constituents, and uniform use of the Site). Exposure estimates exceeding the Toxicity Reference Values (TRVs) were determined to indicate unacceptable risk or were discussed further in light of uncertainties in the estimates due to the model assumptions or potential measurement errors.

5.3.1.1 Potential Ecological Receptors

This section is unchanged

5.3.1.2 Potential Ecological Exposure Pathways

This section is unchanged

5.3.2 Ecological Risk Evaluation

This section is unchanged

5.3.2.1 Metal Exposure for Small Mammalian Predator

This section is unchanged

5.3.2.2 Metal Exposure for Small Mammalian Herbivore

This section is unchanged

5.3.2.3 Metal Exposure for Ungulates

This section is unchanged

5.3.2.4 Metal Exposure for Carnivorous Raptors

This section is unchanged

5.3.2.5 Metals Exposure Estimates for Ducks *the opening paragraph of this section is changed to read*

This receptor group is represented by the mallard duck. Benthic macroinvertebrate tissue concentrations were estimated from sediment ***COC*** concentrations according to MTCA bioaccumulation factors. ***There is limited toxicity reference value data for amphibians such as the Columbia spotted frog (see Section 5.3). Consequently the mallard is presented as a surrogate species for amphibians because relative amphibian sensitivity to chemicals is thought to be intermediate between birds and mammals.*** The exposure model assumes that the ducks forage solely on benthic invertebrates, a condition that only applies to ducklings. Sediments (incidental ingestion; Table 3-11), water (ingestion, Table 3-10), and estimated benthic invertebrate tissue comprise the exposure pathways for the mallard.

5.3.2.6 Metals Exposure for small Avian Predator

This section is unchanged

5.3.2.7 Ecological Risk Characterization

This section is unchanged

5.3.3 Uncertainty Assessment

This section is unchanged

5.3.4 ERA Summary and Conclusions

This section is unchanged

6.0 CLEANUP ACTION OBJECTIVES AND REMEDIAL TECHNOLOGY SCREENING

This section is unchanged

6.1 Development of Remedial Action Objectives *is changed to read*

Remedial action objectives (RAOs) are Site-specific goals based on acceptable exposure levels that are protective of human health and the environment ***under MTCA (WAC 173-340), the governing regulation for the site,*** and consider applicable or relevant and appropriate requirements (ARARs). RAOs combine consideration of ARARs and the specific constituents, affected media, and potential exposure pathways of a site as determined through a risk assessment. Appendix I identifies Federal and Washington State ARARs for the Site. The risk assessment for the Site is presented in Section 5. RAOs identify risk pathways that remedial actions should address, and identify acceptable exposure levels for residual constituents of concern (COC).

6.1.1 Human and Ecological Risk Pathways

This section is unchanged

6.1.1.1 Potential Human Risks

This section is unchanged

6.1.1.2 Potential Ecological Risks

This section is unchanged

6.1.1.3 TDF-1 Stability Risks

This section is unchanged

6.1.2 Remediation Objectives

This section is unchanged

6.2 Identification and Screening of Technologies *the opening paragraph of this section is changed to read*

This section identifies and screens technologies that may be included as part of remediation alternatives for the Site ***as described under MTCA 173-340-350(8)(b). These are not alternatives; rather these are components of remedial alternatives discussed further in Section 7.0.*** A comprehensive list of technologies and process options that are potentially applicable to this Site is developed to cover the applicable general response actions. The list of technologies is then screened to develop a refined list of potentially feasible technologies that can then be used to develop remediation alternatives for the Site. The remediation technologies are screened using the criteria described below.

6.2.1 General Response Actions *by deletion and addition, this section is changed to read*

General response actions are broad categories of remedial actions that can be combined to meet remedial goals at a site. The following general response actions are generally applicable to most sites, including the Site:

- Institutional controls and monitoring;
- Containment (on-site disposal);
- Stability Improvements;
- Treatment (including reuse and recycling), ex-situ or in-situ;
- Off-site disposal; and
- Removal.

Each of these response actions represents a category of technologies. ***Some overlapping of technologies are expected. For instance, institutional controls and monitoring will be required for contaminated media remaining at the site after the cleanup action.*** The technologies applicable to the Site are discussed below by general response actions.

6.2.2 Institutional Controls and Monitoring

This section is unchanged

6.2.3 Containment (On-Site Disposal)

This section is unchanged

6.2.3.1 Capping

This section is unchanged

6.2.3.2 Surface Water Controls

This section is unchanged

6.2.3.3 Ground Water Controls

This section is unchanged

6.2.4 Earthen Dam Stability Improvements

This section is unchanged

6.2.4.1 Groundwater Level Control

This section is unchanged

6.2.4.2 Dam Buttress *is changed to read*

Dam buttresses or berms are typically coarse material placed along the base (toe) of an earthen dam. The buttress improves the stability of an earthen dam. A buttress was previously installed along the base of TDF-1 ***and additional buttressing might be used to minimize the amount of tailings required to be removed to improve stability of the TDF-1 dam. This technology is retained. (Note, by reference Table 6-1 is changed to retain the Dam Buttress technology)***

6.2.4.3 Slope Improvements *is supplemented by Attachment E, TDF-1 Slope Stabilization Concept Development for Amended RI/FS Report, Pend Oreille Mine TDF-1 and TDF-2, URS Corporation, December 28, 2009*

6.2.4.4 Geo-Fabric Netting

This section is unchanged

6.2.5 Treatment

This section is unchanged

6.2.5.1 Waste and Affected Soil

This section is unchanged

6.2.5.2 Ground Water

This section is unchanged

6.2.6 Off-Site Disposal *is changed to read*

Off-site disposal is a general response action for final disposition of excavated waste and affected soil, or waste generated by treatment processes. ***Complete off-site removal of impacted media would include excavating the entire quantity of tailings material in TDF-1 and TDF-2 and moving the material to permitted facility for long-term management. While complete off-site removal would be effective in meeting the minimum requirements of MTCA, it would likely not be implementable considering the large quantity of materials (over 1 million tons), existing infrastructure (roadways), and distance to the nearest permitted landfill capable of managing this volume of material. Similarly, cost of complete removal would clearly be disproportionate to the benefits over other remedial technologies and actually might increase short-term risk to human health through increased potential for vehicular accidents and construction-related accidents. In addition,*** the RI investigative data indicate limited risk to humans and the environment***; consequently*** there is no need to remove the Site waste to another location for disposal or to create a new disposal facility for containing the wastes. TDF-l dam stability is an issue for minimizing the potential for tailings releases, but can be improved at the Site without removal off-Site. Therefore, ***complete*** off-site ***removal and*** disposal is not retained.

An option considered for the Site is partial excavation, removal and off-Site disposal of materials in areas exhibiting elevated concentrations of constituents. The Site wastes are high volume, but low concentration/risk materials, and "hot spots" that may be effective to remove off-Site have not been observed. Again as mentioned above, there is no benefit in partial excavation and disposal to another facility when in-place containment on-Site could be effective. Therefore, partial excavation and off-Site disposal of areas containing elevated concentrations of constituents is not retained.

6.2.7 Removal

This section is unchanged

7.0 CLEANUP ACTION ALTERNATIVE DEVELOPMENT

This section is unchanged

7.1 Development of Remedial Alternatives *References to Alternative 1, 5, and 6 are deleted and the opening paragraph of this section is changed to read*

Remediation alternatives are developed to meet ***the MTCA requirements*** [WAC 173-340-360(2)(a)] which include:

7.2.1 Alternative 1: No Action *This section has been deleted*

7.2.2 Alternative 2: Institutional Controls, Creek #2 Sediment Capture and Monitoring *the opening paragraph of this section is changed to read*

This alternative would eliminate potential Site risks by preventing future residential land use on the tailings facilities and Creek #2 sediment migration toward the Pend Oreille River ***but would not reduce risks associated with TDF-1 slope stability***.

7.2.3 Alternative 3: TDF-1 Slope Improvement (2.5H:1V) and Accelerate Vegetation on TDF-1 and TDF-2 *Attachment E, TDF-1 Slope Stabilization Concept Development for Amended RI/FS Report, Pend Oreille Mine TDF-1 and TDF-2, URS Corporation, December 28, 2009, presents an alternative slope improvement recommendation including 2H:1V and possible use of additional waste rock buttressing. Also, this section is changed to read*

Alternative 3 would include the same deed restrictions and remedial actions included in Alternative 2. Under this alternative the potential risks from erosion or global stability of TDF-1 would be reduced by reducing TDF-1 dam face to a 2.5H:1V slope and stabilizing the dam face with an armored and vegetated surface. TDF-1 and TDF-2 surfaces would have soil amendments and nutrients added to accelerate vegetation. ***Cover material available from the Ione Stockpile or another suitable cover material source will be used as vegetative soils. The Ione Stockpile includes soils and sediment removed from the Cedar Creek dam which has been sampled and characterized by Teck.*** Long-term maintenance of TDF-1 dam for Alternative 3 is anticipated to be significantly reduced compared to Alternative 2.

Alternative 3 includes the following major components, which are illustrated in Figure 7-2:

1. Implement institutional controls, conduct monitoring, refurbish TDF-1 surface water diversion systems, and construct Creek #2 sedimentation basin as described in Alternative 2;
2. Reduce slope of TDF-1 dam face to 2.5H:1V;
3. Grade the consolidated tailings and excavated area for even slope and good stormwater drainage toward the TDF-1 decant tower and new spillway;
4. Place a 0.5-foot thick cap consisting of a mixture of soil (from Ione stockpile ***or another suitable source***) and armor rock (from mine waste rock pile - appropriately sized) over the re-sloped TDF-1 dam face;
5. Vegetate TDF-1 dam face with tilled soil amendments and nutrients followed by hydroseeding;
6. Re-vegetation TDF-1 tailings surface with tilled amendments and nutrients (upper six inches) and hydroseeding, but excluding TDF-1 wetland and wetland perimeter soils;
7. Accelerate vegetation on TDF-1 with surface applied amendments to the TDF-1 wetland perimeter soils;
8. Re vegetate TDF-2 with tilled amendments and nutrients (upper six-inches) followed by hydroseeding; and
9. Annual groundwater monitoring and periodic inspection and maintenance of the sedimentation basin, TDF-1 dam face slope and TDF-1 and TDF-2 vegetation.

7.2.4 Alternative 4: TDF-1 Slope Improvement (2.5H:1V), TDF-2 Partial Soil Cap and Accelerate Vegetation on TDF-1 and TDF-2 *Attachment E presents an alternative slope improvement recommendation including 2H:1V and possible use of additional waste rock buttressing.*

This section is unchanged other than described above

7.2.5 Alternative 5: TDF-1 Slope Improvement (2.5H:1V), TDF-1 Wetland Removal, TDF-2 Partial Soil Cap, Accelerate and Re-Vegetate TDF-1 and TDF-2 , and TDF-1 Wetland Mitigation *this section is deleted*

7.2.6 Alternative 6: TDF-1 Slope Improvement (2.5H:1V), TDF-1 and TDF-2 Soil Cap, Re-Vegetation of TDF-1, and TDF-2 and TDF-1 Wetland Mitigation *this section is deleted*

8.0 CLEANUP ALTERNATIVE EVALUATION *Alternatives 1, 5 and 6 are deleted from Section 8 by reference*

This section is unchanged

8.1 Threshold Evaluation

This section is unchanged

8.1.1 Protection of Human Health and the Environment *is supplemented by Attachment C, Supplemental Monitoring Well Installation and Groundwater Monitoring Report, and Attachment D, Supplemental Groundwater Monitoring Report and is changed to read*

As a threshold criterion, protection of human health and the environment addresses whether a remediation alternative would result in sufficiently low residual risk to current and potential future receptors after completion of the alternative. Potential unacceptable human health risks exist at the Site for future residential land use and, ***while*** ecological risks ***exist at the site, they*** are ***not*** considered ***significant***.

Investigative data indicates that ground water and surface waters are not impacted from Site wastes to unacceptable levels ***at the site boundaries***. Since the Site wastes have been present for decades without any engineering controls, the potential for ground water or for surface waters to become unacceptably impacted by Site wastes ***at the site boundaries*** are very low. All alternatives are, therefore, considered to be protective of ground water and surface water.

Alternatives 2, 3, and 4 ***mitigate potential human exposure pathways and eliminate the risks that were identified in the HHRA (Section 5.2)*** because the deed restrictions would eliminate future residential land use. Alternative 2 provides a higher risk of TDF-1 stability failure with the release of tailings to the environment than Alternatives 3 and 4. ***Alternative 4 provides the greatest protection to Human Health and Environment by providing a soil cap over phytotoxic portions of TDF-2.***

8.1.2 Compliance with Remediation or Cleanup Levels

This section is unchanged

8.1.3 Compliance with ARARs

This section is unchanged

8.1.4 Provision for Compliance Monitoring

This section is unchanged

8.1.5 Summary of Threshold Evaluation

This section is unchanged

8.2 Reasonable Restoration Time Frame *is changed to read*

A criterion for evaluation of remedial actions under MTCA is the time frame necessary for restoration based on factors identified in WAC 173-340-360(4)(b). The factors to be considered for evaluating restoration time frame ***include potential risks to human health and the environment, practicality of achieving a shorter restoration timeframe, current and future uses of the site and surrounding areas that might be affected by releases from the site, availability of alternative water supplies, likely effectiveness and reliability of institutional controls, ability to control and monitor migration of hazardous substances at the site, toxicity of hazardous substances at the site, and natural processes that might reduce concentrations of hazardous substances at the site.***

For instance, Alternative 2, which does not protect slope stability, is considered to have a longer restoration timeframe than the other alternatives because potential future slope failures would reduce the ability to control migration and increase the risk for releases to surrounding areas. Alternatives 2

and 3, which do not provide a soil cover over the phytotoxic portion of TDF-2, reduces the ability to control migration of hazardous substances in a portion of the site.

8.3 Use of Permanent Solutions *is changed to read*

WAC 173-340-360(3) specifies that the remediation alternatives must use permanent solutions to the maximum extent practicable. ***A permanent solution, such as detoxification or complete removal, is not practicable at the Site considering the large volume, low toxicity, and nature of the COC. Therefore, alternatives are weighed relative to the degree of permanence each provides. The degree of permanence is based on consideration of a number of factors.*** The specified factors, or "permanence criteria," are:

- Overall protectiveness;
- Permanence by reduction in toxicity, mobility, and volume;
- Long-term effectiveness and reliability;
- Short-term risks;
- Implementability;
- Cost; and
- Community acceptance.

These criteria and the basis for evaluating the alternatives against them are defined and discussed below. These definitions are consistent with MTCA regulations, but have been refined to minimize the overlap of considerations in the criteria. This allows decision makers to consider each criterion independently and minimizes double-counting of criteria. In addition, use of independent criteria allows better comparisons between and among the criteria; i.e., determining the value of each criterion in terms of the other criteria.

8.3.1 Overall Protectiveness

This section is unchanged

8.3.2 Permanence by the Reduction of Toxicity, Mobility, and Volume of Hazardous Substances *is changed to read*

This criterion addresses the degree to which a remediation alternative reduces the inherent toxicity, the mobility (ability of constituents to migrate from the Site to the environment), or the quantity of material (volume or mass). Since the COC are metals, the principal factor in this criterion to be evaluated for the remediation alternatives is the reduction in mobility ***(such as leaching and direct contact)*** or toxicity through bioavailability, ***evapotranspiration, and barriers***.

8.3.3 Long-Term Effectiveness and Reliability

This section is unchanged

8.3.4 Short-Term Risks

This section is unchanged

8.3.5 Implementability

This section is unchanged

8.3.6 Cost

This section is unchanged

8.3.7 Community Acceptance *is changed to read*

After the RI/FS Report is finalized, an alternative is selected and included into a ***Draft Cleanup Action Plan (DCAP). The preferred alternative may be selected during the RI/FS however; Ecology may elect to accept the alternative or modify it for inclusion into the DCAP. Ecology also reserves the option to choose a different alternative for the DCAP.*** The proposed remedial action is described along with the basis for its selection in the ***DCAP***. Determination of community acceptance is based on public comments on the draft RI/FS Report. Therefore, community acceptance is not included in the FS comparative evaluation. Instead, Ecology evaluates community acceptance after the RI/FS Report and draft DCAP are released to the public. The proposed remedial action may be modified to address community concerns based on public comments.

8.4 Evaluation Methodology for Permanence *is changed to read*

Selection of a remediation alternative is based on comparative evaluation of the alternatives under the permanence criteria. Overall protectiveness and community concerns are not included in the comparative evaluation for reasons discussed in Sections 8.3.1 and 8.3.7. The following methodology was used for the comparative evaluation:

1. Each alternative is scored relative to the other alternatives for the five non-cost permanence criteria (excluding community acceptance). Because of the nature of the criteria and the uncertainties in the evaluation, the scores for these criteria are expressions of relative qualitative or semi-quantitative professional judgments. ***Three alternatives are carried forward to the scoring.*** A relative scale of ***1*** (worst) to ***3*** (best) is used. Qualitative scoring for the criteria is appropriate and is typically conducted when the information to provide meaningful and defensible quantitative scoring is not available, such as is the case for this Site.
2. The relative values of the non-cost criteria are determined. The relative criteria values are expressions of what a scoring unit of one criterion is worth compared to a scoring unit of another criterion. In other words, relative criteria values express how much a decreased value (lower score) of one criterion is acceptable to improvement (higher score) for another criterion.
3. The scores for the five non-cost criteria are combined to give overall alternative scores. These scores express the ***relative ranking of maximum practicable permance***.
4. A qualitative comparison of the cost and benefit of the alternatives is made.

8.5 Evaluation of Permanence Criteria for Remediation Alternatives *is changed to read*

This section provides a comparative evaluation for permanence under MTCA of the alternatives using the criteria (non-cost and the cost criteria) (see Section 8.3 and 8.4). The retained alternatives 2, 3, ***and*** 4 are included in the evaluation, since they meet the threshold criteria (evaluated in Section 8.1). The basis for the scoring is provided below. The evaluation and scoring of the alternatives is summarized in ***revised*** Table 8-1.

8.5.1 Overall Protectiveness *is changed to read*

This criterion of overall protectiveness is a threshold requirement that each remedial alternative must meet to be evaluated in this FS. Although Alternatives 2 through 4 meet the threshold requirement, they are evaluated in this FS by the relative degree in which each alternative is protective. Alternative 2 relies on deed restrictions only for protection of human health risks and is considered to provide the minimum overall protectiveness. Alternative ***4*** provides ***a soil cover over a portion of TDF-2 that*** slightly more protective ***than Alternative 3***.

The overall protectiveness scores for each of the alternatives that meet threshold requirements are as follows:

- Alternative 2 = ***1***
- Alternative 3 = ***2***
- Alternative 4 = ***3***

8.5.2 Long-Term Effectiveness *is changed to read*

The criterion of long-term effectiveness is scored based on professional judgment and experience in the ability of the remedies to achieve and maintain their estimated effectiveness. Alternatives 2, 3, ***and*** 4 create a deed restriction that would prohibit residential land use on site wastes areas. Deed restrictions are a common method for eliminating receptor exposures, remain with the deed in perpetuity and are enforced through local building permits. Alternative 2 also includes Creek #2 sedimentation basin for sediment capture and refurbishing of the existing surface water diversion system to improve reliability during potential storms. Alternative 2 does not improve stability from the TDF-1 dam face erosion or global dam stability for the facility. Because the factor of safety for the existing conditions are lower than typically considered acceptable, there is a higher probability that long-term erosion of the TDF-1 dam face and for a global mass failure to occur than the other alternatives. Erosion of the TDF-l dam face can be controlled in the long-term through regular monitoring and maintenance of local blow-outs, but may not be adequate for global failures. For these reasons, Alternative 2 is therefore given the lowest long-term effectiveness score.

Alternatives 3 ***and 4*** would have all the components of Alternative 2, but would be more effective and reliable because each alternative improves the stability of TDF-1 with dam face slope reduction and surface stabilization with a mixture of armor rock and soil that can be regularly monitored and repaired. Alternatives 3 ***and 4*** improve the TDF-1 dam to a ***reduced*** slope capped with a mixture of soils and wastes rock, and therefore do not differ in the long-term effectiveness criterion for minimizing the potential for tailings release to the environment. Erosion of the dam face can be controlled for the different slopes by using appropriately sized armor rock, ***buttressing*** and vegetation for stability. Therefore dam erosion should not be materially different for Alternatives 3 ***and 4***.

The major difference among Alternatives 3 and 4 are in the extent of re-vegetation and capping that are implemented for TDF-2. The long-term effectiveness of each of these alternatives will be similar once the vegetation is established; although the amount of long-term maintenance to establish vegetation may be lower for Alternative 4 ***than for 3***.

The long-term effectiveness criterion scores for each of the alternatives that meet threshold requirements are as follows:

- Alternative 2 = ***1***
- Alternative 3 = ***2***
- Alternative 4 = ***3***

8.5.3 Permanence by Reduction in Toxicity, Mobility, and Volume of Hazardous Substances *is changed to read*

None of the alternatives provide any reduction in volume of waste materials because the COC are metallic elements, which cannot be destroyed to reduce their volume. Since the metals in the waste tailings at the Site are not ***significantly*** dissolving and impacting Site groundwater or Site surface water, reducing the potential for dissolution by reducing contact with water or chemical fixation is not of primary importance. The only manner in which the metal toxicity could be reduced is by making the metals less bio-available from direct exposures and through food chains. Although animal tracking, airborne dispersion and ecological food chain dispersion of TDF-I and TDF-2 tailings have not been found to be significant at the Site, a clean soil cap can reduce the mobility of metals into the environment from these mechanisms. Alternatives 3 ***and*** 4 include nutrient amendments of phosphate that are expected to bind lead and possibly other metals in the tailings rendering them less bio-available. The major difference in the alternatives regarding the permanence criterion is in the amount of clean soil cap provided over tailings materials.

Alternative 2 does not provide any reduction in Site metal availability (toxicity) and is given the lowest score. Alternatives 3 and 4 add phosphate to the tailings surface to promote plant growth and lower metal (mainly lead) availability and toxicity, but ***Alternative 3*** does not cap any of the tailings surfaces (except TDF-l dam face). Alternative 4 also installs a clean soil cap over a portion of TDF-2. Therefore, Alternatives 4 is given ***the*** higher score. The permanence (by reduction in toxicity. mobility and volume) criterion scores for each of the alternatives that meet threshold requirements are as follows:

- Alternative 2 = ***1***
- Alternative 3 = ***2***
- Alternative 4 = ***3***

8.5.4 Short-Term Risks *is changed to read*

The risk assessment indicates that industrial/construction worker exposures to Site COC by direct contact, incidental ingestion and inhalation are at acceptable levels, therefore, this short-term risk is not considered a major differentiator for this criterion. This criterion best represents the potential for accidents to occur. The potential for accidents to occur is assumed to be dependent on the amount of effort and type of equipment required for implementation of each alternative. Alternatives 2 through ***4*** involve typical construction methods and equipment, which in general lower the potential for accidents. On this basis, Alternative 2 involves relatively little Site work, and is therefore given the highest score. For the TDF· l dam slope reduction and vegetation acceleration, Alternatives 3 ***and 4*** are given lower scores. The only differentiation among these alternatives is the amount of construction from transport and placement of the clean soil cap required to complete Alternative ***4***.

The short-term risk criterion scores for each of the alternatives that meet threshold requirements are as follows:

- Alternative 2 = ***3***
- Alternative 3 = ***2***
- Alternative 4 = ***1***

8.5.5 Technical and Administrative Implementability *is changed to read*

Technical implementability includes factors such as whether the alternative is technically possible and the availability of off-Site facilities, services and materials to complete the remedy. Alternatives 2 through ***4*** are all technically implementable, because they use standard construction equipment and workers are locally available. Therefore technical implementability is not a discriminator among the alternatives. Since Alternatives 2 through ***4*** use similar construction methods and equipment, the availability of resources are not a differentiator for this criterion.

Administrative implementability issues for remedial actions include required permits and approvals from regulatory agencies. Potential approvals or permits that may be necessary include, but are not necessarily limited to: (1) wetlands; (2) forest and wildlife disturbance; and (3) TDF-1 dam stability. Approvals or permits for these issues are used for evaluation of administrative implementability criteria. Alternative 2 would have the least amount of disturbance to natural resources and would be the easiest to obtain regulatory approvals and permits for wildlife and wetlands issues. Alternative 2 may not be acceptable to the State of Washington, because of the current TDF-1 factor of safety is below 1.5. Therefore, Alternative 2 is given the lowest score for this criterion. Alternatives 3 ***and 4*** improve TDF-1 dam stability with an estimated factor of safety greater than 1.5. The administrative implementability for TDF-l stability is therefore the same for Alternatives 3 ***and 4***.

Alternatives 3 and 4 require work near the TDF-1 wetland and produce similar levels of noise, although for progressively longer durations. Approvals or permits for work adjacent to the TDF-1 wetland will be necessary to ensure adequate buffers are maintained for wetland protection. Alternative 3 does not require a borrow source for cap soils from adjacent woodland areas, as is assumed for Alternative 4. Therefore, Alternative 3 is given the highest overall score for administrative implementability, while Alternative 4 is given a slightly lower score.

The technical and administrative criterion scores for each of the alternatives that meet threshold requirements are as follows:

- Alternative 2 = ***1***
- Alternative 3 = ***3***
- Alternative 4 = ***2***

8.5.6 Net Benefit (Overall Non-Cost Evaluation) *is changed to read*

The ***permanence and*** net benefit of the alternatives is determined by combining the criteria scores. The net benefit or overall non-cost scores are given in Table 8- 1. Using these scores, the alternatives rank in the following order (most beneficial to least beneficial):

1. Alternative 4: TDF-1 Slope Improvement, TDF-2 Partial Soil Cap and Accelerate Vegetation on TDF-1 and TDF-2;
2. Alternative 3: TDF-1 Slope Improvement and Accelerate Vegetation on TDF-1 and TDF-2;
3. Alternative 2: Institutional Controls, Creek #2 Sediment Capture

8.5.7 Cost

This section is unchanged

8.5.8 Disproportionate Cost Analysis and Overall Evaluation *is changed to read*

Under WAC 173-340-360(3)(e), a cleanup action ***is disproportionate*** "if the incremental cost of the alternative over that of a lower cost alternative exceeds the incremental degree of benefits achieved by the alternative over that of the other lower cost alternative". The disproportionate cost analysis is only used for the alternatives that meet the minimum threshold criteria (Section 8.1) and provide an appropriate level of protection for the identified risks at the Site.

Alternative 4 provides the greatest degree of permanence of the alternatives evaluated, primarily because of the addition of the soil cap over phytotoxic portions of TDF-2. Therefore, Alternative 4 is the baseline alternative. The disproportionate benefit/cost analysis ***is*** performed ***qualitatively using best professional judgment, comparing Alternative 4 to the other two alternatives.***

Alternative 2, while meeting the minimum requirements of MTCA, is much less permanent than Alternative 4. The incremental benefit to human health and the environment for the additional cost between Alternatives 2 and 4 is large, primarily because of reduced TDF-1 dam slope in Alternative 4. Consequently, Alternative 4 is the preferred alternative between Alternatives 2 and 4 from a benefit/cost perspective.

However, the incremental benefit to human health and environment for the additional cost between Alternatives 3 and 4 are small. For the five evaluation criteria mentioned above, Alternative 4 is the preferred alternative over Alternative 3 in just three of the evaluation criteria. Alternative 4 provides for a covering barrier over phytotoxic portions of TDF-2, which will help protect plants and wildlife in a relatively small area. This benefit will lessen over time as vegetation is established over the phyotoxic area using soil amendments and fertilizers. Based on professional judgment, the estimated incremental cost of approximately $225,000 (Capital and Inspection and Maintenance Costs) of Alternative 4 over Alternative 3 exceeds the degree of benefit provided by the soil cover.

9.0 REFERENCES *this section is amended to include the following additional references*

Golder Associates Inc., "Draft Remedial Investigation/Feasibility Study Report for the Pend Oreille Mine Tailing Disposal Facilities TDF-1 and TDF-2." 10 and 17 October 2006.

Golder Associates Inc., "Appendix A: Sampling and Analysis Plan for the Pend Oreille Mine Tailing Disposal Facilities TDF-1 and TDF-2 Remedial Investigation/Feasibility Study." 24 May 2005.

Golder Associates Inc., "Appendix B: Quality Assurance Project Plan for Remedial Investigation/Feasibility Study at the Pend Oreille Mine Tailings Disposal Facilities TDF-1 and TDF-2." 24 May 2005.

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Archives of Environmental Contamination and Toxicology 39: 20-31.

URS Corporation. Memorandum, "Pend Oreille Mine TDF-1 and TDF-2 Hydrogeology Data Review" prepared for Teck Cominco American Incorporated, 8 May 2008.

URS Corporation. Report, "Groundwater Monitoring, Pend Oreille Mine TDF-1 and TDF-2" 28 January 2010.

URS Corporation. Report, "Supplemental Monitoring Well Installation and Groundwater Monitoring, Pend Oreille Mine TDF-1 and TDF-2." 24 February 2009.

URS Corporation. Report, "TDF-1 Slope Stabilization Concept Development for Amended RI/FS, Pend Oreille Mine TDF-1 and TDF-2." 28 December 2009

REVISED TABLES

Table 3-1 Revised
TDF-1 and TDF-2 Tailings Total Metal Content

Sample Description	Sample ID	Collection Date	As (mg/kg)		Ba (mg/kg)		Cd (mg/kg)		Cu (mg/kg)		Pb (mg/kg)		Se (mg/kg)		Zn (mg/kg)		Hg (mg/kg)		% Moisture	% Solids
TDF-1			Wet Weight	Dry Weight	Wet Weight	Dry Weight	Wet Weight	Dry Weight	Wet Weight	Dry Weight	Wet Weight	Dry Weight	Wet Weight	Dry Weight	Wet Weight	Dry Weight	Wet Weight	Dry Weight		
TDF-1, Test Pit-1 Composite	PO-TDF1-T1C	7/30/2005	**12.8**	**13.9**	**8.35**	**9.1**	**6.54**	**7.1**	**19.3**	**21.0**	**506**	**551**	<4.0 (<1.0 MDL)	<4.0 (<1.0 MDL)	**988**	**1075**	**0.098**	**0.107**	8.1	91.9
TDF-1, Test Pit-2 Composite	PO-TDF1-T2C	7/30/2005	**19.0**	**21.7**	**6.77**	**7.7**	**17.4**	**19.9**	**13.1**	**15.0**	**406**	**464**	<4.0 (<1.0 MDL)	<4.0 (<1.0 MDL)	**2860**	**3269**	**0.302**	**0.345**	12.5	87.5
TDF-1, Test Pit-3 Composite	PO-TDF1-T3C	7/30/2005	**16.6**	**20.2**	**7.42**	**9.0**	**13.3**	**16.2**	**23.9**	**29.0**	**409**	**497**	<4.0 (<1.0 MDL)	<4.0 (<1.0 MDL)	**2190**	**2661**	**0.165**	**0.200**	17.7	82.3
TDF-1, Test Pit-4 Composite	PO-TDF1-T4C	7/30/2005	**13.8**	**16.8**	**7.21**	**8.8**	**14.2**	**17.3**	**34.1**	**41.4**	**360**	**437**	<4.0 (<1.0 MDL)	<4.0 (<1.0 MDL)	**2620**	**3183**	**0.122**	**0.148**	17.7	82.3
TDF-1, Test Pit-5 Composite	PO-TDF1-T5C	7/30/2005	**10.7**	**11.5**	**8.83**	**9.5**	**7.22**	**7.8**	**25.7**	**27.6**	**414**	**445**	<4.0 (<1.0 MDL)	<4.0 (<1.0 MDL)	**1410**	**1516**	**0.125**	**0.134**	7.0	93.0
TDF-1, Test Pit-6 Composite	PO-TDF1-T6C	7/30/2005	**10.9**	**12.1**	**8.76**	**9.7**	**5.03**	**5.6**	**21.9**	**24.3**	**291**	**323**	<4.0 (<1.0 MDL)	<4.0 (<1.0 MDL)	**870**	**966**	**0.113**	**0.125**	9.9	90.1
TDF-1, Test Pit-7 Composite	PO-TDF1-T7C	7/30/2005	**14.3**	**16.2**	**10.6**	**12.0**	**8.14**	**9.2**	**50.8**	**57.7**	**421**	**478**	<4.0 (<1.0 MDL)	<4.0 (<1.0 MDL)	**961**	**1091**	**0.0817**	**0.093**	11.9	88.1
TDF-1, Test Pit-8 Composite	PO-TDF1-T8C	8/12/2005	**10.2**	**14.7**	**26.4**	**38.0**	**11.8**	**17.0**	**87.8**	**126.5**	**935**	**1347**	<4.0 (<1.0 MDL)	<4.0 (<1.0 MDL)	**2560**	**3689**	**0.253**	**0.365**	30.6	69.4
TDF-1, Test Pit-18 Composite (dup)	PO-TDF1-T18C	8/12/2005	**9.3**	**13.3**	**49.7**	**71.3**	**11.2**	**16.1**	**69.2**	**99.3**	**474**	**680**	<4.0 (<1.0 MDL)	<4.0 (<1.0 MDL)	**2270**	**3257**	**0.233**	**0.334**	30.3	69.7
TDF-1, Test Pit-9 Composite	PO-TDF1-T9C	7/30/2005	**7.8**	**8.6**	**9.33**	**10.3**	**10.2**	**11.3**	**20.9**	**23.1**	**352**	**390**	<4.0 (<1.0 MDL)	<4.0 (<1.0 MDL)	**1260**	**1395**	**0.227**	**0.251**	9.7	90.3
TDF-1, Test Pit-10 Composite	PO-TDF1-T10C	7/30/2005	**4.7**	**5.3**	**10.5**	**11.8**	**4.03**	**4.5**	**19.6**	**22.1**	**186**	**210**	<4.0 (<1.0 MDL)	<4.0 (<1.0 MDL)	**730**	**823**	**0.107**	**0.121**	11.3	88.7
TDF-1, Test Pit-11 Composite	PO-TDF1-T11C	7/30/2005	**13.9**	**15.7**	**8.95**	**10.1**	**7.77**	**8.8**	**27.1**	**30.7**	**505**	**572**	<4.0 (<1.0 MDL)	<4.0 (<1.0 MDL)	**968**	**1096**	**0.102**	**0.116**	11.7	88.3
TDF-1, Test Pit-12 Composite	PO-TDF1-T12C	7/30/2005	**9.8**	**11.1**	**10.8**	**12.2**	**4.86**	**5.5**	**33.2**	**37.6**	**314**	**356**	<4.0 (<1.0 MDL)	<4.0 (<1.0 MDL)	**808**	**915**	**0.113**	**0.128**	11.7	88.3
TDF-2																				
TDF-2, Test Pit-13 Composite	PO-TDF2-T13C	7/29/2005	**12.4**	**14.7**	**33.2**	**39.4**	**25.4**	**30.2**	**52.6**	**62.5**	**563**	**669**	<4.0 (<1.0 MDL)	<4.0 (<1.0 MDL)	**4870**	**5784**	**0.578**	**0.686**	15.8	84.2
TDF-2, Test Pit-14 Composite	PO-TDF2-T14C	7/29/2005	**14.9**	**16.4**	**19.4**	**21.3**	**14.2**	**15.6**	**27.1**	**29.8**	**411**	**452**	<4.0 (<1.0 MDL)	<4.0 (<1.0 MDL)	**2440**	**2681**	**0.233**	**0.256**	9.0	91.0
TDF-2, Test Pit-15 Composite	PO-TDF2-T15C	7/29/2005	**10.3**	**11.6**	**239.0**	**269.8**	**9.22**	**10.4**	**44.0**	**49.7**	**375**	**423**	<4.0 (<1.0 MDL)	<4.0 (<1.0 MDL)	**1810**	**2043**	**0.185**	**0.209**	11.4	88.6
TDF-2, Test Pit-16 Composite	PO-TDF2-T16C	7/29/2005	**14.3**	**15.9**	**168.0**	**186.5**	**11.1**	**12.3**	**41.5**	**46.1**	**445**	**494**	<4.0 (<1.0 MDL)	<4.0 (<1.0 MDL)	**1380**	**1532**	**0.142**	**0.158**	9.9	90.1
TDF-2, Test Pit-17 Composite	PO-TDF2-T17C	7/29/2005	**15.7**	**17.1**	**13.6**	**14.8**	**12.1**	**13.2**	**30.4**	**33.2**	**471**	**514**	<4.0 (<1.0 MDL)	<4.0 (<1.0 MDL)	**1740**	**1897**	**0.145**	**0.158**	8.3	91.7
	MTCA Human (Unrestricted)[1]		**20**		**16,000**		**2**		**2,960**		**250**		**400**		**24,000**		**2**			
	MTCA Human (Industrial)[2]		**20**		**700,000**		**2**		**129,500**		**1,000**		**17,500**		**unlimited**		**2**			
	MTCA Ecological (Terrestrial)[3]				**102**				**50**				**1.0**		**86**					

Notes:

[1] MTCA Method A Unrestricted if available, otherwise MTCA Method B direct contac

[2] MTCA Method A Industrial if available, otherwise MTCA Method C direct contac

[3] Lowest value from MTCA Table 749-3 and shown if MTCA Method A value is not available.

Highlighting indicates concentration over any screening level

BOLD numbers indicate analytical detections above laboratory PQL

Initial concentrations were originally reported on a wet weight basis. Comparison to screening levels is on a dry weight basis.

Table 3-11 Revised

Analytical Results of Sediment Samples for the TDF-1 and TDF-2 RI/FS

Sample Description	**Sample ID**	**Collection Date**	**As (mg/kg)**		**Ba (mg/kg)**		**Cd (mg/kg)**		**Cu (mg/kg)**		**Pb (mg/kg)**		**Se (mg/kg)**		**Zn (mg/kg)**		**Hg (mg/kg)**		**% Moisture**	**% Sol**
			Wet Weight	Dry Weight	Wet Weight	Dry Weight	Wet Weight	Dry Weight	Wet Weight	Dry Weight	Wet Weight	Dry Weight	Wet Weight	Dry Weight	Wet Weight	Dry Weight	Wet Weight	Dry Weight		
Creek #1, Sediment Sample, Upstream, near headwaters of creek drainage.	C1-1S	8/25/2005	**4.9**	**6.7**	**92.1**	**126.2**	**1.01**	**1.38**	**19.0**	**26.0**	**51.5**	**70.5**	<4.0	<4.0	**173**	**237**	< 0.0330	< 0.0330	27.0	73.0
	C1-1S	5/10/2006	<2.5	<2.5	**16.3**	**155.2**	**0.28**	**2.67**	**4.0**	**38.1**	**8.31**	**79.14**	<4.0	<4.0	**39.7**	**378**	< 0.0330	< 0.0330	89.5	10.5
Creek #1, Sediment Sample, Downstream, near outfall area.	C1-2S	8/12/2005	<2.5	<2.5	**28**	**57**	**2.13**	**4.30**	**8.3**	**16.8**	**45.9**	**92.7**	<4.0	<4.0	**155**	**313**	< 0.0330	< 0.0330	50.5	49.5
	C1-2S	5/8/2006	**3.8**	**7.6**	**35.3**	**70.2**	**2.05**	**4.08**	**15.9**	**31.6**	**119**	**237**	<4.0	<4.0	**282**	**561**	**0.06**	**0.13**	49.7	50.3
Creek #2, Sediment Sample, Upstream, near diversion pipe discharge area.	C2-1S	8/11/2005	**7.6**	**15.9**	**54.8**	**114.6**	**3.62**	**7.57**	**18.5**	**38.7**	**232**	**485**	<4.0	<4.0	**892**	**1866**	**0.06**	**0.13**	52.2	47.8
	C2-1S	5/8/2006	**22.5**	**32.2**	**113**	**162**	**5.06**	**7.25**	**27.2**	**39.0**	**301**	**431**	**6**	**8.6**	**1580**	**2264**	**0.12**	**0.17**	30.2	69.8
Creek #2, Sediment Sample, Downstream, near outfall area.	C2-2S	8/10/2005	**8.6**	**14.5**	**52.9**	**89.2**	**4.36**	**7.35**	**14.1**	**23.8**	**247**	**417**	<4.0	<4.0	**1050**	**1771**	**0.08**	**0.13**	40.7	59.3
	C2-2S	5/8/2006	**9.6**	**13.0**	**31.6**	**42.7**	**4.68**	**6.32**	**18.7**	**25.3**	**339**	**458**	**6**	**8.1**	**878**	**1186**	**0.13**	**0.18**	26.0	74.0
TDF-1 Wetland Sediment #1	W1-1S	8/12/2005	**3.6**	**8.6**	**44.7**	**106.7**	**5.20**	**12.41**	**36.8**	**87.8**	**212**	**506**	<4.0	<4.0	**1270**	**3031**	**0.17**	**0.40**	58.1	41.9
	W1-1S	5/10/2006	**4.0**	**8.8**	**47.3**	**104.4**	**5.75**	**12.69**	**39.2**	**86.5**	**239**	**528**	**5**	**11.0**	**1290**	**2848**	<5.5	<5.5	54.7	45.3
TDF-1 Wetland Sediment #2	W1-2S	8/12/2005	**6.0**	**9.6**	**44.8**	**71.6**	**7.44**	**11.88**	**48.7**	**77.8**	**328**	**524**	<4.0	<4.0	**1730**	**2764**	**0.15**	**0.24**	37.4	62.6
	W1-2S	5/10/2006	**8.9**	**11.4**	**60.0**	**77.0**	**10.70**	**13.74**	**85.1**	**109.2**	**564**	**724**	**5**	**6.4**	**2900**	**3723**	<5.5	<5.5	22.1	77.9
Unnamed Ditch Sediment	UD-1S	8/12/2005	<2.5	<2.5	**29.10**	**112.79**	**1.58**	**6.12**	**22.4**	**86.8**	**64.9**	**252**	<4.0	<4.0	**197**	**764**	**0.06**	**0.21**	74.2	25.8
	UD-1S	5/8/2006	<2.5	<2.5	**27**	**136**	**1.92**	**9.50**	**15.3**	**75.7**	**59**	**292**	<4.0	<4.0	**190**	**941**	**0.07**	**0.33**	79.8	20.2
Seep #4 Sediment	S4-S	5/10/2006	**4.0**	**8.8**	**30.8**	**67.8**	**1.91**	**4.21**	**16.6**	**36.6**	**193**	**425**	<4.0	<4.0	**738**	**1626**	**0.09**	**0.19**	54.6	45.4
Seep #5 Sediment	S5-1S	8/11/2005	<2.5	<2.5	**129**	**717**	**2.58**	**14.33**	**4.1**	**22.8**	**32.5**	**180.6**	<4.0	<4.0	**254**	**1411**	< 0.0330	< 0.0330	82.0	18.0
	S5-1S	5/8/2006	<2.5	<2.5	**268**	**1729**	**5.04**	**32.52**	**5.9**	**38.1**	**34.5**	**222.6**	<4.0	<4.0	**367**	**2368**	**0.04**	**0.25**	84.5	15.5
Seep #7 Sediment	S7-S	5/10/2006	**2.8**	**17.2**	**45.8**	**281.0**	**1.56**	**9.57**	**9.4**	**57.7**	**97.1**	**595.7**	**5**	**30.7**	**904**	**5546**	**0.06**	**0.34**	83.7	16.3
Seep #8 Sediment	S8-S	5/10/2006	**2.5**	**15.6**	**33.7**	**210.6**	**0.79**	**4.94**	**3.1**	**19.4**	**7.35**	**45.94**	<4.0	<4.0	**1930**	**12063**	< 0.0330	< 0.0330	84.0	16.0
MTCA Human (Direct Contact, Unrestricted)[1]			**20[3]**		**16,000**		**80.0**		**2,960**		**250[3]**		**400**		**24,000**		**24**			
MTCA Human (Direct Contact, Industrial)[2]			**20[4]**		**700,000**		**3,500**		**129,500**		**1,000[4]**		**17,500**		**unlimited**		**1,050**			
MTCA Ecological (Terrestrial)			**10**		**102**		**4.0**		**50**		**50**		**0.3**		**86**		**0.4**			
Proposed Washington State Fresh Water Sediment Criteria			**20**		**NA**		**0.6**		**80**		**335**		**NA**		**140**		**0.5**			
Consenus Based Freshwater Sediment PEC's			**33**		**NA**		**4.98**		**149**		**128**		**NA**		**459**		**1.06**			
Consenus Based Freshwater Sediment TEC's			**9.79**		**NA**		**0.99**		**31.6**		**35.8**		**NA**		**121**		**0.18**			

Highlighting indicates concentration over one or more screening level

BOLD numbers indicate analytical detections above laboratory PQL

NA = Sediment criteria doesn't exist for given parameter

[1] Method B unless otherwise noted

[2] Method C unless otherwise noted

[3] Method A Unrestricted

[4] Method A Industrial

Table 4-3 Revised

Wildlife Species of Concern Found Near the Pend Oreille Mine[1]

Common Name	Scientific Name	Federal Status[2]	State Status[3]
Amphibian			
Columbia spotted frog	*Rana luteiventris*		SC
Northern leopard frog	*Rana pipiens*	FCo	SE
Bird			
Bald eagle	*Haliaeetus leucocephalus*	FCo	SS
Harlequin duck	*Histrionicus histrionicus*	FCo	
Northern Goshawk	*Accipiter gentilis*	FCo	SC
Olive-sided flycatcher	*Contopus borealis*	FCo	
Peregrine falcon	*Falco peregrinus anatum*	FCo	SS
Fish			
Pygmy whitefish	*Prosopium coulteri*	FCo	SS
Bull trout	*Salvelinus confluentus*	FT	SC
Interior redband rainbow trout	*Oncorhynchus mykiss gairdneri*	FCo	
Mammal			
California wolverine	*Gulo gulo luteus*	FCo	SC
Fringed myotis	*Myotis thysanodes*	FCo	
Gray wolf	*Canis lupus*	FE in W 2/3 of WA	SE
Grizzly Bear	*Ursus arctos*	FT	SE
Long-eared myotis	*Myotis evotis*	FCo	
Long-legged myotis	*Myotis volans*	FCo	
North American Lynx	*Lynx canadensis*	FT	ST
Pacific fisher	*Martes pennanti pacifica*	FC	SE
Pale Townsend's big-ear bat	*Corynorhinus townsendii pallescens*	FCo	SC
Woodland caribou	*Rangifer tarandus caribou*	FE	SE
Yuma myotis	*Myotis yumanensis*	FCo	

1 Source: U.S. Fish and Wildlife Service (2009), and Washington Department of Fish and Wildlife (2009).

2 FE = Federal endangered; FT = Federal threatened; FCo = Federal species of concern; FC = Federal candidate; and FP = Federal proposed for listing under the Endangered Species Act

3 SE = State endangered; ST, State threatened; SC = State candidate; and SS = State sensitive.

Table 4-4 Revised

Potentially Applicable Human Health Screening Levels for Soils
Pend Oreille Mine TDF-1 and TDF-2 RI/FS, Washington

Metal Analyte	**Units**	**MTCA Method A Unrestricted Soil Levels**	**MTCA Method B Unrestricted Soil Levels**[b]	**MTCA Method A Industrial Soil Levels**	**MTCA Method C Industrial Soil Levels**[b]	**Typical Pratical Quantification Limits**	**Washington State Background Levels**	**Proposed Unrestricted Land Use Screening Levels**	**Proposed Industrial Land Use Screening Levels**
Arsenic	mg/kg	20	0.67	20	87	2.5	***7***	20	87
Barium	mg/kg	none	16,000	none	700,000	5	***255***	16,000	700,000
Cadmium	mg/kg	2[a]	80	2[a]	3,500	1	1	80[c]	3,500
Copper	mg/kg	none	3,000	none	130,000	5	36	3,000	130,000
Lead	mg/kg	250	none	1,000	none	5	17	250	1,000
Mercury	mg/kg	2[a]	24	2[a]	1,550	0.03	0.07	24	1,550
Selenium	mg/kg	none	400	none	18,000	4	***0.78***	400	18,000
Zinc	mg/kg	none	24,000	none	unlimited	10	86	24,000	unlimited

a = MTCA Method A Cleanup Level for the protection of groundwater, not human soil ingestion or soil direct contact

b = MTCA Method B Cleanup Level for direct human contact and ingestion

Table 4-6 Revised
Potentially Applicable Terrestrial Ecological Health Screening Levels for Soils and Sediments
Pend Oreille Mine TDF-1 and TDF-2 RI/FS

Metal Analyte	Units	MTCA Ecological Soil Indicator Concentration (Plants)	MTCA Ecological Soil Indicator Concentration (Soil Biota)	MTCA Ecological Soil Indicator Concentration (Wildlife)	Proposed Washington State Freshwater Sediment Criteria	EPA Region X Ecological Soil Criteria (National Eco-SSls) [Interim Final: As, Ba, Cd, and Pb March 2005; Cu, Se, Zn, March 2003]				Consensus Based Freshwater Sediment PECs	Consensus Based Freshwater Sediment TECs
						Plants	Invertebrates	Avian	Mammalian		
Arsenic	mg/kg	10	60	132	20	18	NA	43	46	33	9.79
Barium	mg/kg	500	none	102	none	none	330	none	2,000	none	none
Cadmium	mg/kg	4	20	14	0.6	32	140	0.77	0.36	4.98	0.99
Copper	mg/kg	100	50	217	80	95	54	Pending	Pending	149	31.6
Lead	mg/kg	50	500	118	335	210	1,700	11	56	128	35.8
Mercury	mg/kg	0.3	0.1	5.5	0.5	NA	NA	NA	NA	1.06	0.18
Selenium	mg/kg	1	70	0.3	none	1	NA	Pending	Pending	none	none
Zinc	mg/kg	86	200	360	140	130	120	Pending	Pending	459	121

Metal Analyte	Units	Washington State Soil Background Levels	Practical Quantification Limits	Proposed Ecological Soil Screening Criteria			
				Plants	Invertebrates	Avian	Mammalian
Arsenic	mg/kg	7	2.5	20[a]	60	20[a]	132
Barium	mg/kg	255	5	500	255	255	255
Cadmium	mg/kg	1	1	4	20	39[b]	14[b]
Copper	mg/kg	36	5	100	50	217	217
Lead	mg/kg	17	5	50	500	118[b]	125[b]
Mercury	mg/kg	0.07	0.03	0.3	0.1	5.5	5.5
Selenium	mg/kg	0.78	4	1	70	0.87[b]	0.31[b]
Zinc	mg/kg	86	10	86	200	359[b]	973.8[b]

There is a difference between MTCA concentrations and EPA values in terms of intended uses. MTCA values are presented as potential cleanup targets; EPA values are presented as screening-level values that are explicitly identified as not being cleanup targets.

Notes: [a] MTCA Method A Unrestricted Soil Cleanup Level

[b] Site Specific Terrestrial Ecological Risk Evaluation (see Table 4-9). Note that the lowest mammalian value shown.

NEW TABLES

Supplemental Table 4-8

Summary of Screening Level Exceedances
Pend Oreille Mine TDF-1 and TDF-2 RI/FS, Washington

COC	**Tailings and Soils**	
	MTCA Method A Unrestricted Soil Cleanup Levels	MTCA Method B Direct Contact Soil Cleanup Levels
Arsenic	No (two samples exceed [about 10%] and both are less than twice the cleanup level)	N/A
Barium	N/A	No
Cadmium	Yes	No
Copper	N/A	No
Lead	Yes	N/A
Selenium	N/A	No
Zinc	N/A	No
Mercury	None	No
Other	N/A	N/A

COC	**Sediment**	
	Proposed Washington State Fresh Water Sediment Criteria, PECs, TECs[1]	MTCA Method B Direct Contact Soil Cleanup Levels
Arsenic	Yes	No, screened out by MTCA Method A (one sample exceeds but less than twice MTCA A soil cleanup level)
Barium	N/A	No
Cadmium	Yes	No
Copper	Yes	No
Lead	Yes	N/A
Selenium	N/A	No
Zinc	Yes	No
Mercury	Yes	No
Other	N/A	N/A

[1] See below

COC	**Sediment**		
	MTCA Proposed Freshwater Sediment Criteria	PECs	TECs
Arsenic	Yes (one sample from Creek #2 near pipe discharge)	No	Yes
Barium	N/A	N/A	N/A
Cadmium	Yes	Yes	Yes
Copper	Yes, TDF-1, TDF-2, Unnamed Ditch Sediment only	No	Yes
Lead	Yes	Yes	Yes
Selenium	N/A	N/A	N/A
Zinc	Yes	Yes	Yes
Mercury	No	No	Yes
Other	N/A	N/A	N/A

Supplemental Table 4-8

Summary of Screening Level Exceedances
Pend Oreille Mine TDF-1 and TDF-2 RI/FS, Washington

COC	**Seep Water (as groundwater, dissolved results)**	
	MTCA Method A Groundwater Cleanup Levels	MTCA Method B Groundwater Cleanup Levels
Arsenic	No	N/A
Barium	N/A	No
Cadmium	No	N/A
Copper	N/A	No
Lead	Yes (one sample from Seep #4 below TDF-1)	N/A
Selenium	N/A	No
Zinc	N/A	Yes (one sample from Unnamed Ditch below TDF-1)
Mercury	No	No
Other	N/A	Iron (in one sample from TDF-1 North Diversion Culvert) manganese, sulfate

COC	**Groundwater (dissolved results)[1]**	
	MTCA Method A Groundwater Cleanup Levels	MTCA Method B Groundwater Cleanup Levels
Arsenic	No	N/A
Barium	N/A	No
Cadmium	No	N/A
Copper	N/A	No
Lead	No	N/A
Selenium	N/A	No
Zinc	N/A	No
Mercury	No	No
Other	N/A	Iron, manganese, sulfate

[1] See URS 2008-2010 groundwater monitoring reports for total metals results

COC	**Surface Water**		
	MTCA Method B Surface Water	Hardness Dependant Water Quality Criteria	Federal Water Quality Criteria
Arsenic	No	N/A	No
Barium	N/A	N/A	N/A
Cadmium	No	No	Yes (one sample from Creek #1 near outfall area)
Copper	No	No	No
Lead	N/A	No	N/A
Selenium	No	N/A	N/A
Zinc	No	No	No
Mercury	N/A	N/A	No
Other	No	No	No

Supplemental Table 4-8

Summary of Screening Level Exceedances
Pend Oreille Mine TDF-1 and TDF-2 RI/FS, Washington

COC	Ecological Risk of Tailings and Soil		
	MTCA Ecological Indicator Soil Concentraions for Protection of Plants and Animals	Site-Specific Terrestrial Ecological Risk Evaluation (MTCA Table 749-4)	Risk Quotient Analysis (Section 5.3.2) for Small Mammalian Predator, Small Mammalian Herbivore, Ungulates, Carnivorous Raptors, Ducks
Arsenic	No (screened out by Method A)	N/A	N/A
Barium	Yes, two samples from TDF-2	N/A	N/A
Cadmium	Yes	Yes (mammalian predator only)	No
Copper	Yes, one sample from TDF-1 and one from TDF-2	N/A	N/A
Lead	Yes	Yes (mammalian and avian predator only)	No
Selenium	No	No	No
Zinc	Yes	Yes	No
Mercury	No (screened using Method A)	N/A	N/A
Other	N/A	N/A	N/A

Table 4-9
Site-Specific Terrestrial Ecological Risk Evaluation
Pend Oreille Mine TDF-1 and TDF-2 RI/FS

Mammalian Predator

		Cadmium	Lead	Selenium	Zinc
T_{Shrew}	mg/kg-d	15	20	0.725	703.3
$FIR_{Shrew,DW}$	kg dry food/kg body weight-day	0.45	0.45	0.45	0.45
$P_{SB\ (shrew)}$	unitless	0.5	0.5	0.5	0.5
BAF_{Worm}	mg/kg-d	4.6	0.69	10.5	3.19
$SIR_{Shrew,DW}$	kg dry soil/kg body weight-day	0.0045	0.0045	0.0045	0.0045
$RGAF_{Soil,shrew}$	unitless	1.0	1.0	1.0	1.0
$SC_{MP}{}^{1}$	mg/kg	14	125	0.31	973.8

Avian Predator

		Cadmium	Lead	Selenium	Zinc
T_{Robin}	mg/kg-d	20	11.3	1	131
$FIR_{Robin,DW}$	kg dry food/kg body weight-day	0.207	0.207	0.207	0.207
$P_{SB\ (robin)}$	unitless	0.52	0.52	0.52	0.52
BAF_{Worm}	mg/kg-d	4.6	0.69	10.5	3.19
$SIR_{Robin,DW}$	kg dry soil/kg body weight-day	0.0215	0.0215	0.0215	0.0215
$RGAF_{Soil,robin}$	unitless	1.0	1.0	1.0	1.0
$SC_{MP}{}^{1}$	mg/kg	39	118.0	0.87	359

Mammalian Herbivore

		Cadmium	Lead	Selenium	Zinc
T_{vole}	mg/kg-d	15	20	0.55	537.4
$FIR_{Vole,DW}$	kg dry food/kg body weight-day	0.315	0.315	0.315	0.315
$P_{Plant,vole}$	unitless	1.0	1.0	1.0	1.0
K_{Plant}	mg/kg-d	0.14	0.0047	0.0065	0.095
$SIR_{Vole,DW}$	kg dry soil/kg body weight-day	0.0079	0.0079	0.0079	0.0079
$RGAF_{Soil,vole}$	unitless	1.0	1.0	1.0	1.0
$SC_{MP}{}^{1}$	mg/kg	288	2,132	55	14,208

Notes: ^{1} SC_{MP} calculated using equations defined in MTCA Table 749-4 and default assumptions

ATTACHMENT A

DRAFT REMEDIAL INVESTIGATION/FEASIBILITY STUDY REPORT FOR THE PEND OREILLE MINE TAILINGS DISPOSAL FACILITY TDF-1 AND TDF-2, GOLDER ASSOCIATES, OCTOBER 10, 2006

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Golder Associates

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OCT 11 2006
DEPARTMENT OF ECOLOGY
EASTERN REGIONAL OFFICE

DRAFT

REMEDIAL INVESTIGATION/FEASIBILITY STUDY REPORT FOR THE PEND OREILLE MINE TAILING DISPOSAL FACILITIES TDF-1 AND TDF-2

METALINE FALLS, WASHINGTON

Submitted to:

Teck Cominco American Incorporated
Spokane Washington

Submitted by:

Golder Associates Inc.
Redmond, Washington

DRAFT

DRAFT

Douglas Morell
Principal/Project Manager

Micheal Brown
Principal/Geotechnical Engineering

October 10, 2006

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1.0 INTRODUCTION

The Pend Oreille Mine Tailings Disposal Facility- 1 (TDF-1) and Tailings Disposal Facility-2 (TDF-2) is a listed site under the Washington State Model Toxics Control Act (MTCA). Teck Cominco American Incorporated has entered into an Agreed Order (Number 2585) with the Washington State, Department of Ecology (Ecology) to complete a Remedial Investigation/Feasibility Study (RI/FS) for an assessment of environmental impacts associated with the inactive tailings disposal facilities TDF-1 and TDF-2 at their Pend Oreille Mine. The Pend Oreille Mine is about 2 miles north of Metaline Falls, Washington (Figure 1-1). This document is the RI/FS report that is required by the Agreed Order and has been prepared by Golder Associates Inc. (Golder) on behalf of Teck Cominco American Incorporated.

1.1 Purpose of the RI/FS

The purpose for the RI is to collect, develop and evaluate sufficient information regarding the Teck Cominco American Incorporated tailings facilities, TDF-1 and TDF-2 (collectively designated as the Site), to determine their metal content, stability and potential releases of metals to the environment. The data collected during the RI will supplement the existing Site information that is presented in Sections 2 and 4 to complete the RI/FS. An assessment of risks to human and ecological receptors at the Site is conducted as part of the RI to determine if cleanup actions are needed at the Site. The information obtained during the RI supports the FS to evaluate appropriate cleanup actions in accordance with the MTCA. Based on the FS evaluation, Ecology will select the most appropriate cleanup action for the Site. Completing of the RI/FS will effectively satisfy the Agreed Order between Ecology and Teck Cominco American Incorporated.

1.2 RI/FS Objectives

The general objective for an RI/FS is to adequately understand the nature and extent of environmental risks from TDF-1 and TDF-2 to select an appropriate remediation for the Site. The specific objectives of the remedial investigation for this Site were documented in the Site RI/FS Work Plan (Golder 2005) and include:

1. An assessment of historical uses and operations at the Site and surrounding area;
2. An evaluation of previous investigations and remediation conducted at the Site;
3. A classification of the characteristics of the tailings materials in TDF-1 and TDF-2;
4. An assessment of the potential for revegetation of the surface of TDF-1 and TDF-2;
5. A characterization of the groundwater and surface water/sediment quality emanating from TDF-1 and TDF-2;
6. Evaluation of the TDF-1 stability; and,
7. An assessment of human and ecological risks from the tailings facilities and potential impact to adjacent habitat areas.

The RI determines the nature and extent of metal constituents of potential concern (COPC) to Site soil and groundwater, and to develop a conceptual Site model for exposure that identifies potential human health and/or environmental risks associated with the Site. Completion of the RI will provide the necessary data to support the FS, which is principally an evaluation of appropriate remedial alternatives for Site cleanup. This helps ensure selection of a remedy that meets regulatory requirements and is protective of human health and the environment.

The FS is conducted according to the MTCA cleanup regulations, specifically WAC 173-340-350 and 360. It comprehensively evaluates likely remediation alternatives, and proposes a remedial alternative that provides the most practical and achievable results for the Teck Cominco American Incorporated tailings facilities. The remedy selected from the FS will need to be effective for the protection of human health and the environment, achievable in a practical manner and implementable within a reasonable time frame.

1.3 Report Organization

This RI/FS Report has been structured to facilitate a clear understanding of all the elements to be conducted during the RI and FS. This report is organized as follows:

- **Section 1 – Introduction:** This section briefly states the purpose and objectives of the Pend Oreille Mine TDF-1 and TDF-2 RI/FS, and outlines the organization of the RI/FS Report.
- **Section 2 – Site Background Summary:** This section describes the Site including proper facility name, legal description, address, property lines, property history, and review of previous environmental investigations.
- **Section 3 – Site Remedial Investigation:** This section describes the activities and provides the results of the RI investigation.
- **Section 4 – Site Conditions and Nature and Extent of COPC:** This section describes the Site physical and biological setting including Site topography, local and regional geology, hydrogeology, ecology, area meteorology, and demographics. The results of the previous investigations and this RI are used to determine affected areas and COPC.
- **Section 5 – Human and Ecological Risk Assessment:** This section identifies potential exposure pathways and evaluates human and ecological health risks at the Site.
- **Section 6 – Cleanup Action Objectives and Screening of Remedial Technologies:** This section presents remedial action objectives and screens applicable remedial technologies.
- **Section 7 – Cleanup Action Alternative Development:** From the retained technologies, this section develops and describes remedial action alternatives that are appropriate for this Site.
- **Section 8 – Cleanup Alternatives Evaluation:** This section estimates cost and evaluates each alternative in accordance with MTCA.
- **Section 9 – References:** This section includes citations for the references used to prepare this RI/FS Report.
- **Appendices** – Appendices provide:
    1. Laboratory analytical reports;
    2. Test pit logs;
    3. Borehole and well construction logs;
    4. Groundwater hydraulic test analysis;

5. List of vegetation samples obtained;
6. List of wildlife surveyed at the Site;
7. TDF-1 stability analysis;
8. Applicable, relevant and appropriate requirements (ARARs); and
9. Cleanup Alternative Cost Estimates.

2.0 SITE BACKGROUND SUMMARY

The following sections describe the Site, surrounding area and the history of operations at the Site.

2.1 Site Location

The Pend Oreille Mine is located in Pend Oreille County, northeastern Washington State; about 80 miles north of Spokane and about two miles north of Metaline Falls (see Figure 1-1). Figure 2-1 shows the Pend Oreille Mine facilities. The Site, which is comprised of TDF-1 and TDF-2, is within the SE quarter of Section 10 and the NE quarter of Section 15, Township 39 North, Range 43 East, Willamette Meridian. The mine is about 11 miles south of the Canadian International Border and about 15 miles west of the Idaho State border. The approximate latitude is 48^0 53' 54.12" North and longitude is 117^0 21' 36.00" West.

Figure 2-2 provides a detailed project layout map of the Site and adjacent land. TDF-1 and TDF-2 comprise about 19 acres and 9 acres, respectively. Both tailings facilities are situated on glacial terraces at an elevation between 2,200 and 2,400 feet above mean sea level (amsl).

2.2 Property History

The current Pend Oreille Mine is in the Metaline mining district. Ownership of the mine dates back to 1904 when L.P. Larsen began prospecting the area. In 1906 the Pend Oreille Mines & Metals Company was incorporated. The early mining in the area began on the west side of the Pend Oreille River where ore bodies were exposed above the river level. The current Pend Oreille Mine is an underground mine on the east side of the River was in operation from 1952 to 1977. The Pend Oreille Mine was owned and operated by the Pend Oreille Mines & Metals Company until 1974, when the Bunker Hill Company acquired the property and operations. The Bunker Hill Company operated the mine and mill until September 1977, when Pintlar Corporation acquired the property through bankruptcy proceedings. During 1977, the mine and mill were closed, but in 1990 ownership transferred to Resources Finance Corporation, which purchased the mine and mill and 13,000 acres of contiguous mineral property. In 1996, Cominco American, Incorporated acquired the property including the mine and mill complex from Resource Finance Corporation. When Cominco American Incorporated merged with Teck Cominco American Incorporated in 2001, Teck Cominco American Incorporated took ownership of the mine, mill and property. Teck Cominco American Incorporated, in addition to the land ownership obtained with the merger, leased additional contiguous surface lands (including mineral rights) and reopened the mine and mill for production in 2004. The mine and mill are currently operational on privately owned land and is operated by Teck Cominco American Incorporated.

2.3 Description of Adjacent Properties

The landscape of the region consists primarily of rolling to rugged forestland, scattered meadows and lakes, and the Pend Oreille River valley. The Pend Oreille Mine is bounded on the west by the Pend Oreille River, on the north and northeast by Colville National Forest lands, on the east by privately owned lands and on the south by State Route 31 and the Grandview Mine property. The Metaline Falls Golf Course is adjacent and to the east of TDF-2, but is contained within the mine property boundary.

The area is heavily forested and dotted with abundant lakes. The major drainages to the Pend Oreille Mine area are Three Mile Creek on the north end of the mine site and Frog Creek within the southern portion of the mine site. Neither of these drainages receives surface water from TDF-1 and TDF-2.

There are three drainages associated with TDF-1 and TDF-2 (see Figure 2-2). One drainage, called Creek #1, is ephemeral and flows westerly to the north of both TDF-1 and TDF-2. Creek #1 is hydrologically separated from the tailings disposal facilities by topography from surface water and by a bedrock ridge from groundwater. Perennial Creek #2 drains TDF-1 along the northwest side and discharges to the Pend Oreille River. An ephemeral unnamed drainage along the southwest side of TDF-1 appears at times to drain water from the southern portion of TDF-1 based on a topographic depression.

The Pend Oreille County Shoreline Master Plan provides goals and policies for the development and use of shorelines and land within 200 feet of "normal water elevations." The land within 200 feet of the shoreline is owned by Seattle City Light through the Boundary Project. The Shoreline Master Plan classifies the shoreline of the Pend Oreille River along the mine site as a conservancy environment. The objective of this classification is to protect, conserve, and manage existing natural resources and valuable historic and cultural areas to ensure a continuous flow of recreational benefits to the public and to achieve sustained resource utilization. The Shoreline Master Plan regulations applicable to mining state that mining operations that do not substantially change the character of the environment shall be permitted.

Land uses in the area of the Pend Oreille Mine and TDF-1 and TDF-2 include mining, timber harvesting, agriculture, and recreation. Logging continues in the region, but has declined within recent times. A few privately owned hay and beef cattle farms occur in the vicinity of the Site. These farms also lease Colville National Forest lands for summer pasture. Recreation provides important income to the local communities. Popular attractions to the area include nearby Sullivan Lake, Gardner Caves, Boundary and Box Canyon Dams, the Pend Oreille River and the North Pend Oreille Scenic Byway and International Selkirk Loop. Activities include hiking, cross-county skiing, camping, rock climbing, boating, fishing, and wildlife and scenery viewing. The Pend Oreille River is used for boating and fishing. Small and large animal hunting is a common recreational activity in the area. A golf course exists on the Pend Oreille Mine Property and adjacent to TDF-2. This nine-hole golf course includes a small clubhouse, parking area and two outhouses.

There are no residents between the Pend Oreille River and TDF-1 and TDF-2, nor are there any residents within 0.5 miles of either TDF-1 or TDF-2. The closest residences to the Site are along Highway 31 about 0.5 miles to the east and in the Pend Oreille Village, a small community, over a mile south of TDF-1 and TDF-2. Metaline Falls is 2 miles south of the Site and is the largest community in the area. The town of Metaline is a small township south of Metaline Falls and further from the Site. The populations of Metaline Falls, Pend Oreille Village, and Metaline were estimated in 1999 to be about 230, 30, and 170, respectively (Ecology 2000).

2.4 TDF-1 and TDF-2

2.4.1 TDF-1

TDF-1 is located on a terrace approximately 700 feet east and 200 feet above the Pend Oreille River. Tailings were deposited in TDF-1 from 1968 to 1973 (see Figure 2-2). The tailings in TDF-1 were entirely derived from ores extracted from the Josephine Horizon. TDF-1 is about 19 acres and has a maximum thickness of 68 feet. Prior to tailings disposal, the Site consisted of a broad relatively flat bench. TDF-1 was constructed by a starter dam along the facility's downslope western perimeter. The facility was developed by spigoting tailings from this dam, resulting in the coarser size fractions settling first near the dam, while the finer fractions flowed toward the interior and east side of the facility. Batten boards were installed along the dam face to increase beach height. The resulting dam face has a 1.35 to 1 slope ratio (horizontal to vertical). Two decant structures consisting of wooden board wells with horizontal steel pipes along the bottom were used to decant tailings water. Currently, only one of the decant structures is operational.

2.4.2 TDF-2

TDF-2 is located approximately 700 feet east to southeast of TDF-1 (about 250 feet at the closest point) and is shown in Figure 2-2. TDF-2 is about 85 feet higher in elevation than TDF-1 and occupies about 9 acres. Two earthen dams were constructed across natural drainages to develop the facility in the same manner as TDF-1. Tailings were deposited in TDF-2 beginning in 1973. However, the facility was only operated for a few months due to a failure in the lower dam which caused the tailings to flow down the natural draw and into TDF-1. This event resulted in the partial blockage of one of the decant structures in TDF-1. Following this failure, TDF-3 was initiated and used for deposition of tailings until 1977 when the mine shut down. Tailings deposited into TDF-2 were also from ore extracted from the Josephine Horizon (Ecology and Environment, 2002). TDF-2 tailings materials were placed on glacial sediment materials, but the thickness and depth to bedrock is unknown.

2.5 Previous Environmental Investigations

A number of environmental investigations were conducted at TDF-1 and TDF-2 and the surrounding mine site that are relevant to this RI/FS. Figure 2-3 presents the locations of sampling stations, test pits, monitoring wells and boreholes associated with these previous investigations. The data generated from these studies and investigations are available within the Golder project files. Relevant studies and investigations for TDF-1 and TDF-2 that are in the project file are referenced below:

- Cannon Microprobe. 1999. Electron Microprobe Analysis of Lead Bearing Tailings. Conducted for Silver Valley Laboratories, Kellogg, Idaho.

- CH2M HILL. 1998a. Bioassay Report: 96-Hour Static Screening Bioassays Conducted; Conducted December 1 through 5, 1998. Prepared for Washington Department of Ecology, Manchester Laboratory. Port Orchard, Washington.

- CH2M HILL. 1998b. Bioassay Report: 96-Hour Static Screening Bioassays Conducted; Conducted August 3 through 7, 1998. Prepared for North Creek Analytical, Spokane Washington.

- Dames & Moore. 1999. Focused Groundwater Assessment Tailings Storage Facility No. 3, Pend Oreille Mine. Metaline Falls, Washington.

- Dames & Moore. 1997a. Letter Report: Results of Washington State Dangerous Waste Characterization; Pend Oreille Mine; Metaline Falls, Washington. Prepared for Cominco American Incorporated. Spokane, Washington. June 12, 1997.

- Dames & Moore. 1997b. Letter Report: Results From Seep Water Analysis From Tailing Pond No.1; Pend Oreille Mine; Metaline Falls, Washington. Prepared for Cominco American Incorporated. Spokane, Washington. June 25, 1997.

- Dames & Moore. 1988. Report: Stability Assessment, Pend Oreille Tailings Pond No. 1 Metaline Falls, Washington. Prepared for Evans, Keane, Koontz, Boyd, Simko & Ripley. Kellogg, Idaho.

- Devitt, Ron. 1972. Survey on the Tailings Pond at Pend Oreille Mines and Metals near Metaline Falls. Memo Submitted to Dan Neal and Tom Haggarty. December 20, 1972.

- Ecology and Environment, Inc. 2002. Preliminary Assessments and Site Investigations Report; Lower Pend Oreille River Mines and Mills, Pend Oreille County, Washington. Prepared for U.S. Environmental Protection Agency. Region 10 START-2 Contract No. 68-S0-01-01. Seattle, Washington.

- Ecology, Washington State Department of. 2000. Final Environmental Impact Statement, Pend Oreille Mine Project, Pend Oreille County, Washington. Prepared for the Washington State Department of Ecology. Spokane, Washington.

- ENSR. 1999a. Tailings Disposal Facility #3 Water Balance Estimate and Potential Impact to Frog Creek. Report Prepared for Cominco American Incorporated. Spokane Washington.

- ENSR. 1999c. Geochemical Evaluation of Pend Oreille Mine Monitor Wells. Report Prepared for Cominco American Incorporated.. Spokane, Washington.

- Golder Associates Ltd. 1996. Field Investigation and Remedial Design for Tailings Pond No. 1, Pend Oreille Mine. Submitted to Cominco Limited. Vancouver, British Columbia.

- Parametrix. 1998. Results of Dangerous Waste Designation Tests. Report Prepared for Cominco American Incorporated. Spokane, Washington.

- U.S. Department of the Interior-Bureau of Mines. 1995. Well Abandonment Reports. Letter Report submitted to the Washington State Department of Ecology- Eastern Regional Office. Spokane, Washington.

- U.S. Department of the Interior-Bureau of Mines. 1992. Letter Report Water Quality and Other Data, No.1 Tailings Pile. Pend Oreille Mine. Submitted to the Washington State Department of Ecology- Eastern Regional Office. Spokane, Washington.

3.0 SITE REMEDIAL INVESTIGATION

The intent of the RI is to adequately understand the nature and extent of COPC associated with the Site. The RI is the data-gathering phase of the RI/FS process. Data collection activities were defined in the Site RI/FS Work Plan. This section presents the sampling activities and the data generated during the RI. All laboratory analytical reports for RI generated data are provided in Appendix A in a CD format.

3.1 TDF-1 and TDF-2 Tailings Characterization

The tailings material was characterized in TDF-1 and TDF-2 to determine representative metal content, leaching characteristics using TCLP and the agronomic properties as a growth medium.

3.1.1 Sampling Activities and Methods

A total of 17 test pits were excavated on TDF-1 and TDF-2 along transects illustrated in Figure 3-1 to characterize the tailings material. Test pits were excavated by Randall Contracting on July 25 and 26, 2005 using an excavator to dig approximately 12 feet below ground surface (bgs) at each test pit location. Golder personnel collected surface and subsurface soil samples from each of the test pits representing the surface, three-foot depth, six-foot depth, and 10 to 12-foot depth intervals. Test pit logs of the encountered tailings materials are presented in Appendix B.

Test pit soil sampling activities were performed in accordance with the QA protocols and procedures specified in the relevant technical procedures referenced in the Quality Assurance Project Plan (Appendix B-Golder 2005). The three samples from each test pit were composited into a single tailings sample in the field. The 17 composite tailings samples were sent to SVL Analytical, Inc. (SVL) for analysis of total metals and leachability tests using the Toxicity Characteristic Leaching Procedure (TCLP). All analyses followed the reference analytical methods listed in Table QAPP-2 of the QAPP. The leachate from TCLP was analyzed only for lead and cadmium, because they are the only Resource Conservation and Recovery Act (RCRA) metals that were at concentrations in the tailings samples that have the potential to exceed the RCRA and Washington Dangerous Waste (WAC 173-303) toxicity characteristic test concentrations.

In addition to the composite tailings samples, surface samples of the TDF-1 and TDF-2 were obtained for agronomic characterization from each test pit representing discrete depth intervals in the upper two feet of the surface as follows:

- The uppermost two to four inches representing a developing soil horizon;
- The six- to 12-inch depth interval; and
- The 12- to 24-inch depth interval.

Discrete near-surface subsamples from each test pit were sent to Intermountain Laboratories Inc. (INML) for analyses of agronomic properties including available metal content, nutrient content, and organic carbon content.

3.1.2 Analytical Results

3.1.2.1 Total Metal Content

All test pit composite samples were analyzed for Total Metal Content of COPC including arsenic, barium, cadmium, copper, lead, mercury, selenium, and zinc, as well as TCLP testing for cadmium and lead. The composite samples represent the entire test pit column. Table 3-1 summarizes the analytical results for the Total Metal Content analyses. The statistical upper confidence limit (UCL) of the mean and the human and ecological screening level for each metal are provided in Table 3-1 for comparison. The screening values represent either the lowest applicable MTCA cleanup level, the accepted State of Washington background soil concentrations (Ecology 1994; and WAC 173-340), the Practical Quantification Limit (PQL) for laboratory analyses (WAC 173-340-707), or the lowest regulatory criteria for human and ecological health. The screening values are derived and developed in Section 4 of this report.

The tailings material in TDF-1 and TDF-2 contains several metals at concentrations above screening values as shown on Table 3-1. The only metal in either TDF-1 or TDF-2 that is above screening values for Unrestricted Land Use is lead; but lead concentrations are not above screening values for Industrial Land Use in either TDF-1 or TDF-2. Metal content in TDF-1 and TDF-2 that are above ecological risk screening values include: cadmium, lead, mercury, and zinc. Selenium is the only COPC analyzed that is below the laboratory detection limit of 4.0 mg/kg for all tailings composite samples.

3.1.2.2 TCLP Results

TCLP analysis was performed in previous Site investigations on a limited number of TDF-1 tailings samples (Dames & Moore, 1997a). This RI supplemented existing TCLP data with additional TCLP on TDF-1 and TDF-2 composited tailings samples. TCLP analyses were only for cadmium and lead. Other metal COPC were not analyzed in the TCLP leachate because they are either not a RCRA metal or are at concentrations in the tailings that could not fail the TCLP test (based on the 20 times rule). Table 3-2 summarizes the TCLP metal results for the tailings composite samples from the RI and from previous TCLP analyses that were performed (Dames & Moore, 1997a).

The TCLP results indicated that the tailings in both TDF-1 and TDF-2 would not be classified as a dangerous waste based on toxicity characteristic. The TCLP results were statistically evaluated for normal and lognormal distributions by considering all samples and by grouping the samples for each tailings facility. Irrespective of the method of calculation, the UCL of the means calculated below TCLP concentrations for designation. In fact, only one composite soil sample from test pit (Test Pit-8) exceeded Ecology's Dangerous Waste Criteria for TCLP lead. All other tailings composite samples had TCLP contents for cadmium and lead well below Ecology's Dangerous Waste Criteria (WAC 173-303).

3.1.2.3 Surface Agronomic Characteristics

The tailings samples for agronomic analyses were sent to Intermountain Laboratory. Each discrete depth sample was analyzed for a typical suite of parameters to identify the nutrient status of the tailings. The samples were also analyzed for total and plant-available metal concentrations. The results are presented in Table 3-3. The statistical UCL of the means for normal and lognormal distributions are provided in Table 3-3.

3.2 Hydrogeologic Characterization

The hydrogeologic study of the Site focused on the groundwater above the Ledbetter Slate. The Ledbetter Slate is hundreds of feet thick and is an aquitard for groundwater vertical flow. Glaciofluvial deposits mantle the Ledbetter Slate, but can be over a hundred feet in thickness. Groundwater was encountered within the glaciofluvial deposits and within tailings materials. TDF-1 has five existing piezometers that were sampled during the RI (see Figure 3-2). Three monitoring wells (MW-201, MW-202, and MW-203) were installed on TDF-2 (see Figure 3-2), but only two wells (MW-203 and MW-201) encountered groundwater. The third well, MW-202, extended below the TDF-2 tailings material to the Ledbetter Slate, but groundwater did not exist above the slate during the two RI sampling periods. Initial drilling efforts for MW-201 had drilling refusal using a hollow stem auger drill rig before encountering groundwater. The location of these boreholes designated BH-201(A) and BH-201(B) are also shown on Figure 3-2.

Groundwater was further investigated as seep water below TDF-1. The Ledbetter Slate is near surface and the steep topography results in groundwater being near surface and accessible through a drive tube. Seeps represent groundwater down-gradient of TDF-1 above the Ledbetter Slate. The groundwater seeps that were identified in the field along the western and northern perimeter of TDF-1 were sampled and analyzed for metal content.

Two additional boreholes (designated LSB-1 and LSB-2) were drilled north of TDF-1 and TDF-2 to further investigate the groundwater conditions and elevation of the Ledbetter Slate (see Figure 3-2). Investigation boreholes were drilled on the northern perimeter of TDF-1 and TDF-2 and designated LSB1 and LSB2.

Additionally, hydraulic tests were performed in the monitoring wells in TDF-2 and the piezometers in TDF-1 in order to characterize the hydrogeologic conditions of the uppermost saturated zone within or below the tailings material in TDF-1 and TDF-2.

3.2.1 Geologic Borehole Logging and Installation of Monitoring Wells

Since there were no existing monitoring wells on TDF-2, three groundwater monitoring wells (designated MW-201, MW-202, and MW-203) were drilled and installed. Furthermore, the two investigation boreholes, LSB-1 and LSB-2, were drilled on the northwest perimeter of TDF-1 and TDF-2 to better define the geologic occurrence of Ledbetter Slate, which acts as a barrier to groundwater flow from TDF-1 and TDF-2 towards Creek #1.

3.2.1.1 Drilling Procedures and Geologic Logging Results

Groundwater monitoring wells and subsurface investigation boreholes were drilled and installed in TDF-2 using a hollow-stem auger or air-rotary drill rig by Environmental West Drilling on July 27 through August 1, 2005. The drilling, installation and development of the monitoring wells were performed in strict accordance with the QA protocols and procedures specified in the relevant Golder Technical Procedures referenced in the SAP (Golder 2005). The monitoring well and soil boring locations are shown on Figure 3-2, which also shows the location of existing piezometers in TDF-1. All borehole logs generated during the RI are presented in Appendix C.

Hollow-stem auger borings were advanced for well MW-202 and MW-203 installations using continuous 4.5-inch ID auger flights. Soil samples were collected on 2.5- to 5-foot intervals using 2.5-inch diameter, 24-inch long split-tube drive sampler and/or Shelby Tubes. Soil boring samples were lithologically logged in the field by Golder personnel.

Two drilling attempts using hollow stem augering techniques were unsuccessful for MW-201in the south-central area of TDF-2, because very coarse gravels were encountered below the TDF-2 tailings material. An air-rotary drill rig was employed to advance MW-201 to the anticipated depth required to reach the Ledbetter Slate and intersect the uppermost groundwater aquifer (approximately 85 feet bgs). The boreholes that encountered drilling refusal are designated BH-201(A) and BH-201(B) in Figure 3-2.

3.2.1.2 Monitoring Well Construction Details and Geodetic Survey Results

The TDF-2 monitoring well borings were advanced to a depth of approximately 8- to 10-feet below the top of the shallow groundwater table encountered beneath the tailings material in TDF-2. Upon reaching total depth of the borings, a monitoring well was completed with 2-inch diameter, schedule-40 PVC well screen and casing in accordance with Golder's Technical Procedures and Washington State Well Construction Regulations (WAC 173-160) referenced in the SAP (Golder 2005). A schematic installation diagram for the monitoring wells is shown in Figure 3-3. All monitoring wells were completed with protective steel well monuments with lockable lids and developed appropriately in order to produce representative formation water. Installation details for the monitoring wells on TDF-2, existing piezometers on TDF-1, and investigation boreholes are presented in Table 3-4 and are illustrated in Appendix C.

3.2.2 Groundwater Hydraulic Testing Procedures and Results

In order to determine the hydrologic properties of the saturated tailings material in TDF-1 and uppermost aquifer beneath TDF-2, slug tests were conducted in the piezometers located on TDF-1 and pump tests were conducted in the monitoring wells on TDF-2. Pump tests and slug tests were conducted in accordance with Golder Technical Procedures presented in the SAP (Golder 2005), and data was analyzed using standard hydrogeologic methods presented in the QAPP (Golder, 2005). The analyses of the hydraulic pump tests are provided in Appendix D. Results of the pump test and slug tests are presented in Table 3-5.

3.2.2.1 Slug Testing

Due to the short water column existing in the piezometers and the anticipated low permeability of the tailings material on TDF-1, slug tests were conducted by removing a slug of water using the submersible pump and recording water level changes with an automatic pressure transducer and data logger. The water levels in the piezometers were allowed to recover for a minimum of 120 minutes after slug removal. The slug test results for piezometers PO1, PO2 PO3, PO4, and PO5 at TDF-1 indicate that the tailings material in TDF-1 has a hydraulic conductivity of 1.2×10^{-4} to 1.7×10^{-4} cm/s, which is representative of a clayey silt to a sandy silt soil texture. This soil texture correlates with the clayey silt texture observed in the tailings material during test pit excavation on TDF-1.

3.2.2.2 Pump Testing

Following development of the newly-installed wells on TDF-2, pump tests were conducted in MW-201 and MW-203 (MW-202 was omitted due to the unsaturated conditions). Water was pumped from the wells using a submersible pump and water level changes in the wells were recorded using an automatic pressure transducer and data logger. The drawdown in MW-201 was very small, which made the analysis of aquifer hydraulic properties difficult.

Monitoring well MW-203 was pumped at a rate of two gpm for six hours, and the water table was allowed to recover for 10 hours following the end of pumping. The pump test results for MW-203 indicated that the aquifer beneath the tailings material in TDF-2 has a transmissivity value of 160 – 170 ft^2/day. Therefore, the hydraulic conductivity is approximately 7 x 10^{-3} cm/s, which is representative of a sand to sandy gravel type of soil. This soil type corresponds with the sand to gravely sand material that was similar to the glaciofluvial deposits beneath the tailings at MW-201 location.

Monitor Well MW-201 was pumped at a rate of 5 gpm for about 0.5 hours, and the water table was allowed to recover for 10 hours following the end of pumping. The pump test results for MW-201 indicate that the aquifer beneath the tailings material in TDF-2 has a transmissivity value of 2,100 to 8,200 ft^2/day. Therefore, the hydraulic conductivity is approximately 4 x 10^{-2} to 1.5 x 10^{-1} cm/s, which is representative of sandy gravel type of soil. This soil type corresponds with the sand and gravel material that was observed beneath the tailings at the depth of the screened interval of MW-201.

3.2.3 Groundwater Sampling

3.2.3.1 Sampling Activities and Methods

Following well development activities, groundwater samples were collected from the new monitoring wells on TDF-2, from the five piezometers on TDF-1 (Figure 3-2), and from the seeps shown on Figure 3-4. Field parameter measurements and groundwater sampling activities were conducted in accordance with strict QA protocols and procedures specified in the relevant technical procedures referenced in the QAPP (Golder 2005).

Groundwater sampling activities were performed during two different periods to identify any temporal changes to the groundwater chemistry. The first sampling period occurred on August 11 through 18, 2005 during the late summer/early fall of the year to be representative of the dryer season and low-flow hydrologic conditions. The second sampling period occurred on May 4-10, 2006, when hydrologic high-flow conditions were most likely to exist.

After purging a minimum of three well volumes from the wells and piezometers, all field parameters were stabilized in accordance with the QA/QC program presented in the QAPP (Golder 2005). Field parameter measurements for both sampling events are presented in Table 3-6. Groundwater samples were collected using a submersible Grundfos pump for the TDF-2 monitoring wells and filtered through a 0.45 micron membrane in-line filter before preservation. Selected unfiltered groundwater samples were obtained for comparison of metal concentrations. Due to the very slow recharge of the tailings material on TDF-1, groundwater samples were collected from the piezometers on TDF-1 using a peristaltic pump with rigid plastic tubing inserted to the midpoint of the screened interval and filtered through an in-line filter. Groundwater samples were analyzed for Site groundwater COPC, which were identified in the SAP and QAPP. Samples were submitted under chain-of-custody documentation to SVL Analytical of Kellogg, Idaho.

3.2.3.2 Analytical Results

All groundwater samples collected from the monitoring wells on TDF-2 and the piezometers on TDF-1 were analyzed for dissolved metals (field-filtered samples) including silver, arsenic, barium, calcium, cadmium, chromium, copper, iron, magnesium, manganese, mercury, lead, selenium, and zinc, as well as major anions including chloride, sulfate and alkalinity. In addition, groundwater from selected wells and piezometers were analyzed for total metals for comparison with the dissolved metal content. Tables 3-7 and 3-8 summarize the analytical results of groundwater samples from TDF-1 and TDF-2 for both sampling periods.

The groundwater samples collected from TDF-1 piezometers had dissolved iron, manganese, and sulfate, and samples from TDF-2 wells had dissolved manganese concentrations that exceed Ecology's Most Protective Groundwater Cleanup Levels. However, the MTCA criteria for these analytes are not human health-based, but to protect the aesthetic qualities (taste, color, staining, etc.) of water. All other dissolved metal concentrations were either below the PQL of the analytical method or detected at concentrations below MTCA cleanup levels for the highest potential beneficial human use. The PQLs for all analytes are below MTCA cleanup levels for groundwater.

Total metal content was analyzed in selected groundwater samples from TDF-1 and TDF-2 to test for the differences between filtered and unfiltered groundwater samples on the Site. Based on the analytical results presented in Tables 3-7 and 3-8 in conjunction with the field parameter measurements presented in Table 3-6, it is evident that turbidity significantly affects the metals analytical results. The unfiltered groundwater samples collected from MW-203 on May 10, 2006 have a turbidity value of 0.81 NTU. Since the concentrations for total and dissolved metals are similar in this low-turbid sample, these results indicate that if low turbidity is achieved, there is not a large difference between total versus dissolved metal content. In comparison, the unfiltered groundwater sample collected from P02 on May 3, 2006 has a turbidity value of 94.1 NTU, and the analytical results for total cadmium, copper, lead, and zinc in this sample are 10 to 1000 times that of their dissolved contents for this sample. The results from a turbid groundwater sample indicate that the amount of turbidity during groundwater sampling dramatically affects the metal content of the sample.

Natural groundwater has characteristically low turbidity, because groundwater flow is normally laminar (with a low Reynolds number and without turbulence) (Freeze and Cherry, 1979). Laminar flow cannot suspend settleable solids (turbulence is necessary to overcome gravity). Turbidity created by settleable solids is not representative of the natural groundwater phase. EPA (USEPA 1986) has long recognized that groundwater having a turbidity of greater than 5 NTU is not representative of the groundwater phase. Colloids (non-settleable solids) are representative of the groundwater phase, but are typically less than 1 micron in size. Filtering groundwater samples with a 0.45 micron filter does not remove most of the colloid sized particles and is more representative of the groundwater phase when groundwater samples cannot be obtained with low turbidity. Therefore, the filtered samples are more representative of true groundwater conditions than the unfiltered groundwater samples

3.2.4 Groundwater Seep and Culvert Discharge Sampling

Since most of TDF-1 lies directly on top of the Ledbetter Slate, seeps discharging down-gradient of TDF-1 represent groundwater emanating from the tailings facility. Several groundwater seep areas have been identified along the western and northern perimeter of TDF-1 during previous investigations and Site surveys. Seep areas down-gradient from the Diversion Drainage Ditches around TDF-1 were located in the field during the first sampling event in July 2005. These seeps were identified by marshy surface expressions of moist soils some with small puddles of water supporting moss, lichens, and/or fern vegetation and situated on relatively level ground surfaces. These seeps are ephemeral and do not support year-round surface water conditions; however, discharge from seep S-5 was observed to flow on the surface for approximately 100 feet down-slope before infiltrating back into the subsurface.

Three culverts exist below TDF-1 and discharge water into the head waters of Creek 2. These culverts receive TDF-1 diversion waters and decant water from the operational TDF-1 decant tower. A fourth culvert exists below TDF-1 that connects to the collapsed TDF-1 decant tower, but is clogged and is not operational.

During the second sampling event in May 2006, Golder personnel accompanied by an Ecology representative (Mr. Bill Fees) identified two flowing seeps discharging at the toe of the slope below TDF-2 near the top of TDF-1. These two seeps discharge into the head of the lined South Diversion Ditch constructed around TDF-1 just up-gradient from the wetland area located on TDF-1. These seeps are interpreted as being a discharge point for the groundwater emanating from the base of TDF-2.

3.2.4.1 Sampling Activities and Methods

The near-surface seeps identified below TDF-1 were sampled using a stainless-steel "drive-point" sampler, which was driven into saturated soils using a sledge hammer, to sufficient depth to permit the collection of seep water prior to emanating at the ground surface. Seep water samples were collected from within the drive-sampler through silicone tubing connected to a peristaltic pump and filtered through 0.45 micron in-line filters. Water samples from the culverts were obtained directly from the discharge stream and filtered through a 0.45 micron in-line filter. All seep and culvert sampling activities were conducted in accordance with strict QA protocols and procedures specified in the relevant technical procedures referenced in the QAPP (Golder 2005). Some of the seep locations identified during the field survey were found to be dry at the time of sampling and did not produce any near-surface water with the drive-point sampler; therefore, no seep samples were collected at these locations. Seep sampling locations are shown on Figure 3-4 and the culvert sampling locations are shown on Figure 3-5. A description of each culvert and seep are described in detail below:

North Diversion Culvert #1 (Figure 3-5) was collected directly from the North Diversion Drainage Ditch around TDF-1 at the discharging end (referred to as the Drainage Ditch Discharge Area). This black plastic culvert had a continuous flow during the August 2005 and May 2006 sampling events, and was sampled similar to the surface water collection method as described in Section 3.3.1.1.

South Diversion Culvert #2 (Figure 3-5) was collected directly from the South Diversion Drainage Ditch around TDF-1 at the discharging end (referred to as the Drainage Ditch Discharge Area). This black plastic culvert had a continuous flow during the August 2005 and May 2006 sampling events, and was sampled similar to the surface water collection method as described in Section 3.3.1.1.

Decant Tower Discharge Culvert #3 (Figure 3-5) was collected directly from the TDF-1 Decant Discharge Pipe at the discharging end (referred to as the Drainage Ditch Discharge Area). This metal culvert had a continuous flow during the August 2005 and May 2006 sampling events, and was sampled similar to the surface water collection method as described in Section 3.3.1.1.

Seep #4 (Figure 3-4) was identified during the field survey and is approximately 300 feet northeast of the Drainage Ditch Discharge Area. This seep was identified by standing water on the ground surface with abundant ferns growing in and around the area. This seep sample was collected at approximately 1-foot bgs using the "drive-sampler" and peristaltic pump.

Seep #5 (Figure 3-4) was identified during the field survey and is approximately 800 feet north of the Drainage Ditch Discharge Area. This seep was identified by a flowing stretch of water approximately 100 feet long on the ground surface with abundant moss and lichens growing in and around the area.

During the August 2005 and May 2006 sampling events, Seep #5 was observed to be flowing on the surface for approximately 100 feet down-slope before infiltrating back into the subsurface. This seep sample was collected at approximately 3-feet bgs using the "drive-sampler" and peristaltic pump.

Seep #7 (Figure 3-4) was identified during the field survey and is located approximately 100 feet southwest of the Drainage Ditch Discharge Area. This seep was identified by standing water on the ground surface with abundant moss and lichens growing in and around the area. This seep sample was collected at approximately 1-foot bgs using the "drive-sampler" and peristaltic pump.

Seep #8 (Figure 3-4) was identified during the field survey and is located approximately 300 feet southwest of the Drainage Ditch Discharge Area. This seep was identified by standing water on the ground surface with abundant moss and lichens growing in and around the area. This seep sample was collected at approximately 2-feet bgs using the "drive-sampler" and peristaltic pump.

Unnamed Ditch Seep (designated UD-1 in Figure 3-4) was established to the west and down-gradient of TDF-1 at a very marshy area supporting a small puddle of surface water nearly 2.5 feet across. This ditch collects periodic surface water and snowmelt draining down a very broad, undefined surface drainage route to the west of TDF-1. The Unnamed Ditch was observed to have standing water in the marshy area during both sampling periods; however, no actively flowing water was observed in or around the ditch.

Seeps W1-S1 and W1-S2 (Figure 3-4)) are two seeps at the toe of TDF-2 were identified during the second sampling event in May 2006 (see Figure 3-4). Golder personnel and an Ecology representative (Mr. Bill Fees) observed these two flowing seeps discharging at the toe of the slope below TDF-2 near the top of TDF-1 on the up-gradient side of the South Diversion Ditch. These seeps are captured by the lined South Diversion Ditch constructed around TDF-1 and do not contact TDF-1 or the nearby wetland on TDF-1. These seeps are interpreted as being a discharge point for the groundwater emanating from the base of TDF-2. During May 2006, W1-Seep 1 and W1-Seep 2 were flowing at approximately 1.5 gpm and 2.5 gpm, respectively. These seep samples were collected at approximately one-foot bgs using the "drive sampler" and peristaltic pump.

3.2.4.2 Analytical Results

Seep and pipe discharge samples were analyzed for dissolved metals including silver, arsenic, barium, calcium, cadmium, chromium, copper, iron, magnesium, manganese, mercury, lead, selenium, and zinc: major anions including chloride, sulfate and alkalinity. Table 3-6 presents the results of field measured parameters and Table 3-9 summarizes the laboratory analytical results for the groundwater seep and pipe discharge samples.

Groundwater seep water samples from the Site were found to contain several dissolved metals exceeding Ecology's Most Protective Groundwater Cleanup Levels, including iron, manganese, lead, zinc, and sulfate. Iron, manganese, zinc, and sulfate are secondary drinking water standards, which are based on water quality aesthetics but are not health-based. Lead was found to exceed the MTCA Method A Cleanup Level only in Seep #4 during the May 2006 sampling event; the MTCA level for lead was not exceeded during the August 2005 sampling event.

The Wetland Seeps #1 and #2 that are discharging from the base of TDF-2 contain no dissolved metal components exceeding Ecology's most protective groundwater cleanup levels and surface water quality criteria. Additionally, silver, arsenic, cadmium, chromium, copper, iron, lead, mercury, selenium, and zinc were all below the laboratory PQL in the W1-S1 and W1-S2 samples.

3.3 Surface Water and Sediment Characterization

Surface water and sediment samples were collected from the creeks adjacent to TDF-1 and TDF-2 as well as the wetland area on top of TDF-1 to identify any impacts to surface waters that may have occurred from the tailings facilities and to determine if there are any interactions of the shallow groundwater system beneath the tailings facilities with adjacent surface water systems discharging to the Pend Oreille River.

3.3.1 Surface Water

Surface water samples were collected from Creek #1 (located north-northeast of TDF-1 and TDF-2), Creek #2 (located northwest and directly down-gradient from TDF-1), and the wetland area on top of TDF-1 (Figure 3-5). Water discharges from diversion channels/pipes along the north and south perimeter of TDF-1 and the culvert/pipe draining the TDF-1 decant tower represent the beginning of Creek #2 and were sampled during the seep water sampling events as described above in the previous section.

3.3.1.1 Sampling Activities and Methods

Creek surface water sampling locations were established at sections of the creeks where less turbulent flows were observed in order to obtain representative surface water samples with the least amount of suspended materials present. Each surface water sample was collected from a cross-section of the surface water channel at each creek sampling location. All surface water samples were filtered through 0.45-micron in-line filters, and select surface waters were also analyzed for total metals to compare the differences between unfiltered and filtered samples regarding metal content of the surface water systems. Surface water sample collection activities were conducted in accordance with strict QA protocols and procedures specified in the relevant technical procedures referenced in the QAPP (Golder 2005). The surface water sampling locations are described in more detail below:

Creek #1 was sampled at one up-gradient location (C1-1) and one down-gradient location (C1-2) (see Figure 3-5). Creek #1 did not have a continuous flow throughout the length of the channel adjacent to the tailings facilities during both sampling periods, although the creek is constrained to a well-defined deep drainage channel. During the August 2005 sampling event, Creek #1 was dry at the up-gradient sampling location, but had a steady flow (~5 gpm) of surface water emanating within the channel at the down-gradient sampling location. During the May 2006 sampling event, Creek #1 had flowing surface water conditions at both the up-gradient and down-gradient sampling locations; however, the surface water system in this channel was discontinuous throughout the length of the channel.

Creek #2 was sampled at one up-stream location (C2-1) and one down-stream location (C2-1) (see Figure 3-5). Creek #2 was observed to have a continuous flow throughout the length of the channel system during both sampling periods, and is constrained to a well-defined narrow drainage channel. Creek #2 flow was estimated to be approximately the same at the up stream and down-stream stations, about 60 gpm and 15 gpm, respectively, for the August 2005 and May 2006 sampling periods. Creek #2 starts at the toe of TDF-1 at the discharge point of the North and South Diversion Ditches constructed around TDF-1 and the outflow of the TDF-1 decant structure. The up-gradient sample location C2-1 was located just below the confluence of these discharges from and around TDF-1. The down-stream C2-2 sample location was near the discharge of Creek #2 to the Pend Oreille River.

The standing surface water in the wetland on top of TDF-1 was sampled in the western portion (designated W1-1) and the eastern portion (designated W1-2) of the wetland as shown on Figure 3-5

(Note: these samples are not the same as the seep samples W1-S1 and W1-S2 that are groundwater seeps emanating up-gradient of TDF-1 and discharge to the south diversion ditch). During both sampling events, both wetland sampling locations were observed to be continuously submerged by water nearly 10 inches deep. Surface water was observed to be flowing from the TDF-1 wetland area approximately 50 feet through a narrow channel (8 – 10 inches deep) at a rate of about 2 – 3 gpm and discharging into the active decant tower in TDF-1.

3.3.1.2 Analytical Results

All surface water samples were analyzed for dissolved metals including silver, arsenic, barium, calcium, cadmium, chromium, copper, iron, magnesium, manganese, mercury, lead, selenium, and zinc, as well as chloride, sulfate and alkalinity. In addition, selected surface water samples were analyzed for total metals for comparison with the dissolved metal content. The field measured water quality parameters are presented in Table 3-6. Table 3-10 summarizes the laboratory analytical results for the surface water samples for both sampling periods.

None of the Site COPC were found to be above human or aquatic ecological health-based screening levels in the analytical results of filtered surface water samples. The only exception is the surface water sample C1-2 from Creek #1 obtained during the May 2006 sampling period, where cadmium (0.53 µg/L) slightly exceeded the Federal Water Quality Criteria of 0.44 µg/L (Washington Water Quality Criteria is 1.9 µg/L). Creek #1 does not drain TDF-1 or TDF-2 and cannot receive groundwater because of the Ledbetter Slate ridge separating the tailing disposal facilities from Creek #1 (see Section 4.1.8). Therefore, this exceedance during the May 2006 sampling event is believed to be caused by other sources or natural background.

The water quality standards presented in Table 3-10 are based on dissolved metal content. Total metal content in surface water samples was analyzed for comparison with dissolved metal content. Table 3-10 shows that the unfiltered sample collected for C2-2 in Spring 2006 has a higher content of cadmium, copper, iron, lead, and zinc than that found in the filtered sample for C2-2 collected during that sampling period. Therefore, total metal content in the unfiltered surface water sample is considered to be representative of the amount of metals being carried in the surface water system by the sediment load at that specific time.

3.3.2 Sediments

3.3.2.1 Sampling Activities and Methods

Creek sediment samples were collected at the same location of the corresponding surface water sampling locations presented previously. Sediment samples were collected from a cross-section of the creek channel bottom at each location. Additionally, sediment samples were collected at seep S5 where water was observed flowing on the surface for nearly 100 feet down-slope before percolating back into the subsurface during both sampling events. Seep sediments were collected at the other seep locations during May 2006 for comparison with Site soil conditions. Sediment sample collection activities were conducted in accordance with strict QA protocols and procedures specified in the relevant technical procedures referenced in the QAPP (Golder 2005).

3.3.2.2 Analytical Results

All creek and seep sediment samples were analyzed for total metals including arsenic, barium, cadmium copper, lead, mercury, selenium, and zinc. Table 3-11 summarizes the analytical results for the creek sediment samples for both sampling periods.

The Site creek sediments contain several metals at concentrations above human and ecological screening values as shown on Table 3-11. The only metal concentrations in the creek and seep sediments that are above screening values for Unrestricted Land Use by humans are lead. Site creek and seep sediments do not show any metals concentrations that exceed the human screening levels for industrial land use. Metal content in Site creek and seep sediments that are above ecological risk screening values include: barium, copper, lead, mercury, selenium, and zinc.

3.4 Vegetation Characterization

A Site-specific, phased approach and focused terrestrial ecological risk assessment was conducted in the summer of 2005 for the TDF-1 and TDF-2 according to MTCA guidance for the terrestrial ecological evaluation procedures (WAC 173-340-7493). For off-Site adjacent land, the simplified terrestrial ecological evaluation was conducted using the procedures in WAC 173-340-7492.

3.4.1 Vegetation and Perimeter Soil Sampling

A Site reconnaissance was conducted on June 21, 2005 to determine exact sampling locations in susceptible areas where browse foliage could be co-located with tailings material, geotechnical test pit logging and sampling locations. Susceptible areas included the tailings facilities, groundwater seepage areas and animal trails through tailings material and into off-Site areas. On June 28, 2005, the off-Site adjacent lands were traversed during the wildlife surveys. Animal trails and potential sample areas were identified from aerial photos and during Site reconnaissance. Field sampling on TDF-1 and TDF-2 for vegetation, soil, and litter, fibre and humus (LFH) was conducted on July 25 and 26, 2005. Animal trails and groundwater seepage areas in adjacent off-Site areas were sampled for vegetation and soil on July 27, 2005.

Vegetation samples were immediately frozen and archived until the Canadian Food Inspection Agency (CFIA) application to *Import Plants and Other Things* and the *Request for Release* under the *Plant Protection Act* had been granted. Upon permit approval, samples were retrieved from the mine storage facilities and transported across the Canada/United States border on August 25, 2005 for immediate delivery to Cantest Laboratories Ltd. (Cantest) in Vancouver, British Columbia, Canada for analysis and/or archive.

3.4.2 Field Sampling Procedures

Field sampling procedures for soil and vegetation samples as well as sample identification and labeling, sample equipment decontamination, sample handling prior to analysis, quality control, and data management are documented in *Remedial Investigation/Feasibility Study Workplan for the Pend Oreille Mine Tailings Disposal Facilities TDF-1 and TDF-2* (Golder 2005) and *Soil Protocol for Soil Import Permit Specific Work Instructions* (Cantest and Golder 2005).

Vegetation samples chosen for collection were based on patterns of wildlife use, browse availability, and distribution throughout the Site. Conifer, lichen, shrub, herb, and grass samples were collected, where they occurred, to correlate the foliar metals concentrations with those in the associated soils samples collected from the co-located geotechnical test pit sample locations and vegetation field sampling locations adjacent to TDF-1 and TDF-2 that could not be accessed with a backhoe in adjacent areas. Vegetation and ecologic soil sampling locations adjacent to TDF-1 and TDF-2 represent animal paths and potential tailings erosional areas and are shown on Figure 3-6.

LFH sampling was conducted concurrently with vegetation and soil sampling field work. LFH samples were collected, where available, from the plot center soil core location. A 10 × 10 cm sample was collected using a stainless steel garden trowel. This trowel was washed between sampling locations with the decontamination methods described in Golder (2005). Samples were archived for later analysis as necessary.

Twenty-eight sampling locations were selected for the terrestrial ecological risk assessment sampling program. Twelve locations were sampled on TDF-1 and five on TDF-2, to be co-located with tailings material test pit sampling locations. A set of near surface soils were obtained from the fringe area along the TDF-1 wetlands perimeter for ecologic risk evaluations and are designated Ben-1 through Ben-6. One area was sampled in a groundwater seepage area selected for groundwater and seep sampling, and two areas were sampled in additional off-Site locations co-located with other seep sampling locations. In addition, seven sampling locations were selected on adjacent off-Site animal paths and areas between TDF-1 and TDF-2. Collections included 66 soil samples, 13 lichen samples, 74 vegetation samples, and 14 LFH samples. Three duplicate soil samples were collected as per quality control procedures in Golder (2005). Table E-1 in Appendix E lists the inventory of the samples collected for potential analysis. Selected ecological risk indicator samples were analyzed for metal content. Table E-1 in Appendix E identifies vegetation and soil samples selected for laboratory metal analysis.

3.4.3 Analytical Chemistry and Results

Vegetation and soil samples were sent to Cantest and archived until the selection of samples was chosen for analysis. The TDF-1 wetland perimeter soils samples were sent to AVL for metal analysis. Designated samples were analyzed for total metal COPC content. Laboratory analytical results of the selected vegetation tissue samples are presented in Table 3-12 and of soil samples in Tables 3-13 and 3-14. All samples were then disposed of as outlined in *Cantest Ltd. Quality Manual Version 17* (Cantest Laboratories Ltd. 2005) and *Cantest Ltd. Health and Safety Manual for Waste Disposal* (Cantest Laboratories Ltd. 2004) as per CFIA permitting approval and regulations.

Standard operating procedures, in compliance with acceptance criteria for data quality, handling, and holding times were followed as outlined in Golder (2005).

3.5 Wildlife Surveys

A reconnaissance-level wildlife survey was conducted to determine habitat use on the tailings facilities as well as adjacent off-Site areas.

3.5.1 Wildlife Survey Methods

A Site visit was conducted on June 28, 2005 by two professional biologists. They conducted a reconnaissance-level, one-time survey for wildlife by walking through the portion of the tailing facilities and the adjacent forested areas. The survey was conducted between about 0630 and 1200 hours. One biologist focused on searches for amphibians along wetland and ditches on TDF-1 and riparian areas in the adjacent off-Site property. Searches were conducted by walking along the edges of wet areas and looking for adult and/or larval amphibians.

The other biologist focused on breeding bird surveys. Survey methodology mainly followed British Columbia standards for variable width transect breeding bird surveys (RIC 1999). However, since the intent of the surveys was to provide exact locations of birds, some modifications of methods were required. Transects followed natural contours of terrain rather than any pre-selected routes. The observer used a GPS to mark his position and recorded all birds when they were heard or seen. When a bird was detected, a rangefinder and compass were used to estimate distance and direction from the observer.

Observers also recorded any sign (tracks, scat, feathers, fur, etc.) of wildlife found at the Site.

3.5.2 Results

Thirty-three species of birds were detected during the wildlife survey period and are presented in Table F-1 in Appendix F. Most species were associated with forested portions of the study area. The forested parts of the study area contained a variety of coniferous, deciduous, and mixed stands. In addition there was a range of seral stages from early seral to mature. The forest/mine tailing interface often was well-vegetated with deciduous shrubs. This combination of habitats within a relatively small area provided many habitat types and likely accounted for the high diversity of bird species at the Site (a range of songbirds including flycatchers, vireos, warblers, wrens, and sparrows; raptors such as Great Horned Owl and Northern Goshawk; woodpeckers, and one shorebird).

Several species (Turkey Vulture, Violet-green Swallow, Black Swift) were noted flying over the study Site and were not directly "using" the Site, but added to the overall diversity. The mine tailings areas, which were poorly vegetated, were used by few species and individuals. One Killdeer (a shorebird) was present on the tailings. This species uses open and relatively barren habitats. In the shrubby edges of the tailings areas several songbird species were found including Lazuli Bunting, Chipping Sparrow, Orange-crowned Warbler, Dark-eyed Junco, and Song Sparrow.

Several species were confirmed to breed (although most species detected were probably breeding in the area) including Chipping Sparrow (2 nests with eggs), Dark-eyed Junco (1 nest with eggs), Song Sparrow (adult carrying food to young), Red-naped Sapsucker (vocal young in a nest heard at a distance) and Orange-crowned Warbler (female acting agitated at observer). A juvenile Great Horned Owl present on the Site suggested a nearby nest.

Searches for amphibians found one adult Columbia Spotted Frog in a ditch along the edge of TDF-1 eastern boundary, adjacent to the wetland. Surface water was very limited on the Site and the presence of this frog was surprising. Four species of mammals were either observed or deduced based on tracks or scat found. Red Squirrels were numerous in forested parts of the Site. Elk tracks were common on bare soil areas of the Site and a herd of 18 was observed (9 cows, 7 calves, and 2 young bulls). Tracks and scat of deer (mainly White-tailed Deer although Mule Deer likely occur as well) were also numerous. One coyote was observed on the Site and scat was also noted. It is likely that many other species of mammals inhabit the Site but were not detected.

3.6 TDF-1 Piezometer Water Level Monitoring

Water elevations were measured periodically on TDF-1 to characterize the hydrologic conditions of the tailings facility, monitor any temporal effects to the groundwater flow system, and assess the stability of TDF-1.

3.6.1 Sampling Activities and Methods

Monthly water level measurements were manually collected during the remedial investigation from five existing piezometers (P01, P02, P03, P04, and P05) on TDF-1 (see Figure 3-2) for 12 months from July 2005 to July 2006 to monitor any water level variations on TDF-1 as a result of snow melting or other changing hydrologic conditions. Water levels were measured using an electronic water level sounder to measure the depth to water from the surveyed top of casing elevation.

Based on the monthly water level measurements combined with water levels measured in other existing piezometers on TDF-1, pressure transducers were installed in April 2006 in three piezometers (PP-A, PP-C and G-1-S) to continuously record any variations in water levels on TDF-1 (see Figure 3-2). One *PT2X INW Smart Sensor* pressure transducer was installed in each of the selected piezometers at a sufficient depth below the water table to remain submerged throughout the year in order to collect continuous logs of water level readings at 4-hour increments. Piezometers PP-A and PP-C equate to DM-1 and DM-2 (Dames & Moore, 1988), respectively, and are located near the face of the dam on TDF-1. Piezometer G-1-S was previously installed by Golder Associates (Golder 1996) and is closer to the center of TDF-1 near piezometer P02.

3.6.2 Results

Monthly water level measurements for the five existing piezometers (P01, P02, P03, P04, and P05) on TDF-1 during the 12 month period from July 2005 to July 2006 are illustrated in Figure 3-7. Water levels in these piezometers do not appear to fluctuate greatly, with less than 5 feet of variation throughout the year. The greatest changes in water levels occurred during winter and spring. Furthermore, the piezometer with the more rapid recovery rates observed during groundwater sampling activities, P02, consistently displayed the least amount of water level variation throughout the year.

The hydrograph of transducer measurements presented in Figure 3-8 illustrate the more detailed water level readings recorded in piezometers on TDF-1. Figure 3-8 indicates that the piezometers near the dam face of TDF-1 (PP-A and PP-C) displayed very little variation in water levels, while the piezometer closer to the center of TDF-1 (G-1-S) displays less stable water table conditions. The water level in G-1-S appears to be responding more quickly to changing hydrologic conditions at TDF-1 than the water levels in PP-A and PP-C, although the overall change of the water level in G-1-S is less than 1 foot during each month, which is similar to the overall changes of water levels in PP-A and PP-C. Therefore, the immediate response of the water table fluctuations near the dam face of TDF-1 appears to be slower than the response of water table fluctuations at the center of the tailings impoundment; however, the overall water table variations across TDF-1 appear to vary from 1 to 5 feet throughout the year depending on location.

4.0 SITE CONDITIONS AND NATURE AND EXTENT OF COPC

The Site model is presented in this section and includes the physical and biological conditions at the Site and surrounding area. The information and data used for describing the Site physical and biological conditions were obtained from available literature and data generated during the RI as presented in Section 3. Potential regulations or requirements are compiled for each COPC from which conservative screening levels are established. The results of the RI investigation and analytical results of sampled media that were presented in Section 3 of this report are compared to the screening levels for a determination of the extent of COPC that may represent an unacceptable risk. The chemical and physical nature of COPC and their environmental fate and mobility is discussed.

4.1 Physical and Biological Setting

The physical and biological setting at the Site is presented in this section.

4.1.1 Topography

The topography is generally mountainous, with the northward flowing Pend Oreille River forming a broad alluvial valley south of Metaline Falls. North of Metaline Falls to the U.S.-Canadian border, the river is more deeply incised through sedimentary bedrock. The Pend Oreille River joins the Columbia River north of the U.S. - Canadian border. Elevations in the region range from 6,830 ft amsl in distant mountains to 1,990 ft amsl at the Pend Oreille River adjacent to the mine site.

The surface elevations of TDF-1 and TDF-2 are approximately 2,250 ft amsl and 2,335 ft amsl, respectively. The topography between TDF-2 and TDF-1 declines westerly at a 25 to 50 percent slope. West of TDF-1 to the Pend Oreille River, the topography declines at about an average slope of 25 percent. At the Pend Oreille River edge, a cliff drops about 50 feet to the river.

4.1.2 Climate

The climate at the Pend Oreille Mine is influenced by the rugged topography with the prevailing winds from the north-northwest. The major weather fronts are from the Pacific Ocean and from the Arctic. The area is characterized by warm, moderately moist summers and cool, snowy winters. Based on data collected at the Boundary Dam, Metaline Falls and Newport, Washington meteorological stations since 1965, the average monthly temperatures vary from lows of 15^0 to 25 degrees (^{0}) Fahrenheit in the winter to highs of 60^0 to 70^0 in the summer (Knight Piesold Company, 1999). Freezing temperatures have been recorded in the area in June and as early as September.

The average annual precipitation is about 30 inches per year and is relatively evenly distributed throughout the year (Ecology, 2000). Winter snowfall ranges between 40 and 80 inches and is common during December through February. The estimates for the maximum precipitation event for the 24-hour, 100-year, and 24-hour, 500-year storms are 3.5 and 3.8 inches, respectively. Mean annual evaporation has been estimated to be 20.2 inches per year and primarily occurs from May through September.

4.1.3 Soils

Soils near the Site are derived from the weathering of glacial till, colluvium, and glaciofluvial and glaciolacustrine sediments (Soil Conservation Service, 1992). Podzols are common at elevations above 3,600 feet and Brunisols are present in the lower elevations along the valley slopes and in the valleys.

The Soil Conservation Service (SCS) mapped the soils in the vicinity of the Pend Oreille Mine to be the Bonner-Orwig-Kanisku and the Cusick-Martella-Anglen general units. The map of soils types/units are shown in Figure 4-1. Table 4-1 identifies each soil type and general characteristics on depth, drainage, erosion potential and topsoil suitability. The soils in the area are described by the SCS as deep, moderately to well-drained soils formed in glacial outwash or glacial lake sediments that often have a mixture of glacial material and volcanic ash.

4.1.4 Tailings Agronomic Soil Characteristics

The results were compared to several criteria for evaluating soil, including:

- Ecological Indicator Soil Concentrations (mg/kg) for Protection of Terrestrial Plants and Animals (WAC 173-340-900 Table 749-3);
- Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision (Efroymsen, et.al., 1997); and
- Various guidelines for evaluating nutrient and agronomic status of soils in the Western U.S., including (OSM 1999, WDEQ 1999, NMMMD (no date) and Follett, et.al., (1991).

It is important to note that the evaluation criteria are guidelines, not mandatory criteria. The appropriate metal concentration in a soil is a function of numerous factors, including soil texture, organic matter content, pH, oxidation reduction potential (ORP), and relative abundance of carbonates, iron and manganese hydrous oxides, etc. Likewise, most nutrient guidelines are based on research for agricultural crops. The limited research related to nutrient level of soils for native species indicates that native species have lower nutrient requirements.

Nutrient Status

The tailings are deficient in the essential macronutrients, nitrogen, phosphorus, and potassium. Average macronutrients concentrations in the samples are: available nitrogen (N) <1 ppm, available phosphorus (P) <1 ppm and available potassium (K) 16 ppm. Generally, soil test levels of 10 to 20 ppm N, >11 ppm P, and > 60 ppm K are considered adequate to support native vegetation.

Average soil reaction, measured as pH, was reported as approximately 7.5. This value is normal for Western U.S. soils and native vegetation. Organic matter for the samples averages about 2.8%, which is considered adequate for establishing native vegetation in the Western U.S., and similar to the average organic matter content reported for native soils in the area (Soil Conservation Service 1992).

Metals

The laboratory results indicate that total cadmium, lead, and zinc are present in concentrations considered potentially phytotoxic (Efroymsen, et.al., 1997) on both TDF-1 and TDF-2. Total copper on TDF-2 exceeds potentially phytotoxic concentrations. As stated earlier, the phytotoxicity of a given metal concentration in a soil is a function of numerous factors, including soil texture, organic matter content, pH, ORP, and the abundance of carbonates, iron and manganese hydrous oxides, etc. These factors all influence the partitioning of the metal into insoluble and soluble components. Insoluble compounds are not available to plants. The available research indicates that, particularly for arsenic, total concentration is not a good indicator of phytotoxicity. Therefore, the samples were also analyzed using an ammonium-bicarbonate DTPA extractant (AB-DTPA). AB-DTPA is designed to mimic the chemistry in the vicinity of a plant root, and provide an estimate of the plant-available portion of the total soil metal pool. The results are presented in Table 3-3. The results indicate that plant available zinc and lead exceed the concentration generally considered phytotoxic on both areas, and copper exceeds plant-available concentrations on TDF-2. There are insufficient data in the literature to determine a potentially phytotoxic plant-available concentration for cadmium.

In general, total and plant available metal concentrations are higher on TDF-2 than TDF-1. Furthermore, the southern part of TDF-2 (Test Pits -T15, -T16 and -T17) has higher copper (total and plant-available) concentrations than the northern portion (Test Pits 13 and14). It is of particular interest that there is little or stressed vegetation on the southern portion of TDF-2. The plant-available copper concentration on the southern portion of TDF-2 exceeds the potentially phytotoxic level, while it is below the potentially phytotoxic level on the lower part of TDF-2 and all of TDF-1.

Although the agronomic analyses results in general indicate that the tailings are a poor plant growth medium due to lack of nutrients and elevated metals, vegetation has established to varying degrees on most of the tailings. As stated above, the benchmark values for the metals presented above are guidelines above which phytotoxic effects may occur. However, the effect is a function of numerous other soil factors that can increase or reduce the impact on vegetation. The presence of organic matter, slightly alkaline pH and presence of carbonates in the tailings are all factors that reduce the availability of metals and mitigate the impact to vegetation. Despite the elevated soil metal concentration, few symptoms of metal toxicity were observed in the vegetation on the tailings. In addition, plant tissue samples were analyzed (Section 3.5) for metals. The results indicate that the metals of concern were not present in plant tissue at concentrations that are generally considered toxic to plants. The one exception was zinc, which was reported in the black cottonwood at levels well above the 400 ppm concentration generally considered to be toxic (Kabata-Pendias and Pendias (2002), but the cottonwood trees appeared to be healthy on TDF-1

4.1.5 Vegetation

The Pend Oreille Mine is located within the Okanogan Highlands physiographic province. Most of the surrounding area to TDF-1 and TDF-2 is forested except for the current mining activities (TDF-3 and ventilation portals) and the golf course. The predominant forest cover is coniferous and mixed conifer and hardwood stands. Common conifer tree species include western red cedar, western larch, white pine, lodgepole pine, and Douglas fir (Ecology, 2000). Grand fir, western hemlock, ponderosa pine, and Engleman spruce are less common. Deciduous trees include black cottonwood, paper birch, red alder, quaking aspen, and willow. Most of the conifer forest in the mine vicinity has been harvested in the past, and stands are in the pole to young mature stage (6- to 12-inch diameter at breast height).

Common shrubs include snowberry, vine maple, rose, thimbleberry, kinnikinnick, Cascade Oregon grape, Pacific ninebark, and red-osier dogwood. More open forest stands and forest openings have dense cover of forbs and grasses, and are dominated by spreading dogbane, wild strawberry, several species of ferns, asters, and bentgrass and other grasses.

4.1.6 Wildlife

The region including the Selkirk Mountains contains a diversity of wildlife species and habitats representative of northeastern Washington. This section will focus on the types of habitat at the Site and immediate surroundings, as well as threatened, endangered, and sensitive species that are known or suspected to be in the area. A listing of species identified at the Site can be found in the Final Environmental Impact Statement – Pend Oreille Mine Project (Ecology, 2000) and in Appendix F.

4.1.6.1 Habitat

Four general habitat types were identified in the area surrounding the Site:

- Coniferous forest;
- Grassland/shrubland;
- Wetland/deciduous riparian; and,
- Disturbed.

Maps the types of vegetative cover present at the Site and in the adjacent area (Figure 4-2) are supplemented by quantitative descriptions of the cover types in Table 4-2.

4.1.6.2 Endangered, Threatened, Sensitive and other Priority Species

There are several amphibian, bird and mammal species of concern that may use the Site or surrounding area. There are several wildlife species of concern (Table 4-3) identified by their status by Federal and Washington State agencies (Ecology, 2000). Several of these animals were not identified to be present at the Site or surrounding environments, including California Wolverines, and Grey Wolfs. Several of the animals of concern listed on are not expected to live on or in the vicinity of the Site because of elevation or habitat types, but could be an infrequent transient visitor.

4.1.7 Geology

This section describes the regional geologic setting followed by Site-specific geology encountered during subsurface investigations at the Site.

4.1.7.1 Regional Geology

The Site is located in the Metaline Zinc-Lead District (Metaline District), which covers about 75 square miles around Metaline Falls and the Pend Oreille River. The oldest bedrock in the Metaline District is Paleozoic Cambrian limestones and dolomites called the Metaline Limestone. More recent bedrock includes the Ordovician Ledbetter Slate and an unnamed Silurian/Devonian black argillite (shale). These sedimentary bedrocks were formed in an ancient marine depositional environment that began during the Cambrian Period and lasted into the Ordovician Period (Dings and Whitebread, 1965). The depositional environment is believed to have rapidly changed from shallow marine to a deeper marine depositional environment based on the abundance of breccias within the carbonate rocks and the presence of turbidite in the slate (Morton, 1992).

During the late Cretaceous Period (100 to 200 million years ago) rocks in the Metaline District were folded, faulted, and intruded by igneous dikes, sills, and stocks as part of a major orogenic episode. During the early Tertiary (about 50 million years ago), another episode of folding and faulting occurred in the Metaline District and created a wedge-shaped graben that characterizes the area along the Pend Oreille River. Figure 4-3 illustrates the geologic cross-section across the Pend Oreille River valley and shows the approximate location and orientation of the graben.

During the Quaternary Period (Pleistocene Epoch), the area was glaciated and ice covered much of the bedrock and left numerous glacial landforms. The Pend Oreille River follows a former glacial valley. Glaciofluvial and glacial lake bed deposits mantle much of the bedrock and can be up to 500 feet thick in places. Glacial kame terraces exist at two prominent elevations of about 2,100 ft amsl and 2,575 ft amsl in the area. Glacial kettles are numerous in the area and have created some of the local lakes, ponds, and wetlands.

4.1.7.2 Mineralization

Mineralization occurred within the Metaline district as hydrothermal fluids ascended along faults. Hydrothermal fluids were impeded by the Ledbetter Slate and precipitated within upper sequences of the underlying Metaline Limestone. The Metaline Limestone is about 5,500 feet thick. The principal ore bearing horizons within the upper Metaline Limestone are the Josephine Horizon and the Yellowhead Horizon. The Josephine Horizon consists of irregular, localized bodies of ore mineralization hosted by grey to black siliceous carbonate breccia within the upper 450 to 500 feet of the Metaline Limestone. The Yellowhead Horizon occurs as discrete, blanket-like zones from 900 feet to 2,300 feet below the top of the Metaline Limestone. The principal minerals in the ore zones are sphalerite, galena, pyrite, calcite, dolomite, and jasperoid. In oxidized portions of the ore zone, minerals such as smithsonite, cerrusite, and limonite occur and contain the base metals. Copper minerals are occasionally found, but are considered rare. Pyrite is more prevalent in the Yellowhead Horizon in the Pend Oreille Mine (Ecology 2000).

4.1.8 Site Geology

The geology at TDF-1 and TDF-2 are consistent with the regional geology. The sequence starts with glaciofluvial sediments at the surface with the Ledbetter Slate comprising the underlying bedrock, which is over 1,000 feet thick. The Metaline Limestone is encountered below the Ledbetter Slate and extends for over 5,000 feet. Underground mine workings exist in the vicinity of TDF-1 and TDF-2. The mine workings are typically within the Josephine Horizon and the Yellowhead Horizon.

The Site geology along the transect lines shown in Figure 4-4 are illustrated in Figure 4-5 through 4-9. TDF-1 is located on the kame terrace observed at about the 2,250 ft amsl elevation. Most of the tailings materials in TDF-1 appear to be directly in contact with the Ledbetter Slate. The borings in the northern portions of TDF-1 have encountered glacial sediments directly below tailings materials. TDF 2 appears to be underlain entirely by glacial sediments before the Ledbetter Slate is encountered. The thickness of the glacial sediments below TDF-2 varies but is 80 feet at MW-201. In the north portion of TDF-2, tailings are in contact with the Ledbetter Slate. West of TDF-1, the land surface falls rapidly to the Pend Oreille River. The Ledbetter Slate is the bedrock and appears to be relatively shallow beneath a veneer of glacial sediments and colluvium materials. A 50-foot high cliff exists at the edge of the Pend Oreille River and comprises the Ledbetter Slate. Outcrops of the Ledbetter Slate were observed surrounding TDF-1 and are shown in Figure 4-10. The surface of the Ledbetter Slate has been estimated based on boring logs and outcrops and is shown on Figure 4-11.

4.1.9 Site Hydrology and Hydrogeology

As they are interrelated, the conceptual Site hydrogeology and hydrology are presented together in this Section.

4.1.9.1 Hydrology

The glacial sediments and soils are permeable and most precipitation directly infiltrates with little overland flow. Drainage occurs along well defined channels and is typically fed by discharging groundwater. The major drainages in the vicinity of TDF-1 and TDF-2 are two creeks called Creek #1 and Creek #2. The locations of these creeks are shown on Figure 2-2. Creek #1 has flowing surface water most of the year (Ecology, 2000) and Creek #2 is perennial. Creek #1 begins northeast of the tailings facilities near the golf course and flows westward to the north of TDF-1 within a well defined channel. Creek #1 discharge was measured during both sampling events to be about 5 gpm before discharging directly to the Pend Oreille River. Creek #1 does not drain TDF-1 or TDF-2. Creek #2 currently originates below the TDF-1 dam along the northwest side, flows westward, and discharges directly to the Pend Oreille River. Creek #2 is formed by the discharges from surface water diversion systems along the north half and south half of TDF-1, the decant and drainage system within TDF-1 and numerous springs/seeps below the toe of the TDF-1 dam. Based on limited observations, Creek #2 flow has varied from 15 and 60 gpm. Creek #2 cascades over a 50-foot high cliff to enter the Pend Oreille River. Therefore, there is no fishery migration occurring from the Pend Oreille River into Creek #2.

A third unnamed drainage exists along the southwestern portion of TDF-1 (designated UD-1). The gradient in this drainage is westward to the Pend Oreille River. This unnamed drainage did not have surface water flow during any Site visit during the RI or previous investigations (Ecology, 2000). The drainage may have had flowing water at times prior to the construction of TDF-1, but appears to currently be only a small groundwater seep pool.

4.1.9.2 Hydrogeology

Based on the Site geology, the relevant hydrostratigraphic units of interest to the RI/FS for TDF-1 and TDF-2 is comprised of two aquifer systems that are separated by an aquitard. The hydrogeologic stratification at TDF-1 and TDF-2 from the surface to depth is as follows:

- A surficial unconfined aquifer in the glacial sediments and soils. This aquifer lies over the Ledbetter Slate.
- A laterally continuous Ledbetter Slate, which is an aquitard having a thickness of over 1,000 feet that separates the surficial unconfined glacial aquifer from the deeper regional bedrock aquifer.
- The bedrock aquifer in the Paleozoic Metaline Limestone. This aquifer is originally within fractured bedrock. Because of the extensive underground mining and mine dewatering, this aquifer system is strongly influenced by the mine workings and mine water pumping and discharge.

The unconfined surficial aquifer in the glacial sediments varies in saturated thickness depending on the thickness of the glacial sediments. These sediments vary considerably from several feet to hundreds of feet typical of a glacial kame terrace and kettle depositional environment. This unconfined aquifer system is in hydraulic communication with the tailings material in TDF-1, but is only in contact with tailings in TDF-2 in the northwestern corner. The Ledbetter Slate rises in elevation along the northern perimeter of TDF-2 and was found to be unsaturated in MW-202 and borehole LSB1. The Ledbetter Slate is a hydrogeologic barrier to groundwater flow to the north.

The overall groundwater flow in the unconfined aquifer is to the west and northwest toward the Pend Oreille River from topographically higher areas to the southeast. Figures 4-12 and 4-13, respectively, illustrate the potentiometric gradient and groundwater flow direction at the Site during August 2005 and May 2006. The Wetland #1 and #2 seeps that exist along the east side of TDF-1 represent day-lighting of the glacial sediment aquifer from underneath TDF-2. Some of the groundwater within glacial sediments along the east side of TDF-1 discharges to form a wetland along a portion of the eastern perimeter of TDF-1, while the remainder passes through the TDF-1 tailings. Much of the springs/seeps along the east side of TDF-1 are captured in lined drainage ditches that were constructed by Teck Cominco American Incorporated several years ago. This surface water is diverted within the lined drainage ditches along the perimeter of TDF-1 and discharged to a surface water drainage on the west side of TDF-1 called Creek #2 described above.

Most of TDF-1 appears to be directly on the Ledbetter Slate, except for the more northerly portions of the facility. Along the north perimeter of TDF-1 the Ledbetter Slate ridge continues its westerly trend from TDF-2 and rises in elevation (see Figure 4-8, 4-9 and 4-11). The Ledbetter Slate is a hydrogeologic barrier to TDF-1 groundwater flow toward the north. TDF-1 has a decant structure that drains surface and groundwater to an underdrain horizontal pipeline. This pipeline discharges collected water to the beginning of Creek #2 along the northwest side and below the TDF-1 dam.

Creek #2 appears to receive most surface and groundwater from both TDF-1 and TDF-2. Groundwater from TDF-1 that is not captured and discharged to Creek #2 flows westerly through TDF-1 to a veneer of glacial sediments and colluvium on top of the Ledbetter Slate toward the Pend Oreille River. This groundwater would be representative of shallow groundwater emanating at the toe of TDF-1 dam in springs and seeps. A ridge of Ledbetter Slate outcrops along the north and south sides of TDF-1 and TDF-2 (Figures 4-10 and 4-11), but along the south side of Creek #1. This slate ridge is believed to separate groundwater within the tailings facilities from flowing and entering Creek #1.

The hydraulic gradient varies considerably along the groundwater flow path. Changes in the hydraulic gradient are representative of changes in hydraulic transmissivity and conductivity of the materials. The glacial sediments are heterogeneous with transitions between clayey silts to sandy gravels. A particularly permeable sand and gravel zone was observed in monitoring well MW-201 appears to extend to TDF-1 based on the low hydraulic gradient along this flow path. The hydraulic gradient within these permeable sand and gravels is about 0.01 ft/ft (Figures 4-12 and 4-13). The hydraulic gradient in the northern portion of TDF-2 is higher at about 0.12 ft/ft. The hydraulic gradient through TDF-1 tailings materials is relatively constant and averages about 0.1 ft/ft. The tailings are fine-grained silty materials and have lower hydraulic conductivity than the glacial sediments. The range of specific groundwater discharges and average linear velocities of the groundwater is estimated for the each of the Site areas having different hydraulic gradient and hydraulic conductivity as follows (assuming an effective porosity of 25 percent):

- In the sand and gravel aquifer between TDF-2 and TDF-1, the groundwater specific discharge averages 2.5 ft/day (ranges between 1 and 4 ft/day) and the groundwater linear velocity averages 10 ft/day (ranges between 4 and 20 ft/day);

- In the north portion of TDF-2, the groundwater specific discharge is about 2.4 feet./day and groundwater linear velocity is about 10 ft/day; and
- In TDF-1, the groundwater specific discharge averages 0.04 ft./day (ranges between 0.03 and 0.05 ft/day) and the groundwater linear velocity averages 0.17 ft/day (ranges between 0.14 and 0.2 ft/day).

4.1.10 TDF-1 Stability

Analyses were completed to assess the stability of the tailings in TDF-1 with respect to dispersion by geotechnical mechanisms such as slope stability, seismic triggers, and by hydrologic forces such as flooding, debris flows, and surface erosion. These analyses, described in greater detail in Appendix G, were used to determine the stability of the embankment face at its current slope, and to determine stabilization measures.

The stability of the tailings embankment and impoundment were evaluated with respect to sliding under both static and seismic conditions. After establishing appropriate design criteria, the preliminary reconfigurations of the dam and impoundment necessary to achieve those criteria were defined.

For the purposes of these stability analyses, and based on the results of previous studies, the stability for 2.5 Horizontal (H):1 Vertical (V) and 3H:1V slope inclinations was analyzed. The analyses focused on the global stability of the embankment. Two sections (A-A' and B-B' in Figures 4-5 and 4-6) through the embankment were analyzed. The primary difference between the sections is that soil (sand and gravel), instead of bedrock, is present beneath the tailings in Section A-A'.

The commercially available slope stability software package Slide, Version 5.025, was utilized for all stability analyses. The program allows the user to calculate the factor of safety against sliding using many different methods and along different shaped slip surfaces. For the purposes of this report, all calculations used Spencer's Method and circular slip surfaces.

Static and Seismic Stability Analysis Summary

Based on guidelines from the Washington State Dam Safety Office (Ecology, 1993a), and the Army Corp of Engineers (COE, 2003), a factor of safety equal to 1.5 for the static condition was used as the benchmark for stability. The target factor of safety for seismic loading, using a pseudo static method of analysis, is typically 1.0, given the conservative nature of the analysis.

In its current configuration, the embankment face is steeper than 1.5H:1V. The factors of safety for this configuration were calculated to be less than 1.5 for a crest to toe type global failure Therefore, the long-term stability of the embankment does not meet the stability criteria.

Therefore, the static stability of the two selected sections at the re-graded slopes was assessed. The minimum static factor of safety against global stability for Section A-A' at 3H:1V was calculated as **1.70** and at 2.5H:1V was calculated at **1.57**. The minimum static factor of safety for Section B-B' at 3H:1V was calculated as **1.81** and at 2.5H:1V was calculated at **1.54**. This indicates that, based on static analyses, a 2.5H:1V slope angle is acceptable. Based on these results, we are confident that the factors of safety for both Section A-A' and B-B' at 2H:1V are less than 1.5.

Sections A-A' and B-B' were also analyzed for the seismic case. For the project Site, the peak ground acceleration (PGA) for the 475-year event is 0.06g and for the 2,475-year event is 0.13g. The 2,475 year event is considered the more conservative case (larger seismic event). For the 2,475-year seismic event, the 2.5H:1V slope resulted in a factor of safety of **1.10** for both Sections A-A' and B-B'. For the 3H:1V slope, the factors of safety were **1.15** and **1.24** for Sections A-A' and B-B', respectively.

Permanent deformation of the embankment is unlikely for either section based on the calculated factors of safety. The above results indicate that a 2.5H:1V slope angle is considered acceptable.

Hydrologic Analysis Summary

Various hydrologic events were considered to determine the capacity of existing drainage features. The events considered ranged from the 2-year, 24-hour event to a local Probable Maximum Precipitation (PMP) 6-hour event, which is the most extreme event that could occur at the Site (Ecology, 1993b). The diversion channel was designed to convey 38 cfs. This is sufficient capacity for the 10-yr, 25-yr, 100-yr and 500-yr, 24-hr storm estimates from the Hydrologic Engineering

Center-Hydrologic Modeling System analyses. However it will not pass the peak flow from PMP events.

Because the diversion ditch is small in some places, it is reasonable to assume that the diversion ditch may fail during a storm event and water would have to be stored behind the TDF-1 dam or released along another pathway (e.g., dam overtopping or spillway).

Long–Term Erosion Potential Summary

The potential for debris flows threatening the containment of the tailings was evaluated and found to be inconsequential. There is a high risk for long term erosion potential of the outer embankment slope; therefore, it must be addressed through a combination of placing armor rock, establishing vegetation and maintenance. By blending local limestone rock from the waste rock supply into fine grained surface materials that will support vegetation, the surface can be made stable against long term erosion. The details and results of these analyses are described in greater detail in Appendix G.

4.2 Human and Ecological Risk Screening Levels

This section develops conservative screening levels for identifying COPC at the Site based on Federal and State applicable, relevant, and appropriate requirements. Constituents that are above the screening levels were considered further in a risk assessment in Section 5 for the specific COPC, media, and agreed receptors potentially exposed.

4.2.1 Human Risk Screening Levels

Potentially applicable risk-based concentrations for human receptors were identified for soil (Table 4-4) and water (Table 4-5) from Federal and Washington State established criteria for the protection of human health. Some of the listed criteria include multiple pathways for potential exposures. For example, surface water criteria for human screening levels include criteria for drinking surface water and/or eating aquatic organisms from the surface water body. Other relevant criteria, including Washington State background concentrations and analytical PQLs that must be considered when selecting a risk-based screening level, were used (Tables 4-4 and 4-5). Screening levels or cleanup levels cannot be below background or analytical PQLs. The selected human risk-based screening levels for each COPC (Tables 4-4 and 4-5) represent the lowest Federal or State risk-based criteria that are above accepted State background levels and analytical PQLs. Two soil screening levels are presented for human risks; one assuming an unrestricted land use and the other assuming an industrial land use.

4.2.2 Ecological Screening Levels

Potentially applicable risk-based concentrations for ecological receptors were identified for soil/sediment (Table 4-6) and surface water (Table 4-7) from Federal and Washington State established criteria for ecological protection. No comparable screening values are provided for fresh water sediments, but for screening purposes sediment COPC concentrations were compared to the soil clean-up standards and in relation to proposed sediment guidelines in Washington State for some COPC (Ecology 2003). Each Federal and State applicable criterion is identified in the tables. Washington accepted background concentrations and standard PQLs are also included on the tables, since screening levels or cleanup levels cannot be below background or analytical PQLs. The RI/FS uses the clean-up goal as the screening concentration rather than a more conservative toxicity threshold value used in the more detailed Ecological Risk Assessment (ERA) that involve multiple iterations. Interpretation of results using the MTCA criteria in some cases relies on more detailed analyses of recent Federal summaries, in particular for:

- Lead in soils for mammalian receptors;
- Cadmium in soils for avian and mammalian receptors; and
- Zinc in soils for plant receptors.

4.3 Extent of Potential Risks from Metal COPC

The extent of COPC above human and ecological screening levels by media is defined herein by the presence and levels of constituents above screening goals (Table 4-8). Based on the information discussed in this subsection, Site investigations have adequately defined the extent of metals to proceed with this RI/FS Report. Other analyzed parameters were not detected above human or ecological screening levels and these compounds are not considered further. The COPC and associated media that have concentrations above human or ecological screening levels (Table 4-8) are considered in the risk assessment in Section 5.

Human Screening level Exceedances

The only COPC that are above any human health risk levels are;

- Lead in TDF-1 and TDF-2 tailings materials;
- Lead in Creek #2 and TDF-1 Wetland sediments
- Lead in the Seep #4 water during the May 2006 period; and
- Secondary drinking water criteria for zinc, iron, manganese and sulfate in groundwater and seep water.

The upper 95% confidence level ($UCL_{95\%}$) of the mean lead concentrations in tailings are above the MTCA levels of 250 mg/kg for unrestricted land use in both TDF-1 and TDF-2. The lead MTCA level of 1000 mg/kg for industrial land use is not exceeded for tailings in TDF-1 and TDF-2, when the $UCL_{95\%}$ is calculated using all the laboratory analytical results for TDF-2 tailings (both the test pit and agronomic sample analyses). The $UCL_{95\%}$ for a normally and lognormally distributed TDF-2 tailings sample set is 958 mg/kg and 995 mg/kg, respectively, with both the test pit tailings and agronomic tailing analytical results used together in the statistical calculations. Because the UCLs are very similar for test pit soil and the agronomic soil metal concentrations from TDF-1 tailings, combining the results was not warranted.

Except for lead, COPC concentrations in all Site sediments are below MTCA levels for unrestricted land use. Site sediments have lead concentrations greater than the MTCA Method A level of 250 mg/kg for unrestricted use in Creek #2 and TDF-1 Wetland. Sediments in Creek #2 and TDF-1 Wetland contained lead concentrations less than the MTCA Method A level of 1000 mg/kg for industrial land use. The sediments within TDF-1 Wetland actually consist of mainly TDF-1 tailings and have similar COPC concentrations.

The only exceedance of a human health based Primary Drinking Water Standard or Action Level was for lead in one sample from Seep #4 during the May sampling period. The Federal and State Drinking Water Action Level for lead is 15 µg/L. The May 2006 water sample from Seep #4 had a lead concentration of 26.2 μg/L, but the August 2005 corresponding seep water sample was below the human health-based standard at 9.5 μg/L.

All other media investigated at and surrounding TDF-1 and TDF-2 have concentrations below human health screening levels for unrestricted use.

Ecological Screening Exceedances

The measured COPC concentrations in soil/sediments, surface and seep waters and Site vegetation samples (see Table 3-12) were compared to the screening levels presented in Tables 4-6 and 4-7 following the MTCA guidelines. The tailings (TDF-1 and TDF-2) exceeded screening levels for arsenic, cadmium, lead, mercury, and zinc (Table 4-8). In addition, the sediments from creeks and the wetland on TDF-1 as well as the soils on the fringe of the TDF-1 wetland exceeded screening concentrations for selenium. Except for cadmium in the Creek 1, which was selected to provide reference concentrations and is not associated with the Site, there were no exceedances of water quality parameters (Table 4-8).

4.4 Nature of Metal COPC

The COPC were identified in the RI/FS Work Plan (Golder, 2005) and mainly include the metals: arsenic, cadmium, copper, lead, selenium, mercury, and zinc. Arsenic and copper have not been detected in Site media at concentrations greater than Washington State background levels or risk-based screening levels. Arsenic, barium and copper are not considered to be a COPC for this RI/FS, because their concentrations in Site media are either below accepted State of Washington background levels or do not exceed human and ecological screening levels for plants, avian or mammalian potential receptors. Cadmium, lead, mercury, selenium, and zinc have been detected in one or more Site media above Washington State background levels and human or ecological risk-based screening levels. These metals remain COPC and their chemical properties and environmental fate processes are discussed below.

4.4.1 Metal COPC

Cadmium

Cadmium is a relatively mobile metal that is transported in the aqueous environment in solution as a hydrated cation or as an inorganic or organic compound. A typical ambient cadmium concentration range reported for soils in North America is 0.01 to 0.7 mg/kg (Lindsay, 1979); Dragun (1988) reports a range from 0.01 to 45 milligrams per kilogram (mg/kg). Ecology considers background cadmium concentrations for soils in the State of Washington to be 1.0 mg/kg (Ecology 1994).

Cadmium is often present in soils and waters as the divalent cation (Lindsay, 1979). In solution, cadmium is primarily the divalent cation or an oxide. Cadmium hydroxides, [$CdOH^+$ and $Cd(OH)_2$] are important secondary species at pH values greater than 7.5 (Lindsay, 1979). Cadmium solubility is largely affected by pH, but is not affected by redox potential. Cadmium is generally more soluble at lower pH and therefore is more mobile as pH decreases. The typical range of aqueous solubility for cadmium is approximately 0.1 to 1.0 milligrams per liter (mg/L).

The limits on cadmium solubility depend on the presence of inorganic or organic ligands. In most cases, organic substances (i.e., humic substances) can account for the majority of cadmium complexes. The second most important complexing ligand is probably carbonate followed by hydroxide. Cadmium sulfate minerals are generally highly soluble and are unlikely to form in soils.

However, under reducing conditions, in the presence of sulfide, insoluble sulfide precipitates could form (USEPA, 1979). Sorption of cadmium by clays and organic matter, co-precipitation with hydrous iron, aluminum and manganese oxides, and isomorphous substitution in carbonate minerals are all mechanisms for the removal of cadmium from natural waters.

Lead

Lead is a relatively immobile element. Typical lead concentrations in soils range from 2 to 200 mg/kg (Lindsay, 1979), but lead concentrations for natural soils have been reported ranging from 0.1 to 3,000 mg/kg (Dragun, 1988) with higher lead levels associated with sulfide mineralized areas. Ecology considers background lead concentrations for soils in the State of Washington to be 17 mg/kg (Ecology 1994).

Naturally occurring lead minerals (i.e. carbonates, sulfates, and sulfides) have low solubilities in water and are generally not very mobile in natural waters due to the tendency to be adsorbed or to precipitate from solution (USEPA, 1979). In an aqueous environment, Pb^{2+} is expected to be the primary species at a pH less than about 7. At a pH from 7 to 9, $PbCO_3$ is the primary species. Under oxidizing conditions, lead carbonates and sulfates [i.e. cerrusite ($PbCO_3$) and anglesite ($PbSO_4$)] will to a large extent limit lead solubility. In the presence of reduced sulfur, galena (PbS) will greatly limit the solubility of lead due to its extremely low solubility.

Hem (1970) suggests that in most natural waters at equilibrium, lead solubility (as Pb^{2+}) is limited to about 0.02 mg/l. As with the other metals, lead solubility is pH dependent and increases with an increase or decrease in pH. Also, as with cadmium, lead forms complexes with organic ligands, which can increase lead solubility (USEPA, 1992).

Mercury

Typical mercury concentrations in soils range from less than 0.01 mg/kg to over 0.23 mg/kg with a Washington State average of 0.07 mg/kg (Ecology 1994).

The most common natural forms of mercury found in the environment are metallic mercury, mercuric sulfide (cinnabar ore), mercuric chloride, and methylmercury. Cinnabar, HgS, has a low solubility in natural waters. The presence of organic and inorganic ligands in water systems does not enhance the dissolution of mercury from the sulfide mineral. Mercury is also more soluble at lower pH conditions. The presence of divalent cations such as Ca^{2+} has been found to inhibit the dissolution of cinnabar. However, mercury can be transformed into readily soluble aqueous species such as mercury oxides and chlorides (Stumm and Morgan,1981). Free elemental mercury has the highest solubility in water of any metal, and easily vaporizes into the air, making it very mobile in the environment under certain conditions.

The distribution of mercury species in soils is dependent on soil pH and redox potential, with increased mercury adsorption onto clay minerals, oxides, and organic matter under high pH soil conditions as well as in mildly reducing soils (USEPA, 1992). Stable solid mercury species will precipitate in the presence of phosphate, carbonate, and hydroxide in alkaline soils. However, soluble mercury complexes may be formed under mildly reducing soil conditions and in the presence of organic matter, chlorides, and hydroxides which may contribute to increased mobility. Furthermore, stable inorganic forms of mercury (Hg) can be converted to mobile organic forms by microbial action in the biosphere.

Selenium

Selenium is a naturally occurring element found in many igneous rocks, volcanic sulfur deposits, hydrothermal deposits, and in sedimentary rocks such as sandstone, carbonaceous siltstones, phosphoritic rocks, limestone, iron, coal and some crude oil deposits. Selenium is usually found in sulfide ores of the heavy metals as a substitution for sulfur. Concentrations of selenium in the soil depend on the rocks from which the soil was derived. Selenium is particularly concentrated in the soils of the drier regions of the world where the soil tends to be more alkaline (University of Idaho, http://egj.lib.uidaho.edu/egj07/bauer.htm). In soils, selenium tends to be associated with the clay fraction and, therefore, tends to have higher concentrations in heavier soils. Typically soil selenium concentrations range from <0.1 to 2.0 mg/kg with the mean concentrations generally <0.5 mg/kg (Kabata-Pendias and Pendias, 1992). Soils originating from cretaceous shales tend to have high natural (2 to 10 ppm) soil selenium concentrations (http://www.saanendoah.com/map1.html). Natural weathering of rocks and soils provide the major source of selenium to soil and groundwater. Selenium solubility varies from greater than 40 percent by weight for the sodium selenates to between 16 and 33 mg/L for the silver selenates.

Zinc

Typical zinc concentrations in soils range from 10 to 300 mg/kg (Lindsay, 1979); zinc concentration ranges for soils are from 3 to 10,000 mg/kg (Dragun, 1988) with higher concentrations typically occurring over sulfide mineralized areas. Ecology considers background zinc concentrations for soils in the State of Washington to be 86 mg/kg (Ecology 1994).

Zinc is one of the more mobile metallic elements in water with a solubility similar to cadmium; however, zinc is generally more abundant than cadmium in soils. Zinc and cadmium chemistry is very similar because both metals are Group IIB transition metals and have similar bonding capabilities and chemical characteristics. Zinc is slightly soluble under neutral to alkaline pH conditions (Lindsay, 1979). However, zinc is more soluble and, therefore, more mobile with decreasing pH. Under oxidizing conditions, zinc is present as the divalent cation.

4.4.2 Environmental Fate Processes

The COPC are metal elements, which are not subject to degradation. The COPC originate in the tailings materials and are capable of migration either through erosion via water-borne or airborne mechanisms or by becoming dissolved in contacting water and migrating with the movement of water. The erosion or dam slope failure of tailings could potentially release solid materials downslope in an uncontrolled manner. Airborne releases of tailings do not appear to be operative at the Site. The surface of the TDF-1 and TDF-2 has developed a crust and layer of lichen that minimizes the potential for fugitive dust emissions. If airborne fugitive dust emissions had occurred or are occurring at the Site, elevated COPC concentrations would be expected in surface soils adjacent to the tailings facilities. Animal pathways from the tailings facilities should represent impacts to adjacent soils from both fugitive dust emissions and animal tracking tailings material. Soil samples obtained along animal pathways adjacent to the tailings facilities are either at accepted Washington State background concentrations (Ecology 1994) or are below risk screening levels. Since low COPC concentrations were observed in animal pathways soils, there is no evidence that airborne fugitive emissions from the tailings facilities have or are operative to impact surrounding soils to unacceptable levels.

Metals dissolved in water are subjected to several physical processes including advection, dispersion, and molecular diffusion. Advection is the migration of a substance due to the bulk movement of water. Advection tends to move chemicals in the direction of flow. Hydrodynamic dispersion, which consists of both mechanical dispersion and molecular diffusion, dilutes concentrations primarily in the direction of flow. Mechanical dispersion of ground water plumes is caused primarily by the movement of ground water around the soil particles that are in the flow path. These particles divert the forward motion of ground water and tend to disperse substances. Molecular diffusion, caused by intermolecular collisions, also causes chemicals to dilute in ground water. Therefore, as COPC migrate, these physical processes, in combination with the chemical and biological processes, retard and dilute COPC concentrations in water along the infiltration and ground water pathways.

Infiltrating rainwater comes into contact with soil containing COPC at the Site. For pathways activated by contact of water with soil containing COPC (e.g., overland runoff and infiltration), the migration rate is controlled by the availability of water, the time of contact between the water and the constituents, the rate of evaporation, the permeability and wetting characteristics of soil and the vadose zone, and the solubility of the COPC. The relative partitioning of COPC between the dissolved and particulate phases is controlled by a complex combination of precipitation, dissolution, and sorption reactions.

Sorption is an important process affecting metals migration for infiltrating rainwater and ground water. Sorption can be thought of as an equilibrium-partitioning process between the soil and water.

5.0 HUMAN AND ECOLOGICAL RISK ASSESSMENT

This Risk Assessment provides an evaluation of the risk to human health and the environment associated with the Site. The risk assessment for human receptors and ecological receptors are presented separately in Sections 5.2 and 5.3, respectively.

5.1 Identification of Site Areas for the Risk Assessment

Based upon information presented in Section 3 and summarized in Table 4-8, the following areas of the Site are evaluated in the risk assessment.

- Tailings in Tailings Disposal Facility TDF-1 (including the TDF-1 Wetland Sediments);
- Tailings in Tailings Disposal Facility TDF-2;
- Surface Water in Creeks; and
- Creek #2 and TDF-1 Sediments.

5.2 Human Health Risk Assessment (HHRA)

The HHRA evaluates potentially complete exposure pathways for media at the Site, and then characterizes cancer and non-cancer risks associated with the potentially complete exposure pathways. The HHRA initially develops a conceptual Site model (CSM) for evaluating exposures from the available data. The HHRA CSM is shown on Figure 5-1 and identifies the potential human receptors and operative exposure pathways.

5.2.1 Exposure Evaluation

Information concerning potential receptors and exposure pathways, including chemical sources and chemical constituent release mechanisms, are integrated into a CSM. The CSM provides a framework for problem definition, defines the framework for the risk assessment, and assists in identifying response actions for the Site, if necessary. A CSM is typically based on current information available, but is dynamic and can change as new information becomes available for the Site.

The human health CSM for the Site (Figure 5-1) reflects current and reasonable future land uses of the Site. The potential sources presented in the CSM represent the suspected sources of chemical releases at the Site and are identified on the basis of historical information and Site investigations.

5.2.1.1 Potential Human Health Receptors

The Site is currently an inactive portion of the operational Pend Oreille Mine. The area surrounding the Site is also within the boundary of the Pend Oreille Mine and is mainly undisturbed, composed of native soil cover, rock outcrops, and vegetation. There are no residences or schools on or immediately adjacent to the Site; however, there are several single-family homes within a mile of the Site. Access to the Site is controlled by locked gates at road entrances.

The following receptors may be exposed to Site COPC and were included as potential receptors in the human health CSM:

- Current and future on-Site trespassers/recreational visitors;
- Current and future off-Site residents;
- Future on-Site industrial/construction workers; and
- Future on-Site residents.

5.2.1.2 Potential Human Health Exposure Pathways

A complete exposure pathway is defined by the following four elements (USEPA, 1989):

- A source of chemical release into the environment;
- An environmental medium for transport of the chemical (e.g., air, ground water, or soil);
- A point of potential exposure for a receptor; and
- A route of exposure for the receptor (e.g., ingestion inhalation or dermal contact).

An exposure pathway is considered complete or potentially complete when all four of these elements are present. All potential human health exposure pathways for the media of concern depict primary and secondary release mechanisms, retention-exposure mechanisms, and potential exposure routes (Figure 5-1).

Complete and potentially complete exposure pathways are identified by comparing media concentrations to conservative risk-based screening values (Tables 4-4 and 4-5). The screening values for soil and sediment are selected as the lowest human risk-based criteria that are above accepted background levels and above standard laboratory analytical PQLs. The sources of the human risk-based screening are referenced in Tables 4-4 and 4-5.

5.2.1.2.1 Groundwater Pathway

Data collected during this investigation have shown that leaching pathways from surface to subsurface soils and subsequently to groundwater have not resulted in a pathway to a receptor. Detected groundwater concentrations of all parameters, are below drinking water MCLs. Given the amount of time that the present conditions at the Site have been in existence, it is highly unlikely that the ground water pathway would result in different exposures in the future.

5.2.1.2.2 Surface Water Pathway

Surface water data collected at the Site indicate that COPC concentrations are below conservative human health risk screening levels in Creek #2. It was assumed that Creek #1 and #2 could become a drinking water source in the future, but that the Site waters in TDF-1 Wetland and seeps would not be used as a drinking water source. Humans were assumed to become exposed to TDF-1 Wetland and Site seep waters through incidental ingestion rather than as a primary drinking water source.

Surface water in Creek #1 and Creek #2 has COPC concentrations below human health-based screening levels (see Table 4-5) and is not considered to pose any risk to humans. Creek #1 does not drain the Site, and should not become impacted in the future. Creek #2 drains the Site and represents surface water migrating from the Site. Creek #2 surface water is acceptable for use as a drinking water source for future on-Site residents because its water quality meets MCLs. The surface water pathway to off-Site human receptors is not complete and will not be assessed for potential risks. Given the amount of time the present conditions at the Site have existed and the water quality of groundwater and diversion ditch water discharging to Creek #2, it is highly unlikely that this surface water pathway would result in different exposures in the future. Creek #2 water, therefore, is not included in the HHRA for the current or future human receptors.

5.2.1.2.3 Air Pathway

Tailings materials are the only impacted media that may release COPC through fugitive dust emissions. Other impacted media are either moist or too coarse to be considered amenable to fugitive dust emissions. The tailings impoundment has developed a crust on its surface and does not appear to be amenable to fugitive dust emissions unless disturbed. The adjacent off–Site soils and animal path soils data supports this observation, where wind-deposited or animal tracking dispersion of tailings material did not exceed human risk-based COPC concentration. Disturbance could occur during future construction or earthwork at the Site with potential exposures to on-Site industrial/construction workers or to future on-Site residents. Trespassers/future recreational visitors could potentially disturb Site soils by digging, bike riding, ATV motoring or other recreational activities. Because of this potential exposure pathway to soils that contain COPC above screening levels, fugitive dust inhalation will be considered for current and future recreational visitors/trespassers and for future on-Site residents and industrial/construction workers.

Because the metal COPC are not volatile constituents, the HHRA will not evaluate inhalation of volatile COPC.

Off-Site residents are not potentially exposed to Site-related constituents through the dust inhalation pathway, or by direct contact with dust that has deposited on the ground, because there is no known COPC airborne pathway to off-Site residents when the data for adjacent off-Site soils do not exceed any human heath-based concentrations.

5.2.1.2.4 Soil and Sediment Pathway

Current and future trespassers/recreational visitors may access the Site for biking, hiking, wading, and hunting. These receptors can be exposed to Site soils and sediments impacted with COPC during their visits to the Site. Several areas contain soils with COPC above human risk screening levels for unrestricted land use. Since trespassers are not exposed to Site soils and sediments on a continual basis, a HHRA will determine whether trespassers could be exposed to unacceptable health risks from occasional exposure events.

The Site currently is used for industrial operations. The current or future industrial worker may become exposed to Site tailings, soils, and sediments. The RI data did not identify any Site tailings, soils, or sediments that have a mean concentration above MTCA acceptable human health-based concentrations for industrial land use. Therefore, risks to the industrial/construction worker are considered acceptable and will not be further evaluated in the HHRA.

Future residents could be exposed on a more or less continual basis to Site COPC in soils. Since TDF-1 and TDF-2 tailings and Creek #2 and TDF-1 Wetland sediments contain COPC concentrations exceeding the MTCA level for unrestricted land use, the future resident scenario will be included in the HHRA.

5.2.2 Risk Evaluation

For the purposes of the HHRA, existing data are adequate for completing data evaluation and exposure assessment. A toxicity assessment is not completed for the HHRA. Risk calculations are summarized below.

As shown in Figure 5-1, the current and future human receptors who may access the Site and for which potentially complete exposure pathways may exist are:

- Current and future trespassers/visitors engaged in recreational activities; and
- Future on-Site residents.

The HHRA was performed in accordance with USEPA CERCLA risk assessment guidance and the State of Washington MTCA. The cumulative health risk is calculated to determine the excess lifetime cancer risks and non-cancer hazards. Risks are assessed for receptors that may contact soil or water at the Site under the existing and foreseeable future conditions. The cancer risks for each constituent included in the risk evaluation are summed by medium to obtain cumulative excess lifetime cancer risk. The cumulative excess lifetime cancer risk value is compared to the excess lifetime cancer risk range of $1x10^{-6}$ to $1x10^{-5}$ (WAC 173-340). The non-cancer hazards for each constituent included in the risk evaluation are summed by medium to obtain a cumulative Hazard Index (HI) value. The calculated HI values will be compared to a threshold HI value of 1.0.

This process entails the following components:

- Selection of Site Media and COPC;
- Reasonable Maximum Exposure Assessment; and
- Risk Characterization.

The basic approach used to develop each step of the HHRA and the results of each step are outlined in the following subsections.

5.2.2.1 Selection of Site Media and COPC

Based upon the information presented in Section 3 and summarized in Table 4-8, the following Site media contained COPC concentrations above human health-based criteria and are evaluated in the HHRA.

- TDF-1 tailings;
- TDF-2 tailings;
- Creek, seep and wetland sediments; and
- Seep and wetland water.

The Site COPC were identified in the RI/FS Work Plan (Golder, 2005) based on previous Site investigations (Dames & Moore, 1997a and 1997b) and PA/SI (Ecology and Environment, 2002). The Site COPC that are above human health based concentrations include only the metal lead. To ensure that potential risks are not underestimated, all inorganic COPC are conservatively carried through HHRA. Therefore, the risk evaluation quantifies cumulative risks associated with potential exposures to the other inorganic constituents detected in the identified areas (Table 4-8). It should be emphasized that some of these constituents occur naturally in soils at concentrations that are generally similar to those reported for Site soils. (See Section 4)

5.2.2.2 Reasonable Maximum Exposure Assessment

Consistent with USEPA and MTCA guidance for calculating exposure point concentrations (USEPA, 2002 and WAC 173-340), the exposure point concentration (EPC) for COPC is the lesser of the maximum detected concentration or 95% UCL of the mean. The UCL was either based on a normal or lognormal distribution for specific media. For the Site seep and wetland waters, the maximum concentration in any seep or wetland water was used. For Site sediments, the maximum concentration of each COPC in any sediment sample was used in the HHRA. The EPCs used for TDF-1 and TDF-2 tailings represent the greater of either the 95% UCL for a normally distributed population or a lognormally distributed population (Gilbert, 1987).

The statistical 95% UCLs for the appropriate distribution for each media used in the HHRA are presented in Tables 3-1, 3-3, 3-11, and 3-14, except for the tailings in TDF-2. All TDF-2 tailings samples (both test pit samples and agronomic samples) were used to calculate the UCL for each metal. The greater UCL between the TDF-1 test pit soil and agronomic soil concentrations were used in the HHRA.

From the CSM, the major exposure and COPC intake assumptions for each of the potential human receptors identified from Figure 5-1 are presented below:

Trespasser or Future Recreational Receptor:

A trespasser or future recreational visitor at the Site may be engaged in several outdoor activities such as hiking, mountain or motor-biking, ATV riding, hunting or other activities. It should be noted, as reflected in the CSM, that trespassers may potentially be exposed to pond sediments and surface water by swimming or wading in surface waters during their visits. Exposures would be expected to occur equally throughout the Site and, consequently, the exposure area for a trespasser would be the entire Site area. However, to provide a conservative assessment of potential risks, and to account for the disparity in constituent concentrations among the various exposure media evaluated in this HHRA, separate exposure points are evaluated in the risk HHRA.

Exposures were assumed to occur from incidental ingestion and dermal contact with soils, sediments, and surface waters. Inhalation of fugitive dust was also included in the HHRA for exposures to Site tailings materials. The standard recreational visitor/trespasser scenario (USEPA, 1989) was used for the HHRA. This scenario assumes an adult accesses the Site 50 days per year, over a 30-year period. Although the Site is too remote for small children (six years old or less) to access the Site alone, a child may be exposed to the Site under supervision from an adult. Therefore, a child was assumed to be the recreational visitor/trespasser. Exposure parameters used in this assessment are conservative. For example, to assess potential exposures, it is assumed that all soil contact occurs at the Site on the days that access to the Site occurs. This provides a very conservative assessment of potential exposures because contact with soil would occur during all outdoor exposure time, including the time spent outdoors at a place of residence and the time that it would take to walk to the Site. The soil ingestion rate used to evaluate incidental ingestion exposures is 200 mg/day for a child (MTCA-WAC 173-340). Inhalation exposures assumed an average daily child-breathing rate of 8.3 m^3/day. For estimating concentrations of COPC in air, a particulate fugitive dust emission factor of 1.32 E+09 m^3/kg was used from the USEPA "*Soil Screening Guidance*" (USEPA, 1996). Other exposure parameters such as body weight (16 kg) and averaging times were based on MTCA (173-340) if default values were provided, or based on USEPA default parameters as presented in Risk Assessment Guidance for Superfund (USEPA, 1989).

The HHRA evaluated exposures to lead separately than for the other COPC at the Site. Lead does not have an accepted reference dose (RfD) intake that can be applied to risk evaluation methods used for the other Site COPC. Therefore, the manner for evaluating risk from lead is to estimate lead blood levels in receptors from exposures to Site media. For the trespasser/future recreational visitor scenario, potential risk levels were determined based on Site exposures that would not result in more than 5 percent of a population of children having a lead blood level of 10 micrograms per deciliter (µg/dL) or more. The Integrated Exposure Uptake Biokinetic (IEUBK) model (USEPA, 1994) was used for estimating child lead blood levels from exposures to Site media. The standard default input parameters to the model were used for a child residing off-Site (for antecedent lead blood level) and additional exposure to Site media containing lead was input to the IEUBK model. Additional lead intake from Site media were based on standard exposure assumptions used for the other COPC in the trespasser/future recreational visitor scenario. The input values and resulting child lead blood levels are provided in Appendix H and summarized in Table 5-1. The modeling results indicate child lead blood levels would be below 10 µg/dL for more than 95 percent of the population from exposure to Site media for trespassers/future recreational visitors.

Future On-Site Resident Receptor

A future resident at the Site may be exposed on a continuous basis to Site waste materials. Exposures would be expected to occur anywhere on the Site and, consequently, the exposure area for a resident could be at any of the Site areas. To provide a conservative assessment of potential risks, and to account for the disparity in constituent concentrations among the various exposure media evaluated in this HHRA (e.g., lead concentrations are higher in tailings impoundment), separate exposure points for each media are evaluated in the HHRA.

Exposures were assumed to occur from incidental ingestion and dermal contact with soils, sediments, and surface waters. A future resident may be exposed to pond sediments and surface water by swimming or wading in surface waters. Inhalation of fugitive dust was also included in the HHRA for exposures to Site soils from the tailings impoundments. The standard residential scenario (USEPA, 1989) assumes residents live on the Site 365 days per year. A child was assumed to be the most sensitive receptor in a future resident scenario. Exposure parameters used in this assessment are conservative. For example, to assess potential exposures, it is further assumed that all soil contact occurs at the Site. The soil ingestion rate used to evaluate incidental ingestion exposures is 200 mg/day for a child (MTCA-WAC 173-340). Inhalation exposures assumed an average daily child-breathing rate of 8.3 m^3/day. For estimating concentrations of COPC in air, a particulate fugitive dust emission factor of 1.32 E+09 m^3/kg was used from the USEPA *Soil Screening Guidance* (USEPA, 1996). Other exposure parameters such as body weight (16 kg) and averaging times were based on MTCA (173-340) if default values are provided, or based on USEPA default parameters as presented in Risk Assessment Guidance for Superfund (USEPA, 1989).

The HHRA evaluated exposures to lead separately than for the other COPC at the Site. Lead does not have an accepted reference dose (RfD) intake that can be applied to risk evaluation methods used for the other Site COPC. Therefore, the manner for evaluating risk from lead is to estimate lead blood levels in receptors from Site lead exposures. For the future on-Site residential scenario, potential risk levels were determined based on Site exposures that would not result in more than 5 percent of a child population having a lead blood level 10 µg/dL or more. The Integrated Exposure Uptake Biokinetic (IEUBK) model (USEPA, 1994) was used for estimating child lead blood levels from exposures to

Site media. The standard default input parameters to the model were used for a child residing on-Site, except the UCL lead concentration of each Site media was used as the lead concentrations in the residential yard and resulting indoor dust (internal IEUBK algorithm). Additional exposure to adjacent Site media containing lead was also input to the IEUBK model, because a resident on the Site would likely visit other Site media on occasion. Additional lead intake from adjacent Site media were based on standard exposure assumptions used in the trespasser/future recreational visitor scenario. The input values and resulting child lead blood levels are provided in Appendix H and summarized in Table 5-1. The modeling results indicate child lead blood levels would be above 10 μg/dL for more than 95 percent of the population from exposure to Site media for a future residential scenario.

Human Risk Characterization Summary

The cumulative risk calculations are summarized in Tables 5-2 and 5-3 for human exposures to the Site COPC (except lead) for the Recreational Trespasser/Future Recreational Visitor and Future On-Site Resident scenarios, respectively. Chronic non-cancer risk was evaluated by calculation of HQs for exposure to each constituent, and a total HI for concomitant exposure to all constituents. Lead blood levels for children exposed to lead from the Site is summarized in Table 5-1. Cumulative carcinogenic potential (i.e., cancer risk) was calculated solely for cadmium inhalation given that only this metal has applicable toxicological evidence for potential carcinogenic heath risks by the inhalation pathway. Therefore, the risk for the inhalation of cadmium was also estimated in the HHRA.

Table 5-1and 5-2 shows that the risk to human trespassers/future recreational visitors associated with any of the Site media is below MTCA acceptable levels (HI is less than 1) and would result in acceptable lead blood levels to children. Carcinogenic risks from any media or impacted area at the Site are well below acceptable risk levels ($<10^{-6}$ risk). Remedial alternatives for the Site evaluated in subsequent sections of this RI/FS Report does not need to reduce or eliminating risk for these human receptors from the Site.

The data collected during Site investigations show that COPC exist at the Site in concentrations in Site tailings and sediments that are above risk-based levels (HI above 1.0) and result in unacceptable lead blood levels for unrestricted land use (Tables 5-1 and 5-3). Carcinogenic risk levels are well below acceptable levels ($<10^{-6}$ risk) for all Site impacted media. The highest unrestricted use of the Site would be for future residents to occupy and inhabit the Site; therefore, the Site represents an unacceptable risk for future human residents. Remedial alternatives for the Site evaluated in subsequent sections of this RI/FS Report include consideration for reducing or eliminating risk for potential future human residential receptors.

5.2.3 Uncertainty Assessment

In reviewing the results of this risk characterization, it should be emphasized that the potential risks estimated in this analysis are based on a series of conservative assumptions regarding exposure and toxicity. For example, although the true exposure area at the Site is the entire Site area, risks were evaluated for discrete exposure points within the Site area, assuming that exposures only occurred at each of the areas, rather than across the entire Site. Trespassers/future recreational visitors would be expected to use the entire Site rather than spend all their visits and time in one specific area. Since The HHRA also used the maximum concentration of the sediments and waters from different seep and wetland locations and human exposure would be to the maximum concentration for the entire exposure duration is physically impossible and results in a very conservative calculated risk.

Risks to humans from inhalation and dermal contact may be overestimated. Inhalation reference concentrations (RfCs) were not available for the inorganic analytes evaluated in the HHRA. Therefore, dust inhalation non-cancer risks were conservatively estimated using oral RfDs. However, dust inhalation exposures are negligible compared to ingestion exposures. Similarly, dermal exposure to soil was evaluated in the risk characterization using the suggested MTCA (WAC 173-340-740 and 745) estimate of 0.2 times the oral RfD for the corresponding inhalation RfD. Both of these approaches are conservative and likely overestimate the true risks at the Site.

5.3 Ecological Risk Assessment (ERA)

The ERA evaluates potentially complete exposure pathways between the COPC and valued ecological receptors at the Site. Information concerning potential receptors and exposure pathways, including chemical sources and chemical constituent release mechanisms, are integrated into an ecological CSM (Figure 5-2). The potential sources presented in the CSM represent the suspected sources of chemical releases at the Site and are identified on the basis of history and previous investigations.

5.3.1 Exposure Evaluation

An initial screening level assessment for all COPC was undertaken by comparing the concentrations of COPC at the Site in various media to relevant screening criteria. The measured COPC concentrations in soil/sediments (see Tables 3-1, 3-3, 3-11, 3-13, and3-14) and surface waters (see Table 3-9 and 3-10) were compared to the MTCA wildlife cleanup standards. No comprehensive screening values are available for fresh water sediments. Therefore, sediments were screened using a combination of the Washington State proposed freshwater sediment guidelines (Ecology 2003) and the MTCA soil cleanup standards. All of the metal COPC, except arsenic, barium, and copper, exceeded the screening standards in at least one of the exposure media for wildlife, and therefore were carried forward in the ERA. Copper was dropped from further consideration in the ERA.

For the more in-depth analyses of the COPC carried forward in the ERA, generally accepted practices to estimate risks to wildlife were followed. Because most measurements of COPC concentrations in various media (water, soil, sediment, or food items) were limited to a few samples, the 95-percentile of the UCL of the mean based on the appropriate distributions for the data was used. Calculated exposure values were based on default assumptions (i.e., 100% bioavailability, continuous exposure to maximum concentration of media constituents, and uniform use of the Site). Exposure estimates exceeding the Toxicity Reference Values (TRVs) were determined to indicate unacceptable risk or were discussed further in light of uncertainties in the estimates due to the model assumptions or potential measurement errors.

5.3.1.1 Potential Ecological Receptors

The range of ecological receptors relevant for the Site included the types of plants, invertebrates, amphibians, birds, mammals, and fish observed or suspected to occur on the Site. This ERA evaluates risks to six receptor groups: a small mammal predator (specified under MTCA as a shrew in the genus *Sorex*); a small mammal herbivore (specified under MTCA as a vole of the genus *Microtus*); an avian predator (specified under MTCA as the American robin *Turdus migratorius*) ungulates, represented by elk, moose and white-tailed deer; raptors, represented by the red-tailed hawk; and waterfowl, represented by the mallard. The federal endangered (gray wolf) and threatened (grizzly bear, Canada lynx) species are assessed qualitatively in comparison to estimates of risk to the red-tailed hawk. As none of the waters on the Site support fish populations, aquatic receptors were only considered indirectly in terms of water quality criteria and as potential exposure pathways to the terrestrial receptors. Other receptors such as plants, and invertebrate were also evaluated as potential exposure pathways between the COPC and valued receptor groups.

5.3.1.2 Potential Ecological Exposure Pathways

Exposure pathways illustrate potential avenues along which COPC could reach valued receptors and cause adverse effects. Primary and secondary release mechanisms, retention-exposure mechanisms, and potential exposure routes trace the potential transfer of COPC from soils, sediments and water into plants or invertebrates, and ultimately into valued vertebrate receptors (Figure 5-2). Ground water pathways were not considered relevant to ecological receptors. Likewise, inhalation and dermal contact are generally insignificant for wildlife exposure routes and are not included.

5.3.2 Ecological Risk Evaluation

The assessment species for the ERA were the shrew, vole, American robin, red-tailed hawk, mallard duck, and ungulates (represented by elk, moose, and white-tailed deer). The terrestrial exposure pathways focused primarily on food and incidental soil ingestion, although water intake was considered. There were no strictly aquatic receptors (i.e., fish) identified as assessment species, surface waters were evaluated by comparison to conservative screening criteria and the prominent routes of exposure to the assessment species (water, sediment, benthic invertebrates for the mallard duck and drinking water for American robin, red-tailed hawk, and mammals) were considered in the ERA. MTCA guidance regarding exposure equations for robins and shrews eating worms (e.g., 52% of the diet comprise worms) and voles eating plants were followed in calculating screening-level exposure estimates. Additional guidance for ecological risk assessment (USEPA, 1998) was used to supplement MTCA guidance, especially for assessments that were carried out beyond the screening phase. In particular, the estimated wildlife exposures were compared to TRVs developed by the USEPA (2005) in its Ecological Screening Level (Eco-SSL) effort. The avian TRVs (mg/kg-day) used were: cadmium, 1.47; lead, 1.63; selenium, 0.3; and zinc, 131. Mammalian TRVs were: cadmium, 0.77; lead, 4.7; selenium, 0.3; and zinc, 320 mg/kg/day. In this ERA, risks are expressed as a Risk Quotient (RQ) in which the estimated exposures were compared to the respective TRV according to the equation:

$$RQ=EE/TRV$$

Where:

RQ = Risk Quotient (unitless)
EE = Estimated Exposure (mg/kg BW/day)
TRV [Toxicity Response Value (mg/kg BW/day)]

$$EE = [(FIR*Fc*P)+(SIR*Sc)+(WIR*Wc)]\ AUF*TUF$$

Where:

FIR [Food Ingestion Rate (kg/kg BW/day)]
Fc = concentration in food (mg/kg)
SIR [Soil Ingestion Rate (kg/kg BW/day)]
Sc = concentration in soil (mg/kg)
WIR [Water Ingestion Rate (kg/kg BW/day)]
Wc = concentration in water (mg/kg or mg/L)
P [Proportion of food item in diet (unitless)]
AF [Accumulation Factor (unitless)]
TUF [Proportion of time spent in area (unitless)]

AUF [Proportion of foraging area represented by Site (unitless)]

In the following sections the major exposure and COPC intake assumptions are presented with the corresponding RQ estimates for each receptor group. Where the estimated RQs are above 1 the risks are discussed further in light of potential mitigating factors such as uncertainties in the estimates due to the model assumptions or potential measurement errors.

5.3.2.1 *Metal Exposure for Small Mammalian Predator*

The shrew is identified in MTCA as a default surrogate receptor. The portion of the site that provides suitable habitat for the shrew is the fringe wetland area. Data used to calculate risk were as follows:

Shrew (*Sorex*)

Parameter	Value	Units	Reference
Body Weight (BW)	4.5	g	*Sorex cinereus*, US EPA 1993 Volume I of II (Range 3 to 6 g)
Food Ingestion Rate (FIR)	0.45	kg/kg BW-day	MTCA Cleanup Regulation
Dietary Proportion (P)	0.5	unitless	n/a
Soil Ingestion Rate (SIR)	0.0045	kg/kg BW-day	MTCA Cleanup Regulation
Water Ingestion Rate (WIR)	Allometric scaling as (0.099*BW)^0.9/BW	kg/kg BW/day	US EPA 1993 Volume I of II
Area Use Factor (AUF)	1.0	unitless	n/a
Site Area	2	hectares	Golder 2005 (wetland fringe)
Forage Range	— , 1 acre 0.04	hectares	Buckmaster *et al.*, 1999 —
Time Use Factor (TUF)	1.00	unitless	n/a
Months Occupied	12	months	

The exposure calculations for the shrew identified negligible risk as all RQ values were <0.2.

5.3.2.2 *Metal Exposure for Small Mammalian Herbivore*

The vole is identified in MTCA as a default surrogate receptor. The portion of the site that provides suitable habitat for the vole is the fringe wetland area. Data used to calculate risk were as follows:

Vole (*Microtus* sp.)

Parameter	Value	Units	Reference
Body Weight (BW)	42	g	US EPA 1993 Volume I of II (M. montanus)
Food Ingestion Rate (FIR)	0.315	kg/kg BW-day	MTCA Cleanup Regulation
Dietary Proportion (P)	1	unitless	MTCA Cleanup Regulation
Soil Ingestion Rate (SIR)	0.0079	kg dry wt/kg BW/day	MTCA Cleanup Regulation
Water Ingestion Rate (WIR)	Allometric scaling as (0.099*BW)^0.9/BW	kg/kg BW/day	US EPA 1993 Volume I of II
Area Use Factor (AUF)	1.0	unitless	n/a

Parameter	Value	Units	Reference
Site Area	2	hectares	Golder 2005
Forage Range	0.03	hectares	Buckmaster *et al.*, 1999
Time Use Factor (TUF)	1.00	unitless	n/a
Months Occupied	12	months	

The exposure calculations for the vole identified negligible risk as all RQ values were <0.2.

5.3.2.3 Metal Exposure for Ungulates

This group of receptors is represented by elk, moose, and white-tailed deer, providing an estimate of exposures for these valued resources of the region.

The parameters used in calculating exposure were as follows:

Elk (*Cervus elaphus*) [Smithsonian National Museum of Natural History, North American Mammals at http://www.mnh.si.edu/mna/main.cfm as accessed August 2006]:

Parameter	Value	Units	Reference
Body Weight (BW)	265	kg	Jenson, 2000
Food Ingestion Rate (FIR)	0.577*BW(g)^0.727	g/day normalized to BW	US EPA 2005 Eco-SSL Guidance
Dietary Proportion (P)	1	unitless	n/a
Soil Ingestion Rate (SIR)	2% of FIR	kg dry wt/kg BW/day	Sample and Suter 1994
Water Ingestion Rate (WIR)	Allometric scaling as (0.099*BW)^0.9/BW	kg/kg BW/day	US EPA 1993 Volume I of II
Area Use Factor (AUF)	0.002	unitless	n/a
Site Area	10	hectares	Golder 2005
Forage Range	>5,000	hectares	Buckmaster *et al.*, 1999
Time Use Factor (TUF)	1.00	unitless	n/a
Months Occupied	12	months	

Moose (*Alces alces*) [Smithsonian National Museum of Natural History, North American Mammals at http://www.mnh.si.edu/mna/main.cfm as accessed August 2006]:

Parameter	Value	Units	Reference
Body Weight (BW)	395	kg	Jenson, 2000
Food Ingestion Rate (FIR)	0.577*BW(g)^0.727	g/day normalized to BW	US EPA 2005 Eco-SSL Guidance
Dietary Proportion (P)	1	unitless	n/a
Soil Ingestion Rate (SIR)	2% of FIR	kg dry wt/kg BW/day	Sample and Suter 1994
Water Ingestion Rate (WIR)	Allometric scaling as (0.099*BW)^0.9/BW	kg/kg BW/day	US EPA 1993 Volume I of II
Area Use Factor (AUF)	0.001	unitless	n/a

Parameter	Value	Units	Reference
Site Area	10	hectares	Golder 2005
Forage Range	>15,000	hectares	Romito *et al.*, 1999
Time Use Factor (TUF)	1.00	unitless	n/a
Months Occupied	12	months	

White-tailed deer (*Odocoileus virginanus*) [Smithsonian National Museum of Natural History, North American Mammals at http://www.mnh.si.edu/mna/main.cfm as accessed August 2006]:

Parameter	Value	Units	Reference
Body Weight (BW)	60	kg	Jenson, 2000
Food Ingestion Rate (FIR)	0.577*BW(g)^0.727	g/day normalized to BW	US EPA 2005 Eco-SSL Guidance
Dietary Proportion (P)	1	unitless	n/a
Soil Ingestion Rate (SIR)	2% of FIR	kg dry wt/kg BW/day	Sample and Suter 1994
Water Ingestion Rate (WIR)	Allometric scaling as (0.099*BW)^0.9/BW	kg/kg BW/day	US EPA 1993 Volume I of II
Area Use Factor (AUF)	0.04	unitless	n/a
Site Area	10	hectares	Golder 2005
Forage Range	250	hectares	Boulanger et al., 2000
Time Use Factor (TUF)	1.00	unitless	n/a
Months Occupied	12	months	

The exposure calculations for ungulates indicated that for cadmium, and zinc the risks are negligible (i.e., RQ<1.0), even if the animals were to derive their entire diet from the Site. Lead (RQ = 4.8, 3.5, and 7.0 for elk, moose, and white-tailed deer respectively) and selenium (RQ = 5.8, 2.7, and 9.2 for elk, moose, and white-tailed deer respectively) exposures exceedances occur under the unlikely scenario that the animals would live solely on the Site. However, when the large range across which these animals forage is taken into account, the effective RQ for both lead and selenium drops below 1.0, indicating that adverse effects to these animals from metal exposures are not expected.

5.3.2.4 Metal Exposure for Carnivorous Raptors

This receptor group is represented by the red-tailed hawk. COPC concentrations in small mammals that serve as prey for raptors such as the red-tailed hawk were estimated using soil-to-small mammal transfer factors proposed by the US EPA (2005) for the respective COPC.

The parameters used in calculating exposure were as follows:

Red-tailed Hawk (*Buteo jamaicensis*) [Sibley, 2000]:

Parameter	Value	Units	Reference
Body Weight (BW)	1.13	kg	Dunning 1993
Food Ingestion Rate (FIR)	0.0353	kg dry wt/kg BW/day	US EPA 2005 Eco-SSL Guidance
Dietary Proportion (P)	1	unitless	n/a

Parameter	Value	Units	Reference
Soil Ingestion Rate (SIR)	0	kg dry wt/kg BW/day	Sample and Suter 1994
Water Ingestion Rate (WIR)	0.06	g/g BW/day	US EPA 1993 Volume I of II
Area Use Factor (AUF)	0.27	unitless	n/a
Site Area	40	acres	Golder 2005
Forage Range	148.2	acres	US EPA 1993 Volume I of II
Time Use Factor (TUF)	1.00	unitless	n/a
Months Occupied	7	months	http://www.wrcc.dri.edu/index.html saved on E:\COLVILLE, WASHINGTON - Climate Summary files\COLVILLE, WASHINGTON - Climate Summary.htm

There are conflicting professional opinions regarding soil ingestion by red-tailed hawks. Sample and Suter (1994) stated that incidental soil ingestion by red-tailed hawks is negligible. Many current sources list the soil ingestion rate as a default value of 2%, though there is no clear indication as to the origin of that assumption. A table in Attachment 4-1 of the USEPA Eco-SSL (2005) revision on guidance contains a footnote indicating that the soil ingestion rates for the red-tailed hawk assumed the soil ingestion values for red fox reported in Beyer et al. (1994). No further explanation is provided justifying the assumption of using a ground-dwelling, den-inhabiting furry predator as a surrogate for a raptor. For the calculations of exposure in this ERA, the opinion of Sample and Suter (1994) was adopted. That opinion is that incidental soil ingestion by the red tailed hawk is negligible.

The foraging range for a red-tailed hawk (60 to 160 ha) is much greater than the tailings area of the Site. Moreover, the potential small mammal carrying capacity of the tailings area is much less than the surrounding areas, making it unlikely that prey captured by a red-tailed hawk over the course of several days would come mostly from the relatively small tailings area.

Based on these assumptions for exposures (without considering home range), the RQs for the COPC are: cadmium, 0.04; lead, 0.91; selenium, 0.20; and zinc, 0.05). Given the foraging range of the red-tailed hawk, which is several fold greater than the Site are under consideration, the conclusion is that raptors do not experience unacceptable exposures to COPC.

5.3.2.5 Metals Exposure Estimates for Ducks

This receptor group is represented by the mallard duck. Benthic macroinvertebrate tissue concentrations were estimated from sediment COPC concentrations according to MTCA bioaccumulation factors. The exposure model assumes that the ducks forage solely on benthic invertebrates, a condition that applies only to ducklings. Sediments (incidental ingestion; Table 3-11), water (ingestion, Table 3-10), and estimated benthic invertebrate tissue comprise the exposure pathways for the mallard.

The parameters used in calculating the exposure levels for mallards (*Anas platyrhynchos;* Sibley, 2000) were:

Parameter	Value	Units	Reference
Body Weight (BW)	1.13	kg	USEPA 1993 Volume I of II

Parameter	**Value**	**Units**	**Reference**
Food Ingestion Rate (FIR)	0.023	kg dry wt/kg BW/day	Cal/USEPA, 1999; converted to dry weights for aquatic invertebrates using 0.1 conversion (Pace and Orcutt,1981)
Dietary Proportion (P)	1	unitless	USEPA 1993 Volume I of II
Soil Ingestion Rate (SIR)	3.18E-03	kg dry wt/kg BW/day	Beyer 1994
Water Ingestion Rate (WIR)	0.57	g/g BW/day	USEPA 1993 Volume I of II
Area Use Factor (AUF)	0.09	unitless	n/a
Site Area	1.5	acres	Golder 2005
Forage Range	249	acres	USEPA 1993 Volume I of II
Time Use Factor (TUF)	1.00	unitless	n/a
Months Occupied	7	months	http://www.wrcc.dri.edu/index.html saved on E:\COLVILLE, WASHINGTON - Climate Summary files\COLVILLE, WASHINGTON - Climate Summary.htm

The RQ for mallards using the assumptions identified above are: cadmium, 3.9; lead, 44.0; selenium, 2.3; and zinc, 12.9. Given the size of this wetland, which is well below the minimal size needed for sustained residence, these values need to be considered in terms of foraging ranges. When adjusted by an Area Use Factor typical of mallard ducks, the RQs become: cadmium, 0.1; lead, 0.6; selenium, 0.0; and zinc 0.2. Therefore the likelihood of adverse consequences to waterfowl, represented by the mallard duck, is low.

5.3.2.6 *Metals Exposure Estimates for small Avian Predator*

This group of receptors is represented by the American robin. For this evaluation it has been assumed that 52 percent of the diet of the robin is earthworms per MTCA guidelines. No Site-specific data on COPC concentrations in earthworms was available for the ERA. Consequently, the concentration in this food item was estimated using conservative bioaccumulation factors. Species characteristics used to estimate exposures to the American robin (*Turdus migratorius;* Sibley, 2000) were:

Parameter	**Value**	**Units**	**Reference**
Body Weight (BW)	0.077	kg	USEPA 1993 Volume I of II
Food Ingestion Rate (FIR)	0.207	kg dry wt/kg BW/day	MTCA Cleanup Regulation
Dietary Proportion (P)	0.520	unitless	MTCA Cleanup Regulation
Soil Ingestion Rate (SIR)	0.022	kg dry wt/kg BW/day	MTCA Cleanup Regulation
Water Ingestion Rate (WIR)	0.140	g/g BW/day	USEPA 1993 Volume I of II
Area Use Factor (AUF)	1.00	unitless	n/a
Site Area	1	ha	Inferred from geometry of tailings pond
Forage Range	0.4	ha	USEPA 1993 Volume I of II
Time Use Factor (TUF)	1.00	unitless	n/a
Months Occupied	5	months	http://www.wrcc.dri.edu/index.html saved on E:\COLVILLE, WASHINGTON - Climate Summary files\COLVILLE, WASHINGTON - Climate Summary.htm

Assuming that the entire complement of earthworms in the American robin diet was from the soils around the perimeter of the TDF-1 wetland, calculated RQs were well below 1.0 for cadmium, selenium, and zinc, but exceeded unity for lead (RQ = 7.0). Because the home/foraging range for an American robin is less than the combined area occupied by the wetland perimeter soil area use factors based on ratios are not relevant. However, the quality of the habitat in terms of attractiveness for American robins, the availability of earthworms, and the actual concentrations of COPC in earthworms on Site could serve to lower the risk estimates. These additional features were not evaluated in the investigation of the Site. Given the poor-quality habitat that would occupy the tailings surface outside of the wetland perimeter, it is highly unlikely that an individual organism's foraging range would be comprised solely of the wetland perimeter. It is more likely that individual organisms would only make transient visits to the wetlands soil area, and therefore the actual exposures would be proportionally less than assumed in the exposure models used to calculate the risk levels.

5.3.2.7 *Ecological Risk Characterization*

This ERA evaluates risks to six terrestrial receptor groups: (1) a small mammal predator (specified under MTCA as a shrew in the genus *Sorex*),; (2) a small mammal herbivore (specified under MTCA as a vole of the genus *Microtus*); (3) an avian predator (specified under MTCA as the American robin *Turdus migratorius*); (4) ungulates, represented by elk, moose and white-tailed deer; (5) raptors, represented by the red-tailed hawk; and (6) waterfowl, represented by the mallard. Aquatic receptors were considered indirectly in terms of water quality criteria. The Federal endangered (gray wolf) and threatened (grizzly bear, Canada lynx) species were assessed qualitatively in comparison to estimates of risk to the red-tailed hawk. Following the MTCA procedures and appropriate US EPA guidelines for ERA, we conclude that the site poses no unacceptable risk for small mammalian predators, small mammalian herbivores, ungulates, or raptors. Were the open water area larger, it would pose some risk to waterfowl, however, the very small extent of water on the site makes it very unlikely that waterfowl use would occur, and therefore we conclude that the Site poses minimal risk to waterfowl. By extension, it is reasonable to conclude that the Site poses negligible risk to the Federally listed species. The wetlands fringe, based on the assumptions used in the modeling of exposure, does pose a moderate risk to the American robin.

5.3.3 Uncertainty Assessment

There are many highly protective assumptions built into the exposure models in order to minimize or eliminate the chance of underestimating risks. In this assessment, added protectiveness occurred as the exposure concentrations in food items (COPC concentrations in earthworms for American robin; COPC concentrations in small mammals for Red-tailed hawk; COPC concentrations in benthic invertebrates for Mallard duck; and selenium in vegetation for ungulates). A key precautionary assumption of each of the exposure models is that of 100% bioavailability of COPC in all media, a situation that ensures that risks are overestimated. Dietary assumptions are also set to maximize the estimated exposure. At the same time, the TRVs are derived using assumptions that err on the side of protection. Collectively, these assumptions serve to maximize the exposure estimate and minimize the toxicity threshold value so that the RQ is maximized.

We explored probabilistic modeling of exposure media for the ungulates. If probabilistic sampling of measured lead concentrations in media is used (instead of the 95%UCL) the RQ values for elk, moose, and white-tailed deer become 0.1, 0.1, and 0.2 respectively. Note that these lowered values assume 100% of their forage time on the small Site. Given the large foraging range of these animals, and their tendencies to shift their forage area frequently, the probabilistic sampling more closely reflects the likely exposures these animals would receive. And the most realistic exposures would take into account the diet from off-site areas.

5.3.4 ERA Summary and Conclusions

Aquatic Resources/Receptors

The potential for adverse impacts from the aquatic resources at the Site is low as the water bodies at the Site do not support fish populations and there are ample water resources in the surrounding area resulting in only occasional use of water at the Site by terrestrial wildlife. Therefore, under the ERA, assessment of aquatic receptors was limited to water quality criteria with no specific assessment species or other assessment endpoints indicated in the work plan. On the whole, there were no risks to aquatic resources on the Site. Except for cadmium in the Creek 1, which was selected to provide reference concentrations and is not believed to receive water from the Site, there were no exceedances of water quality parameters

Location	Risk	Comment
Creek #1	Cd in the down-stream sample	Water Quality Criteria
Creek #2	None	Water Quality Criteria
TDF-1 Wetland	None	No aquatic receptors
Groundwater	Not applicable for ERA	Not applicable for ERA

Terrestrial Resources/Receptors

Exposure estimates to these assessment species using conservative assumptions indicate very limited risk due to lead (robin). If ducks and ungulates were to derive all of their exposures from the Site, there would be exceedances that suggest adverse consequences, however, when foraging ranges are considered the exposures fall below the levels of concern.

Location	Risk	Comment
TDF-1 soils and TDF-1 and TDF-2 tailings □	Lead	RQs >1 robins, and ungulates if one assumes that they derive all their exposure solely on the tailings impoundment.
Creek 2 Surface Water	None	Ruled out in screening
Creek 2 Sediments	None	Ruled out in screening
TDF-1 Wetland Sediments	Cadmium, lead, selenium, and zinc	RQs to be >1for ducks if one assumes that they derive all their exposure solely on the tailings impoundment.
	Lead	Area of exceedance restricted to the area closest to the tailings impoundment. Low quality habitat for robins is a mitigating factor that effectively

Location	Risk	Comment
Perimeter Soils along Animal Paths		lowers the exposure to robins.

Of the three indicator species, the red-tailed hawk provides the best indicator of risk for the Federal endangered (gray wolf) and threatened (grizzly bear, Canada lynx) species. Each of these three species roams over large foraging areas, many times greater than that of the red-tailed hawk. Though these species would ingest some soil (nominally 2%), only a small portion of their dietary needs could be met by the small mammal population that resides on the Site. As the red-tailed hawk RQs for all COPC were substantially below unity, it can confidently be assumed that the risks to these threatened and endangered species are very low. Based upon the results of the ERA, there is no significant risk to ecological receptors at the Site, and no further action to address ecological risks is considered herein.

Amphibians were observed on the Site, including in the wetland on TDF-1. A toxicity profile search was performed by Cantox for Teck Cominco – Trail, BC. That effort yielded no useable TRVs as the data were primarily restricted to water exposures (i.e., no dietary values or sediment contact exposures were reported). Additional checks of potential sources of TRVs confirmed the paucity of useable toxicity information regarding amphibians. Consequently, it is not possible to conduct a risk assessment comparable to that done for the other receptors of interest.

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REMEDIAL INVESTIGATION/FEASIBILITY STUDY REPORT FOR THE PEND OREILLE MINE TAILING DISPOSAL FACILITIES TDF-1 AND TDF-2

METALINE FALLS, WASHINGTON

Submitted to:

Teck Cominco American Incorporated
Spokane Washington

Submitted by:

Golder Associates Inc.
Redmond, Washington

DRAFT	DRAFT
Douglas Morell Principal/Project Manager	Michael Brown Principal/Geotechnical Engineering

October 17, 2006

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6.0 CLEANUP ACTION OBJECTIVES AND REMEDIAL TECHNOLOGY SCREENING

This section presents the initial components of the FS remedial action evaluation for the Site, as follows:

- **Development of remedial action objectives and goals.** Objectives and cleanup level goals are established that provide the basis for developing and evaluating alternatives for remediation of the Site.
- **Identification and screening of remediation technologies.** Candidate technologies are screened on a Site-specific basis to obtain a list of technologies feasible for use in assembling remediation alternatives.

These components are presented in the following sections. Remediation alternatives are assembled and developed from the retained technologies in Section 7, and evaluated in Section 8.

6.1 Development of Remedial Action Objectives

Remedial action objectives (RAOs) are Site-specific goals based on acceptable exposure levels that are protective of human health and the environment and consider applicable or relevant and appropriate requirements (ARARs). RAOs combine consideration of ARARs and the specific constituents, affected media, and potential exposure pathways of a site as determined through a risk assessment. Appendix I identifies Federal and Washington State ARARs for the Site. The major Site ARAR is MTCA (WAC 173-340) and the risk assessment for the Site is presented in Section 5. RAOs identify risk pathways that remedial actions should address, and identify acceptable exposure levels for residual constituents of concern (COC).

6.1.1 Human and Ecological Risk Pathways

6.1.1.1 Potential Human Risks

The HHRA presented in Section 5.2 identified potential adverse human health effects attributable to the Site could occur to the following receptors from residual COC at specific waste areas:

Future On-Site Resident:

- Lead in TDF-1 tailings impoundment;
- Lead, and possible cadmium and zinc inTDF-2 tailings impoundment; and
- Lead in TDF-1 wetland and Creek #2 sediments.

Trespasser/Future Recreational Visitor:

- **None**

Future Industrial/Construction Worker:

- **None**

Off-Site Resident:

- **None.**

The evaluation of Site data in the HHRA did not indicate that Site groundwater and surface waters represent a risk to human health. As the Site has existed in its current condition for several decades, waste materials are not anticipated to impact these media or migrate off-Site in surface water or ground water in the future that would pose a risk to humans. The HHRA indicates that risks from fugitive dusts emissions from the Site wastes are not significant.

The only unacceptable potential impacts to humans at the Site are from tailings in TDF-1 and TDF-2 and Site sediments for an unrestricted land use. Other than for a future on-Site resident, the Site does not pose an unacceptable risk to humans for other potential current or future uses.

6.1.1.2 Potential Ecological Risks

This ERA presented in Section 5.3 evaluated risks to five terrestrial receptor groups: small mammal herbivores, represented by voles, small mammal predators, represented by shrews, raptors, represented by the red-tailed hawk; waterfowl, represented by the mallard; and vermivores, represented by the American robin. Aquatic receptors were considered indirectly in terms of water quality criteria. The federal endangered (gray wolf) and threatened (grizzly bear, Canada lynx) species were assessed qualitatively in comparison to estimates of risk to the red-tailed hawk.

Aquatic Resources/Receptors

Under the ERA, assessment of aquatic receptors was limited to water quality criteria with no specific assessment species or other assessment endpoints incorporated into the work plan. None of the surface waters on the Site support fish populations and there are ample water resources in the area so that wildlife use of water on the Site is occasional. On the whole, there were no risks to aquatic resources on the Site.

Terrestrial Resources/Receptors

Exposure estimates to these assessment species using conservative assumptions indicate very limited risk due to lead (robin) from perimeter soils of TDF-1 wetland. Given the protectiveness of the assumptions, the calculated risk for robins is unlikely to pose a real adverse condition, when it is likely that individual robins would make transient visits to the wetlands. If ducks and ungulates were to derive all of their exposures from the Site, there would be exceedences that suggest adverse consequences, however, when foraging ranges are considered, the exposures fall below the levels of concern.

Based upon the results of the ERA, there is no significant risk to ecological receptors at the Site, and no further action to address ecological risks is considered herein.

6.1.1.3 TDF-1 Stability Risks

Analyses were completed to assess the stability of the tailings in TDF-1 with respect to dispersion by geotechnical mechanisms such as slope stability, seismic triggers, and by hydrologic forces such as flooding, debris flows and surface erosion. In TDF-1's current configuration, the face is at or steeper than 1.5H:1V. The factors of safety for this configuration were calculated to be less than 1.5 for a crest to toe type global failure. Therefore, the long term stability of the embankment does not meet the normally accepted stability criteria. There is also the potential risk for long term erosion of the outer embankment slope.

6.1.2 Remediation Objectives

The objective of remedial actions is to eliminate or sufficiently reduce exposure pathways that represent a potential unacceptable risk or mechanisms that could release waste materials to the environment. The remediation objectives specific for the Site include:

- Reduce exposure of potential future residents to Site TDF-1 and TDF-2 tailings and Site sediments via direct contact and ingestion exposure pathways.
- Reduce the potential for TDF-1 tailings to be released to the environment from long-term erosion or dam failure.

6.2 Identification and Screening of Technologies

This section identifies and screens technologies that may be included as part of remediation alternatives for the Site. A comprehensive list of technologies and process options that are potentially applicable to this Site is developed to cover the applicable general response actions. The list of technologies is then screened to develop a refined list of potentially feasible technologies that can then be used to develop remediation alternatives for the Site. The remediation technologies are screened using the criteria described below.

> **Effectiveness** - The potential effectiveness of the technology to (1) address Site-specific conditions, including applicability to the media to be addressed as part of the remedy and areas having elevated COC concentrations (2) meet RAOs, (3) minimize human health and environmental impacts during implementation, and (4) provide proven and reliable remediation under Site conditions.
>
> **Implementability** - The technical and administrative feasibility of implementing a technology. Technical implementability considers Site-specific factors that could prevent successful use of a technology, such as physical interferences or constraints, practical limitations of a technology, and soil properties. Administrative implementability considers the ability to obtain permits required to use the technology, and the availability of qualified contractors, equipment, and disposal services.
>
> **Cost** - The capital costs and operation and maintenance costs associated with the technology. Costs that are excessive compared to the overall effectiveness of the technology may be considered as one of several factors used to eliminate technologies. Technologies providing comparable effectiveness and implementability to that of another technology by employing a similar method of treatment or engineering control, but at greater cost, may be eliminated. At the screening level, the cost evaluation is based on engineering judgment of relative costs.

Evaluation and screening of technologies are performed in steps. The first step is to determine if the technology is applicable to meet Site remedial objectives and therefore could be effective. Once a technology is rejected based on effectiveness, it is not further evaluated based on implementability or cost. Similarly, in the second step, if a technology is effective, but not implementable, the technology is rejected and evaluation of cost is not undertaken. The final step uses all three screening criteria to retain or eliminate technologies for further consideration. This approach streamlines the evaluation of technologies while maintaining a consistent screening methodology.

The key criterion in selecting the screening level (technology types or individual technologies) is whether there is a significant difference between the technologies when evaluated against the screening criteria (effectiveness, implementability, and cost). Technologies that are judged to have significant differences are screened separately, and the retained technologies will be developed into separate remediation alternatives in Section 7. The potentially applicable technologies considered for the Site are presented in Table 6-1. The technology screening is also summarized in this table. Brief descriptions of the technologies and discussions of the screening evaluations are provided in subsequent sections.

6.2.1 General Response Actions

General response actions are broad categories of remedial actions that can be combined to meet remedial goals at a site. The following general response actions are generally applicable to most sites, including the Site:

- No action;
- Institutional controls and monitoring;
- Containment (on-site disposal);
- Stability Improvements;
- Treatment (including reuse and recycling), *ex-situ* or *in-situ*;
- Off-site disposal; and
- Removal.

Except for the "no action" alternative, each of these response actions represents a category of technologies. The technologies applicable to the Site are discussed below by general response actions.

6.2.2 Institutional Controls and Monitoring

Institutional controls are legal and physical restrictions to exposure to COC at a site. Risk is reduced by institutional controls to the extent that they prevent receptor exposure to affected media including areas where elevated concentrations are present. However, institutional controls do not prevent off-site transport of constituents. Institutional controls require maintenance for ongoing effectiveness. Institutional controls are effective within their limitations, are easily implemented, and are low in cost. Institutional controls are typically included in site remedies where COC will remain after completion of remediation.

Site Access Restrictions: Access restrictions involve preventing access by unauthorized persons. Fencing, combined with warning signs, is the most common means of restricting access. Fencing provides a physical barrier to access. Warning signs discourage trespassers by warning potential intruders of the hazards of entering the area. Fencing and warning signs are retained for further consideration.

Land Use Restrictions: Land use restrictions are legal controls such as deed restrictions and zoning that limit development or activities at a site. Deed restrictions are notices of land use restrictions that accompany the deed to the property in a manner that is legally binding and must be transferred to all subsequent owners of the property. The restrictions include a description of a site and reasons for the limits on future activity. Such restrictions would prevent activities or development that could cause direct exposure to COC, or that would compromise the integrity of the remedy. For example, deed restrictions can be used to prohibit site development that could impair the effectiveness of a cap remedy. Land use restrictions are retained for further consideration.

Monitoring: Site monitoring is a required component of any site remedy. Short-term monitoring is conducted to ensure that potential risks to human health and the environment are controlled while a site remedy is being implemented. Long-term monitoring is conducted to measure the effectiveness of the remedy and thereby ensure that the remedy continues to be protective of human health and the environment. Long-term monitoring includes periodic site inspections as necessary to determine maintenance needs (e.g., for fencing or a cap). Monitoring is retained for further consideration.

6.2.3 Containment (On-Site Disposal)

In-situ containment is a general response action used to prevent exposure to material affected by COC that are left in place, and to control migration of constituents. Containment technologies are identified and screened in this section.

6.2.3.1 Capping

Capping is a proven, effective technology for providing reliable long-term containment and preventing or minimizing off-site migration of constituents. Capping minimizes risk by preventing direct contact with waste and affected soil, and preventing off-site migration of constituents in surface water or airborne dust. Where infiltration through waste or affected soil is a concern, a low-permeability cap design is used to minimize the potential for constituent migration into ground water by minimizing infiltration of precipitation. Capping is effective for a site having areas with variable concentrations of constituents.

Caps may be constructed of a variety of natural materials (i.e., clay, sand, and other soils), synthetic liners, geotextiles, and other geomembranes, and other synthetic materials (e.g., asphalt or concrete). They may consist of a single layer or a composite of several layers. Caps provide containment in three primary ways:

- A cap serves as a physical barrier to prevent humans, animals, and vegetation from coming in contact with materials affected by COC.
- A cap prevents erosion of soil by surface water and wind, thereby preventing off-site transport of COC via these media.
- A low-permeability cap minimizes infiltration of surface water, decreasing the potential for transport of COC from waste to ground water.

Caps can be designed to be compatible with many potential future site uses. Land use restrictions and other institutional controls are typically employed along with capping to prevent future site activities that could violate the integrity of the cap (e.g., excavation or support pilings for buildings). Long-term maintenance and monitoring are required.

Capping is readily implemented using standard design and construction techniques. It is relatively low cost, and thus highly cost-effective (i.e., high incremental protection relative to remediation cost). A wide variety of cap designs are possible that vary in effectiveness, implementability and cost. The representative cap designs that were identified and screened for consideration are described below.

- **Soil cap:** A soil cap consists of clean fill soil beneath vegetated topsoil. This type of soil cover is effective at preventing direct contact and off-site migration of constituents by erosion into surface water or adjacent land. A soil cap does not reduce water infiltration through waste materials. A soil cap would be relatively inexpensive and easy to construct and maintain. This cap design is retained for further consideration.

- **Low-permeability soil cap:** A low-permeability cap would primarily consist of a liner of compacted low-permeability soil or an impermeable flexible membrane liner, overlain by soils and vegetated topsoil. This cap type would provide all of the benefits of a soil cap, and also the benefit of decreasing infiltration through Site waste. A low permeability cap is more costly to install and maintain than a soil cap. Since ground water and surface water are not impacted by dissolved metals to a level that represents a risk and are not expected to become a risk in the future, low-permeability caps would not provide additional protection over soil caps and are not retained for further consideration at the Site.

- **Pavement:** Asphalt and/or concrete pavement provides an effective cap for some sites. However, paving as a cap is generally considered for developed areas where there is a need to combine containment with continued commercial or industrial use (e.g., as a parking lot). Paving requires higher maintenance than other types of caps, and is prone to cracking. Site settlement increases maintenance costs. Paving increases stormwater runoff velocities, which could enhance erosion of surrounding areas. Paving is therefore not retained as a cap design for the Site.

- **RCRA Subtitle C design: RCRA Subtitle C Cap:** Design standards for hazardous waste Sites under RCRA (40 CFR 264) provide the most conservative cap design. A typical RCRA cap design consists of (from top to bottom): topsoil, clean fill, a drainage layer (sand or geosynthetic) to direct infiltration away from the liners, a synthetic liner, and a low-permeability soil liner. The soil liner typically has a very low permeability soil ($<10^{-7}$ cm/sec). The RCRA cap is designed to provide additional protection by adding reliability, in the form of redundant protection, against water infiltration. This complex cap design is significantly more difficult to install and much more expensive than the other types of caps. Since ground water within or beneath the tailings and surface waters adjacent to TDF-1 and TDF-2 are not impacted by dissolved metals to a level that represents a risk and are not expected to become a risk in the future, the RCRA cap would not provide additional protection over soil caps and are not retained for further consideration at the Site.

- **Vegetative Cover:** Vegetative cover is a common, highly effective means of reducing soil erosion. Once established, vegetation requires little or no maintenance. Vegetation also provides evapotranspiration that reduces infiltration of stormwater through a cap. Vegetative cover is commonly used with other cap designs to stabilize and control erosion and is therefore retained to be used in conjunction with the soil cap.

6.2.3.2 Surface Water Controls

Surface water management involves controlling surface water run-on and runoff at a site. The purpose of these controls is to minimize erosion that can entrain exposed soil affected by COC, and expose underlying affected materials. Surface water controls by themselves are not generally effective as a permanent remedy. These controls may be used as short-term measures (e.g., during excavation), or as long-term measures (e.g., as part of capping). Surface water controls are proven technology, effective, easily implemented and inexpensive. They are therefore retained for use in conjunction with other remediation technologies.

- **Grading**: Grading is used to promote stormwater drainage, which reduces infiltration through a cap while minimizing erosion. Grading is desirable at this Site to remove existing slopes that are susceptible to erosion and, therefore, this technology is retained for the Site.
- **Stormwater Drainage Controls**: In addition to grading, stormwater drainage can be controlled by berms and ditches or swales. Ditches and swales are channels designed to collect stormwater and route it to a desired discharge point. They may be unlined or, to reduce erosion, lined with gravel, concrete, synthetic membranes, or other materials. Piping can also be used to route collected stormwater to the desired discharge point. Retention basins can be used to slow flow velocities and trap sediment, thereby decreasing erosion potential. This technology is retained for the Site.
- **Vegetative Cover:** Vegetative cover is a common, highly effective means of reducing soil erosion. Once established, vegetation requires little or no maintenance. Vegetation also provides evapotranspiration that reduces infiltration of stormwater through a cap. As discussed above, vegetative cover is retained.

6.2.3.3 Ground water Controls

Ground water control systems are needed at sites where ground water is impacted by site COC and represents an unacceptable risk. Ground water controls may be hydraulic barriers and are intended to minimize lateral flow of ground water or may involve active manipulation of hydraulic heads thereby preventing or minimizing migration of COC. At this Site, ground water already meets cleanup goals. Therefore, hydraulic containment is not necessary and hydraulic containment technologies are not retained.

6.2.4 Earthen Dam Stability Improvements

Earthen dams impounding tailings must be stable in order to minimize the potential release of waste materials to the environment. Stability improvements for existing earthen dams are site-specific. General methods for improving stability are presented below.

6.2.4.1 Groundwater Level Control

Groundwater levels within earthen dams are important for stability. Lowering groundwater levels typically increase stability. Control of groundwater levels can be accomplished by installation of passive or active drain systems or dewatering systems and/or by control of water entering the impoundment. Drain systems include horizontal drains along the base of the earthen dam that can collect drain groundwater within the dam and waste materials to effectively lower groundwater levels. Dewatering systems include wells that can pump sufficient groundwater for the dam or waste material to effectively lower the groundwater levels. Typical technologies that minimize water entering the impoundment include low permeability caps and/or groundwater and surface water diversions. TDF-1 has controlled seasonal fluctuations of groundwater levels by collection and diversion of surface water and shallow groundwater along the up-gradient slope of the facility. A decant tower drains surface water away from the facility and also stabilizes the groundwater level within the tailings. It is possible that groundwater levels could be lowered by diversion of deeper groundwater that will reduce the amount of groundwater entering the facility and lower the water levels within the facility. Therefore, this technology is retained for further consideration.

6.2.4.2 Dam Buttress

Dam buttresses or berms are typically coarse material placed along the base (toe) of an earthen dam. The buttress improves the stability of an earthen dam. Since a buttress was previously installed along the base of TDF-1, this technology is not retained.

6.2.4.3 Slope Improvements

The slope of the earthen dams is important for the long-term stability from erosion and dam failure. Typically slopes of greater than 2H:1V are required to establish an adequate surface to minimize the potential for erosion and meet dam safety requirements. Since the TDF-1 dam is at a 1.5H: 1V or steeper slope, this technology is retained for further consideration.

6.2.4.4 Geo-Fabric Netting

Geo-fabric netting used in conjunction with revegetation, and placed along the face of an earthen dam is an effective technology for minimizing the potential for erosion. The life expectancy of the available products are not known, but is expected to be effective for 50 to 100 years. Since this technology does not materially improve dam stability that is also needed for TDF-1, this technology is not retained.

6.2.5 Treatment

6.2.5.1 Waste and Affected Soil

The COC at the Site are primarily metals. Metals cannot be destroyed, but may be stabilized to render them less soluble and mobile. Stabilization of metal impacted soils is a commonly used treatment to protect ground water and surface water from being impacted through dissolved metals leaching. As ground water is not impacted now nor is it expected to become impacted from site wastes and soils, immobilization of metals in Site wastes and soils is not necessary and is not retained for further consideration.

Metal extraction by recycling tailings or impacted soils is desirable when feasible and cost-effective. However, at this Site, the wastes are the by-product of ore processing and beneficiation and are not believed to be economically recoverable for the remaining metal content. Therefore, reuse and recycling are not retained.

6.2.5.2 Ground water

Ground water at this Site already meets remediation goals; therefore, there is no need to treat ground water.

6.2.6 Off-Site Disposal

Off-site disposal is a general response action for final disposition of excavated waste and affected soil, or waste generated by treatment processes. Since the RI investigative data indicate limited risk to humans and the environment,, there is no need to remove the Site waste to another location for disposal or to create a new disposal facility for containing the wastes. TDF-1 dam stability is an issue for minimizing the potential for tailings releases, but can be improved at the Site without removal off-Site. Therefore, off-site disposal is not retained.

An option considered for the Site is partial excavation, removal and off-Site disposal of materials in areas exhibiting elevated concentrations of constituents. The Site wastes are high volume, but low concentration/risk materials, and "hot spots" that may be effective to remove off-Site have not been observed. Again as mentioned above, there is no benefit in partial excavation and disposal to another facility when in-place containment on-Site could be effective. Therefore, partial excavation and off-Site disposal of areas containing elevated concentrations of constituents is not retained.

6.2.7 Removal

Removal is a general response action for media affected by COC prior to ex-situ treatment (on-Site or off-Site) or disposal. Removal by itself is not a complete remedial action, but must be combined with subsequent disposition of the removed media. Removal technologies include excavation and consolidation of wastes or impacted media at a site where appropriate. Because Site tailings and sediments represent a minimal risk for current and future receptors, but constitute a relatively large area and volume of material, excavation and consolidation could be effective and is retained for further consideration in combination with other on-Site disposal or containment technologies.

As discussed above, at this Site there is no need for waste treatment or off-Site disposal. Therefore, there is no need for waste removal or waste excavation technologies, except as they apply to Site regrading, waste consolidation or stabilization, and cap construction.

7.0 CLEANUP ACTION ALTERNATIVE DEVELOPMENT

In this section, remediation alternatives are developed from the remediation technologies retained after screening. The alternatives are then evaluated in Section 8.

7.1 Development of Remedial Alternatives

Remediation alternatives are developed to meet the major ARAR (MTCA) requirements [WAC 173-340-360(2)(a)] which include:

- Protect human health and the environment;
- Comply with MTCA cleanup standards;
- Comply with applicable laws and regulations; and
- Provide for compliance monitoring.

Other requirements of cleanup actions that must be considered per MTCA regulation WAC 173-340-360(2)(b) are:

- Use permanent solutions to the maximum extent practicable;
- Provide for reasonable restoration time frame; and
- Consider public concerns.

As discussed in Section 6, reuse/recycling or treatment is neither necessary nor appropriate for this Site. Considering MTCA regulations and other ARARs (Appendix I), RAOs (Section 6.1), and the technology screening (Section 6.2), the following alternatives have been assembled:

Alternative 1: No Action

Alternative 2: Institutional Controls, Creek #2 Sediment Capture and Monitoring;

Alternative 3: TDF-1 Slope Improvement (2.5H:1V) and Accelerate Vegetation on TDF-1 and TDF-2;

Alternative 4: TDF-1 Slope Improvement (2.5H:1V), TDF-2 Partial Soil Cap, and Accelerate Vegetation on TDF-1 and TDF-2;

Alternative 5: TDF-1 Slope Improvement (2.5H:1V), TDF-1 Wetland Removal, TDF-2 Partial Soil Cap, Accelerate and Re-Vegetate TDF-1 and TDF-2, and TDF-1 Wetland Mitigation; and

Alternative 6: TDF-1 Slope Improvement (2.5H:1V), TDF-1 and TDF-2 Soil Cap, Re-Vegetation of TDF-1, and TDF-2, and TDF-1 Wetland Mitigation.

Alternative components are listed below. It is necessary to make a number of design assumptions to fully develop and evaluate each alternative. These design assumptions are representative of the technologies used in the alternatives. However, the design assumptions used here are not necessarily the same as the design assumptions that would be used for the final detailed design.

7.2 Description of Remediation Alternatives

7.2.1 Alternative 1: No Action

Typically evaluated in a FS, a "no action" alternative is included as a baseline for comparison to the other alternatives. This alternative would leave the Site in its current state, assuming no restrictions on future Site use and no Site maintenance or monitoring. The risks to human receptors would not change from that evaluated in the risk assessments that were presented in Section 5.

7.2.2 Alternative 2: Institutional Controls, Creek #2 Sediment Capture and Monitoring

This alternative would eliminate potential Site risks by preventing future residential land use on the tailings facilities and Creek #2 sediment migration toward the Pend Oreille River.

Alternative 2 includes the following major components, which are illustrated in Figure 7-1:

1. Deed restrictions to prevent future residential land use;
2. Construct TDF-1 access road;
3. Short-term monitoring during remedial implementation;
4. Refurbish existing TDF-1 surface water diversion systems;
5. Construct a surface water spillway from the surface of TDF-1 to the improved surface water diversion systems;
6. Construct a sedimentation basin for Creek #2; and
7. Annual groundwater monitoring and periodic inspection dredging and maintenance of the sedimentation basin and TDF-1 dam.

7.2.3 Alternative 3: TDF-1 Slope Improvement (2.5H:1V) and Accelerate Vegetation on TDF-1 and TDF-2

Alternative 3 would include the same deed restrictions and remedial actions included in Alternative 2. Under this alternative the potential risks from erosion or global stability of TDF-1 would be reduced by reducing TDF-1 dam face to a 2.5H:1V slope and stabilizing the dam face with an armored and vegetated surface. TDF-1 and TDF-2 surfaces would have soil amendments and nutrients added to accelerate vegetation. Long-term maintenance of TDF-1 dam for Alternative 3 is anticipated to be significantly reduced compared to Alternative 2.

Alternative 3 includes the following major components, which are illustrated in Figure 7-2:

1. Implement institutional controls, conduct monitoring, refurbish TDF-1 surface water diversion systems, and construct Creek #2 sedimentation basin as described in Alternative 2;

2. Reduce slope of TDF-1 dam face to 2.5H:1V;
3. Grade the consolidated tailings and excavated area for even slope and good stormwater drainage toward the TDF-1 decant tower and new spillway;
4. Place a 0.5-foot thick cap consisting of a mixture of soil (from Ione stockpile)and armor rock (from mine waste rock pile - appropriately sized) over the re-sloped TDF-1 dam face;
5. Vegetate TDF-1 dam face with tilled soil amendments and nutrients followed by hydroseeding;
6. Re-vegetation TDF-1 tailings surface with tilled amendments and nutrients (upper six-inches) and hydroseeding, but excluding TDF-1 wetland and wetland perimeter soils;
7. Accelerate vegetation on TDF-1 with surface applied amendments to the TDF-1 wetland perimeter soils;
8. Re vegetate TDF-2 with tilled amendments and nutrients (upper six-inches) followed by hydroseeding; and
9. Annual groundwater monitoring and periodic inspection and maintenance of the sedimentation basin, TDF-1 dam face slope and TDF-1 and TDF-2 vegetation.

7.2.4 Alternative 4: TDF-1 Slope Improvement (2.5H:1V), TDF-2 Partial Soil Cap and Accelerate Vegetation on TDF-1 and TDF-2

Alternative 4 is the same as Alternative 3, except that the southern-potentially phytotoxic portion of TDF-2 would be capped with six-inches of soils and six-inches of vegetative soils with appropriate amendments and nutrients to sustain vegetation. Alternative 4 would include the same deed restrictions and remedial actions included in Alternative 2.

Alternative 4 includes the following major components, which are illustrated in Figure 7-3:

1. Implement institutional controls, conduct monitoring, refurbish TDF-1 surface water diversion systems, and construct Creek #2 sedimentation basin as described in Alternative 2;
2. Reduce slope of TDF-1 dam face to a 2.5H:1V;
3. Grade the consolidated tailings and excavated area for even slope and good stormwater drainage toward the TDF-1 decant tower and the new surface water spillway;
4. Place a 0.5-foot thick cap consisting of a mixture of soil (from Ione stockpile)and armor rock (from mine waste rock pile - appropriately sized) over the re-sloped TDF-1 dam face;
5. Vegetate TDF-1 dam face with tilled soil amendments and nutrients followed by hydroseeding;

6. Re-vegetate TDF-1 tailings with tilled amendments and nutrients (upper six-inches) followed by hydroseeding, but excluding TDF-1 wetland and wetland perimeter soils;
7. Accelerate vegetation on TDF-1 with surface applied amendments to the TDF-1 wetland perimeter soils;
8. Cap south portion of TDF-2 that is potentially phytotoxic with six-inches of soil cap (from Site borrow source area) and six-inches of growth soil (from Ione stockpile);
9. Vegetate entire TDF-2 surface (including the southern capped portion) with tilled amendments and nutrients (upper six-inches) followed by hydroseeding; and
10. Annual groundwater monitoring and periodic inspection and maintenance of the sedimentation basin, TDF-1 slopes, TDF-1 and TDF-2 vegetation and soil caps.

7.2.5 Alternative 5: TDF-1 Slope Improvement (2.5H:1V), TDF-1 Wetland Removal, TDF-2 Partial Soil Cap, Accelerate and Re-Vegetate TDF-1 and TDF-2 , and TDF-1 Wetland Mitigation

Alternative 5 is the same as Alternative 4, except that the wetland on TDF-1 would be removed and mitigated. Alternative 5 would include the same deed restrictions and remedial actions included in Alternative 2.

Alternative 5 includes the following major components, which are illustrated in Figure 7-4:

1. Implement institutional controls, conduct monitoring, refurbish TDF-1 surface water diversion systems, and construct Creek #2 sedimentation basin as described in Alternative 2;
2. Reduce slope of TDF-1 dam face to a 2.5H:1V;
3. Grade the consolidated tailings and excavated area to cover the TDF-1 wetland and perimeter soils with an even slope and good stormwater drainage toward the TDF-1 decant tower and new spillway;
4. Place a 0.5-foot thick cap consisting of a mixture of soil (from Ione stockpile)and armor rock (from mine waste rock pile - appropriately sized) over the re-sloped TDF-1 dam face;
5. Vegetate TDF-1 dam face with tilled soil amendments and nutrients followed by hydroseeding;
6. Re-vegetate TDF-1 tailings with tilled amendments and nutrients (upper six-inches) followed by hydroseeding;
7. Mitigate TDF-1 wetland with an alternate wetland south of TDF-1;
8. Cap south portion of TDF-2 that is potentially phytotoxic with six-inches of soil cap (from Site borrow source area) and six-inches of growth soil (from Ione stockpile);

9. Vegetate entire TDF-2 surface (including the southern capped portion) with tilled amendments and nutrients (upper six-inches) followed by hydroseeding; and

10. Annual groundwater monitoring and inspection and maintenance of the sedimentation basin, wetland mitigation area, TDF-1 slopes, TDF-1 and TDF-2 vegetation and soil caps.

7.2.6 Alternative 6: TDF-1 Slope Improvement (2.5H:1V), TDF-1 and TDF-2 Soil Cap, Re-Vegetation of TDF-1, and TdF-2 and TDF-1 Wetland Mitigation

Alternative 6 would reduce the slope of TDF-1 dam to 2.5H:1V for stability and remove the TDF-1 wetland as in Alternative 5, but would cap the entire surface of both TDF-1 and TDF-2. Alternative 6 would include the same deed restrictions and remedial actions included in Alternative 2.

Alternative 6 includes the following major components, which are illustrated in Figure 7-5:

1. Implement institutional controls, conduct monitoring, refurbish the existing TDF-1 surface water diversion systems, and construct Creek #2 sedimentation basin as described in Alternative 2;

2. Reduce slope of TDF-1 dam face to a 2.5H:1V;

3. Grade the consolidated tailings and excavated area to cover the TDF-1 wetland with an even slope and good stormwater drainage toward the TDF-1 decant tower and new spillway;

4. Place a 0.5-foot thick cap consisting of a mixture of soil (from Ione stockpile)and armor rock (from mine waste rock pile - appropriately sized) over the re-sloped TDF-1 dam face;

5. Vegetate TDF-1 dam face with tilled soil amendments and nutrients followed by hydroseeding;

6. Mitigate TDF-1 wetland with an alternate wetland south of TDF-1;

7. Cap TDF-1 tailings with six-inches of soil cap (from Site borrow source area) and six-inches of growth soil (from Ione stockpile);

8. Cap TDF-2 tailings with six-inches of soil cap (from Site borrow source area) and six-inches of growth soil (from Ione stockpile);

9. Vegetate TDF-1 and TDF-2 caps with tilled amendments and nutrients (upper six-inches) followed by hydroseeding; and

10. Annual groundwater monitoring and inspection and maintenance of the sedimentation basin, wetland mitigation area, TDF-1 slopes, TDF-1 and TDF-2 vegetation and soil caps.

8.0 CLEANUP ALTERNATIVE EVALUATION

This section evaluates the remediation alternatives developed and described in Section 7.. The evaluation concludes with a discussion of the overall evaluation and scoring and identifies the preferred alternative. The evaluation of remedial alternatives is consistent with the MTCA regulation process (WAC 173-340-360). As required by MTCA, a three-step evaluation process is conducted. The first step in the remedial alternative evaluation process is a "threshold" evaluation (Section 8.1), the second step is an evaluation of reasonable restoration time frame (Section 8.2), and the third step is a "permanence" evaluation (Sections 8.4 and 8.5). The remedial alternative that meets the threshold criteria, has a reasonable restoration time frame and has the best benefit/cost ratio for permanence is recommended for remedy selection.

8.1 Threshold Evaluation

The threshold evaluation determines whether each alternative meets the minimum requirements for consideration. Only alternatives that meet the minimum threshold criteria can be considered for selection. Under MTCA, remediation alternatives must meet the following threshold requirements (WAC 173-340-360(2)(a)):

- Protection of human health and the environment;
- Compliance with cleanup standards;
- Compliance with ARARs; and
- Provision for compliance monitoring.

Each alternative is evaluated individually against the threshold criteria in the following sections.

8.1.1 Protection of Human Health and the Environment

As a threshold criterion, protection of human health and the environment addresses whether a remediation alternative would result in sufficiently low residual risk to current and potential future receptors after completion of the alternative. Potential unacceptable human health risks exist at the Site for future residential land use, but ecological risks are considered acceptable.

Investigative data indicates that ground water and surface waters are not impacted from Site wastes to unacceptable levels. Since the Site wastes have been present for decades without any engineering controls, the potential for ground water or for surface waters to become unacceptably impacted by Site wastes are very low. All alternatives are, therefore, considered to be protective of ground water and surface water.

Alternative 1 does not mitigate potential human exposure pathways and would not eliminate the risks that were identified in the HHRA (Section 5.2) and, therefore, is not deemed protective of human health. Alternatives 2, 3, 4 and 5 meet this threshold because the deed restrictions would eliminate future residential land use. Alternative 2 provides a higher risk of TDF-1 stability failure with the release of tailings to the environment than Alternatives 3, 4, and 5.

8.1.2 Compliance with Remediation or Cleanup Levels

Compliance with MTCA cleanup standards does not require removing all waste or affected soil from a site; these regulations include provisions for meeting cleanup requirements through containment (e.g., WAC 173-340-740(6)(f)). For cleanup levels to be attained for a containment alternative, six conditions specified in WAC 173-340-740(6)(f) (i through vi) must be provided. Alternatives 2, 3, 4, 5, and 6 meet the six conditions for: (1) permanence; (2) protective of human health; (3) protective of ecological receptors; (4) provides institutional controls; (5) provide for compliance monitoring; and (6) prevents migration of contained wastes. Alternative 1 does not meet all these specified conditions and therefore does not meet the threshold requirement for compliance with MTCA cleanup levels.

8.1.3 Compliance with ARARs

MTCA (WAC 173-340) is the applicable regulation for the Site and this FS incorporates the MTCA procedures for evaluation of remedial actions. MTCA is a comprehensive State of Washington environmental regulation that requires compliance with other environmental regulations including Federal and State drinking water, ground water and surface water standards. This FS evaluates remedial alternatives using MTCA requirements to eventually select a remedial alternative that is fully compliant with MTCA and other ARARs. Potential ARARs for the Site are presented and evaluated in Appendix I. All alternatives that are being evaluated comply with ARARs.

8.1.4 Provision for Compliance Monitoring

Compliance monitoring requirements are defined in the applicable MTCA regulations (WAC 173-340-410). Compliance monitoring includes: (1) "protection monitoring" to confirm that human health and the environment are adequately protected during implementation of an alternative; (2) "performance monitoring" to confirm that cleanup standards or other performance standards have been attained; and (3) "confirmational monitoring" to monitor the long-term effectiveness of the remedy after completion of the alternative.

Alternative 1 (No Action) does not provide compliance monitoring, and, therefore, does not meet this requirement. The remaining alternatives meet this requirement by providing appropriate protection, performance, and long-term confirmational inspection monitoring.

8.1.5 Summary of Threshold Evaluation

Based on the foregoing evaluation, the following alternative does not meet threshold criteria:

- Alternative 1 (No Action).

Alternative 1 does not meet the threshold evaluation criteria under MTCA, and will not be carried forward in the evaluation for comparison with the other alternatives as typically conducted under MTCA. The other five alternatives meet the threshold criteria and are carried forward for the second and third evaluation steps.

8.2 Reasonable Restoration Time Frame

A criterion for evaluation of remedial actions under MTCA is the time frame necessary for restoration based on factors identified in WAC 173-340-360(4)(b). The factors to be considered for evaluating restoration time frame do not distinguish the remedial alternatives developed in Section 7. For example, the COC are metals and will not reduce in concentration over time. The time frame for implementation is relatively short (less than two years) for all developed alternatives. Long-term compliance monitoring would also be similar for each alternative. Therefore, this criterion is not considered to affect remedy selection for this FS and is not considered further.

8.3 Use of Permanent Solutions

WAC 173-340-360(3) specifies that the remediation alternatives must use permanent solutions to the maximum extent practicable. A determination that a cleanup action satisfies the requirement to use permanent solutions to the maximum extent practicable is based on consideration of a number of factors. The specified factors, or "permanence criteria," are:

- Overall protectiveness;
- Permanence by reduction in toxicity, mobility, and volume;
- Long-term effectiveness and reliability;
- Short-term risks;
- Implementability;
- Cost; and
- Community acceptance.

These criteria and the basis for evaluating the alternatives against them are defined and discussed below. These definitions are consistent with MTCA regulations, but have been refined to minimize the overlap of considerations in the criteria. This allows decision makers to consider each criterion independently and minimizes double-counting of criteria. In addition, use of independent criteria allows better comparisons between and among the criteria; i.e., determining the value of each criterion in terms of the other criteria.

8.3.1 Overall Protectiveness

This criterion is one of the threshold criteria that were discussed in Section 8.1. Overall protectiveness addresses the degree to which each alternative attains cleanup standards and is protective of human health and the environment, considering both long-term and short-term risks. Each alternative is evaluated for overall protectiveness on a relative basis.

8.3.2 Permanence by the Reduction of Toxicity, Mobility, and Volume of Hazardous Substances

This criterion addresses the degree to which a remediation alternative reduces the inherent toxicity, the mobility (ability of constituents to migrate from the Site to the environment), or the quantity of material (volume or mass). Since the COC are metals, the principal factor in this criterion to be evaluated for the remediation alternatives is the reduction in mobility or toxicity through bio-availability.

8.3.3 Long-Term Effectiveness and Reliability

This criterion addresses the long-term effectiveness and reliability of the alternatives at reducing risks over an extended period of time after the remedy is implemented. Risks during the implementation period are addressed under short-term risks. Reliability involves estimating the longevity of the remedy, (e.g., the lifespan of institutional controls or containment) and the chances of remedy failure.

8.3.4 Short-Term Risks

This criterion addresses short-term effects on human health and the environment while the alternative is being implemented. The evaluation includes consideration of the following factors:

- Risk to Site workers;
- Risk to the community; and
- Risk to the environment (wildlife).

Short-term risks were primarily scored based on evaluation of the degree of risk to Site workers, wildlife, and TDF-1 wetland, Creek #2 and the Pend Oreille River surface waters. The primary risk to Site workers would be due to construction accidents and inhalation exposure to dust during grading and capping. The primary short-term risk to wildlife would be due to noise and human activity associated with the implementation of the remedy. The primary risk to wetlands and surface waters would be due to haul road crossings, potential erosion and stormwater runoff.

Because the Site is remote and residents do not live in the vicinity, remedial actions would not create an unacceptable short-term risk to the public. Therefore, short-term risks to the public are not as significant in distinguishing between alternatives as Site worker, wildlife species and wetland issues.

8.3.5 Implementability

This criterion addresses the degree of difficulty in implementing each alternative. Implementability issues are important because they address the potential for delays, cost overruns, and failure. Known implementation difficulties with quantifiable cost impacts are included in the cost estimates. The implementability criterion focuses on less quantifiable known and potential difficulties. Implementability is evaluated considering the following:

- **Technical Feasibility**. Technical feasibility addresses the potential for problems during implementation of the alternative and related uncertainties. The evaluation includes the likelihood of delays due to technical problems and the ease of modifying the alternative, if required.
- **Availability of Services and Materials**. This criterion considers the availability of experienced contractors and personnel, equipment, and materials needed to implement the alternative. Availability of disposal capacity is also included in the evaluation.
- **Administrative Feasibility**. This criterion considers the degree of difficulty anticipated due to regulatory constraints and permits. The degree of coordination required between various agencies is also considered.
- **Scheduling.** This criterion considers the time required until remedial action would be complete, and any difficulties associated with scheduling.
- **Complexity and Size**. The more complex or large a remedial action, the more difficult it is to construct or implement. In addition, the more items there are that can go wrong, the greater the chance of failure that could affect remedy effectiveness.

- **Other Considerations.** Monitoring requirements, access for construction and operation and maintenance, integration with existing mine operations and current or potential remedial action, and other factors are considered.

8.3.6 Cost

This criterion considers the costs of performing the remedial actions, including capital, operation and maintenance, and monitoring costs. Alternative costs are compared on a net present value basis. Known implementation difficulties with quantifiable cost impacts are included in the cost estimates. The cost estimates for each alternative are based on conceptual level design (not final design) and are mainly for relative alternative comparisons in this FS.

8.3.7 Community Acceptance

After the RI/FS Report is finalized, an alternative is selected as the proposed remedial action. The proposed remedial action is described along with the basis for its selection in the draft Cleanup Action Plan (CAP). Determination of community acceptance is based on public comments on the draft RI/FS Report. Therefore, community acceptance is not included in the FS comparative evaluation. Instead, Ecology evaluates community acceptance after the RI/FS Report and draft CAP are released to the public. The proposed remedial action may be modified to address community concerns based on public comments.

8.4 Evaluation Methodology for Permanence

Selection of a remediation alternative is based on comparative evaluation of the alternatives under the permanence criteria. Overall protectiveness and community concerns are not included in the comparative evaluation for reasons discussed in Sections 8.3.1 and 8.3.7. The following methodology was used for the comparative evaluation:

1. Each alternative is scored relative to the other alternatives for the five non-cost permanence criteria (excluding community acceptance). Because of the nature of the criteria and the uncertainties in the evaluation, the scores for these criteria are expressions of relative qualitative or semi-quantitative professional judgments. A relative scale of 0 (worst) to 10 (best) is used. Qualitative scoring for the criteria is appropriate and is typically conducted when the information to provide meaningful and defensible quantitative scoring is not available, such as is the case for this Site.

2. The relative values of the non-cost criteria are determined. The relative criteria values are expressions of what a scoring unit of one criterion is worth compared to a scoring unit of another criterion. In other words, relative criteria values express how much a decreased value (lower score) of one criterion is acceptable to improvement (higher score) for another criterion.

3. The scores for the five non-cost criteria are combined using the criteria weightings to give overall alternative scores. These scores express the net benefit of the alternatives.

4. A comparison of the cost and benefit of the alternatives is made. The alternative with the best benefit and cost/benefit ratio is the preferred alternative.

8.5 Evaluation of Permanence Criteria for Remediation Alternatives

This section provides a comparative evaluation for permanence under MTCA of the alternatives using the criteria (non-cost and the cost criteria) (see Section 8.3 and 8.4). The retained alternatives 2, 3, 4, 5, and 6 are included in the evaluation, since they meet the threshold criteria (evaluated in Section 8.1). The basis for the scoring is provided below. The evaluation and scoring of the alternatives is summarized in Table 8-1.

8.5.1 Overall Protectiveness

This criterion of overall protectiveness is a threshold requirement that each remedial alternative must meet to be evaluated in this FS. The only alternative that does not meet this threshold requirement is Alternative 1-No Action Alternative. Although Alternatives 2 through 6 meet the threshold requirement, they are evaluated in this FS by the relative degree in which each alternative is protective. Alternative 2 relies on deed restrictions only for protection of human health risks and is considered to provide the minimum overall protectiveness. Alternative 3 through 6 provide various amounts of clean soil cap on portions of TDF-1 and TDF-2 that will be slightly more protective. Although Alternatives 4 and 5 have the same amount of clean soil cap, Alternative 5 removes TDF-1 wetland that may attract humans and wildlife, therefore is given a slightly higher score for overall protectiveness. Alternative 6 completely caps TDF-1 and TSD-2 with clean soil and is given the highest score.

The overall protectiveness scores for each of the alternatives that meet threshold requirements are as follows:

- Alternative 2 = 0
- Alternative 3 = 5
- Alternative 4 = 6
- Alternative 5 = 8
- Alternative 6 = 10

8.5.2 Long-Term Effectiveness

The criterion of long-term effectiveness is scored based on professional judgment and experience in the ability of the remedies to achieve and maintain their estimated effectiveness. Alternatives 2, 3, 4, 5, and 6 create a deed restriction that would prohibit residential land use on site wastes areas. Deed restrictions are a common method for eliminating receptor exposures, remain with the deed in perpetuity and are enforced through local building permits. Alternative 2 also includes Creek #2 sedimentation basin for sediment capture and refurbishing of the existing surface water diversion system to improve reliability during potential storms. Alternative 2 does not improve stability from the TDF-1 dam face erosion or global dam stability for the facility. Because the factor of safety for the existing conditions are lower than typically considered acceptable, there is a higher probability that long-term erosion of the TDF-1 dam face and for a global mass failure to occur than the other alternatives. Erosion of the TDF-1 dam face can be controlled in the long-term through regular monitoring and maintenance of local blow-outs, but may not be adequate for global failures. For these reasons, Alternative 2 is therefore given the lowest long-term effectiveness score.

Alternatives 3, 4, 5, and 6 would have all the components of Alternative 2, but would be more effective and reliable because each alternative improves the stability of TDF-1 with dam face slope reduction and surface stabilization with a mixture of armor rock and soil that can be regularly monitored and repaired. Alternatives 3, 4, 5, and 6 improve the TDF-1 dam to a 2.5H:1V slope capped with a mixture of soils and wastes rock, and therefore do not differ in the long-term effectiveness criterion for minimizing the potential for tailings release to the environment. Erosion of the dam face can be controlled for the different slopes by using appropriately sized armor rock and vegetation for stability. Therefore dam erosion should not be materially different for Alternatives 3 through 6.

The major differences among Alternatives 3, 4, 5 and 6 are in the extent of re-vegetation and capping that are implemented for TDF-1 and TDF-2. The long-term effectiveness of each of these alternatives will be similar once the vegetation is established; although the amount of long-term maintenance to establish vegetation may be progressively lower for Alternative 3 through 6.

The long-term effectiveness criterion scores for each of the alternatives that meet threshold requirements are as follows:

- Alternative 2 = 0
- Alternative 3 = 7
- Alternative 4 = 8
- Alternative 5 = 9
- Alternative 6 = 10

8.5.3 Permanence by Reduction in Toxicity, Mobility, and Volume of Hazardous Substances

None of the alternatives provide any reduction in volume of waste materials because the COC are metallic elements, which cannot be destroyed to reduce their volume. Since the metals in the waste tailings at the Site are not dissolving and impacting Site groundwater or Site surface water, reducing the potential for dissolution by reducing contact with water or chemical fixation is not of primary importance. The only manner in which the metal toxicity could be reduced is by making the metals less bio-available from direct exposures and through food chains. Although animal tracking, air-borne dispersion and ecological food chain dispersion of TDF-1 and TDF-2 tailings have not been found to be significant at the Site, a clean soil cap can reduce the mobility of metals into the environment from these mechanisms. Alternatives 3, 4, 5 and 6 include nutrient amendments of phosphate that are expected to bind lead and possibly other metals in the tailings rendering them less bio-available. The major difference in the alternatives regarding the permanence criterion is in the amount of clean soil cap provided over tailings materials.

Alternative 2 does not provide any reduction Site metal availability (toxicity) and is given the lowest score. Alternatives 3 and 4 add phosphate to the tailings surface to promote plant growth and lower metal (mainly lead) availability and toxicity, but do not cap any of the tailings surfaces (except TDF-1 dam face). Alternatives 4 and 5 also provide phosphate on tailings to render them less bio-available, but also install clean soil caps over a portion of TDF-2. Therefore, Alternatives 4, and 5 are given higher scores. Alternative 6 caps both TDF-1 and TDF-2 with clean soils, therefore is given the highest score

The permanence (by reduction in toxicity, mobility and volume) criterion scores for each of the alternatives that meet threshold requirements are as follows:

- Alternative 2 = 0
- Alternative 3 = 5
- Alternative 4 = 7
- Alternative 5 = 8
- Alternative 6 = 10

8.5.4 Short-Term Risks

The risk assessment indicates that industrial/construction worker exposures to Site COC by direct contact, incidental ingestion and inhalation are at acceptable levels, therefore, this short-term risk is not considered a major differentiator for this criterion. This criterion best represents the potential for accidents to occur. The potential for accidents to occur is assumed to be dependent on the amount of effort and type of equipment required for implementation of each alternative. The Alternatives 2 through 6 involve typical construction methods and equipment, which in general lower the potential for accidents. On this basis, Alternative 2 involves relatively little Site work, and is, therefore, given the highest score. For the TDF-1 dam slope reduction and vegetation acceleration, Alternatives ,3, 4, 5, and 6 are given lower scores. The only differentiation among these alternatives is the amount of construction from transport and placement of the clean soil cap required to complete each alternative.

The short-term risk criterion scores for each of the alternatives that meet threshold requirements are as follows:

- Alternative 2 = 10
- Alternative 3 = 6
- Alternative 4 = 4
- Alternative 5 = 2
- Alternative 6 = 0

8.5.5 Technical and Administrative Implementability

Technical implementability includes factors such as whether the alternative is technically possible and the availability of off-Site facilities, services and materials to complete the remedy. Alternatives 2 through 6 are all technically implementable, because they use standard construction equipment and workers are locally available. Therefore technical implementability is not a discriminator among the alternatives. Since Alternatives 2 through 6 use similar construction methods and equipment, the availability of resources are not a differentiator for this criterion.

Administrative implementability issues for remedial actions include required permits and approvals from regulatory agencies. Potential approvals or permits that may be necessary include, but are not necessarily limited to: (1) wetlands; (2) forest and wildlife disturbance; and (3) TDF-1 dam stability. Approvals or permits for these issues are used for evaluation of administrative implementability criteria. Alternative 2 would have the least amount of disturbance to natural resources and would be the easiest to obtain regulatory approvals and permits for wildlife and wetlands issues. Alternative 2 may not be acceptable to the State of Washington, because of the current TDF-1 factor of safety is below 1.5. Therefore, Alternative 2 is given the lowest score for this criterion. Alternatives 3, 4, 5, and 6 improve TDF-1 dam stability with an estimated factor of safety greater than 1.5. The administrative implementability for TDF-1 stability is therefore the same for Alternatives 3 through 6.

Alternatives 3 and 4 require work near TDF-1 wetland and produce similar levels of noise, although for progressively longer durations. Approvals or permits for work adjacent to TDF-1 wetland will be necessary to ensure adequate buffers are maintained for wetland protection. Alternative 3 does not require a borrow source for cap soils from adjacent woodland areas, as is assumed for Alternative 4. Therefore, Alternative 3 is given the highest overall score for administrative implementability, while Alternative 4 is given a slightly lower score.

As in Alternative 4, it is assumed for Alternatives 5 and 6 that a portion of the soil caps in these alternatives would come from extending the existing borrow source area (adjacent to TDF-2) with some disturbance of local forest. The amount of disturbance increases from Alternative 4 through 6. Alternatives 5 and 6 will destroy TDF-1 wetland and require wetland mitigation. Approvals or permits will be needed and could represent a considerable administrative difficulty. Therefore, Alternatives 5 and 6 are given progressively lower scores for administrative implementability than Alternative 4.

The technical and administrative criterion scores for each of the alternatives that meet threshold requirements are as follows:

- Alternative 2 = 0
- Alternative 3 = 10
- Alternative 4 = 9
- Alternative 5 = 5
- Alternative 6 = 4

8.5.6 Net Benefit (Overall Non-Cost Evaluation)

The net benefit of the alternatives is determined by combining the criteria scores, weighting the criteria based on the relative values assigned to the criteria (see Section 8.3). The net benefit or overall non-cost scores are given in Table 8-1. Using these scores, the alternatives rank in the following order (most beneficial to least beneficial):

1. Alternative 4: TDF-1 Slope Improvement (2.5H:1V), TDF-2 Partial Soil Cap and Accelerate Vegetation on TDF-1 and TDF-2;
2. Alternative 6: TDF-1 Slope Improvement (2.5H:1V), TDF-1 and TDF-2 Soil Cap, Re-Vegetation of TDF-1, and TdF-2 and TDF-1 Wetland Mitigation.
3. Alternative 3: TDF-1 Slope Improvement (2.5H:1V) and Accelerate Vegetation on TDF-1 and TDF-2;
4. Alternative 5: TDF-1 Slope Improvement (2.5H:1V), TDF-1 Wetland Removal, TDF-2 Partial Soil Cap, Accelerate and Re-Vegetate TDF-1 and TDF-2 , and TDF-1 Wetland Mitigation; and
5. Alternative 2: Institutional Controls, Creek #2 Sediment Capture

8.5.7 Cost

The estimated costs for the alternatives are summarized in Table 8-2. Detailed cost estimates are presented in Appendix J.

The cost estimates in this FS are based on the description of the alternatives in Section 7 and associated design assumptions in Appendix J. The design assumptions and cost estimates used here are representative and sufficient for the purposes of comparative evaluation of the alternatives, but are not necessarily the same as the design basis that would be used for the final, detailed design. Pre-design investigations (i.e., additional stability testing, topographic mapping, etc.) will be included in the final design phase for any of the action remedies, and the results of these investigations could result in changes from the preliminary designs presented in this FS.

The estimates were prepared to allow comparative evaluation of alternatives, not for budgeting purposes. The design basis is subject to change during final, detailed design of the selected alternative, and these changes would affect the cost of the remedy. The uncertainties in the FS designs and associated cost estimates are such that actual costs could vary significantly from these estimates. However, the uncertainty in the *relative* cost of the alternatives is much less than the uncertainty in the magnitude of the costs, and these cost estimates are suitable for comparative evaluation of the alternatives.

8.5.8 Disproportionate Cost Analysis and Overall Evaluation

Under WAC 173-340-360(3)(e), a cleanup action shall not be considered practicable "if the incremental cost of the alternative over that of a lower cost alternative exceeds the incremental degree of benefits achieved by the alternative over that of the other lower cost alternative". The disproportionate cost analysis is only used for the alternatives that meet the minimum threshold criteria (Section 8.1) and provide an appropriate level of protection for the identified risks at the Site.

The determination of practicability is made using an analysis of benefit vs. cost. The disproportionate benefit/cost analysis can be performed quantitatively using the overall judged scoring of the non-cost criteria as the net benefit. The ratio of net benefit to estimated cost, which is a measure of cost-effectiveness, is given in Table 8-1. On a strict benefit to cost basis, Alternative 3 (4.6 benefit to cost ratio) is preferred, followed in order by Alternative 4, Alternative 5, and Alternative 6 having benefit/cost ratios ranging from 4.1 for Alternative 4 to 3.0 for Alternative 6. Alternative 2 has the lowest benefit/cost ratio (2.3) of all the alternatives. Alternative 1 (No Action) cannot be used in the disproportionate cost analysis, because it does not meet MTCA threshold criteria.

However, the MTCA regulations refer to an incremental benefit and incremental cost analysis. To evaluate incremental cost-effectiveness, the difference in cost between alternatives is calculated, going from the least costly alternative to the most costly. Alternative 2 represents the lowest cost alternative that meets the threshold criteria and is made the baseline cleanup alternative against which the other alternatives are compared. The corresponding difference in net benefit (overall non-cost score) is then calculated. The incremental cost-effectiveness is estimated by dividing the incremental benefit by the incremental cost. These values are also shown for the alternatives in Table 8-1.

The disproportionate cost analysis reveals that Alternative 3 has the only incremental benefit to incremental cost ratio that is over 1.0 and is actually much greater at 8.1 (Table 8-1). Alternatives 4, 5 and 6 have incremental benefit to incremental cost ratios that are less than 1.0. Alternative 5 actually has a negative number that denotes less incremental benefit for the additional cost. This analysis indicates a disproportionate incremental benefit to incremental cost for Alternatives 4, 5 and 6 compared to the Alternative 3. Therefore, based on the scoring and cost estimates, Alternative 3 provides the best overall benefits for Site remediation cost.

9.0 REFERENCES (SUBMITTED WITH SEPARATE REPORT)

TABLES

Table 3-1

TDF-1 and TDF-2 Tailings Total Metal Content[a]

Sample Description	**Sample ID**	**Collection Date**	**As (mg/kg)**	**Ba (mg/kg)**	**Cd (mg/kg)**	**Cu (mg/kg)**	**Pb (mg/kg)**	**Se (mg/kg)**	**Zn (mg/kg)**	**Hg (mg/kg)**	**% Sol**
TDF-1											
TDF-1, Test Pit-1 Composite	PO-TDF1-T1C	7/30/2005	**12.8**	**8.35**	**6.54**	**19.3**	**506**	< 4.0 (<1.0 MDL)	**988**	**0.098**	91.9%
TDF-1, Test Pit-2 Composite	PO-TDF1-T2C	7/30/2005	**19.0**	**6.77**	**17.40**	**13.1**	**406**	< 4.0 (<1.0 MDL)	**2860**	**0.302**	87.5%
TDF-1, Test Pit-3 Composite	PO-TDF1-T3C	7/30/2005	**16.6**	**7.42**	**13.30**	**23.9**	**409**	< 4.0 (<1.0 MDL)	**2190**	**0.165**	83.9%
TDF-1, Test Pit-4 Composite	PO-TDF1-T4C	7/30/2005	**13.8**	**7.21**	**14.20**	**34.1**	**360**	< 4.0 (<1.0 MDL)	**2620**	**0.122**	82.3%
TDF-1, Test Pit-5 Composite	PO-TDF1-T5C	7/30/2005	**10.7**	**8.83**	**7.22**	**25.7**	**414**	< 4.0 (<1.0 MDL)	**1410**	**0.125**	93.0%
TDF-1, Test Pit-6 Composite	PO-TDF1-T6C	7/30/2005	**10.9**	**8.76**	**5.08**	**21.9**	**291**	< 4.0 (<1.0 MDL)	**870**	**0.113**	90.1%
TDF-1, Test Pit-7 Composite	PO-TDF1-T7C	7/30/2005	**14.3**	**10.60**	**8.14**	**50.8**	**421**	< 4.0 (<1.0 MDL)	**961**	**0.082**	88.1%
TDF-1, Test Pit-8 Composite	PO-TDF1-T8C	8/12/2005	**10.2**	**26.40**	**11.80**	**87.8**	**935**	< 4.0 (<1.0 MDL)	**2560**	**0.253**	69.4%
TDF-1, Test Pit-8 Composite (Duplicate)	PO-TDF1-T18C	8/12/2005	**9.3**	**49.70**	**11.20**	**69.2**	**474**	< 4.0 (<1.0 MDL)	**2270**	**0.233**	69.7%
TDF-1, Test Pit-9 Composite	PO-TDF1-T9C	7/30/2005	**7.8**	**9.33**	**10.20**	**20.9**	**352**	< 4.0 (<1.0 MDL)	**1260**	**0.227**	90.3%
TDF-1, Test Pit-10 Composite	PO-TDF1-T10C	7/30/2005	**4.7**	**10.50**	**4.03**	**19.6**	**186**	< 4.0 (<1.0 MDL)	**730**	**0.107**	88.7%
TDF-1, Test Pit-11 Composite	PO-TDF1-T11C	7/30/2005	**13.9**	**8.95**	**7.77**	**27.1**	**505**	< 4.0 (<1.0 MDL)	**968**	**0.102**	88.3%
TDF-1, Test Pit-12 Composite	PO-TDF1-T12C	7/30/2005	**9.8**	**10.80**	**4.86**	**33.2**	**314**	< 4.0 (<1.0 MDL)	**808**	**0.113**	88.3%
Arithmetic Average	(Dry Weight Basis)		**13.9**	**13.7**	**10.8**	**36.8**	**482**	< 4.0 (<1.0 MDL)	**1780**	**0.15**	**0.87**
UCL Mean (normal Distribution)	(Dry Weight Basis)		**16.2**	**20.4**	**13.5**	**50.6**	**585**	**NA**	**2320**	**0.19**	
UCL Mean (lognormal Distribution)	(Dry Weight Basis)		**17.5**	**18.2**	**15.0**	**51.7**	**609**	**NA**	**2580**	**0.22**	
TDF-2											
TDF-2, Test Pit-13 Composite	PO-TDF2-T13C	7/29/2005	**12.4**	**33.20**	**25.40**	**52.6**	**563**	< 4.0 (<1.0 MDL)	**4870**	**0.578**	84.2%
TDF-2, Test Pit-14 Composite	PO-TDF2-T14C	7/29/2005	**14.9**	**19.40**	**14.20**	**27.1**	**411**	< 4.0 (<1.0 MDL)	**2440**	**0.233**	91.0%
TDF-2, Test Pit-15 Composite	PO-TDF2-T15C	7/29/2005	**10.3**	**239.00**	**9.22**	**44.0**	**375**	< 4.0 (<1.0 MDL)	**1810**	**0.185**	88.6%
TDF-2, Test Pit-16 Composite	PO-TDF2-T16C	7/29/2005	**14.3**	**168.00**	**11.10**	**41.5**	**445**	< 4.0 (<1.0 MDL)	**1380**	**0.142**	90.1%
TDF-2, Test Pit-17 Composite	PO-TDF2-T17C	7/29/2005	**15.7**	**13.60**	**12.10**	**30.4**	**471**	< 4.0 (<1.0 MDL)	**1740**	**0.145**	91.7%
Arithmetic Average	(Dry Weight Basis)		**15.1**	**106**	**16.3**	**44.2**	**510**	**NA**	**2780**	**0.29**	**0.89**
UCL Mean (normal Distribution)	(Dry Weight Basis)		**17.2**	**216**	**23.9**	**56.8**	**601**	**NA**	**4430**	**0.51**	
UCL Mean (lognormal Distribution)	(Dry Weight Basis)		**17.8**	**7580**	**28.6**	**64.3**	**618**	**NA**	**6130**	**0.81**	
	MTCA Human (Unrestricted)		**20**	**16,000**	**80**	**3,200**	**250**	**400**	**24,000**	**24**	
	MTCA Human (Industrial)		**20**	**70,000**	**3,500**	**140,000**	**1,000**	**17,500**	**unlimited**	**1,050**	
	MTCA Ecological (Terrestrial)		**20**	**330**	**14**	**54**	**118**	**4**	**120**	**0.1**	

Yellow higlighting indicates mean concentration over any screening level
BOLD numbers indicate analytical detections above laboratory PQL.
UCL used based on W test for normality
a = Sample results reported on an as-received (wet weight) basis

Table 3-2

TCLP Metal Results on TDF-1 and TDF-2 Tailings Composite Samples

Sample Description	Sample ID	Collection Date	Cd (mg/L)	Pb (mg/L)
TDF-1				
TDF-1, Test Pit-1 Composite	PO-TDF1-T1C	7/30/2005	**0.134**	**2.22**
TDF-1, Test Pit-2 Composite	PO-TDF1-T2C	7/30/2005	**0.128**	**3.86**
TDF-1, Test Pit-3 Composite	PO-TDF1-T3C	7/30/2005	**0.119**	**1.31**
TDF-1, Test Pit-4 Composite	PO-TDF1-T4C	7/30/2005	**0.091**	**2.23**
TDF-1, Test Pit-5 Composite	PO-TDF1-T5C	7/30/2005	**0.145**	**0.79**
TDF-1, Test Pit-6 Composite	PO-TDF1-T6C	7/30/2005	**0.075**	**2.30**
TDF-1, Test Pit-7 Composite	PO-TDF1-T7C	7/30/2005	**0.114**	**0.98**
TDF-1, Test Pit-8 Composite	PO-TDF1-T8C	8/12/2005	**0.035**	**5.44**
TDF-1, Test Pit-8 (Split Composite)	PO-TDF1-T8C	8/12/2005	N/A	**6.06**
TDF-1, Test Pit-8 (Duplicate)	PO-TDF1-T18C	8/12/2005	**0.040**	**2.81**
TDF-1, Test Pit-9 Composite	PO-TDF1-T9C	7/30/2005	**0.217**	**0.92**
TDF-1, Test Pit-10 Composite	PO-TDF1-T10C	7/30/2005	**0.072**	**1.84**
TDF-1, Test Pit-11 Composite	PO-TDF1-T11C	7/30/2005	**0.098**	**3.81**
TDF-1, Test Pit-12 Composite	PO-TDF1-T12C	7/30/2005	**0.105**	**3.09**
D & M Composite 1		4/25/1997	**0.011**	**3.30**
D & M Composite 2		4/25/1997	**0.030**	**4.64**
D & M Composite 3		4/25/1997	**0.073**	**1.57**
TDF-2				
TDF-2, Test Pit-13 Composite	PO-TDF2-T13C	7/29/2005	**0.598**	**3.56**
TDF-2, Test Pit-13 (Split Composite)	PO-TDF2-T13C	7/29/2005	N/A	**1.15**
TDF-2, Test Pit-14 Composite	PO-TDF2-T14C	7/29/2005	**0.130**	**0.38**
TDF-2, Test Pit-15 Composite	PO-TDF2-T15C	7/29/2005	**0.104**	**1.21**
TDF-2, Test Pit-16 Composite	PO-TDF2-T16C	7/29/2005	**0.134**	**0.46**
TDF-2, Test Pit-17 Composite	PO-TDF2-T17C	7/29/2005	**0.101**	**0.54**
WAC 173-303 Dangerous Waste Criteria			**1.0**	**5.0**
$UCL_{95\%}$ Normal (All Tailings)			**0.17**	**2.66**
$UCL_{95\%}$ Log Normal (All Tailings)			**0.20**	**3.37**
$UCL_{95\%}$ Normal (TDF-1 only)			**0.12**	**3.11**
$UCL_{95\%}$ Log Normal (TDF-1 only)			**0.17**	**3.63**
$UCL_{95\%}$ Normal (TDF-2 only)			**0.42**	**1.78**
$UCL_{95\%}$ Log Normal (TDF-2 only)			**0.89**	**4.69**

BOLD numbers indicate analytical detections above laboratory PQL.
NA = Not Analyzed at Laboratory

Table 3-3

Argonomic Analytical Results for TDF-1 and TDF-2 Tailings Materials[a]

SAMPLE_ID	UPPR DEPTH inches	LOWR DEPTH inches	SAMPLED	PH	EC dS/m	SAND %	SILT %	CLAY %	TEXTURE	OM %	NITRATE ppm	TKN %	P ppm	K ppm	Available As ppm	Total As ppm	Available Cd ppm	Total Cd ppm	Available Cu ppm	Total Cu ppm	Available Pb ppm	Total Pb ppm	Available Zn ppm	Total Zn ppm
TDF-1																								
PO-TDF1-T1-AG	0	4	7/30/2005	7.1	2.35	66	30	4	SANDY LOAM	1.4	0.88	0.01	0.44	8.2	0.19	4.6	0.8	12.5	3.94	20.5	44.8	510	72.3	1,040
PO-TDF1-T1-AG	4	12	7/30/2005	7.3	2.12	69	27	4	SANDY LOAM	1.6	0.32	<0.01	<0.01	6	0.15	4.7	0.9	11	4.82	17	74.8	363	160	990
PO-TDF1-T1-AG	12	24	7/30/2005	7.5	2.25	82	10	8	LOAMY SAND	1.5	0.26	<0.01	<0.01	8.4	0.22	4.7	1.1	11	4.7	17	62.2	383	47.5	1,030
PO-TDF1-T2-AG	0	8	7/30/2005	7.4	2.26	32	62	6	SILT LOAM	2.4	0.32	<0.01	2.34	7.9	0.16	7	3.2	21	6.94	76	56.4	505	205	2,960
PO-TDF1-T2-AG	8	12	7/30/2005	7.3	2.14	66	30	4	SANDY LOAM	2.9	0.26	<0.01	<0.01	7.6	0.13	5.5	13	31.5	4.7	42.5	75.8	426	345	4,770
PO-TDF1-T2-AG	12	24	7/30/2005	7.4	2.15	76	16	8	SANDY LOAM	2.9	0.26	<0.01	<0.01	9.5	0.11	34.8	7.7	36	1.94	28	84.6	462	434	7,200
PO-TDF1-T3-AG	0	3	7/30/2005	7.4	1.43	30	62	8	SILT LOAM	2.9	0.4	0.06	2.11	29	<0.05	7	1	14	14.1	77	24	530	118	2,160
PO-TDF1-T3-AG	3	12	7/30/2005	7.5	2.35	46	48	6	SANDY LOAM	2.7	0.36	<0.01	<0.01	9.5	0.16	6.5	1.6	16.5	3.98	31.5	33.4	338	144	2,160
PO-TDF1-T3-AG	12	24	7/30/2005	7.5	2.23	72	22	6	SANDY LOAM	2.7	0.28	<0.01	<0.01	11	0.09	5.5	2.1	21	1.14	16.5	33.8	275	203	3,910
PO-TDF1-T4-AG	0	6	7/30/2005	7.6	2.21	46	48	6	SANDY LOAM	1.8	0.46	<0.01	<0.01	12.2	0.15	6	1.4	14.5	5.12	32.5	31.4	330	216	2,730
PO-TDF1-T4-AG (aver)	6	12	7/30/2005	7.2	2.36	24	67	9	SILT LOAM	3.95	0.29	<0.01	<0.01	7.35	0.2	5	1.2	16.2	56.9	71.7	250	299	323	3,870
PO-TDF1-T4-AG	12	24	7/30/2005	7.4	2.59	28	61	11	SILT LOAM	3.9	0.26	<0.01	0.28	7.3	0.25	6.5	<0.5	13.5	52	59.5	240	306	88.4	2,770
PO-TDF1-T5-AG	0	6	7/30/2005	7.8	0.9	62	32	6	SANDY LOAM	0.9	0.9	0.01	0.81	8.8	0.23	5.5	0.7	7.5	5.84	23.5	47.4	303	70.1	715
PO-TDF1-T5-AG	6	12	7/30/2005	8	0.56	81	15	4	LOAMY SAND	0.9	0.26	<0.01	3.22	8.2	0.22	3.5	0.7	7.5	3.72	7.5	36.4	85.5	35.6	222
PO-TDF1-T5-AG	12	24	7/30/2005	7.6	2.24	69	27	4	SANDY LOAM	2.2	0.26	<0.01	<0.01	8	0.18	22.5	3.1	22	3.02	25.5	103	735	121	1,410
PO-TDF1-T6-AG	0	6	7/30/2005	7.5	2	50	46	4	SANDY LOAM	1.5	2.82	0.04	0.83	11.3	0.25	5	<0.5	11	3.44	32.5	19.6	476	40.5	1,130
PO-TDF1-T6-AG	6	12	7/30/2005	7.6	2.3	62	30	8	SANDY LOAM	2.2	0.24	<0.01	<0.01	10.4	0.19	4.5	<0.5	9	2.32	13	37.6	273	120	995
PO-TDF1-T6-AG	12	24	7/30/2005	7.4	2.31	12	76	12	SILT LOAM	2.6	0.48	<0.01	<0.01	13.6	0.24	4	5.2	15.5	123	160	690	955	586	3,880
PO-TDF1-T7-AG	0	4	7/30/2005	7.6	1.61	51	47	2	SANDY LOAM	1.7	0.38	<0.01	0.2	18.6	0.19	4	1	8.5	3.88	13	26	319	99.2	945
PO-TDF1-T7-AG	4	12	7/30/2005	7.6	2.21	59	37	4	SANDY LOAM	1.9	0.22	<0.01	<0.01	13.3	0.25	4	0.9	7.5	2.6	12	40.2	254	79.6	790
PO-TDF1-T7-AG	12	24	7/30/2005	7.6	2.2	17	71	12	SILT LOAM	2.5	1.04	<0.01	<0.01	15.2	0.22	4.5	3.2	14.5	54	113	186	545	394	2,660
PO-TDF1-T8 (aver)	3	6	8/12/2005	6.9	1.62	19	69	12	SILT LOAM	3.25	1.61	1.57	1.55	39.15	1.67	6.45	1.7	3.55	5.43	19.8	96	231.5	51	747
PO-TDF1-T8 (aver)	6	12	8/12/2005	6.8	1.92	15	76	9	SILT LOAM	4.7	2.41	2.39	2.36	43.4	2.43	7.15	2.55	6.85	6.8	43.3	65.8	287.3	58.85	1,527
PO-TDF1-T8 (aver)	12	24	8/12/2005	6.8	1.82	17	68	15	SILT LOAM	4.60	1.51	1.41	1.57	46.30	1.55	9	1.73	11.2	33.5	90.4	324	851	130	3,031
PO-TDF1-T9-AG	0	8	7/30/2005	7.5	2.21	50	35	15	LOAM	2.3	0.34	0.01	0.17	11	0.18	4	3.5	22	6.3	26	54.8	525	251	2,660
PO-TDF1-T9-AG	8	12	7/30/2005	7.6	2.16	40	51	9	SILT LOAM	3.5	0.28	<0.01	<0.01	12	0.18	6	14.6	50.5	13.4	90	103	970	830	11,400
PO-TDF1-T9-AG	12	24	7/30/2005	7.6	2.17	70	23	7	SANDY LOAM	2.9	0.36	<0.01	<0.01	10.2	0.2	6.5	4.2	18	2	13	74.2	300	426	3,680
PO-TDF1-T10-AG	0	3	7/30/2005	7.5	2.08	22	69	9	SILT LOAM	3.7	0.26	0.02	0.86	43.2	0.25	6	2.7	24.5	19.1	129	31.8	725	351	5,350
PO-TDF1-T10-AG (aver)	3	12	7/30/2005	7.6	1.79	46	48	6	SANDY LOAM	1.15	0.85	<0.01	0.195	15.15	0.29	3.75	0.6	10.75	15.25	48.25	273	777	139	987
PO-TDF1-T10-AG	12	24	7/30/2005	7.7	2.29	16	74	10	SILT LOAM	1.2	0.4	<0.01	<0.01	13.5	0.23	3.5	1.8	10.5	40.6	127	374	885	309	1,520
PO-TDF1-T11-AG	0	6	7/30/2005	7.7	0.45	26	66	8	SILT LOAM	2.9	0.46	0.04	1.64	66.4	0.22	5.5	2.8	21.5	20.2	114	64.6	625	312	4,010
PO-TDF1-T11-AG	6	12	7/30/2005	8	0.48	10	77	13	SILT LOAM	1.1	0.24	<0.01	0.06	10.8	0.58	4.5	3.8	18	72.2	164	628	1,680	421	1,830
PO-TDF1-T11-AG	12	24	7/30/2005	7.8	0.64	54	40	6	SANDY LOAM	3.2	0.32	<0.01	<0.01	23.3	0.12	7	4.5	15	8.4	26	286	497	193	985
PO-TDF1-T12-AG	0	3	7/30/2005	7.7	0.53	32	61	7	SILT LOAM	2.2	0.46	0.02	1.1	18.3	0.09	5.5	2.1	17	9.08	83.5	37.6	497	267	3,580
PO-TDF1-T12-AG	3	12	7/30/2005	7.8	0.86	26	64	10	SILT LOAM	1.6	0.32	0.01	0.14	12.3	0.14	4.5	0.8	13	22.6	82	282	890	104	935
PO-TDF1-T12-AG	12	24	7/30/2005	7.9	0.83	42	52	6	SILT LOAM	1.6	0.34	<0.01	0.33	8.5	0.14	4.5	0.7	8	10.8	42.5	123	379	99.3	590
Arithmetic Mean										2.4	0.58	0.15	0.56	16.8	0.34	6.6	2.7	15.9	18	55.2	139	522	218	2,530
$UCL_{95\%}$ Mean (Normal Distribution)										2.7	0.76	0.3	0.8	20.6	0.47	8.3	3.6	18.4	25.12	67.7	185	607	267	3,150
$UCL_{95\%}$ Mean (Lognormal Distribution)										2.8	0.69	0.13	12.8	19.9	0.4	7.3	4.1	18.8	28.9	78.1	199	630	299	3,500

Table 3-3

Argonomic Analytical Results for TDF-1 and TDF-2 Tailings Materials[a]

SAMPLE_ID	UPPR DEPTH inches	LOWR DEPTH inches	SAMPLED	PH	EC dS/m	SAND %	SILT %	CLAY %	TEXTURE	OM %	NITRATE ppm	TKN %	P ppm	K ppm	Available As ppm	Total As ppm	Available Cd ppm	Total Cd ppm	Available Cu ppm	Total Cu ppm	Available Pb ppm	Total Pb ppm	Available Zn ppm	Total Zn ppm
TDF-2																								
PO-TDF2-T13-AG	0	6	7/30/2005	7.7	1.41	23	67	10	SILT LOAM	2.9	0.38	0.02	0.12	26.7	0.13	7.5	8.4	42	29.8	244	70.4	1,180	648	8,300
PO-TDF2-T13-AG	6	12	7/30/2005	7.6	2.15	62	33	5	SANDY LOAM	3.2	0.36	<0.01	<0.01	18.6	0.06	7	20.4	54	5.24	42	9.2	472	623	13,700
PO-TDF2-T13-AG (aver)	12	24	7/30/2005	7.5	2.17	22	64	14	SILT LOAM	3.4	0.44	0.01	0.005	13.75	0.065	6	14.15	38.2	57.3	196	183	1,770	783	9,400
PO-TDF2-T14-AG	0	4	7/30/2005	7.5	1.76	32	62	6	SILT LOAM	3.4	0.5	0.04	1.99	23.3	0.11	6.5	7	35.5	9.52	76.5	25.6	545	630	7,050
PO-TDF2-T14-AG	4	12	7/30/2005	7.6	2.12	42	52	6	SILT LOAM	2.9	0.84	<0.01	<0.01	11.9	0.1	5.5	10.6	48.5	9.58	44.5	13.1	427	987	11,500
PO-TDF2-T14-AG (aver)	12	24	7/30/2005	7.6	2.14	67	25	8	SANDY LOAM	2.5	0.35	0.005	0.005	10	0.1	5.7	8.2	22.2	10.9	28.5	101	376	503	3,950
PO-TDF2-T15-AG	0	6	7/30/2005	7.7	2.44	8	77	15	SILT LOAM	4	0.4	0.01	<0.01	16.1	0.08	7.5	5	30	39	242	132	1,390	590	5,050
PO-TDF2-T15-AG	6	12	7/30/2005	7.5	3.05	18	68	14	SILT LOAM	6	0.34	0.01	<0.01	20	0.1	8	11.2	58.5	83	323	159	1,570	816	13,700
PO-TDF2-T15-AG	12	24	7/30/2005	7.4	2.8	18	69	13	SILT LOAM	4.3	0.42	<0.01	<0.01	17.2	0.13	6	8.1	38.5	126	222	478	965	640	8,300
PO-TDF2-T16-AG	0	6	7/30/2005	7.6	2.19	36	56	8	SILT LOAM	3.4	0.5	<0.01	<0.01	9.8	0.14	5.5	4.4	21	26.8	112	140	935	311	2,140
PO-TDF2-T16-AG (aver)	6	12	7/30/2005	7.5	2.09	51	43	6	SANDY LOAM	2.6	0.37	0.005	0.005	9.3	0.072	16.2	4.6	20	11.8	68.2	85.4	677	289	2,170
PO-TDF2-T16-AG	12	24	7/30/2005	7.3	2.51	12	76	12	SILT LOAM	6.2	0.5	<0.01	<0.01	12.6	0.15	20.9	7.1	53	136	303	340	1,500	841	14,900
PO-TDF2-T17-AG	0	6	7/30/2005	7.7	2.26	50	45	5	SANDY LOAM	3.4	0.36	<0.01	0.04	7.9	0.14	6	1.8	16	6.3	39	58.2	535	88.8	1,210
PO-TDF2-T17-AG	6	12	7/30/2005	7.7	2.06	40	54	6	SILT LOAM	5.5	0.44	<0.01	0.41	11	0.06	7.5	11.8	30.5	6.18	61	82.2	520	415	3,770
PO-TDF2-T17-AG	12	24	7/30/2005	7.6	2.06	36	54	10	SILT LOAM	4.1	0.4	<0.01	<0.01	11.5	<0.05	5	8.4	22.5	28.8	111	132	540	602	4,620
Arithmetic Mean										3.8	0.44	0.01	0.17	14.6	0.098	8	8.7	35.4	39.1	141	134	893	584	7,320
UCL$_{95\%}$ Mean (Normal Distribution)										4.4	0.5	0.01	0.41	17.2	0.11	10.1	10.8	41.6	58.7	188	191	1,110	691	9,390
UCL$_{95\%}$ Mean (Lognormal Distribution)										4.4	0.49	0.01	1	17.7	0.13	9.8	12.6	44.3	96.9	255	359	1,290	876	12,670

(aver) = the concentration represents the average of all duplicate sample results
< = the analysis was not quantifiable at the concentration noted
Means were calculated using one-half the qunatification limit for non-detected analytes
a = Sample results reported on a dry-weight basis
OM = Organic Matter

Table 3-4

Monitoring Well and Piezometer Construction Details

							Well Screen					Sample Date			
								Top of Screen		Bottom of Screen		August 2005		May 2006	
Monitoring Well/ Piezometer	**Borehole Diameter (inches)**	**Borehole Total Depth (ft bgs)**	**Well Diameter (inches)**	**Well Depth (ft btoc)**	**Ground Surface Elevation (ft msl)**	**Top of PVC Casing Elevation (ft msl)**	**Slot Size (inch)**	**Depth (ft-bgs)**	**Elevation (ft msl)**	**Depth (ft-bgs)**	**Elevation (ft msl)**	**WL Depth (ft toc)**	**WL Elev. (ft msl)**	**WL Depth (ft toc)**	**WL Elev. (ft msl)**
MW-201	6	100	2	95.0	2332.33	2335.07	0.02	75	2257.33	95	2237.33	81.67	2253.40	81.50	2253.57
MW-202	8	55.5	2	55.0	2330.04	2332.5	0.02	45	2285.04	55	2275.04	DRY	NA	DRY	NA
MW-203	8	46.5	2	46.0	2330.45	2332.68	0.02	36	2294.45	46	2284.45	42.51	2290.17	42.28	2290.40
PO1	8	32	2	33.0	2251.01	2253.03	0.02	26.24	2224.77	31.24	2219.77	26.94	2226.09	26.37	2226.66
PO2	8	55.5	2	55.0	2250.91	2251.37	0.02	49.3	2201.61	54.3	2196.61	16.65	2234.72	15.17	2236.20
PO3	8	63	2	35.0	2253.31	2254.13	0.02	29.1	2224.21	34.1	2219.21	27.57	2226.56	25.47	2228.66
PO4	8	35	2	36.5	2252.66	2254.46	0.02	29.6	2223.06	34.6	2218.06	28.52	2225.94	27.81	2226.65
PO5	8	29	2	18.5	2251.23	2253.75	0.02	11.2	2240.03	16.2	2235.03	9.46	2244.29	7.19	2246.56
BH-96-G1-S	NA	63	2	32.5	2251.5	2252.95	0.01	27.5	2224	32.5	2219	22.52	2230.43	NA	NA
BH-96-G1-D	NA	63	2	57.0	2251.8	2253.33	0.01	52	2199.8	57	2194.8	24.75	2228.58	NA	NA
LSB-1	8	35	none constructed		2334.75	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LSB-2	8	25.5	none constructed		2276	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

ft btoc = "below top of riser casing" measured in feet.
ft MSL = "mean sea level" measured in feet.
NA = Not Available

Table 3-5

Hydraulic Testing Results

Piezometer / Well #	**Aquifer Matrix**	**Test**	**Hydraulic Conductivity (cm/s)**	**Transmissivity (ft^2/day)**
MW-203	Glaciofluvial deposits	Pumping	7×10^{-3}	170
MW-201	Glaciofluvial deposits	Pumping	0.4 to 1.5×10^{-1}	2100 to 8200
P01	Tailings Material	Slug	1.7×10^{-4}	NA
P02	Tailings Material	Slug	1.2×10^{-4}	NA
P03	Tailings Material	Slug	1.2×10^{-4}	NA
P04	Tailings Material	Slug	1.2×10^{-4}	NA
P05	Tailings Material	Slug	1.2×10^{-4}	NA

TABLE 3-6

Field Measured Water Quality Parameters on TDF-1 and TDF-2 Groundwater, Seeps, and Surface Waters

Monitoring Media/Location	Date	Time	pH	Temperature (°C)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)
TDF-1 GROUNDWATER							
PO1	8/18/2005	1700	6.62	11.8	1205	6.54	25.90
	5/3/2006	1000	6.59	12.6	1684	2.39	13.80
PO2	8/18/2005	1030	7.04	12.9	445	5.73	33.90
	5/3/2006	915	6.51	11.1	482	3.30	94.10
PO3	8/18/2005	1015	6.73	12.8	931	5.46	46.60
	5/3/2006	830	6.34	10.4	1820	2.52	25.30
PO4	8/17/2005	1800	7.06	10.1	761	9.06	38.70
	5/3/2006	1030	6.75	11.7	1287	2.61	42.20
PO5	8/17/2005	1300	7.62	15.7	505	5.31	43.90
	5/3/2006	1445	6.65	10.2	661	2.53	56.70
BH-96-G1-S	8/19/2005	1140	8.72	19.7	220	4.23	97.80
BH-96-G1-D	8/19/2005	1015	7.73	19.2	423	4.87	27.70
TDF-2 GROUNDWATER							
MW-201	8/15/2005	1300	7.43	12.2	419	4.72	0.43
	5/9/2006	1100	7.16	9.8	409	4.16	0.33
MW-202	8/15/2005	1430	NA	NA	NA	NA	NA
	5/9/2006	1030	NA	NA	NA	NA	NA
MW-203	8/15/2005	1545	7.45	12.7	437	1.19	2.36
	5/9/2006	1452	7.55	11.7	676	9.99	0.81

TABLE 3-6

Field Measured Water Quality Parameters on TDF-1 and TDF-2 Groundwater, Seeps, and Surface Waters

Monitoring Media/Location	Date	Time	pH	Temperature (°C)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)
GROUNDWATER SEEPS							
TDF-1 North Diversion Culvert (S-1)	8/11/2005	1020	7.40	15.2	742	5.32	5.14
	5/4/2006	1510	7.17	14.3	975	3.25	3.02
TDF-1 South Diversion Culvert (S-2)	8/11/2005	1050	7.26	16.8	387	5.02	0.89
	5/4/2006	1505	7.65	15.4	562	4.52	0.31
TDF-1 South Metal Culvert (S-3)	8/11/2005	1055	7.33	15.8	348	4.98	3.21
	5/4/2006	1515	7.59	14.5	538	4.60	4.11
Seep #4 below TDF-1 (S-4)	8/11/2005	900	7.32	19.2	562	4.52	2.86
	5/10/2006	1300	7.51	18.6	843	3.72	2.54
Seep #5 below TDF-1 (S-5)	8/11/2005	1430	6.86	12.2	580	4.64	189.00
	5/4/2006	1205	6.54	10.8	799	3.64	218.00
Seep #7 below TDF-1 (S-7)	8/11/2005	1130	7.85	16.5	343	5.32	1.02
	5/10/2006	1330	7.88	15.9	558	4.40	0.44
Seep #8 below TDF-1 (S-8)	8/11/2005	1230	7.32	17.3	642	3.29	8.62
	5/10/2006	1400	7.54	16.7	893	2.69	9.90
Unnamed Ditch below TDF-1 (UD-1)	8/12/2005	1130	6.87	12.2	885	4.22	93.00
	5/4/2006	1045	6.92	9.2	1004	3.44	82.00
Seep Above TDF-1 Wetland (W1-S1)	5/5/2006	1540	7.63	11	603	0.54	0.46
Seep Above TDF-1 Wetland (W1-S2)	5/5/2006	1555	7.58	11	564	0.56	0.57

TABLE 3-6

Field Measured Water Quality Parameters on TDF-1 and TDF-2 Groundwater, Seeps, and Surface Waters

Monitoring Media/Location	**Date**	**Time**	**pH**	**Temperature (°C)**	**Specific Conductivity (µS/cm)**	**Dissolved Oxygen (mg/L)**	**Turbidity (NTU)**
SURFACE WATERS							
C1-1	8/12/2005	1400	NA	NA	NA	NA	NA
	5/10/2006	1430	7.68	16.2	271	4.80	1.74
C1-2	8/12/2005	1300	7.42	14.3	385	4.42	0.46
	5/4/2006	1300	7.18	12.1	418	4.28	0.32
C2-1	8/11/2005	1530	7.23	18.2	512	4.83	0.86
	5/4/2006	1500	7.47	16.1	598	4.50	1.06
C2-2	8/10/2005	1400	7.48	13.5	548	4.72	0.52
	5/4/2006	1120	7.34	11.6	627	4.48	0.57
W1-1	8/12/2005	1145	7.32	10.2	483	0.87	1.03
	5/5/2006	1700	7.43	9.4	533	1.62	1.16
W1-2	8/12/2005	1215	7.67	10.2	424	0.72	1.27
	5/5/2006	1630	7.33	9.5	557	1.35	1.35

Table 3-7

Analytical Results of Groundwater Samples at TDF-1

Piezometer ID	Collection Date	Metals Analysis	Ag (µg/L)	As (µg/L)	Ba (µg/L)	Ca (µg/L)	Cd (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Mg (µg/L)	Mn (µg/L)	Pb (µg/L)	Se (µg/L)	Zn (µg/L)	Hg (µg/L)	Cl (mg/L) *	SO4 (mg/L) *	Alkalinity (mg/L) *
Most Protective Groundwater Cleanup Levels			50^a	5	1000	NSA	5	50	1000	300^a	NSA	50^a	15	50	4800^a	2	250^a	250^a	NSA
Piezometer P01	8/18/2005	Dissolved	< 5.0	< 3.0	**14.6**	**421,000**	< 0.2	< 6.0	< 1.0	< 60.0	**222000**	**57.8**	< 3.0	< 3.0	**30**	< 0.2	**1.7**	**1660**	**29.4**
	5/3/2006	Dissolved	< 5.0	< 3.0	**15.6**	**391,000**	< 0.2	< 6.0	< 1.0	**210**	**196,000**	**59**	< 3.0	< 3.0	< 10.0	< 0.2	**0.71**	**1750**	**12.4**
Piezometer P02	8/18/2005	Dissolved	< 5.0	< 3.0	**116**	**77,100**	< 0.2	< 6.0	**22.7**	**2,150**	**22000**	**757**	< 3.0	< 3.0	**81**	< 0.2			
	8/18/2005	Total	< 5.0	**4.2**	**126**	**81,400**	**0.23**	< 6.0	**86.2**	**3,790**	**23,700**	**786**	**23.7**	< 3.0	**109**	< 0.2	**4.24**	**40.6**	**270**
	5/3/2006	Dissolved	< 5.0	**4.4**	**111**	**76,200**	< 0.2	< 6.0	**1.26**	**2,220**	**21,200**	**714**	< 3.0	< 3.0	< 10.0	< 0.2	----	----	----
	5/3/2006	Total	< 5.0	**8.4**	**126**	**86,600**	**1.35**	< 6.0	**1040**	**5,300**	**23,200**	**739**	**177**	< 3.0	**420**	< 0.2	**4.31**	**36.3**	**259**
Piezometer P03	8/18/2005	Dissolved	< 5.0	< 3.0	**11.7**	**607,000**	< 0.2	< 6.0	< 1.0	**19,900**	**140,000**	**37.6**	< 3.0	< 3.0	**93**	< 0.2	**0.46**	**1620**	**338**
	5/3/2006	Dissolved	< 5.0	< 3.0	**12**	**557,000**	< 0.2	< 6.0	< 1.0	**22,700**	**137,000**	**37**	< 3.0	< 3.0	< 10.0	< 0.2	**0.35**	**1630**	**331**
Piezometer P04	8/17/2005	Dissolved	< 5.0	< 3.0	**34.9**	**244,000**	< 0.2	< 6.0	< 1.0	**1,140**	**113,000**	**123**	< 3.0	< 3.0	< 10.0	< 0.2	**3.26**	**791**	**270**
	5/3/2006	Dissolved	< 5.0	< 3.0	**26.3**	**249,000**	< 0.2	< 6.0	**5.09**	**1,180**	**112,000**	**108**	< 3.0	< 3.0	< 10.0	< 0.2	**2.21**	**835**	**254**
Piezometer P05	8/17/2005	Dissolved	< 5.0	**3.7**	**216**	**63,300**	< 0.2	< 6.0	**1.9**	< 60.0	**42,100**	**32**	< 3.0	< 3.0	**19**	< 0.2	**4.46**	**6.18**	**368**
	5/3/2006	Dissolved	< 5.0	< 3.0	**248**	**82,300**	< 0.2	< 6.0	< 1.0	**410**	**49,900**	**29**	< 3.0	< 3.0	< 10.0	< 0.2	**3.44**	**47.2**	**390**
Piezometer BH-96-G1-S (Shallow)	8/19/2005	Dissolved	< 5.0	< 3.0	**52.2**	**8,400**	< 0.2	< 6.0	< 1.0	< 60.0	**28,700**	**4.2**	< 3.0	< 3.0	< 10.0	< 0.2	**3.39**	**20.7**	**142**
Piezometer BH-96-G1-D (Deep)	8/19/2005	Dissolved	< 5.0	< 3.0	**140**	**85,700**	< 0.2	< 6.0	**5.7**	**1,880**	**20,800**	**190**	< 3.0	< 3.0	**91**	< 0.2	**3.7**	**22.4**	**295**

BOLD numbers indicate analytical detections above laboratory PQL.
Yellow Highlighted numbers indicate analytical detections exceeding MTCA Groundwater Cleanup Level
Purple Highlighted numbers indicate analytical results of the unfiltered sample.
NSA = No Standard Available
* - Anions (Cl, SO4, and ALK) reported in mg/L; all others reported in µg/L
a = Groundwater cleanup criteria based on secondary drinking water standards that are not health-based

Table 3-8

Analytical Results of Groundwater Samples at TDF-2

Well #	Collection Date	Metals Analysis	Ag (µg/L)	As (µg/L)	Ba (µg/L)	Ca (µg/L)	Cd (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)
Most Protective Groundwater Cleanup Levels			**50[a]**	**5**	**1000**	**NSA**	**5**	**50**	**1000**	**300[a]**
MW - 201	8/15/2005	Dissolved	< 5.0	< 3.0	**54.5**	**73,500**	< 0.2	< 6.0	< 1.0	< 60
MW - 201	8/15/2005	Total	< 5.0	< 3.0	**55.2**	**75,100**	< 0.2	< 6.0	< 1.0	< 60
MW - 201	5/10/2006	Dissolved	< 5.0	< 3.0	**52.7**	**72,000**	< 0.2	< 6.0	< 1.0	< 60
MW - 203	8/15/2005	Dissolved	< 5.0	< 3.0	**100**	**77,400**	< 0.2	< 6.0	< 1.0	< 60
MW - 203	5/10/2006	Dissolved	< 5.0	< 3.0	**91.8**	**145,000**	**0.21**	< 6.0	< 1.0	< 60
MW - 203	5/10/2006	Total	< 5.0	< 3.0	**96.2**	**130,000**	0.16	< 6.0	**1.65**	**560**

Well #	Collection Date	Metals Analysis	Mg (µg/L)	Mn (µg/L)	Pb (µg/L)	Se (µg/L)	Zn (µg/L)	Hg (µg/L)	Cl (mg/L) *	SO4 (mg/L) *	Alkalinity (mg/L) *
Most Protective Groundwater Cleanup Levels			**NSA**	**50[a]**	**15**	**50**	**4800[a]**	**2**	**250[a]**	**250[a]**	**NSA**
MW - 201	8/15/2005	Dissolved	**21,300**	**6.2**	< 3.0	< 3.0	< 10	< 0.2	NA	NA	NA
MW - 201	8/15/2005	Total	**21,700**	**4.95**	< 3.0	< 3.0	< 10	< 0.2	**4.3**	**32.5**	**257**
MW - 201	5/10/2006	Dissolved	**19,700**	< 4.0	< 3.0	< 3.0	< 10	< 0.2	NA	NA	NA
MW - 203	8/15/2005	Dissolved	**23,600**	**143**	< 3.0	< 3.0	< 10	< 0.2	**0.24**	**58.8**	**253**
MW - 203	5/10/2006	Dissolved	**46,000**	**121**	< 3.0	< 3.0	< 10	< 0.2	NA	NA	NA
MW - 203	5/10/2006	Total	**40,700**	**166.5**	< 3.0	< 3.0	< 10	< 0.2	**0.6**	**220**	**250**

BOLD numbers indicate analytical detections above laboratory PQL.
Yellow Highlighted numbers indicate analytical detections exceeding MTCA Groundwater Cleanup Level
Purple Highlighted numbers indicate analytical results of the unfiltered sample.
NSA = No Standard Available
NA = Not Analyzed at Laboratory
* - Anions (Cl, SO4, and ALK) reported in mg/L; all others reported in µg/L
a = Groundwater cleanup criteria based on secondary drinking water standards that are not health-based

Table 3-9

Analytical Results of Seep Samples Adjacent to TDF-1

Sample Description	Sample ID	Collection Date	Metals Analysis	Ag (µg/L)	As (µg/L)	Ba (µg/L)	Ca (µg/L)	Cd (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Mg (µg/L)
Most Protective Groundwater Cleanup Levels				**50[a]**	**5**	**1,000**	**NSA**	**5**	**50**	**1000**	**300[a]**	**NSA**
TDF-1 North Diversion Culvert #1	PO-TDF1-S1	8/11/2005	Dissolved	< 5.0	< 3.0	**47.8**	**154,000**	< 0.2	< 6.0	< 1.0	< 60	**68,800**
		5/4/2006	Dissolved	< 5.0	< 3.0	**51.1**	**151,000**	0.24	< 6.0	< 1.0	**530**	**64,900**
TDF-1 South Diversion Culvert #2	PO-TDF1-S2	8/11/2005	Dissolved	< 5.0	< 3.0	**57.5**	**95,900**	< 0.2	< 6.0	< 1.0	< 60	**28,700**
		5/4/2006	Dissolved	< 5.0	< 3.0	**59.8**	**94,900**	< 0.2	< 6.0	< 1.0	< 60	**27,800**
TDF-1 South Metal Culvert #3	PO-TDF1-S3	8/11/2005	Dissolved	< 5.0	< 3.0	**92.2**	**74,000**	< 0.2	< 6.0	< 1.0	< 60	**30,200**
		5/4/2006	Dissolved	< 5.0	< 3.0	**88.7**	**75,100**	< 0.2	< 6.0	< 1.0	< 60	**29,600**
Seep #4 below TDF-1 (S-4)	PO-TDF1-S4	8/11/2005	Dissolved	< 5.0	**3.1**	**60.3**	**184,000**	**1.03**	< 6.0	< 1.0	**85**	**44,500**
		5/10/2006	Dissolved	< 5.0	< 3.0	**49.3**	**197,000**	**2.27**	< 6.0	< 1.0	< 60	**41,700**
Seep #5 below TDF-1 (S-5)	PO-TDF1-S5	8/11/2005	Dissolved	< 5.0	< 3.0	**81.1**	**154,000**	**1.61**	< 6.0	< 1.0	< 60	**38,000**
		5/4/2006	Dissolved	< 5.0	< 3.0	**74.8**	**148,000**	**0.97**	< 6.0	< 1.0	< 60	**37,100**
Seep #7 below TDF-1 (S-7)	PO-TDF1-S7	8/11/2005	Dissolved	< 5.0	< 3.0	**60.5**	**106,000**	< 0.2	< 6.0	< 1.0	< 60	**35,300**
		5/10/2006	Dissolved	< 5.0	< 3.0	**60.1**	**104,000**	< 0.2	< 6.0	< 1.0	< 60	**31,200**
Seep #8 below TDF-1 (S-8)	PO-TDF1-S8	8/11/2005	Dissolved	< 5.0	< 3.0	**139**	**201,000**	< 0.2	< 6.0	< 1.0	**83**	**87,800**
		5/10/2006	Dissolved	< 5.0	< 3.0	**86.6**	**175,000**	< 0.2	< 6.0	< 1.0	< 60	**70,100**
Unnamed Ditch below TDF-1 (UD-1)	PO-UD-1W	8/12/2005	Dissolved	< 5.0	< 3.0	**67.5**	**260,000**	**0.42**	< 6.0	< 1.0	< 60	**60,800**
		5/4/2006	Dissolved	< 5.0	< 3.0	**58.6**	**205,000**	**0.82**	< 6.0	**1.27**	< 60	**45,800**
Seep at toe of slope at head of Southern Diversion Ditch (200-feet upgradient of Wetland Area on TDF-1) (W1-S1)	W1-Seep 1	5/5/2006	Dissolved	< 5.0	< 3.0	**38.7**	**97,400**	< 0.2	< 6.0	< 1.0	< 60	**31,400**
Seep #2 at toe of slope at head of Southern Diversion Ditch (150-feet upgradient of Wetland Area on TDF-1) (W1-S2)	W1-Seep 2	5/5/2006	Dissolved	< 5.0	< 3.0	**50.2**	**92,600**	< 0.2	< 6.0	< 1.0	< 60	**27,200**

BOLD numbers indicate analytical detections above laboratory PQL.

Yellow Highlighted numbers indicate analytical detections exceeding MTCA Groundwater Cleanup Level

NSA = No Standard Available

NA = Not Analyzed at Laboratory

* - Anions (Cl, SO4, and ALK) reported in mg/L; all others reported in µg/L

a = Groundwater cleanup criteria based on secondary drinking water standards that are not health-based

Table 3-9

Analytical Results of Seep Samples Adjacent to TDF-1

Sample Description	**Sample ID**	**Collection Date**	**Metals Analysis**	**Mn (µg/L)**	**Pb (µg/L)**	**Se (µg/L)**	**Zn (µg/L)**	**Hg (µg/L)**	**Cl (mg/L) ***	**SO4 (mg/L) ***	**Alkalinity (mg/L) ***
Most Protective Groundwater Cleanup Levels				**50^a**	**15**	**50**	**4800^a**	**2**	**250^a**	**250^a**	**NSA**
TDF-1 North Diversion Culvert #1	PO-TDF1-S1	8/11/2005	Dissolved	**103**	< 3.0	< 3.0	**745**	< 0.2	**3.58**	**433**	**251**
		5/4/2006	Dissolved	**361**	< 3.0	< 3.0	**987**	< 0.2	**2.62**	**416**	**212**
TDF-1 South Diversion Culvert #2	PO-TDF1-S2	8/11/2005	Dissolved	**12.7**	< 3.0	< 3.0	**12**	< 0.2	**3.01**	**112**	**259**
		5/4/2006	Dissolved	**13**	< 3.0	< 3.0	**53.4**	< 0.2	**3.38**	**110**	**249**
TDF-1 South Metal Culvert #3	PO-TDF1-S3	8/11/2005	Dissolved	**324**	< 3.0	< 3.0	< 10.0	< 0.2	**3.39**	**71.5**	**251**
		5/4/2006	Dissolved	**344**	< 3.0	< 3.0	37.5	< 0.2	**3.42**	**87.7**	**225**
Seep #4 below TDF-1 (S-4)	PO-TDF1-S4	8/11/2005	Dissolved	**37.5**	**9.5**	< 3.0	**3,030**	< 0.2	**3.77**	**388**	**260**
		5/10/2006	Dissolved	**9**	**26.2**	< 3.0	**3,160**	< 0.2	**2.91**	**409**	**252**
Seep #5 below TDF-1 (S-5)	PO-TDF1-S5	8/11/2005	Dissolved	**74.9**	< 3.0	< 3.0	**2,230**	< 0.2	**3.39**	**288**	**269**
		5/4/2006	Dissolved	**12**	< 3.0	< 3.0	**643**	< 0.2	**2.93**	**294**	**246**
Seep #7 below TDF-1 (S-7)	PO-TDF1-S7	8/11/2005	Dissolved	**81.1**	< 3.0	< 3.0	**606**	< 0.2	**3.75**	**161**	**257**
		5/10/2006	Dissolved	**14**	< 3.0	< 3.0	**506**	< 0.2	**3.75**	**161**	**257**
Seep #8 below TDF-1 (S-8)	PO-TDF1-S8	8/11/2005	Dissolved	**985**	< 3.0	< 3.0	**1,900**	< 0.2	**3.40**	**595**	**300**
		5/10/2006	Dissolved	**168**	< 3.0	< 3.0	**1,440**	< 0.2	**3.40**	**595**	**300**
Unnamed Ditch below TDF-1 (UD-1)	PO-UD-1W	8/12/2005	Dissolved	**62.4**	< 3.0	< 3.0	**2,050**	< 0.2	**1.78**	**650**	**260**
		5/4/2006	Dissolved	**52**	< 3.0	< 3.0	**6,690**	< 0.2	**2.05**	**491**	**229**
Seep at toe of slope at head of Southern Diversion Ditch (200-feet upgradient of Wetland Area on TDF-1) (W1-S1)	W1-Seep 1	5/5/2006	Dissolved	**11**	< 3.0	< 3.0	< 10	< 0.2	**3.95**	**126**	**254**
Seep #2 at toe of slope at head of Southern Diversion Ditch (150-feet upgradient of Wetland Area on TDF-1) (W1-S2)	W1-Seep 2	5/5/2006	Dissolved	**5**	< 3.0	< 3.0	< 10	< 0.2	**4.06**	**100**	**253**

BOLD numbers indicate analytical detections above laboratory PQL.

Yellow Highlighted numbers indicate analytical detections exceeding MTCA Groundwater Cleanup Level

NSA = No Standard Available

NA = Not Analyzed at Laboratory

* - Anions (Cl, SO4, and ALK) reported in mg/L; all others reported in µg/L

a = Groundwater cleanup criteria based on secondary drinking water standards that are not health-based

Table 3-10

Analytical Results of Surface Water Samples for the TDF-1 and TDF-2 RI/FS

					Ag		As		Ba		Ca		Cd	
Sample Description	Sample ID	Collection Date	Analysis	Calculated Hardness (mg/L)	Lab Result (µg/L)	*Hardness-Dependent† Water Quality Criteria*	Lab Result (µg/L)	*Water Quality Criteria*	Lab Result (µg/L)	*Water Quality Criteria*	Lab Result (µg/L)	*Water Quality Criteria*	Lab Result (µg/L)	*Hardness-Dependent† Water Quality Criteria*
Creek #1, Upstream near headwaters of drainage	C1-1	8/12/2005	No Sample - Dry Creek											
	C1-1	5/10/2006	Dissolved	175.7	< 5.0	9.1(8.5)	< 3.0	190 (150)	**24.8**	NSA	**47,600**	NSA	< 0.2	1.56 (0.36)
Creek #1, Downstream near outfall area	C1-2	8/12/2005	Dissolved	418.9	< 5.0	40.5 (37.8)	< 3.0	190 (150)	**65.5**	NSA	**114,000**	NSA	< 0.2	2.97 (0.66)
	C1-2	5/4/2006	Dissolved	229.0	< 5.0	14.4 (13.4)	< 3.0	190 (150)	**32.9**	NSA	**66,000**	NSA	**0.53**	1.9 (0.44)
Creek #2, Upstream below collection pipes	C2-1	8/11/2005	Dissolved	377.2	< 5.0	33.8 (31.6)	< 3.0	190 (150)	**59.8**	NSA	**97,800**	NSA	< 0.2	2.75 (0.62)
	C2-1	5/4/2006	Dissolved	348.4	< 5.0	29.5 (27.5)	< 3.0	190 (150)	**55.2**	NSA	**90,200**	NSA	< 0.2	2.59 (0.58)
Creek #2, Downstream near outfall area	C2-2	8/10/2005	Dissolved	381.5	< 5.0	34.51 (32.2)	< 3.0	190 (150)	**60.3**	NSA	**99,200**	NSA	< 0.2	2.77 (0.62)
	C2-2	5/4/2006	Dissolved	382.4	< 5.0	34.6 (32.3)	< 3.0	190 (150)	**58.6**	NSA	**98,900**	NSA	< 0.2	2.77 (0.62)
	C2-2	5/4/2006	Total	411.3	< 5.0	NSA	< 3.0	190 (150)	**61.8**	NSA	**105,000**	NSA	**0.42**	NSA
TDF-1 Wetland Area, #1	W1-1W	8/12/2005	Dissolved	401.5	< 5.0	37.7	< 3.0	190	**58**	NSA	**109,000**	NSA	< 0.2	2.87
	W1-1W	5/5/2006	Dissolved	347.9	< 5.0	29.5 (27.5)	< 3.0	190 (150)	**60.9**	NSA	**94,800**	NSA	< 0.2	2.59 (0.58)
TDF-1 Wetland Area, #2	W1-2W	8/12/2005	Dissolved	383.2	< 5.0	34.8	< 3.0	190	**58**	NSA	**104,000**	NSA	< 0.2	2.78
	W1-2W	5/5/2006	Dissolved	330.1	< 5.0	26.91 (25.1)	< 3.0	190 (150)	**60.7**	NSA	**89,800**	NSA	< 0.2	2.49 (0.56)

			Cr		Cu		Fe		Mg		Mn		Pb	
Sample Description	Sample ID	Collection Date	Lab Result (µg/L)	*Hardness-Dependent† Water Quality Criteria*	Lab Result (µg/L)	*Hardness-Dependent† Water Quality Criteria*	Lab Result (µg/L)	*Water Quality Criteria*	Lab Result (µg/L)	*Water Quality Criteria*	Lab Result (µg/L)	*Water Quality Criteria*	Lab Result (µg/L)	*Hardness-Dependent† Water Quality Criteria*
Creek #1, Upstream near headwaters of drainage	C1-1	8/12/2005	No Sample - Dry Creek											
	C1-1	5/10/2006	< 6.0	282 (118)	< 1.0	18.4 (14.5)	< 60.0	NSA	**13,800**	NSA	**6**	NSA	< 3.0	4.6
Creek #1, Downstream near outfall area	C1-2	8/12/2005	< 6.0	575 (240)	< 1.0	38.6 (30.5)	< 60.0	NSA	**32,600**	NSA	< 4.0	NSA	< 3.0	11.5
	C1-2	5/4/2006	< 6.0	351 (146)	< 1.0	23 (18.2)	< 60.0	NSA	**15,600**	NSA	< 4.0	NSA	< 3.0	6.1
Creek #2, Upstream below collection pipes	C2-1	8/11/2005	< 6.0	528 (220)	< 1.0	35.3 (27.8)	< 60.0	NSA	**32,300**	NSA	**17.1**	NSA	< 3.0	10.3
	C2-1	5/4/2006	< 6.0	495 (206)	< 1.0	33 (26.0)	< 60.0	NSA	**29,900**	NSA	**21**	NSA	< 3.0	9.5
Creek #2, Downstream near outfall area	C2-2	8/10/2005	< 6.0	533 (222)	< 1.0	35.6 (28.1)	< 60.0	NSA	**32,500**	NSA	**7.6**	NSA	< 3.0	10.4
	C2-2	5/4/2006	< 6.0	534 (222)	< 1.0	35.7 (28.2)	< 60.0	NSA	**32,900**	NSA	**15**	NSA	< 3.0	10.4
	C2-2	5/4/2006	< 6.0	NSA	**1.7**	NSA	**900**	NSA	**36,200**	NSA	**63**	NSA	**24.5**	NSA
TDF-1 Wetland Area, #1	W1-1W	8/12/2005	< 6.0	556	< 1.0	37.2	< 60.0	NSA	**31,400**	NSA	**151**	NSA	< 3.0	10.99
	W1-1W	5/5/2006	< 6.0	494 (205)	< 1.0	32.9	**70**	NSA	**27,000**	NSA	**55**	NSA	< 3.0	9.5
TDF-1 Wetland Area, #2	W1-2W	8/12/2005	< 6.0	535	< 1.0	35.8	< 60.0	NSA	**30,000**	NSA	**15.8**	NSA	< 3.0	10.47
	W1-2W	5/5/2006	< 6.0	473 (197)	< 1.0	31.5 (24.8)	**60**	NSA	**25,700**	NSA	**29**	NSA	< 3.0	9

Table 3-10

Analytical Results of Surface Water Samples for the TDF-1 and TDF-2 RI/FS

			Se		Zn		Hg				
Sample Description	**Sample ID**	**Collection Date**	**Lab Result (µg/L)**	***Water Quality Criteria* †**	**Lab Result (µg/L)**	***Hardness-Dependent* † *Water Quality Criteria***	**Lab Result (µg/L)**	***Water Quality Criteria* ¥**	**Cl (µg/L)**	**SO4 (µg/L)**	**Alkalinity (µg/L)**
Creek #1, Upstream near headwaters of drainage	C1-1	8/12/2005	No Sample - Dry Creek								
	C1-1	5/10/2006	< 3.0	5.0	< 10	168 (190)	< 0.2	0.2 (0.77)	**310**	**5,000**	**177,000**
Creek #1, Downstream near outfall area	C1-2	8/12/2005	< 3.0	5.0	< 10	352 (394)	< 0.2	0.2 (0.77)	**2,120**	**230,000**	**257,000**
	C1-2	5/4/2006	< 3.0	5.0	**33.3**	211 (236)	< 0.2	0.2 (0.77)	**420**	**56,000**	**177,000**
Creek #2, Upstream below collection pipes	C2-1	8/11/2005	< 3.0	5.0	**25**	322 (361)	< 0.2	0.2 (0.77)	**3,680**	**133,000**	**258,000**
	C2-1	5/4/2006	< 3.0	5.0	**80.3**	301 (337)	< 0.2	0.2 (0.77)	**2,540**	**106,000**	**192,000**
Creek #2, Downstream near outfall area	C2-2	8/10/2005	< 3.0	5.0	**24**	325 (364)	< 0.2	0.2 (0.77)	**3,050**	**134,000**	**251,000**
	C2-2	5/4/2006	< 3.0	5.0	**96.4**	326 (365)	< 0.2	0.2 (0.77)	**3,300**	**145,000**	**262,000**
	C2-2	5/4/2006	< 3.0	5.0	197	NSA	< 0.2	NSA	**3,300**	**145,000**	**262,000**
TDF-1 Wetland Area, #1	W1-1W	8/12/2005	< 3.0	5.0	**20**	339	< 0.2	0.012 (<0.2)	**1,360**	**113,000**	**302,000**
	W1-1W	5/5/2006	< 3.0	5.0	**58.8**	301(336)	< 0.2	0.2 (0.77)	**5,210**	**106,000**	**256,000**
TDF-1 Wetland Area, #2	W1-2W	8/12/2005	< 3.0	5.0	< 10	326	< 0.2	0.012 (<0.2)	**1,540**	**130,000**	**262,000**
	W1-2W	5/5/2006	< 3.0	5.0	< 10	287 (322)	< 0.2	0.2 (0.77)	**4,030**	**93,400**	**250,000**

BOLD numbers indicate analytical detections above laboratory PQL.
Yellow Highlighted numbers indicate analytical detections exceeding MTCA Groundwater Cleanup Level
NSA = No Standard Available
NA = Not Analyzed at Laboratory
U = Analytical result below laboratory PQL.
† = Water Quality Criteria for Surface Water from WAC 173-201(A); Federal Water Quality Criteria is in parenthesis
¥ = Mercury Water Quality Criteria presented is the lowest detection limit above surface water criteria; therefore, in accordance with WAC 173-340-707(2), the cleanup level shall be considered to have been attained if concentrations are below detection.
Purple Highlighted numbers indicate analytical results of the unfiltered sample

Table 3-11

Analytical Results of Sediment Samples for the TDF-1 and TDF-2 RI/FS[a]

Sample Description	Sample ID	Collection Date	As (mg/kg)	Ba (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)	Hg (mg/kg)	% Sol
Creek #1, Sediment Sample, Upstream, near headwaters of creek drainage.	C1-1S	8/25/2005	**4.9**	**92.1**	**1.01**	**19.0**	**51.5**	< 4.0	**173**	<0.0330	73.0%
	C1-1S	5/10/2006	<2.5	**16.3**	**0.28**	**4.0**	**8.31**	< 4.0	**39.7**	<0.0330	10.5%
Creek #1, Sediment Sample Downstream, near outfall area	C1-2S	8/12/2005	<2.5	**28**	**2.13**	**8.3**	**45.9**	< 4.0	**155**	<0.0330	49.5%
	C1-2S	5/8/2006	3.8	**35.3**	**2.05**	**15.9**	**119**	< 4.0	**282**	**0.063**	50.3%
Creek #2, Sediment Sample Upstream, near diversion pipe discharge area.	C2-1S	8/11/2005	**7.6**	**54.8**	**3.62**	**18.5**	**232**	< 4.0	**892**	**0.063**	47.5%
	C2-1S	5/8/2006	**22.5**	**113**	**5.06**	**27.2**	**301**	**6**	**1580**	**0.117**	69.8%
Creek #2, Sediment Sample Downstream, near outfall area	C2-2S	8/10/2005	**8.6**	**52.9**	**4.36**	**14.1**	**247**	< 4.0	**1050**	**0.077**	59.3%
	C2-2S	5/8/2006	**9.6**	**31.6**	**4.68**	**18.7**	**339**	**6**	**878**	**0.132**	74.0%
TDF-1 Wetland Sediment #1	W1-1S	8/12/2005	**3.6**	**44.7**	**5.2**	**36.8**	**212**	< 4.0	**1270**	**0.168**	41.9%
	W1-1S	5/10/2006	**4**	**47.3**	**5.75**	**39.2**	**239**	**5**	**1290**	**<5.5**	45.3%
TDF-1 Wetland Sediment #2	W1-2S	8/12/2005	**6**	**44.8**	**7.44**	**48.7**	**328**	< 4.0	**1730**	**0.152**	62.6%
	W1-2S	5/10/2006	**8.9**	**60**	**10.7**	**85.1**	**564**	**5**	**2900**	**<5.5**	77.9%
Unnamed Ditch Sediment	UD-1S	8/12/2005	<2.5	**29.1**	**1.58**	**22.4**	**64.9**	< 4.0	**197**	**0.055**	25.8%
	UD-1S	5/8/2006	<2.5	**27.4**	**1.92**	**15.3**	**59**	< 4.0	**190**	**0.067**	20.2%
Seep #4 Sediment	S4-S	5/10/2006	**4**	**30.8**	**1.91**	**16.6**	**193**	< 4.0	**738**	**0.087**	45.4%
Seep #5 Sediment	S5-1S	8/11/2005	<2.5	**129**	**2.58**	**4.1**	**32.5**	< 4.0	**254**	<0.0330	18.0%
	S5-1S	5/8/2006	<2.5	**268**	**5.04**	**5.9**	**34.5**	< 4.0	**367**	**0.038**	15.5%
Seep #7 Sediment	S7-S	5/10/2006	**2.8**	**45.8**	**1.56**	**9.4**	**97.1**	**5**	**904**	**0.055**	16.3%
Seep #8 Sediment	S8-S	5/10/2006	<2.5	**33.7**	**0.79**	**3.1**	**7.35**	< 4.0	**1930**	<0.0330	16.0%
Arithmetic Average	(Dry Weight Basis)		**10.7**	**233**	**9.1**	**49.4**	**346**	**4.8**	**2400**	**0.18**	
UCL Mean (normal Distribution)	(Dry Weight Basis)		**13.2**	**338**	**11.8**	**60.7**	**425**	**7.6**	**3470**	**0.23**	
UCL Mean (lognormal Distribution)	(Dry Weight Basis)		**14.2**	**332**	**13.5**	**66.3**	**593**	**9.0**	**4700**	**0.32**	
	MTCA Human (Unrestricted)		**20**	**16,000**	**80**	**3,200**	**250**	**400**	**24,000**	**24**	
	MTCA Human (Industrial)		**20**	**70,000**	**3,500**	**140,000**	**1,000**	**17,500**	**unlimited**	**1,050**	
	MTCA Ecological (Terrestrial)		**20**	**330**	**14**	**54**	**118**	**4**	**120**	**0.1**	

Yellow higlighting indicates mean concentration over any screening level
BOLD numbers indicate analytical detections above laboratory PQL.
a = Sample Results reported on an as-received (wet weight) basis

Table 3-12

Analytical Results for Metals in Vegetation Samples[a]

Site Identification	Unique Sample Number	CANTEST ID	Date Sampled	Common Species Name	Latin Species Name	Arsenic mg/kg	Cadmium mg/kg	Copper mg/kg	Lead mg/kg	Mercury mg/kg	Zinc mg/kg
PO-TDF1-T1	PO-TDF1-T1-Act-19V	512130430	7/26/2005	black cottonwood	*Populus balsamifera ssp.trichocarpa*	0.5	4.53	10.9	14.2	< 0.01	1090
	PO-TDF1-T1-GR-20V	512130431	7/26/2005	Canada bluegrass	*Poa compressa*	< 0.1	0.16	5.9	2.9	< 0.01	191
PO-TDF1-T2	PO-TDF1-T2-GR-22V	512130432	7/26/2005	Canada bluegrass	*Poa compressa*	< 0.1	0.09	3.8	1.4	< 0.01	130
PO-TDF1-T3	PO-TDF1-T3-GR-26V	512130434	7/26/2005	Canada bluegrass	*Poa compressa*	< 0.1	0.03	2.8	1	< 0.01	74.1
PO-TDF1-T4	PO-TDF1-T4-Act-29V	512130436	7/26/2005	black cottonwood	*Populus balsamifera ssp.trichocarpa*	< 0.1	6.92	6.3	1.1	< 0.01	1260
	PO-TDF1-T4-Pl-27V	512130435	7/26/2005	lodgepole pine	*Pinus contorta*	< 0.1	0.24	1.8	0.4	< 0.01	103
PO-TDF1-T7	PO-TDF1-T7-Act-37V	512130438	7/26/2005	black cottonwood	*Populus balsamifera ssp.trichocarpa*	< 0.1	5.97	8.3	0.6	< 0.01	1120
	PO-TDF1-T7-GR-38V	512130439	7/26/2005	Canada bluegrass	*Poa compressa*	< 0.1	0.05	5	0.7	< 0.01	157
	PO-TDF1-T7-Pl-36V	512130437	7/26/2005	lodgepole pine	*Pinus contorta*	< 0.1	0.3	2.7	0.2	< 0.01	121
PO-TDF1-W1a	PO-TDF1-W1a-TY-31V	512130440	7/23/2005	common cattail	*Typha latifolia*	< 0.1	0.03	0.6	0.3	< 0.01	17.7
PO-TDF1-W1b	PO-TDF1-W1b-TY-80V	512130441	7/23/2005	common cattail	*Typha latifolia*	< 0.1	0.03	1.2	0.3	< 0.01	32
PO-TDF1-T10	PO-TDF1-T10-Act-48V	512130443	7/26/2005	black cottonwood	*Populus balsamifera ssp.trichocarpa*	< 0.1	3.75	6.3	0.5	< 0.01	999
	PO-TDF1-T10-Pl-47V	512130442	7/26/2005	lodgepole pine	*Pinus contorta*	< 0.1	0.21	2.7	0.3	< 0.01	126
PO-TDF1-T12	PO-TDF1-T12-Act-55V	512130416	7/26/2005	black cottonwood	*Populus balsamifera ssp.trichocarpa*	< 0.1	6.37	5.8	0.5	< 0.01	1160
	PO-TDF1-T12-Pl-57V	512130418	7/26/2005	lodgepole pine	*Pinus contorta*	< 0.1	0.69	2.9	0.3	< 0.01	166
PO-TDF2-T13	PO-TDF2-T13-Act-11V	512130420	7/25/2005	black cottonwood	*Populus balsamifera ssp.trichocarpa*	< 0.1	7.29	9.5	0.6	< 0.01	1150
	PO-TDF2-T13-GR-12V	512130422	7/25/2005	Canada bluegrass	*Poa compressa*	< 0.1	0.13	3.9	0.6	< 0.01	196
	PO-TDF2-T13-Pl-10V	512130419	7/25/2005	lodgepole pine	*Pinus contorta*	< 0.1	1.42	3.3	0.2	< 0.01	168
PO-TDF2-T14	PO-TDF2-T14-Act-2V	512130423	7/25/2005	black cottonwood	*Populus balsamifera ssp.trichocarpa*	< 0.1	7.09	7.2	0.3	< 0.01	903
	PO-TDF2-T14-GR-3V	512130424	7/25/2005	Canada bluegrass	*Poa compressa*	< 0.1	0.02	4	0.4	< 0.01	111
PO-TDF2-T16	PO-TDF2-T16-GR-8V	512130425	7/25/2005	Canada bluegrass	*Poa compressa*	< 0.1	0.11	4.9	2.8	< 0.01	178
PO-TDF2-T17	PO-TDF2-T17-Act-5V	512130426	7/25/2005	black cottonwood	*Populus balsamifera ssp.trichocarpa*	0.1	6.18	10.5	3.4	< 0.01	990
	PO-TDF2-T17-GR-6V	512130428	7/25/2005	Canada bluegrass	*Poa compressa*	< 0.1	0.05	4.3	1.1	< 0.01	124
	PO-TDF2-T17-Pl-7V	512130429	7/26/2005	lodgepole pine	*Pinus contorta*	< 0.1	0.12	2.9	0.3	< 0.01	60.2

a = Sample results reported on a dry-weight basis

Table 3-13

Analytical Results for Metals in Soils Adjacent to TDF-1 and TDF-2[a]

Site Identification	Sample Location Description	CANTEST ID	Date Sampled	pH	Arsenic mg/kg	Cadmium mg/kg	Copper mg/kg	Lead mg/kg	Mercury mg/kg	Zinc mg/kg
PO-TDF1-T8	Wetland located on TDF-1. Sample collected from north side of access road in inundated area.	510210529	7/26/2005	7.3	14.7	6.7	39	743	0.1	1650
PO-TDF1-T8	Wetland located on TDF-1. Sample collected from south side of access road in inundated area.	510210538	7/26/2005	7.4	15.2	11.2	144	996	0.22	2900
PO-OS-AP1a	Animal path routed through forested area between TDF-1 and TDF-2. Sample collected nearest TDF-1.	510210539	7/26/2005	6.3	5.8	0.6	25	18.9	0.01	116
PO-OS-AP1b	Animal path routed through forested area between TDF-1 and TDF-2. Sample collected at mid-point of TDF-1 and TDF-2.	510210540	7/26/2005	6.9	4.4	0.4	15	20	0.01	90
PO-OS-AP1c	Animal path routed through forested area between TDF-1 and TDF-2. Sample collected nearest TDF-2.	510210541	7/26/2005	6.6	5.4	0.7	23	33.3	0.01	132
PO-OS-AP2a	Animal path routed up crest of borrow pit on east side of TDF-2 (north end). Sample collected from forest edge nearest TDF-2.	510210542	7/26/2005	6.6	5.1	0.4	22	18.2	< 0.01	76
PO-OS-AP2b	Animal path routed up crest of borrow pit on east side of TDF-2 (north end). Sample collected in forested area south of borrow pit.	510210545	7/26/2005	6.2	5	0.3	21	13.6	< 0.01	65
PO-OS-B01	Slope failure debris area below northern end of TDF-2. Sample collected in forested area nearest to TDF-2.	512070215	7/25/2005	8.2	11.4	10.7	44	382	0.201	2680
PO-OS-B02	Slope failure debris area below northern end of TDF-2. Sample collected in forested area nearest to TDF-1.	512070217	7/25/2005	8.1	10.1	8.5	40	390	0.169	1950
PO-OS-DT	Collapsed decant tower located below northeast boundary of TDF-1. Sample collected as grab sample on north side of headpipes in inundated area where vegetation tissue was collected.	512070218	7/25/2005	8.3	7.6	3	17	31.4	0.072	321
PO-OS-DT	Collapsed decant tower located below northeast boundary of TDF-1. Sample collected as grab samples around headpipes in inundated area and composited for analysis.	512070219	7/25/2005	8.5	40.5	5.9	32	365	0.109	3280
Arithmetic Average		(Dry Weight Basis)			11.4	4.4	38.4	274	0.08	1,200
UCL Mean (normal Distribution)		(Dry Weight Basis)			17.1	6.8	58.2	459	0.13	1,920
UCL Mean (lognormal Distribution)		(Dry Weight Basis)			18.6	39.8	57.8	4560	0.86	17,000

a = Sample results reported on a dry-weight basis

Table 3-14

Analytical Results for Wetland-Perimeter Tailings[a]

Sample Description	Sample ID	Collection Date	As (mg/kg)	Ba (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)	Hg (mg/kg)	% Sol
Outer-Wetland Benthic Soil #1	BEN-1	5/10/2006	**10.5**	**7.7**	**5.48**	**68.6**	**415**	**7**	**1060**	< 5.5	75.5%
Outer-Wetland Benthic Soil #2	BEN-2	5/10/2006	**13.1**	**9.84**	**6.73**	**88.4**	**578**	**4**	**1820**	< 5.5	78.1%
Outer-Wetland Benthic Soil #3	BEN-3	5/10/2006	**8.6**	**47**	**7.5**	**71.1**	**483**	**5**	**2270**	< 5.5	43.4%
Outer-Wetland Benthic Soil #4	BEN-4	5/10/2006	**8.7**	**8.65**	**7.3**	**67.4**	**1020**	< 4	**1250**	< 5.5	77.4%
Outer-Wetland Benthic Soil #5	BEN-5	5/10/2006	**10.7**	**14.1**	**15**	**120**	**1520**	< 4	**2560**	< 5.5	75.9%
Outer-Wetland Benthic Soil #6	BEN-6	5/10/2006	**9.7**	**12**	**5.07**	**46.1**	**822**	**5**	**1190**	< 5.5	67.5%
Arithmetic Average	(Dry Weight Basis)		**15.0**	**29.8**	**11.6**	**114**	**1160**	**5.8**	**2620**	**N/D**	
UCL Mean (normal Distribution)	(Dry Weight Basis)		**17.4**	**61.5**	**16.1**	**146**	**1570**	**9.5**	**3820**	**N/D**	
UCL Mean (lognormal Distribution)	(Dry Weight Basis)		**18.0**	**88.9**	**19.1**	**166**	**2000**	**159**	**4860**	**N/D**	
	MTCA Human (Unrestricted)		**20**	**16,000**	**80**	**3,200**	**250**	**400**	**24,000**	**24**	
	MTCA Human (Industrial)		**20**	**70,000**	**3,500**	**140,000**	**1,000**	**17,500**	**unlimited**	**1,050**	
	MTCA Ecological (Terrestrial)		**20**	**330**	**14**	**54**	**118**	**4**	**120**	**0.1**	

Yellow higlighting indicates mean concentration over any screening level

BOLD numbers indicate analytical detections above laboratory PQL.

NA = Not Analyzed at Laboratory

a = Sample results reported on an as-received basis

Table 4-1

Soil Characteristics Summary

SCS Map Unit (Slope Percent)	Soil Depth[1]	Primary Soil Drainage	Erosion Hazard	Topsoil Suitability
18 – Belzar, rock outcrop (40-65)	Moderately deep	Well	Very Severe	Poor
20 – Bonner silt loam (0-10)	Deep	Well	Slight	Poor
43 – Dufort silt loam (0-15)	Deep	Well	Moderate	Poor
44 – Dufort very stony silt loam (0-40)	Deep	Well	Severe	Poor
46 – Hartill silt loam (0-15)	Moderately deep	Well	Moderate	Poor
47 – Hartill silt loam (15-25)	Moderately deep	Well	Moderate	Poor
48 – Hartill silt loam (25-40)	Moderately deep	Well	Severe	Poor
49 – Hartill silt loam (40-65)	Moderately deep	Well	Severe	Poor
60 – Kaniksu sandy loam (0-15)	Deep	Well	Moderate	Poor
61 – Kaniksu sandy loam (15-40)	Deep	Well	Severe	Poor
71 – Martella silt loam (5-15)	Deep	Moderately well	Moderate	Poor
99 - Pits	NA[2]	NA	NA	NA
125 – Sacheen loamy fine sand (5-15)	Deep	Somewhat excessive	Slight	Fair
129 – Scotia fine sandy loam (7-15)	Deep	Well	Moderate	Fair
143 – Threemile silt loam (25-40)	Deep	Well	Severe	Poor

1 Moderately deep = 20 to 40 inches; Deep = > 40 inches.

2 NA = Not applicable. Soil characteristics not determined for soil underlying tailings at TDF-1 and TDF-2.

SOURCE: Ecology, 2000

Table 4-2

Habitat Types in the Pend Oreille Mine Area

Cover Type Symbol	Cover Type Characteristics
IR	Industrial facilities and other disturbed areas.
C3	Young mature successional conifer forest, 10 to 16 inches average diameter at breast height, greater than 50 percent canopy cover.
C2S	Silviculturally-treated pole successional conifer forest, 5 to 10 inches average diameter at breast height, greater than 50 percent canopy cover.
C3S	Silviculturally-treated young mature conifer forest, 11 to 16 inches average diameter at breast height, greater than 50 percent canopy cover.
PP3	Naturally occurring young mature successional conifer forest, 11 to 16 inches average diameter at breast height, 20 to 50 percent canopy cover.
PP2S	Naturally occurring pole successional conifer forest, 5 to 10 inches average diameter at breast height, 20 to 50 percent canopy cover.
PP3S	Naturally occurring pole successional conifer forest, 10 to 16 inches average diameter at breast height, 20 to 50 percent canopy cover.
SS	Shrubland.
RT	Tall shrubs and deciduous trees, greater than 50 percent canopy cover.
WE	Palustrine emergent wetland with greater than 30 percent herbaceous vegetative cover

SOURCE: Ecology, 2000

Table 4-3

Wildlife Species of Concern Found Near the Pend Oreille Mine[1]

Common Name	Scientific Name	Federal Status[2]	State Status[3]
Amphibian			
Columbia spotted frog	*Rana luteiventris*	SC	SC
Northern leopard frog	*Rana pipiens*	SC	SE
Bird			
Bald eagle	*Haliaeetus leucocephalus*	FT	ST
Harlequin duck	*Histrionicus histrionicus*	SC	
Northern goshawk	*Accipiter gentilis*	SC	SC
Olive-sided flycatcher	*Contopus borealis*	SC	
Peregrine falcon	*Falco peregrinus anatum*	SC	SE
Mammal			
California wolverine	*Gulo gulo luteus*	SC	SC
Fringed myotis	*Myotis thysanodes*	SC	
Gray wolf	*Canis lupus*	FE	SE
Grizzly bear	*Ursus arctos*	FT	SE
Long-eared myotis	*Myotis evotis*	SC	
Long-legged myotis	*Myotis volans*	SC	
North American lynx	*Lynx canadensis*	FT	ST
Pacific fisher	*Martes pennanti pacifica*	SC	SE
Pale Townsend's big-ear bat	*Corynorhinus townsendii pallescens*	SC	SC
Woodland caribou	*Rangifer tarandus caribou*	FE	SE
Yuma myotis	*Myotis yumanensis*	SC	

1 Source: U.S. Fish and Wildlife Service (1998), and Washington Department of Fish and Wildlife (1999).

2 FE = Federal endangered; FT = Federal threatened; SC = Federal species of concern; and FP = Federal proposed for listing under the Endangered Species Act.

3 SE = State endangered; ST = State threatened; and SC = State candidate.

SOURCE: Ecology, 2000

Table 4-4

Potentially Applicable Human Health Screening Levels for Soils
Pend Oreille Mine TDF-1 and TDF-2 RI/FS, Washington

METAL ANALYTE	Units	MTCA Method A Unrestricted Soil Levels	MTCA Method B Unrestricted Soil Levels[b]	MTCA Method A Industrial Soil Levels	MTCA Method B Industrial Soil Levels[b]	Typical Practical Quantification Limits	Washington State Background Levels	Proposed Unrestricted Land Use Screening Level[c]	Proposed Industrial Land Use Screening Level[c]
Arsenic	mg/kg	20	0.67	20	87	2.5	20	20	87
Barium	mg/kg	none	16,000	none	700,000	5	not determined	16,000	700,000
Cadmium	mg/kg	2[a]	80	2[a]	3,500	1	1	80[c]	3500
Copper	mg/kg	none	3,200	none	140,000	5	36	3200	140000
Lead	mg/kg	250	none	1,000	none	5	17	250	1000
Mercury	mg/kg	2[a]	24	2[a]	1050	0.03	0.07	24	1050
Selenium	mg/kg	none	400	none	17,500	4	not determined	400	17500
Zinc	mg/kg	none	24,000	none	unlimited	10	86	24000	unlimited

a = MTCA Method A Cleanup Level for the protection of groundwater, not human soil ingestion or soil direct contact

b = MTCA Method B Cleanup Level for direct human contact and ingestion

c = Groundwater not impacted above human health levels within or below TDF-1 and TDF-2; therefore soil cleanup levels for the protection of groundwater is not applicable

Table 4-5

Potentially Applicable Human Health Screening Levels for Water
Pend Oreille Mine TDF-1 and TDF-2 RI/FS, Washington

METAL ANALYTE	Units	MTCA Method A Groundwater Levels	MTCA Method B Groundwater Levels	WAC 246-290 MCLs Criteria	Federal Primary & Secondary MCLs/Action Levels	MTCA Method B Surface Water Criteria (Human Health)	2002 National Water Quality Criteria (Drinking and Comsuming Organisms)	2002 National Water Quality Criteria (Comsuming Organisms)	Washington State Background Concentrations	Standard Analytical Dectection Limits	Proposed Human Health Groundwater Screening Level	Proposed Human Health Surface Water Screening Level[a]
Arsenic	mg/L	0.005	0.000058	0.01	0.01	0.000014	0.000018	0.00014	0.005	0.003	0.005	0.005 (Background)
Cadmium	mg/L	0.005	0.008	0.005	0.005	0.013	0.005 (MCL)	none	none	0.0002	0.005	0.005 (MCL)
Copper	mg/L	none	0.64	1.3	1.0 (secondary)	0.518	1.3	none	none	0.001	0.64	0.64 (Method B)
Lead	mg/L	0.015	0.015	0.015	0.015	0.015 (MCL)	none	none	none	0.003	0.015	0.015 (MCL)
Mercury	mg/L	0.002	0.0048	0.002	0.002	0.00078	none	none	none	0.0002	0.002	0.002 (MCL)
Selenium	mg/L	none	0.08	0.05	0.05	0.065	0.17	4.2	none	0.003	0.05	0.05 (MCL)
Zinc	mg/L	none	4.8	5	5.0 (secondary)	0.78	7.4	26	none	0.01	4.8	4.8

a = Surface water creeks at the Site do not support fish for human consumption

Table 4-6

Potentially Applicable Terrestrial Ecological Health Screening Levels for Soils and Sediments
Pend Oreille Mine TDF-1 and TDF-2 RI/FS

METAL ANALYTE	Units	MTCA Ecological Indicator Concentration (Plants)	MTCA Ecological Indicator Concentration (Soil Biota)	MTCA Ecological Indicator Concentration (Wildlife)	Proposed Washington State Fresh Water Sediment Criteria	EPA Region X Ecological Soil Criteria (National Eco-SSLs) [Interim Final: As, Ba, Cd, and Pb March 2005; Cu, Se, Zn, March 2003]				EPA Region X FreshWater Sediment Criteria	Other Ecological Soil Criteria
						Plants	Invertebrates	Avian	Mammalian		
Arsenic	mg/kg	10	60	132	20	18	NA	43	46	none	none
Barium	mg/kg	500	none	102	none	none	330	none	2,000	none	none
Cadmium	mg/kg	4	20	14	0.6	32	140	0.77	0.36	none	none
Copper	mg/kg	100	50	217	80	95	54	Pending	Pending	none	none
Lead	mg/kg	50	500	118	335	120	1,700	11	56	none	none
Mercury	mg/kg	0.3	0.1	5.5	0.5	NA	NA	NA	NA	none	none
Selenium	mg/kg	1	70	0.3	none	1	NA	Pending	Pending	none	none
Zinc	mg/kg	86	200	360	140	130	120	Pending	Pending	none	none

METAL ANALYTE	Units	Washington State Background Levels	Practical Quantification Limits	Proposed Screening Criteria			
				Plants	Invertebrates	Avian	Mammalian
Arsenic	mg/kg	20	2.5	20	60	43	132
Barium	mg/kg	not determined	5	500	330	none	2,000
Cadmium	mg/kg	1	1	32	140	14	14
Copper	mg/kg	36	5	100	54	217	217
Lead	mg/kg	17	5	120	1,700	118	118
Mercury	mg/kg	0.07	0.03	0.3	0.1	none	5.5
Selenium	mg/kg	not determined	4	4	4	4	4
Zinc	mg/kg	86	10	130	120	360	360

There is a difference between MTCA concentrations and EPA values in terms of intended uses. MTCA values are presented as potential cleanup targets; EPA values are presented as screening-level values that are explicitly identified as not being cleanup targets.

Table 4-7

Potentially Applicable Aquatic Ecological Health Screening Levels for Surface Water
Pend Oreille Mine TDF-1 and TDF-2 RI/FS, Washington

ANALYTE	Units	Federal Primary & Secondary MCLs/Action Levels	MTCA Surface Water Levels (WAC 173-201A)	2002 National Water Quality Criteria-Section 304 (chronic to organisms)	Washington State Background Concentrations	Standard Practical Quantification Limits	Proposed SW Screening Criteria
Arsenic	mg/L	0.01	0.19	0.15	0.005	0.003	0.15
Cadmium	mg/L	0.005	0.00203	0.00046	none	0.0002	0.00046
Copper	mg/L	1.0 (secondary)	0.0248	0.0196	none	0.001	0.02
Lead	mg/L	0.015	0.00672	0.00672	none	0.003	0.0067
Mercury	mg/L	0.002	0.000012	0.00077	none	0.0002	0.0002
Selenium	mg/L	0.05	0.005	0.005	none	0.003	0.005
Zinc	mg/L	5.0 (secondary)	0.227	0.257	none	0.01	0.227

Surface Water Criteria assumed a hardness of 250 mg/L as CaCO3 (lowest hardness observed at Site)

Table 4-8

Summary of Media Screening Level Exceedances
Pend Oreille Mine TDF-1 and TDF-2 RI/FS , Washington

Human Risk Screening Level Exceedances					Ecological Risk Screening Level Exceedances			
Tailings, Soils, and Sediments - Unrestricted Land Use	**Tailings, Soils, and Sediments - Indusrtrial Land Use**	**Seep Water**	**Groundwater**	**Surface Water**	**Tailings and Soils**	**Creek and Wetland Sediments**	**Groundwater**	**Surface Water**
TDF-2 Tailings for Lead	None	Seep #4 for Lead	None	None	TDF-1 for Cd, Pb and Zn	Lower and Upper Creek # 2 for Pb, Se, & Zn	NA	Lower Creek #1 for Cd
TDF-1 Tailings for Lead	None	None	None	None	TDF-2 for Cd, Pb and Zn	TDF-1 Wetland for Cd, Pb, Se and Zn	NA	None
TDF-1 Wetland Sediments for Lead	None	None	None	None	None	None	NA	None
Creek #2 Sediments for Lead	None	None	None	None	None	None	NA	None

Table 5-1

Summary of IEUBK Model Results for Human Lead Blood Levels[a]

Human Receptor	Maximum Lead Blood Level (µg/L)
Tresspasser / Recreational Visitor Scenarios	
Child Visitor to TDF-1	6.0
Child Visitor to TDF-2	7.2
Child Visitor to Site Sediments	5.9
On-Site Residential Scenarios	
Residential on TDF-1 with Child Visitor to TDF-2	10.9
Residential on TDF-2 with Child Visitor to TDF-1	13.1
Residential on Site Sediments with Child Visitor to TDF-2	10.6

a = IEUBK Model Inputs and Outputs for each case is provided in Appendix H.

Table 5-2

Calculation of Potential Risks for Trespasser/Recreational Visitor Scenario
Pend Oreille Mine TDF-1 and TDF-2 RI/FS

TAILINGS DISPOSAL FACILITY TDF-1 TAILINGS	Maximum Log UCL (95%) Concentration from Tables 3-1 and 3-3 (mg/kg)	Maximum Concentration Air (mg/m^3)	Inhalation Rate (m^3/day)	Oral CPF (kg-day/mg)	Respiratory CPF (kg-day/mg)	RfD_o (mg/kg-day)	RfD_d (mg/kg-day)	RfDi** (mg/kg-day)	ATcr (years)	Atnc (years)	ABW (kg)	ED (years)	UCF (mg/kg)	SIR mg/day	AB1 (unitless)	EF (unitless)	SA (cm^2)	ABS (unitless)	AF (mg/cm^2-day)	Potential Oral Hazard Quotient	Potential Dermal Hazard Quotient	Potential Inhalation Hazard Quotient	Total Potential Hazard Quotient	Potential Respiratory Cancer Risk
Arsenic[a]	0	0	8.3	NA	NA	0.2	0.04	0.000143	75	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
Cadmium	18.8	1.42424E-08	8.3	NA	6.3	0.001	0.0002	0.001	75	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	3.22E-02	3.54E-03	1.01E-06	3.57E-02	7.12E-10
Copper	78.1	5.91667E-08	8.3	NA	NA	0.04	0.008	0.04	75	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	3.34E-03	3.68E-04	1.05E-07	3.71E-03	0
Mercury	0.22	1.66667E-10	8.3	NA	NA	0.0003	0.000021	0.0003	75	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	1.26E-03	3.95E-04	3.95E-08	1.65E-03	0
Selenium[b]	0	0	8.3	NA	NA	0.005	0.001	0.005	75	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
Zinc	3500	2.65152E-06	8.3	NA	NA	0.3	0.06	0.3	75	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	2.00E-02	2.20E-03	6.28E-07	2.22E-02	0
																			TOTALS	**5.68E-02**	**6.50E-03**	**1.78E-06**	**6.33E-02**	**7.12E-10**

TAILINGS DISPOSAL FACILITY TDF-2 TAILINGS	Log UCL (95%) Combining Tables 3-1 and 3-3 (mg/kg)	Maximum* Concentration Air (mg/m^3)	Inhalation Rate (m^3/day)	Oral CPF (kg-day/mg)	Respiratory CPF (kg-day/mg)	RfD_o (mg/kg-day)	RfD_d (mg/kg-day)	RfDi** (mg/kg-day)	ATcr (years)	Atnc (years)	ABW (kg)	ED (years)	UCF (mg/kg)	SIR mg/day	AB1 (unitless)	EF (unitless)	SA (cm^2)	ABS (unitless)	AF (mg/cm^2-day)	Potential Oral Hazard Quotient	Potential Dermal Hazard Quotient	Potential Inhalation Hazard Quotient	Total Potential Hazard Quotient	Potential Respiratory Cancer Risk
Arsenic[a]	0	0	8.3	NA	NA	0.2	0.04	0.000143	75	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
Cadmium	39.9	3.02273E-08	8.3	NA	6.3	0.001	0.0002	0.001	75	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	6.83E-02	7.52E-03	2.15E-06	7.58E-02	1.51E-09
Copper	187	1.41667E-07	8.3	NA	NA	0.04	0.008	0.04	75	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	8.01E-03	8.81E-04	2.52E-07	8.89E-03	0
Mercury	0.81	6.13636E-10	8.3	NA	NA	0.0003	0.000021	0.0003	75	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	4.62E-03	1.45E-03	1.45E-07	6.08E-03	0
Selenium[b]	0	0	8.3	NA	NA	0.005	0.001	0.005	75	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
Zinc	9870	7.47727E-06	8.3	NA	NA	0.3	0.06	0.3	75	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	5.63E-02	6.20E-03	1.77E-06	6.25E-02	0
																			TOTALS	**1.37E-01**	**1.60E-02**	**4.32E-06**	**1.53E-01**	**1.51E-09**

SEEP and TDF-1 WETLAND WATERS	Maximum Concentration from Tables 3-9 and 3-10	RFD_o (mg/kg-day)	RfD_d (mg/kg-day)	DWIR (L/day)	Atnc (years)	ABW (kg)	ED (years)	UCF (ug/mg)	DWF (unitless)	AB1 (unitless)	EF (unitless)	SA (cm^2)	ABS (unitless)	AF (mg/cm^2day)	Potential Oral Hazard Quotient	Potential Dermal Hazard Quotient	Total Potential Hazard Quotient
Arsenic[a]	0	0.2	0.04	1	6	16	6	1000	0.125	1	0.137	6600	0.01	0.2	0.00E+00	0.00E+00	0.00E+00
Cadmium	0.0023	0.001	0.0002	1	6	16	6	1000	0.125	1	0.137	6600	0.01	0.2	2.43E-03	4.82E-03	7.25E-03
Copper	0.0017	0.04	0.008	1	6	16	6	1000	0.125	1	0.137	6600	0.01	0.2	0	0	0
Mercury[c]	0	0.0003	0.000021	1	6	16	6	1000	0.125	1	0.137	6600	0.01	0.2	0.00E+00	0.00E+00	0.00E+00
Selenium[b]	0	0.005	0.001	1	6	16	6	1000	0.125	1	0.137	6600	0.01	0.2	0.00E+00	0.00E+00	0.00E+00
Zinc	6.69	0.3	0.06	1	6	16	6	1000	0.125	1	0.137	6600	0.01	0.2	2.39E-02	4.74E-02	7.12E-02
														TOTALS	**2.63E-02**	**5.22E-02**	**7.85E-02**

CREEK, SEEP and WETLAND SEDIMENTS	Log UCL (95%) from Table 3-11 (mg/kg)	RfD_o (mg/kg-day)	RfD_d (mg/kg-day)	ATcr (years)	Atnc (years)	ABW (kg)	ED (years)	UCF (mg/kg)	SIR mg/day	AB1 (unitless)	EF (unitless)	SA (cm^2)	ABS (unitless)	AF (mg/cm^2day)	Potential Oral Hazard Quotient	Potential Dermal Hazard Quotient	Total Potential Hazard Quotient
Arsenic[a]	0	0.2	0.04	75	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	0.00E+00	0.00E+00	0.00E+00
Cadmium	13.5	0.001	0.0002	75	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	2.31E-02	2.54E-03	2.57E-02
Copper	66.3	0.04	0.008	75	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	2.84E-03	3.12E-04	3.15E-03
Mercury	0.32	0.0003	0.000021	75	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	1.83E-03	5.74E-04	2.40E-03
Selenium[b]	9	0.005	0.001	75	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	3.08E-03	3.39E-04	3.42E-03
Zinc	4700	0.3	0.06	75	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	2.68E-02	2.95E-03	2.98E-02
														TOTALS	**5.77E-02**	**6.72E-03**	**6.44E-02**

a- Arsenic concentration are below Washington State background levels; b- Selenium was not detected; c- Mercury was not detected.
Potential Risk = (Maximum Concentration x CPF x SIR x AB1 x ED x EF) / (ABW x ATcr x UCF), Hazard Quotient = (Maximum Concentration x SIR x AB1 x EF x ED) / (RFD x ABW x UCF x ATnc), CPF = Oral Carcinogenic Potency Factor, RFD = Reference Dos (Method B Formula Value for Non-Carcinogen), SIR = Soil Ingestion Rate, AB1 = Gastrointestinal Absorption Rate, ABW = Average Body Weight, UCF = Unit Conversion Factor, ED = Duration of Exposure, ATcr = Averaging time for Carinogenic Risk, ATnc = Avergi Time for Non-Carcinogenic Risk, EF = Exposure Frequency(Calculated as 50/365=0.13)or 50 days/year, SA = Dermal Surface Area, ABS = Dermal absorption factor, AF = Adherence factor, DWIR = Incidental Drinking Water Ingestion Rate

Table 5-3

Calculaton of Potential Risks for Future Residential Scenerio
Pend Oreille Mine TDF-1 and TDF-2

TAILINGS DISPOSAL FACILITY TDF-1 TAILINGS	Maxiimum Log UCL (95%) Concentration from Tables 3-1 and 3-3 (mg/kg)	Maximum Concentration Air (mg/m^3)	Inhalation Rate (m^3/day)	Oral CPF (kg-day/mg)	Respiratory CPF (kg-day/mg)	Oral RfD_o (mg/kg-day)	Dermal RfD_d (mg/kg-day)	Inhalation RfDi** (mg/kg-day)	ATcr (years)	Atnc (years)	ABW (kg)	ED (years)	UCF (mg/kg)	SIR mg/day	AB1 (unitless)	EF (unitless)	SA (cm^2)	ABS (unitless)	AF (mg/cm^2-day)	Potential Oral Hazard Quotient	Potential Dermal Hazard Quotient	Potential Inhalation Hazard Quotient	Total Potential Hazard Quotient	Potential Respiratory Cancer Risk
Arsenic[a]	0	0	8.3	NA	NA	0.2	0.04	0.000143	75	6	16	6	1000000	200	1	1	2200	0.01	0.2					0
Cadmium	18.8	1.42424E-08	8.3	NA	6.3	0.001	0.0002	0.001	75	6	16	6	1000000	200	1	1	2200	0.01	0.2	2.35E-01	2.59E-02	7.39E-06	2.61E-01	5.20E-09
Copper	78.1	5.91667E-08	8.3	NA	NA	0.04	0.008	0.04	75	6	16	6	1000000	200	1	1	2200	0.01	0.2	2.44E-02	2.68E-03	7.67E-07	2.71E-02	0
Mercury	0.22	1.66667E-10	8.3	NA	NA	0.0003	0.000021	0.0003	75	6	16	6	1000000	200	1	1	2200	0.01	0.2	9.17E-03	2.88E-03	2.88E-07	1.20E-02	0
Selenium[b]	0	0	8.3	NA	NA	0.005	0.001	0.005	75	6	16	6	1000000	200	1	1	2200	0.01	0.2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
Zinc	3500	2.65152E-06	8.3	NA	NA	0.3	0.06	0.3	75	6	16	6	1000000	200	1	1	2200	0.01	0.2	1.46E-01	1.60E-02	4.58E-06	1.62E-01	0
																			TOTALS	4.14E-01	4.75E-02	1.30E-05	4.62E-01	5.20E-09

TAILINGS DISPOSAL FACILITY TDF-2 TAILINGS	Log UCL (95%) Combining Tables 3-1 and 3-3 (mg/kg)	Maximum* Concentration Air (mg/m^3)	Inhalation Rate (m^3/day)	Oral CPF (kg-day/mg)	Respiratory CPF (kg-day/mg)	RfD_o (mg/kg-day)	RfD_d (mg/kg-day)	RfDi** (mg/kg-day)	ATcr (years)	Atnc (years)	ABW (kg)	ED (years)	UCF (mg/kg)	SIR mg/day	AB1 (unitless)	EF (unitless)	SA (cm^2)	ABS (unitless)	AF (mg/cm^2-day)	Potential Oral Hazard Quotient	Potential Dermal Hazard Quotient	Potential Inhalation Hazard Quotient	Total Potential Hazard Quotient	Potential Respiratory Cancer Risk
Arsenic[a]	0	0	8.3	NA	NA	0.2	0.04	0.000143	75	6	16	6	1000000	200	1	1	2200	0.01	0.2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
Cadmium	39.9	3.02273E-08	8.3	NA	6.3	0.001	0.0002	0.001	75	6	16	6	1000000	200	1	1	2200	0.01	0.2	4.99E-01	5.49E-02	1.57E-05	5.54E-01	1.10E-08
Copper	187	1.41667E-07	8.3	NA	NA	0.04	0.008	0.04	75	6	16	6	1000000	200	1	1	2200	0.01	0.2	5.84E-02	6.43E-03	1.84E-06	6.49E-02	0
Mercury	0.81	6.13636E-10	8.3	NA	NA	0.0003	0.000021	0.0003	75	6	16	6	1000000	200	1	1	2200	0.01	0.2	3.38E-02	1.06E-02	1.06E-06	4.44E-02	0
Selenium[b]	0	0	8.3	NA	NA	0.005	0.001	0.005	75	6	16	6	1000000	200	1	1	2200	0.01	0.2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
Zinc	9870	7.47727E-06	8.3	NA	NA	0.3	0.06	0.3	75	6	16	6	1000000	200	1	1	2200	0.01	0.2	4.11E-01	4.52E-02	1.29E-05	4.57E-01	0
																			TOTALS	1.00E+00	1.17E-01	3.15E-05	1.12E+00	1.10E-08

SEEP and TDF-1 WETLAND WATERS	Maximum Concentration from Tables 3-9 and 3-10 (mg/L)	RFD_o (mg/kg-day)	RfD_d (mg/kg-day)	DWIR (L/day)	Atnc (years)	ABW (kg)	ED (years)	UCF (ug/mg)	DWF (unitless)	AB1 (unitless)	EF (unitless)	SA (cm^2)	ABS (unitless)	AF (mg/cm^2-day)	Potential Oral Hazard Quotient	Potential Dermal Hazard Quotient	Total Potential Hazard Quotient
Arsenic[a]	0	0.2	0.04	1	6	16	6	1000	0.125	1	1	6600	0.01	0.2	0.00E+00	0.00E+00	0.00E+00
Cadmium	0.0023	0.001	0.0002	1	6	16	6	1000	0.125	1	1	6600	0.01	0.2	1.77E-02	3.52E-02	5.29E-02
Copper	0.0017	0.04	0.008	1	6	16	6	1000	0.125	1	1	6600	0.01	0.2	0	0	0
Mercury[c]	0	0.0003	0.000021	1	6	16	6	1000	0.125	1	1	6600	0.01	0.2	0.00E+00	0.00E+00	0.00E+00
Selenium[b]	0	0.005	0.001	1	6	16	6	1000	0.125	1	1	6600	0.01	0.2	0.00E+00	0.00E+00	0.00E+00
Zinc	6.69	0.3	0.06	1	6	16	6	1000	0.125	1	1	6600	0.01	0.2	1.74E-01	3.46E-01	5.20E-01
														TOTALS	1.92E-01	3.81E-01	5.73E-01

CREEK, SEEP and WETLAND SEDIMENTS	Log UCL (95%) from Table 3-11 (mg/kg)	RfD_o (mg/kg-day)	RfD_d (mg/kg-day)	Atnc (years)	ABW (kg)	ED (years)	UCF (mg/kg)	SIR mg/day	AB1 (unitless)	EF (unitless)	SA (cm^2)	ABS (unitless)	AF (mg/cm^2 day)	Potential Oral Hazard Quotient	Potential Dermal Hazard Quotient	Total Potential Hazard Quotient
Arsenic[a]	0	0.2	0.04	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	0.00E+00	0.00E+00	0.00E+00
Cadmium	13.5	0.001	0.0002	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	2.31E-02	2.54E-03	2.57E-02
Copper	66.3	0.04	0.008	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	2.84E-03	3.12E-04	3.15E-03
Mercury	0.32	0.0003	0.000021	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	1.83E-03	5.74E-04	2.40E-03
Selenium[b]	9	0.005	0.001	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	3.08E-03	3.39E-04	3.42E-03
Zinc	4700	0.3	0.06	6	16	6	1000000	200	1	0.137	2200	0.01	0.2	2.68E-02	2.95E-03	2.98E-02
													TOTALS	5.77E-02	6.72E-03	6.44E-02

a- Arsenic concentration are below Washington State background levels; b- Selenium was not detected; c- Mercury was not detected.

Potential Risk = (Maximum Concentration x CPF x SIR x AB1 x ED x EF) / (ABW x ATcr x UCF), Hazard Quotient = (Maximum Concentration x SIR x AB1 x EF x ED) / (RFD x ABW x UCF x ATnc), CPF = Oral Carcinogenic Potency Factor, RFD = Reference Dose (Method B Formula Value for Non-Carcinogen), SIR = Sc Ingestion Rate, AB1 = Gastrointestinal Absorption Rate, ABW = Average Body Weight, UCF = Unit Conversion Factor, ED = Duration of Exposure, ATcr = Averaging time for Carinogenic Risk, ATnc = Averging Time for Non-Carcinogenic Risk, EF = Exposure Frequency(Calculated as 50/365=0.13)or 50 days/year, SA = Dermal Surface Area, ABS = Dermal absorption factor, AF = Adherence factor, DWIR = Incidental Drinking Water Ingestion Rate

Remediation Technology Screening

Technology	Screening Comments	Retained? (Yes/No)
INSTITUTIONAL CONTROLS AND MONITORING		
Site Access Restrictions		
Fencing	Effective, easy to implement, low cost	Yes
Warning Signs	Effective, easy to implement, low cost	Yes
Security Patrols	Expensive and unnecessary	No
Land Use Restrictions		
Deed Restrictions	Effective, easy to implement, low cost	Yes
Groundwater Use Restrictions	No current need because groundwater is not impacted.	No
Alternate Water Supply	No current need because groundwater is not impacted.	No
Monitoring	Required component of site remedy	Yes
CONTAINMENT		
Capping Technologies	Capping is proven, effective technology for providing reliable long-term containment and preventing or minimizing off-site migration of constituents of concern.	Yes
Soil Cap	Effective; readily implemented; inexpensive	Yes
Pavement Cap (asphalt/concrete)	Subject to cracking; not as reliable as other cap options of comparable cost	No
Low-permeability Soil Cap	Not necessary because groundwater is not impacted.	No
FML Cap	Not necessary because groundwater is not impacted.	No
RCRA Subtitle C Cap	Not necessary because groundwater is not impacted. Tailings not classified as "Dangerous Waste." Other cap options provide sufficient protection and are easier to implement for much less cost	No
Sedimentation Basins	Effective for capturing impacted sediments, relatively low cost	Yes
Surface Water Controls Grading Stormwater Drainage Controls Vegetative Cover	Useful component of cap remedy	Yes
Vertical Barriers Slurry Wall Grout Wall Sheet Pile Wall	Groundwater is not impacted; therefore, no need for groundwater containment at this site.	No
Horizontal Barriers Grout Injection	Groundwater is not unacceptably impacted; therefore, no need for groundwater containment at this site.	No
Hydraulic Groundwater Containment	Groundwater is not impacted; therefore, no need for groundwater containment at this site.	No

Table 6-1

Remediation Technology Screening

Technology	Screening Comments	Retained? (Yes/No)
STABILITY IMPROVEMENT		
Groundwater Level Control	Currently the diversion ditches are controling groundwater levels	No
Dam Buttress	TDF-1dam already has a rock buttress along the base	No
Erosion Control	The TDF-1 dam slope could need erosion control measures such as vegetation or Geo-fabrics	Yes
Stormwater Drainage Controls	TDF-1 has surface water diversion, but may need improvements. TDF-2 has no surface water control	Yes
Dam Slope Improvements	Stability analyses indicates that measures are needed to improve stability such as dam slope reduction	yes
WASTE/SOIL TREATMENT		
Reuse/Recycling	No waste materials identified with the potential for reuse or recycling.	No
Other Waste/soil Treatment	No need for waste treatment at this site. Metals cannot be distroyed and they are not mobile through dissolution mechanism.	No
Groundwater Treatment	Groundwater is not impacted; therefore, groundwater treatment is not needed.	No
OFF-SITE DISPOSAL/ REMOVAL	Current disposal site is acceptable; therefore, no point in moving waste to another disposal location at considerable cost.	No
Excavation (soil/waste)	No need for waste treatment or off-site disposal; therefore, no need for waste excavation. Excavation retained as it applies to regrading and capping the site.	Yes
Backhoe		
Loader		
Bulldozer		
Clamshell		
Dragline		
Groundwater Extraction	Groundwater is not unacceptably impacted; therefore, no need for groundwater extraction.	No

TABLE 8-1

Summary of Remediation Alternative Evaluation

Criteria [a]	Relative Value of Criterion [b]	Calculated Criteria Weights	Alternative Scores [c]				
			Alternative 2: Institutional Controls, Creek #2 Sedimentation Basin	Alternative 3: TDF-1 Slope @ 2.5H:1V, Accelerate Vegetation on TDF-1 and TDF-2	Alternative 4: TDF-1 Slope @ 2.5H:1V, TDF-2 Partial Soils Cover, Accelerate Vegetation on TDF-1 and TDF-2	Alternative 5: TDF-1 Slope @ 2.5H:1V, TDF-2 Partial Soil Cover, TDF-1 Wetland Removal and Mitigation, TDF-1 and TDF-1 Re-Vegetation	Alternative 6: TDF-1 Slope @ 2.5H:1V, Soil Cover and Revegetation on TDF-1 and TDF-2, TDF-1 Wetland Mitigation
Overall Protectiveness	0.2	20%	0	5	6	8	10
Long-Term Effectiveness and Reliability	0.2	20%	0	7	8	9	10
Reduction in Toxicity, Mobility, and Volume	0.2	20%	0	5	7	8	10
Short-Term Effectiveness	0.2	20%	10	6	4	2	0
Implementability	0.2	20%	0	10	9	5	4
Net Benefit		100%	2.0	6.6	6.8	6.4	6.8
Incremental Benefit			NA	4.6	0.2	-0.4	0.4
Cost (present value, millions)			$737,160.00	$1,334,489.00	$1,559,000.00	$1,766,000.00	$2,187,000.00
Benefit : Cost (i.e., cost-effectiveness)			2.7	4.9	4.4	3.6	3.1
Incremental Cost			NA	$597,329.00	$224,511.00	$207,000.00	$421,000.00
Incremental Benefit : Incremental Cost			NA	7.7	0.9	-1.93	0.95

[a] See text for criteria definitions.

[b] The numeric weighing value of each scoring unit of the criterion

[c] See text for score basis.

TABLE 8-2

Summary of Estimated Remedial Alternatives Costs

Alternative		Estimated Costs		
		Capital	I&M	Total
2	Institutional Controls, Sediment Capture, and Monitoring	$238,160	$499,000	$737,160
3	TDF-1 Slope Improvement (2.5H:1V) and Accelerate Re-Vegetation	$1,285,489	$49,000	$1,334,489
4	TDF-1 Slope Improvement (2.5H:1V), TDF-2 Partial Soil Cap and Re-Vegetation	$1,496,000	$63,000	$1,559,000
5	TDF-1 Slope Improvement (2.5H:1V), TDF-1 Wetland Removal, TDF-2 Partial Soil Cap, and Re-Vegetation	$1,697,000	$69,000	$1,766,000
6	TDF-1 Slope Improvement (2.5H:1V), TDF-1 and TDF-2 Soil Cap, and Re-Vegetation	$2,118,000	$69,000	$2,187,000

FIGURES

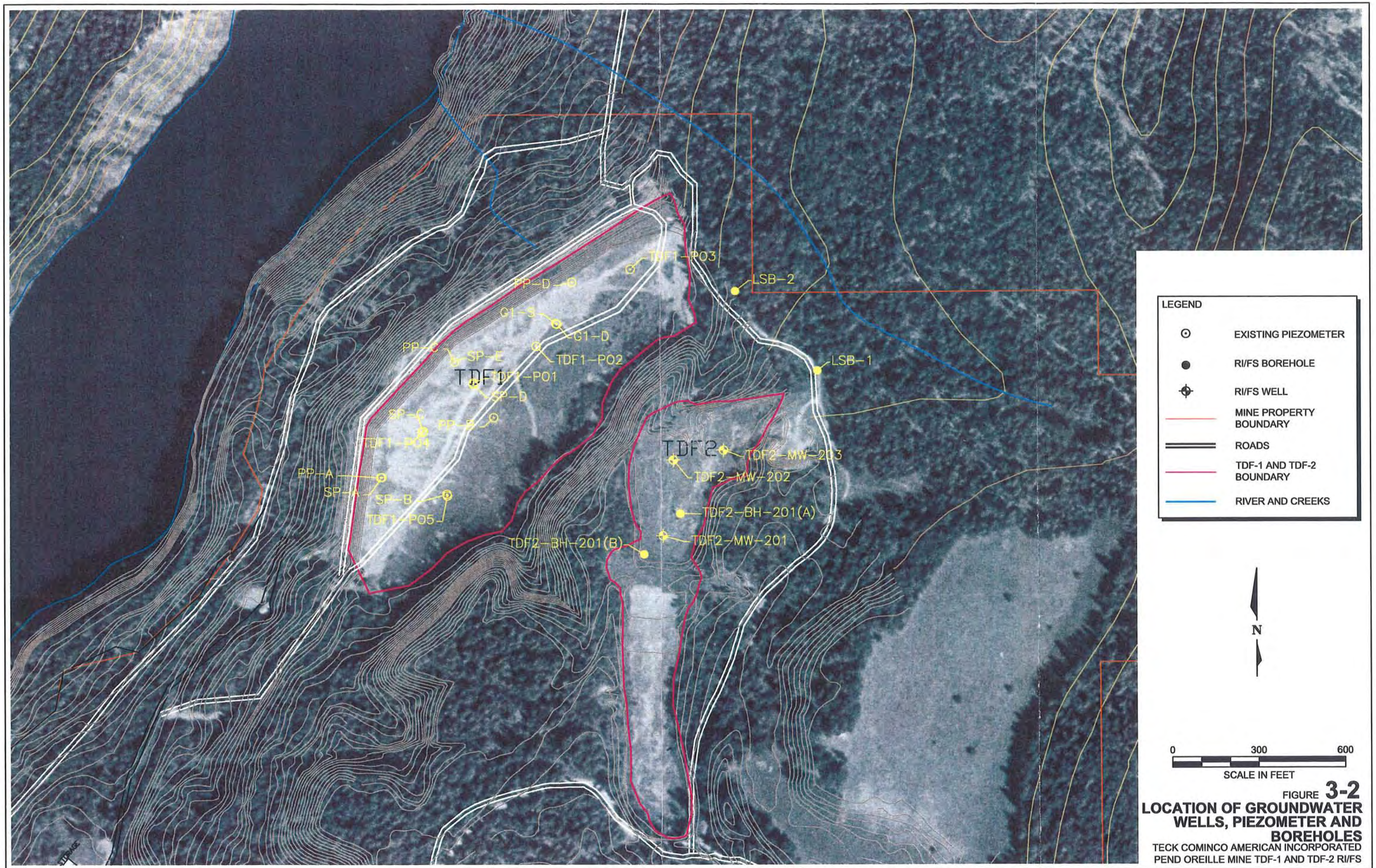

FIGURE **3-2**

LOCATION OF GROUNDWATER WELLS, PIEZOMETER AND BOREHOLES

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

0431344516F07.dwg | Ground water | Mod: 10/02/2006, 09:12 | Plot: 10/05/2006, 15:49 | aforcier

Golder Associates

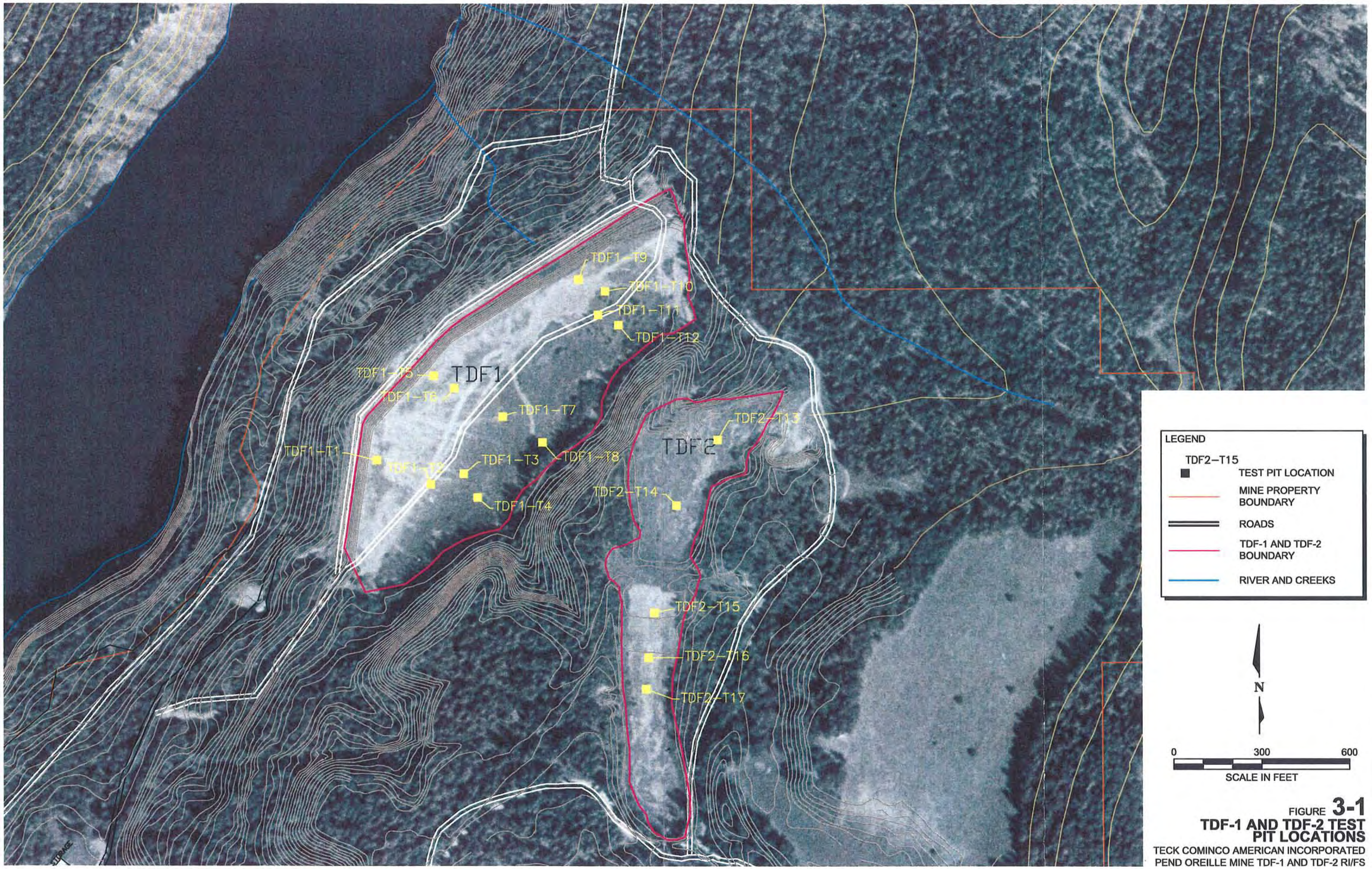

FIGURE **3-1**

TDF-1 AND TDF-2 TEST PIT LOCATIONS

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

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Golder Associates

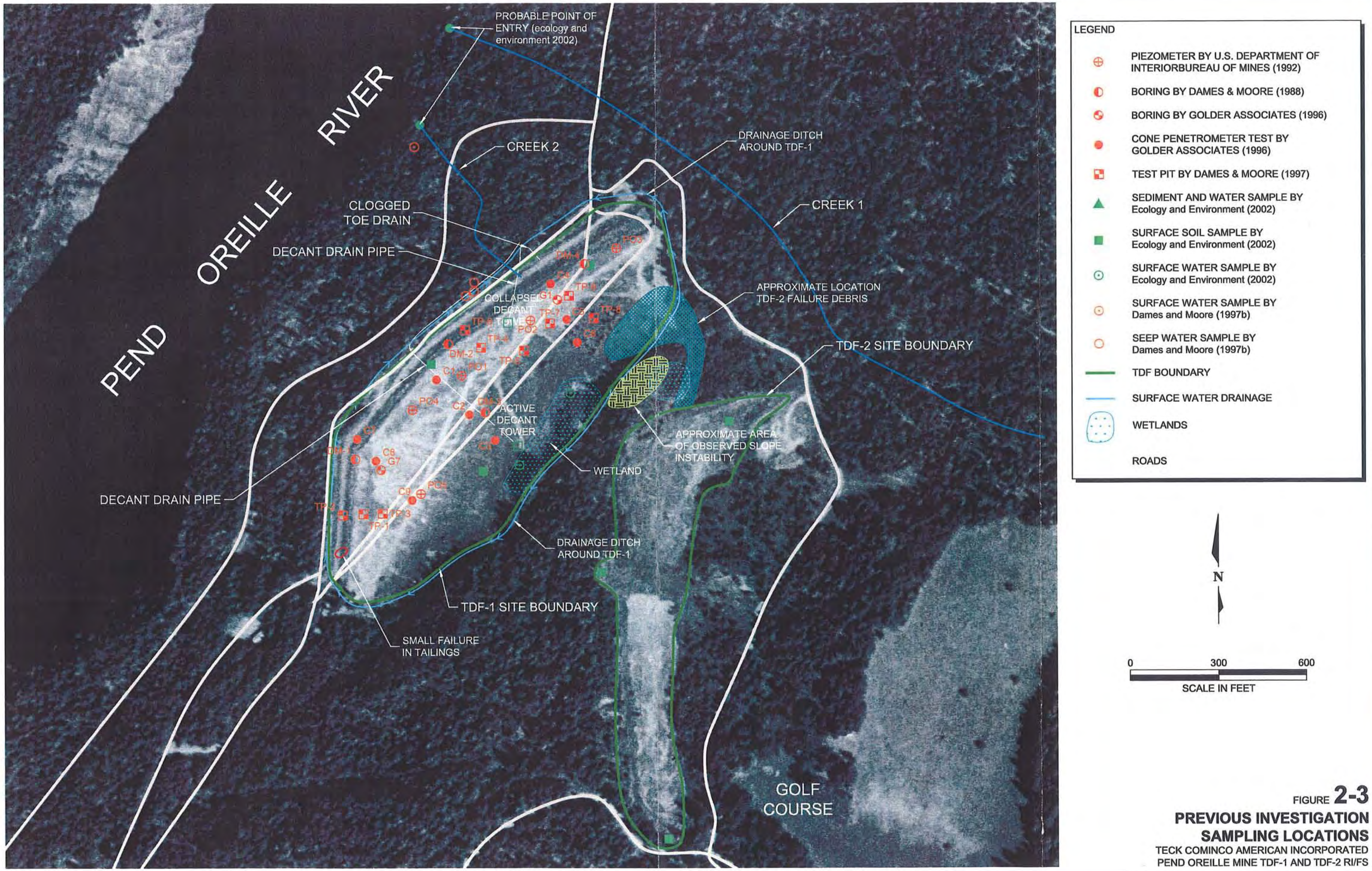

FIGURE **2-3**

PREVIOUS INVESTIGATION SAMPLING LOCATIONS

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

0431344516F13.dwg | Layout: Layout1 | Modified: 08/28/2006, 09:40 | Plotted: 08/28/2006, 16:17

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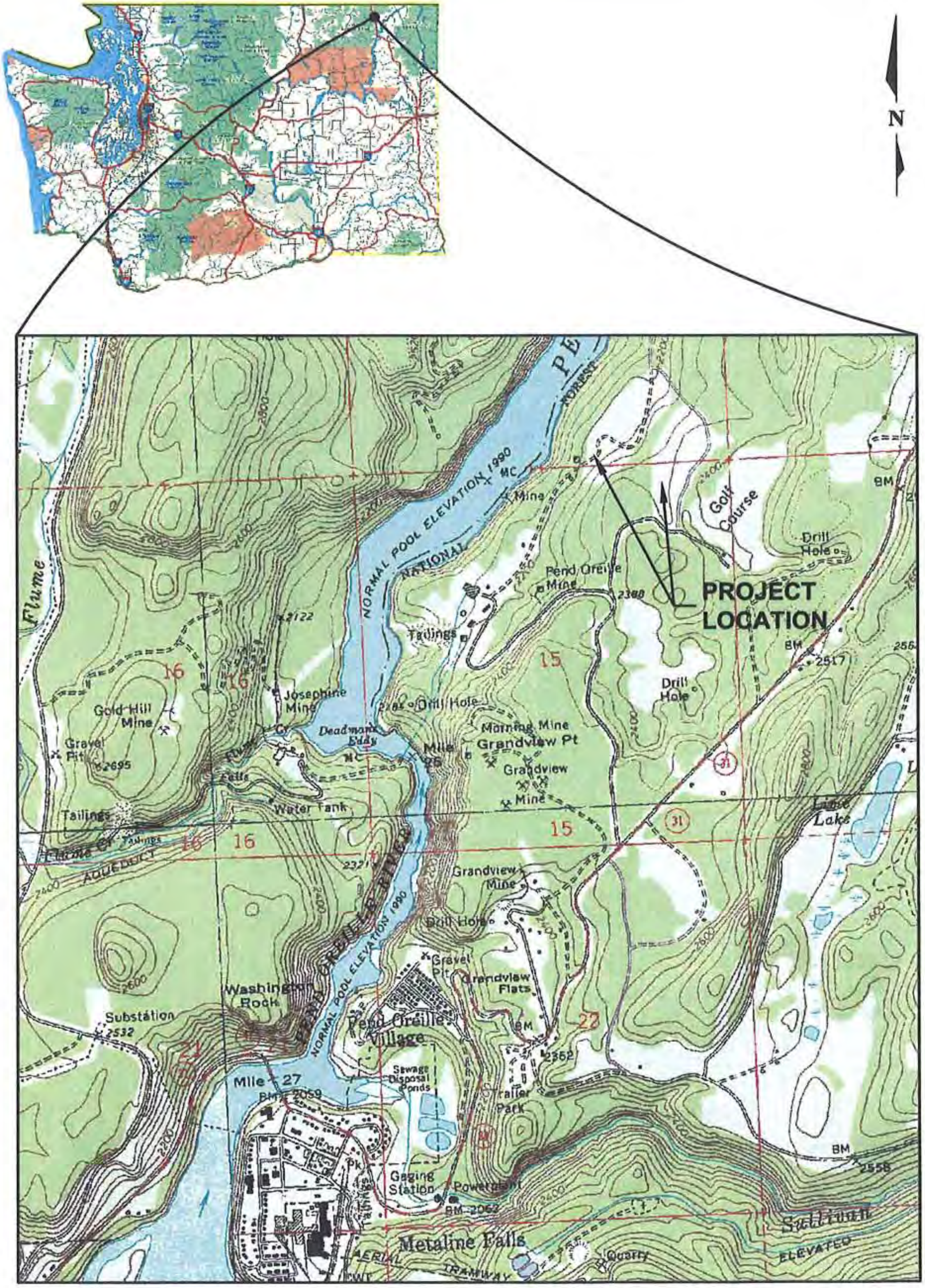


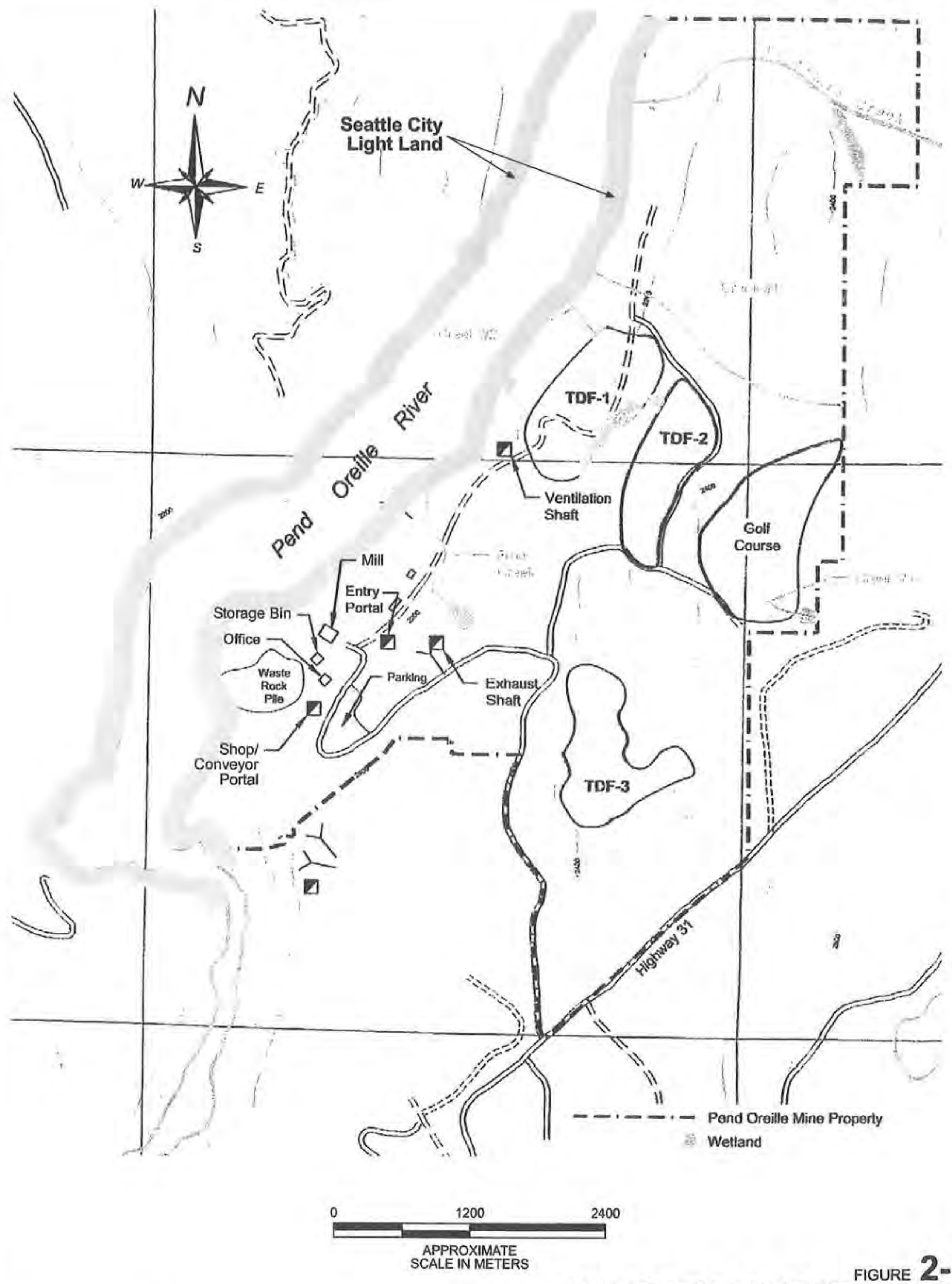
FIGURE **1-1**

PROJECT LOCATION

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

0431344516F1-1.dwg | Layout: Layout1 | Modified: 08/28/2006, 14:45 | Plotted: 08/29/2006, 10:26

Golder Associates



Source: Ecology (2000)

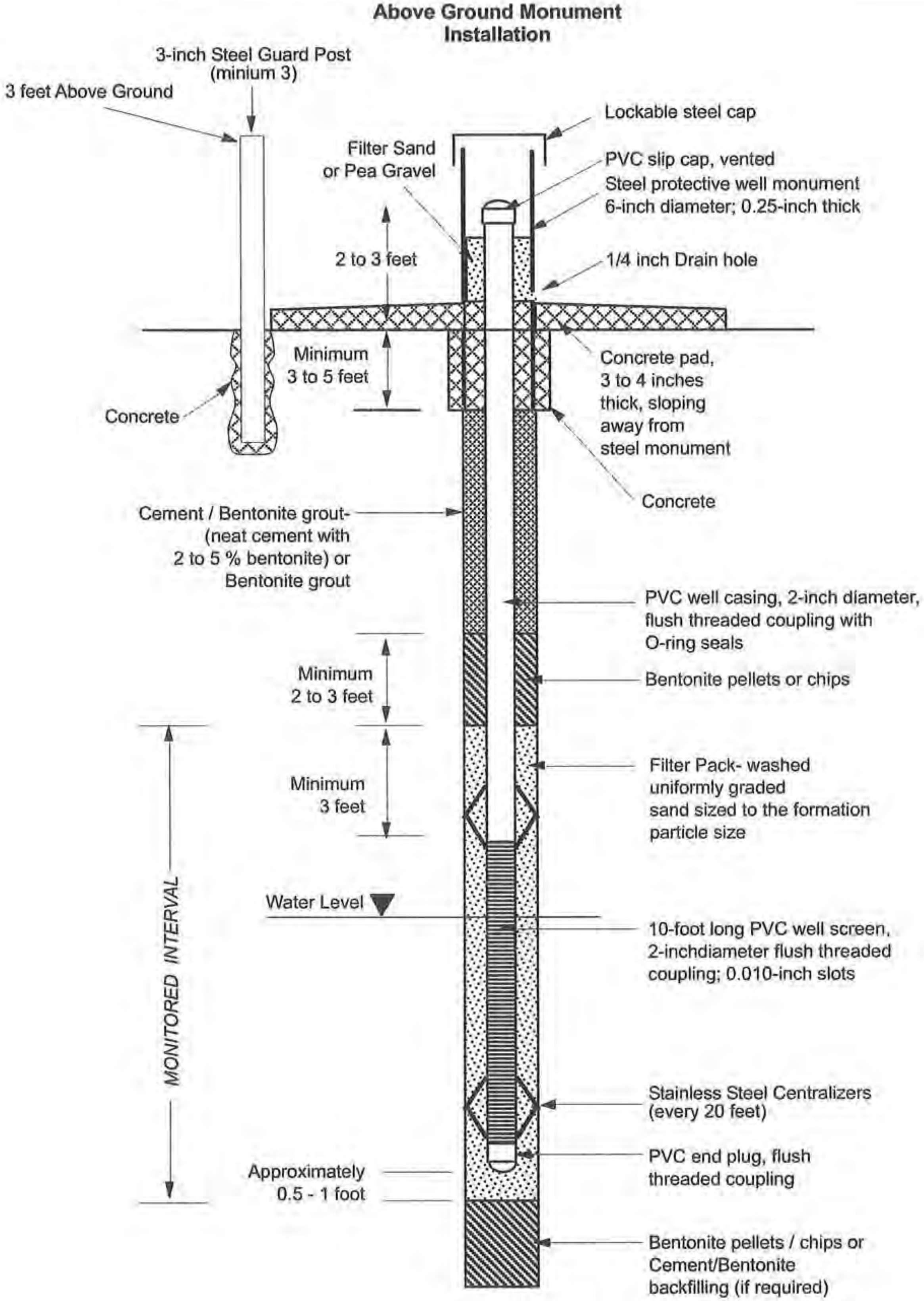
FIGURE **2-1**

PEND OREILLE MINE FACILITY MAP

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

DRAWING NO. 0431344516fg04.fh11 DATE 08/17/06 DRAWN BY JDD

Golder Associates



NOT TO SCALE

FIGURE **3-3**

SCHEMATIC MONITORING WELL INSTALLATION DIAGRAM

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

DRAWING NO. 0431344516fg05.fh11 DATE 08/28/06 DRAWN BY JDD

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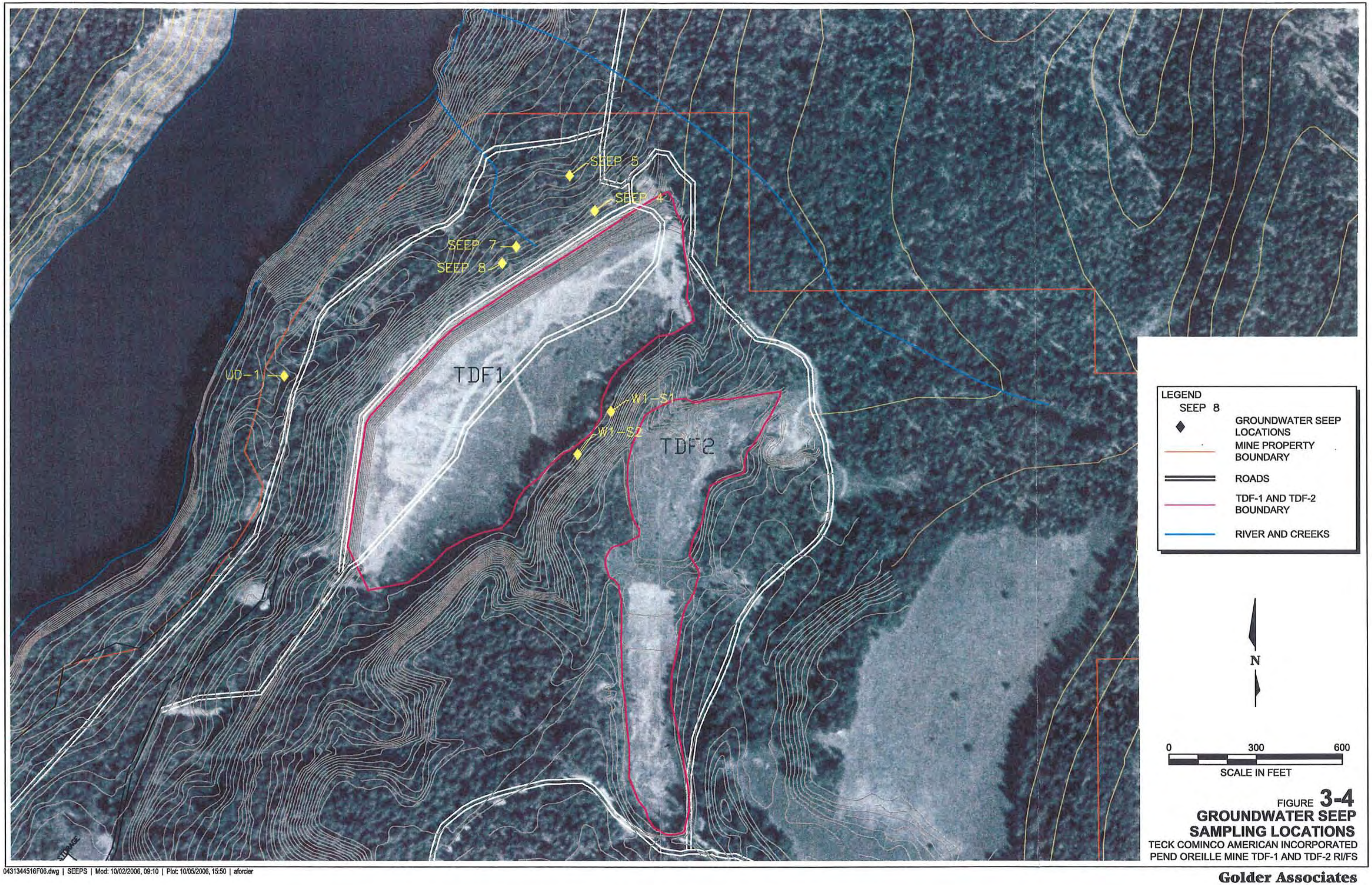

FIGURE 3-4
GROUNDWATER SEEP SAMPLING LOCATIONS
TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

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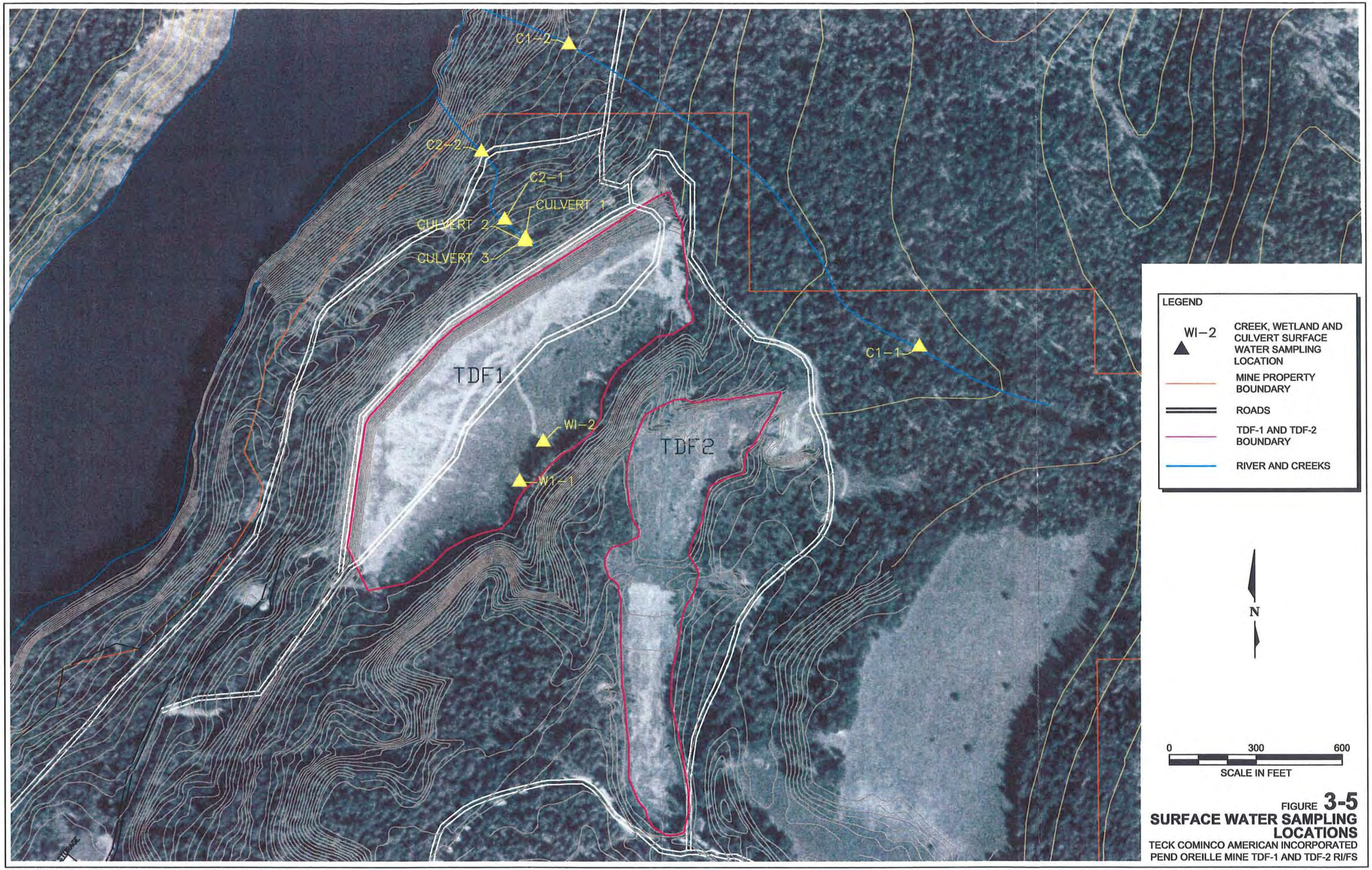


FIGURE **3-5**

SURFACE WATER SAMPLING LOCATIONS

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

0431344516F08.dwg | Surface Water | Mod: 10/02/2006, 09:08 | Plot: 10/05/2006, 15:48 | aforcier

Golder Associates

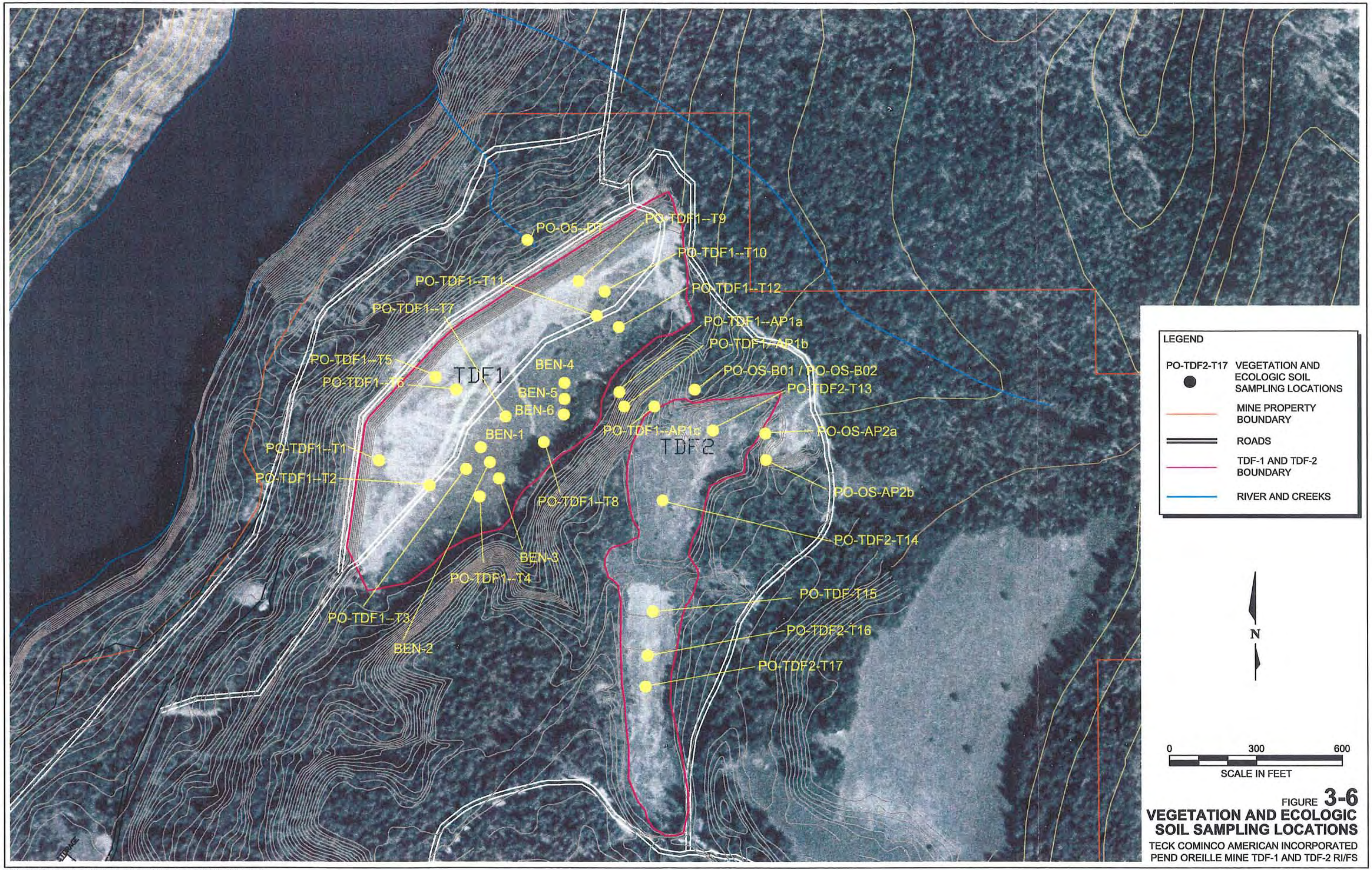


FIGURE **3-6**

VEGETATION AND ECOLOGIC SOIL SAMPLING LOCATIONS

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

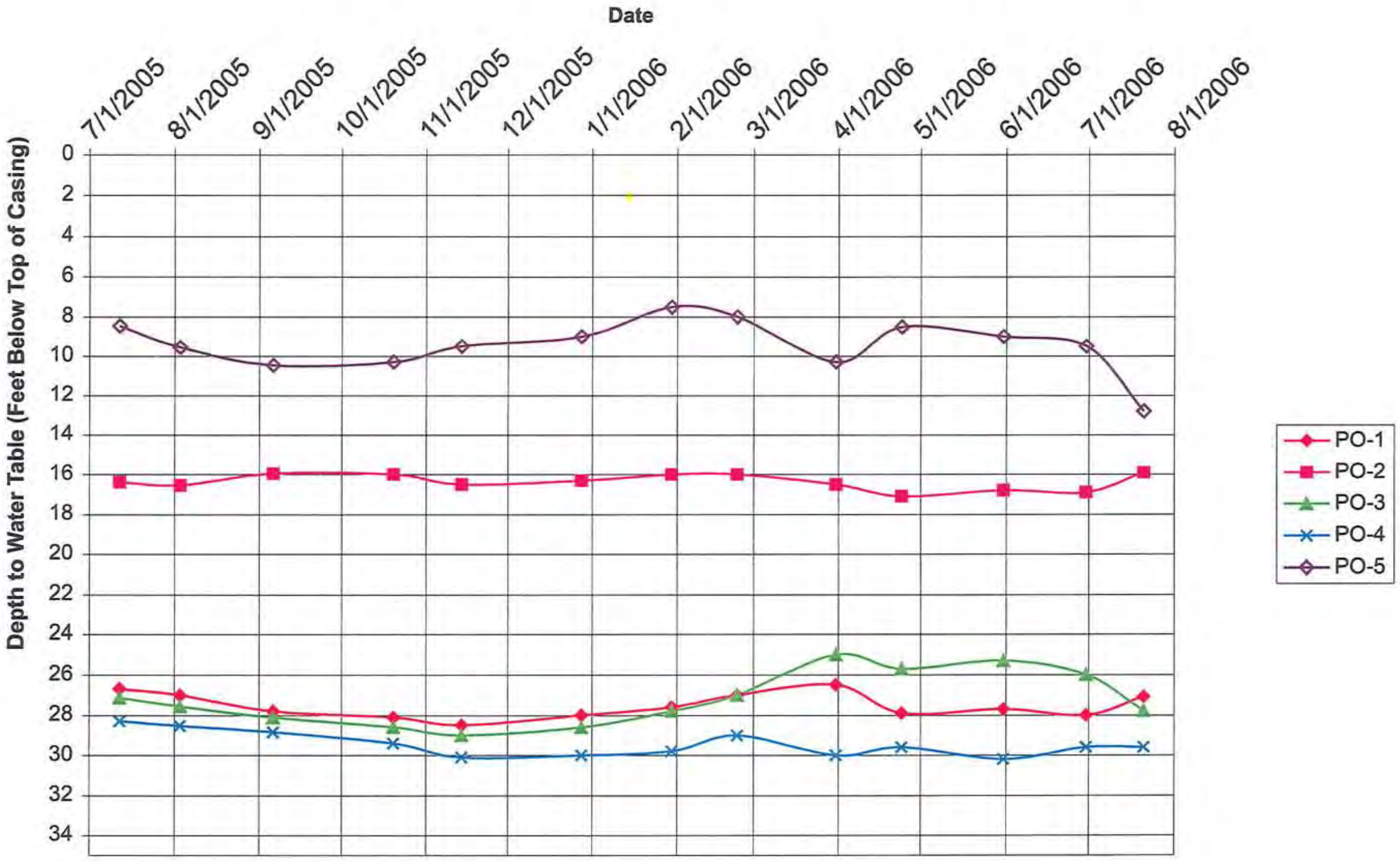


FIGURE **3-7**

MONTHLY PIEZOMETER WATER LEVEL MEASUREMENTS ON TDF-1

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

DRAWING NO. 0431344516fg08.fh11 DATE 08/28/06 DRAWN BY AMP

Golder Associates

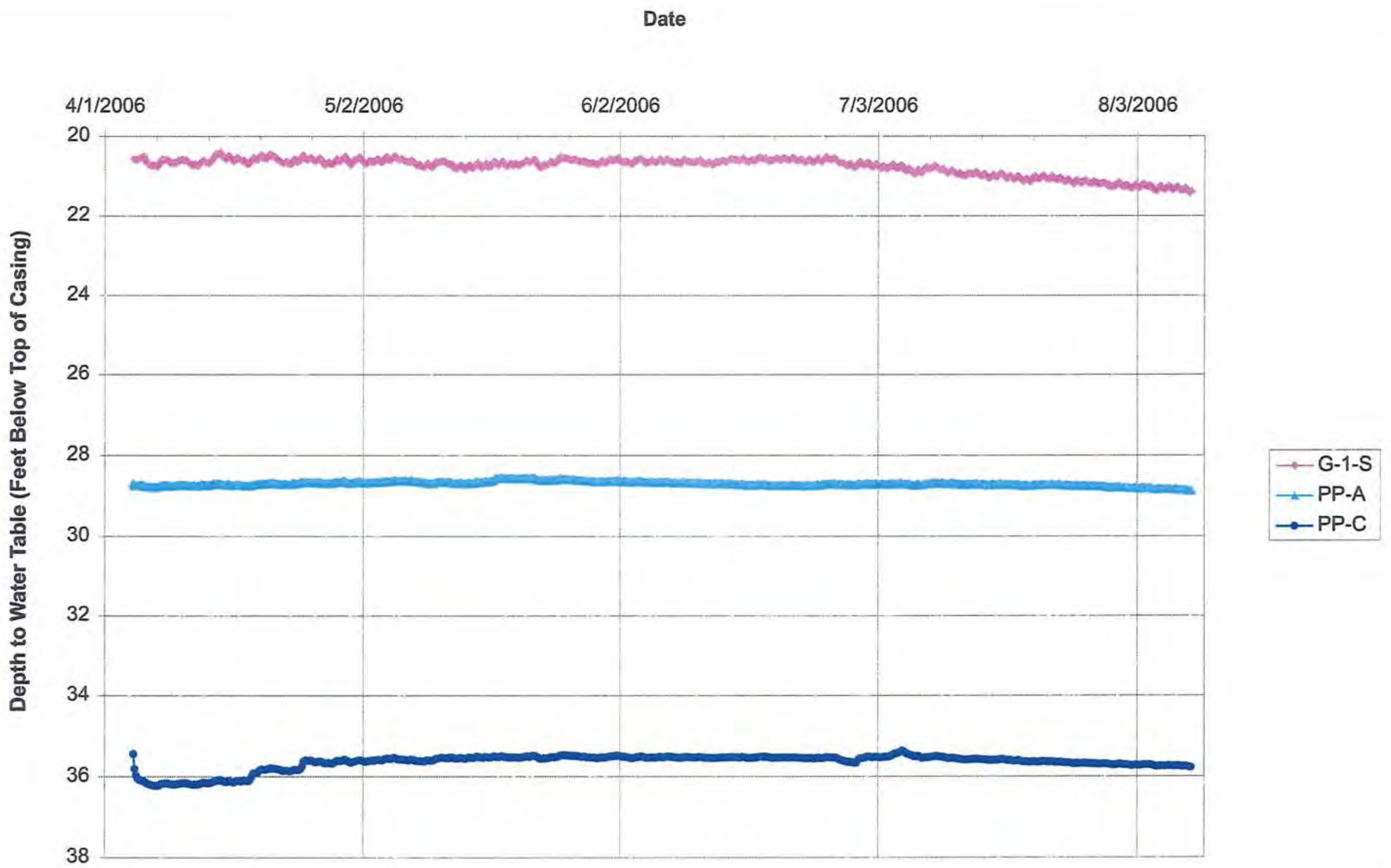


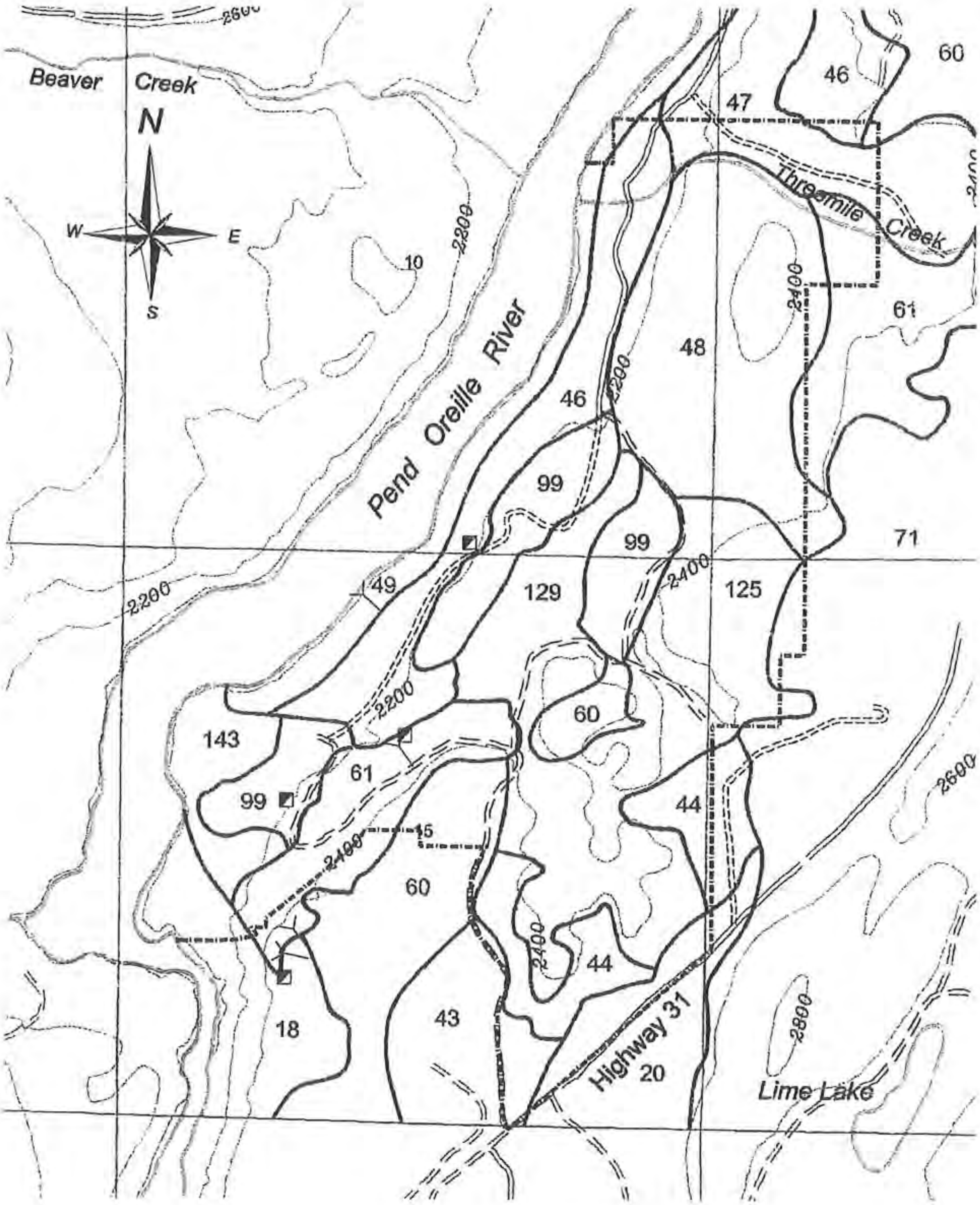
FIGURE **3-8**

TRANSDUCER WATER LEVEL MEASUREMENTS ON TDF-1

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

DRAWING NO. 0431344516fig09.fh11 DATE 08/28/06 DRAWN BY AMP

Golder Associates



Note: *See Table 4-1 for Soil Unit Description*

Source: Ecology (2000)

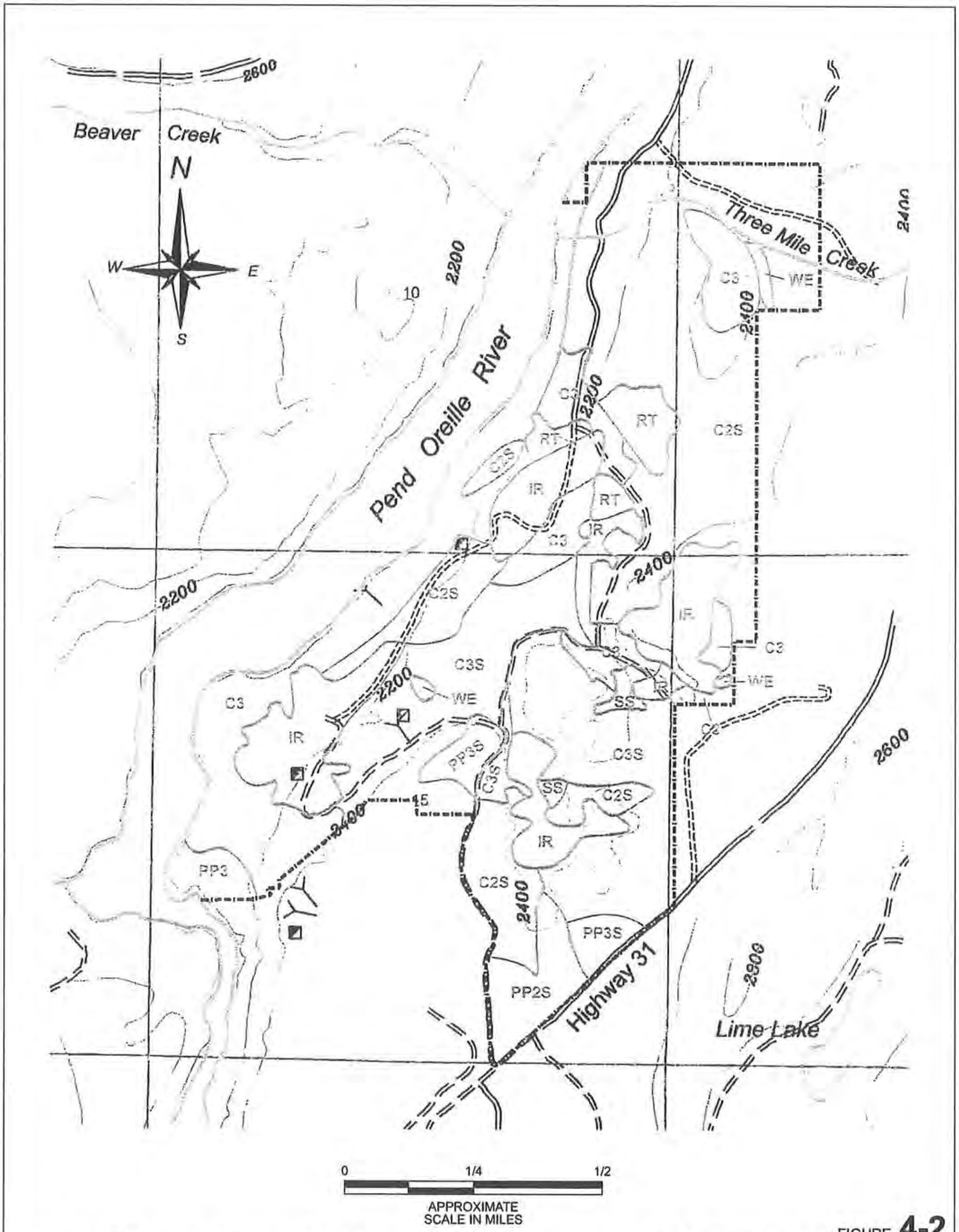
FIGURE **4-1**

SOIL MAP UNITS

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

DRAWING NO. 0431344516fg02.fh11 DATE 08/28/06 DRAWN BY JDD

Golder Associates



Note: See Table 4-2 for Vegetation Description

Source: Ecology (2000)

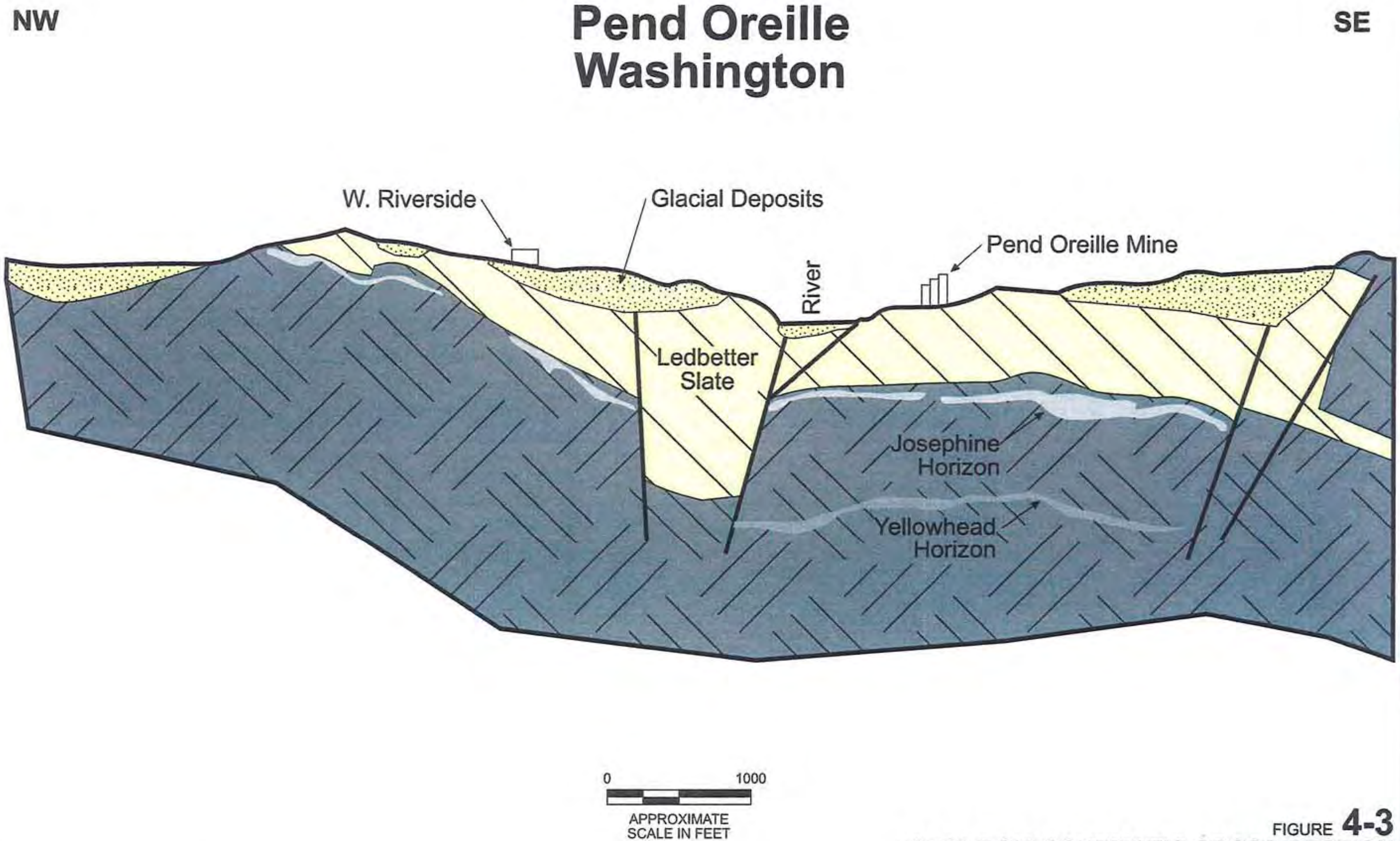
FIGURE **4-2**

VEGETATIVE COVER TYPES

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

DRAWING NO. 0431344516fg03.fh11 DATE 08/28/06 DRAWN BY JDD

Golder Associates



Source: *Ecology (2000)*

FIGURE **4-3**
GEOLOGIC SCHEMATIC CROSS-SECTION
AT PEND OREILLE MINE
TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

DRAWING NO. 04313445l6fg01.fh11 DATE 08/28/06 DRAWN BY JDD

Golder Associates

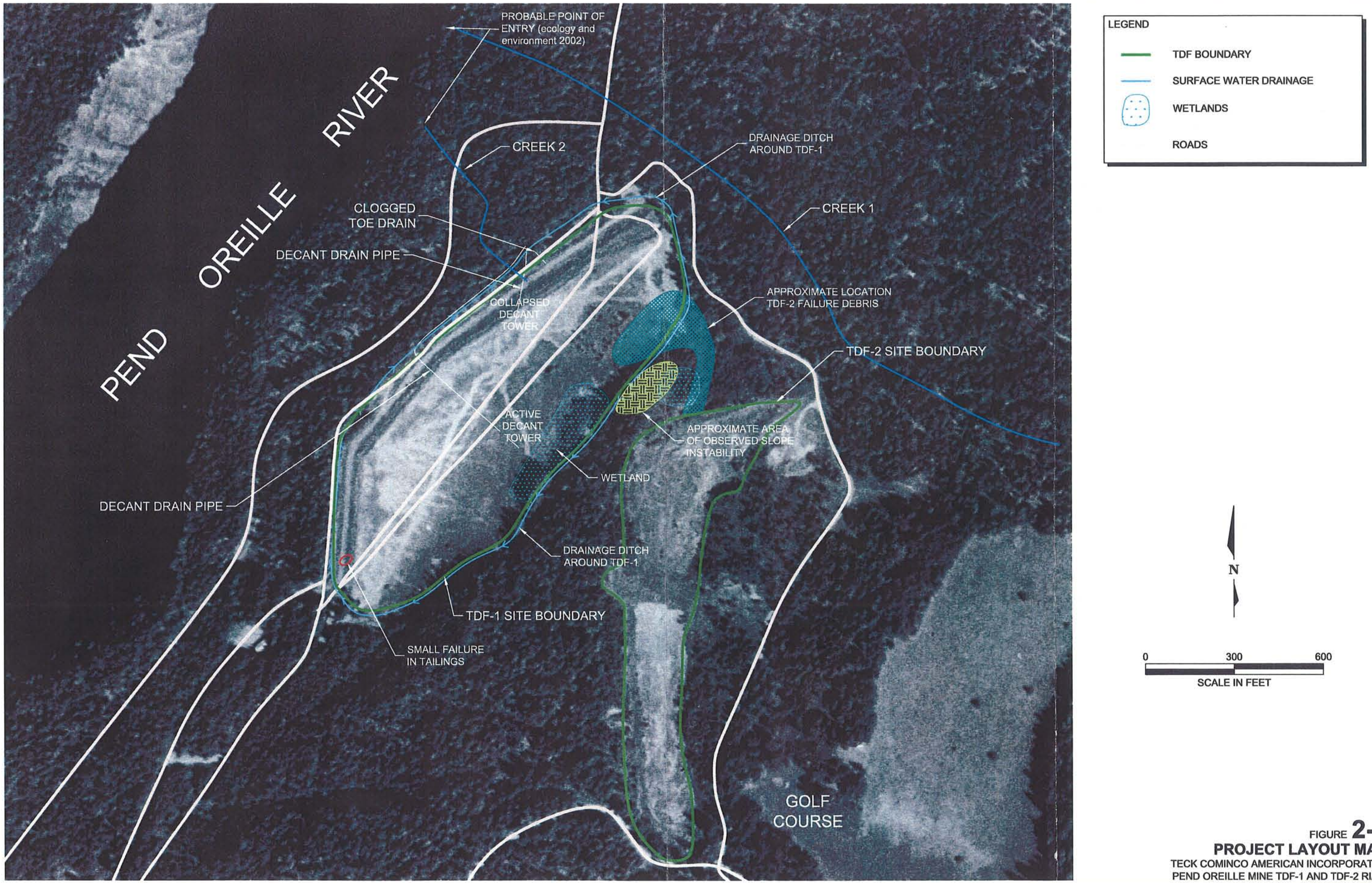


FIGURE **2-2**

PROJECT LAYOUT MAP

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

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Golder Associates

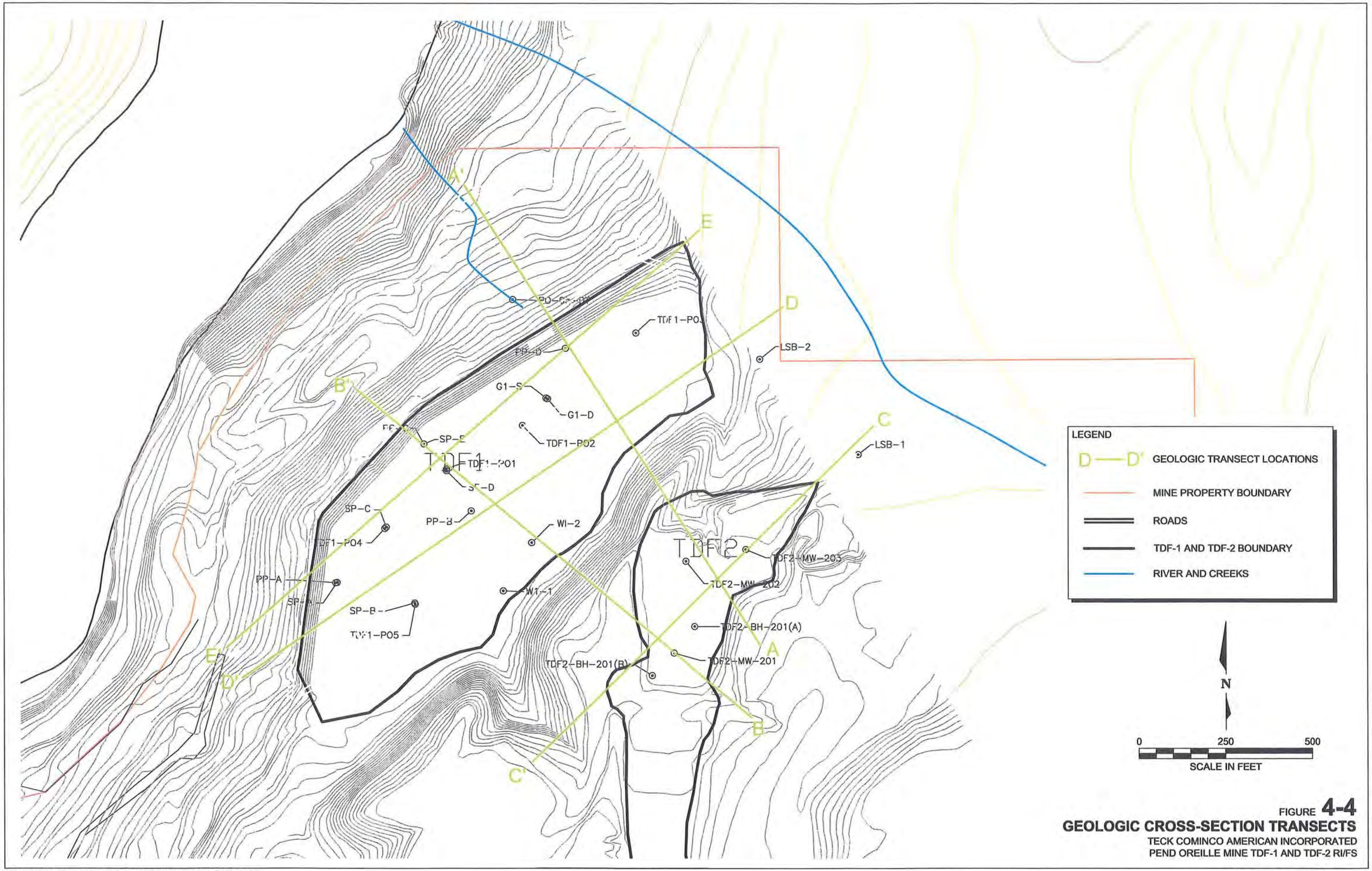


FIGURE **4-4**

GEOLOGIC CROSS-SECTION TRANSECTS

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

0431344516F01.dwg | Layout: Layout1 | Modified: 08/28/2006, 10:14 | Plotted: 10/06/2006, 09:47

Golder Associates

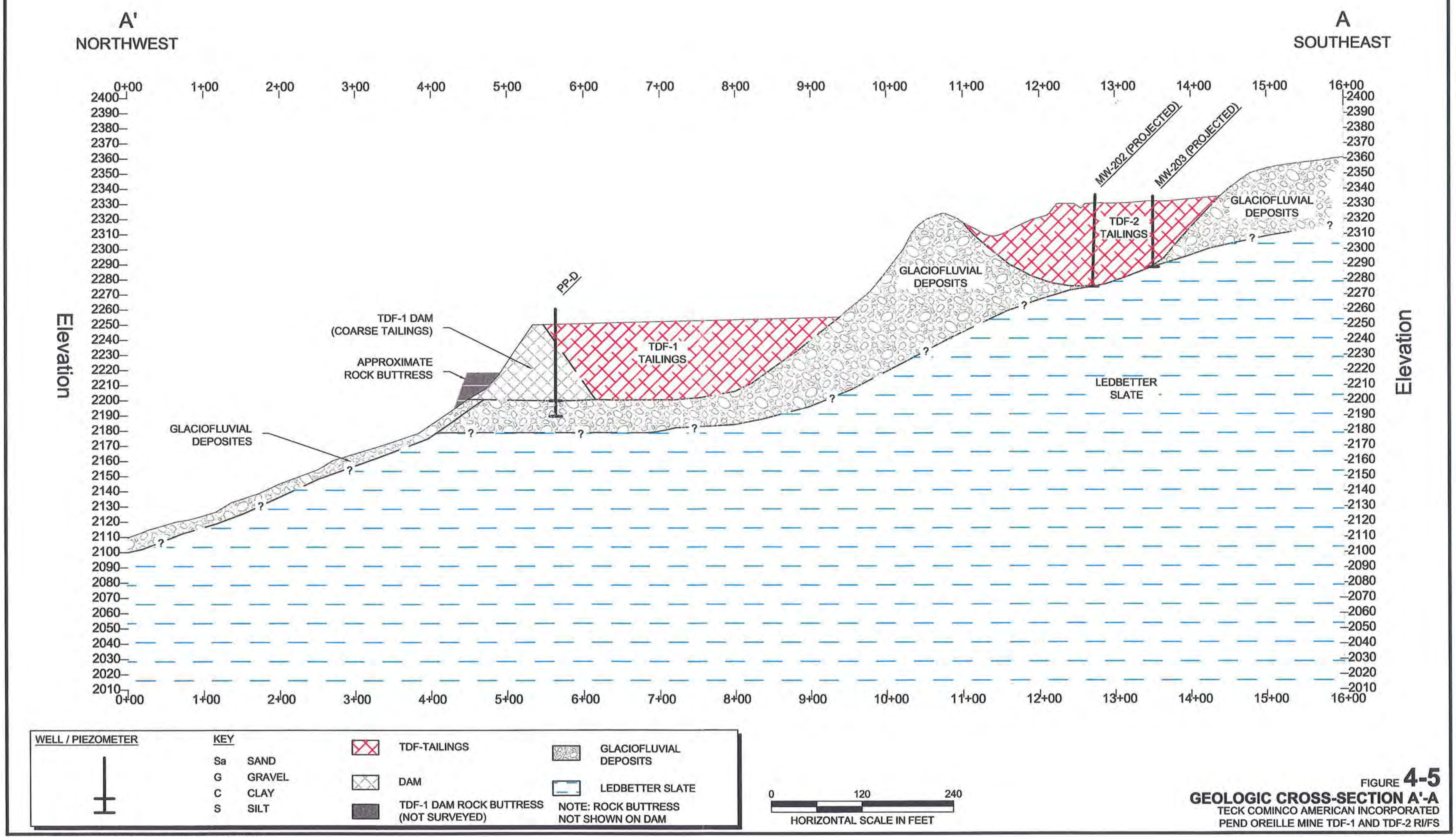


FIGURE **4-5**

GEOLOGIC CROSS-SECTION A'-A

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

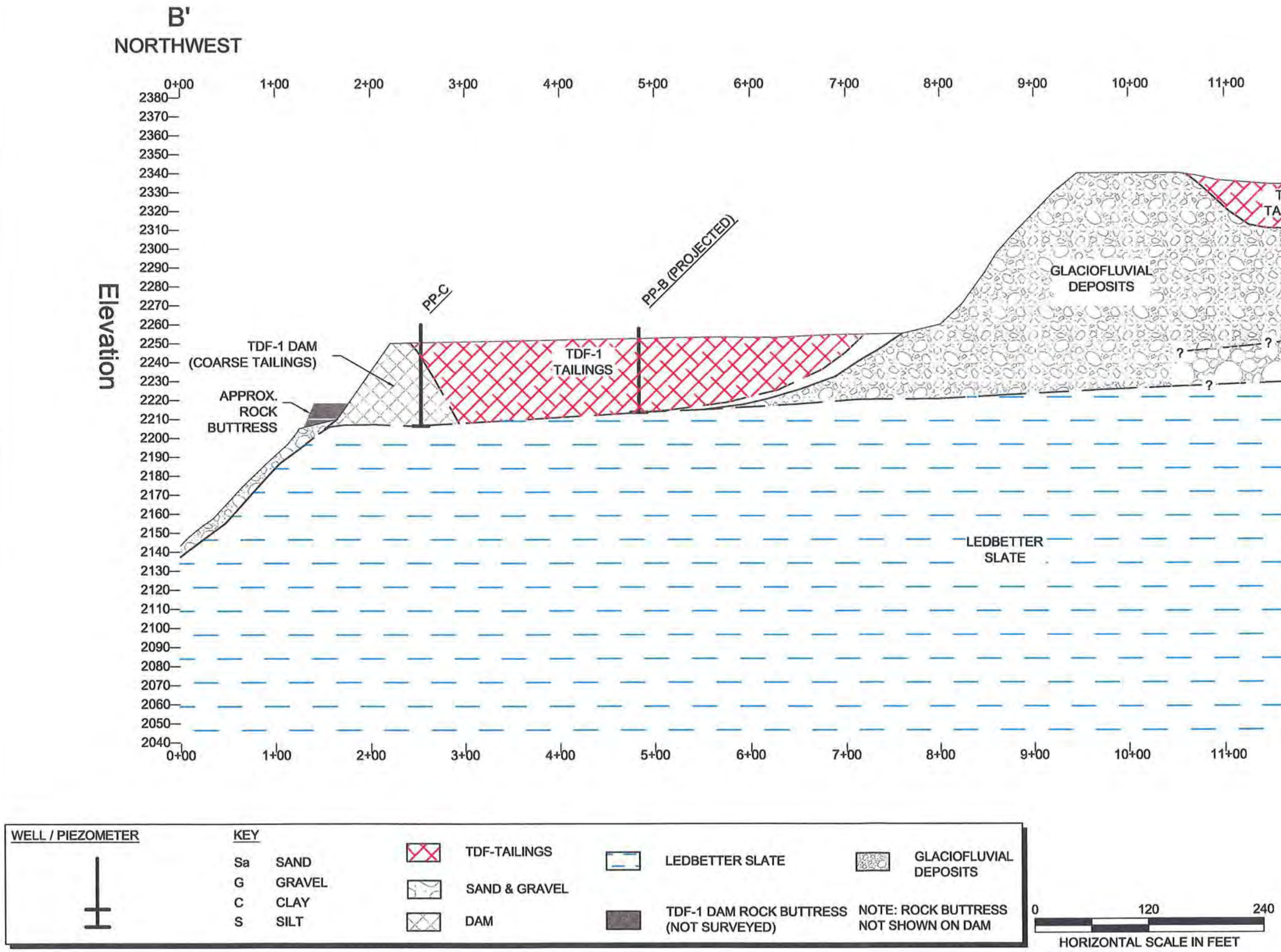
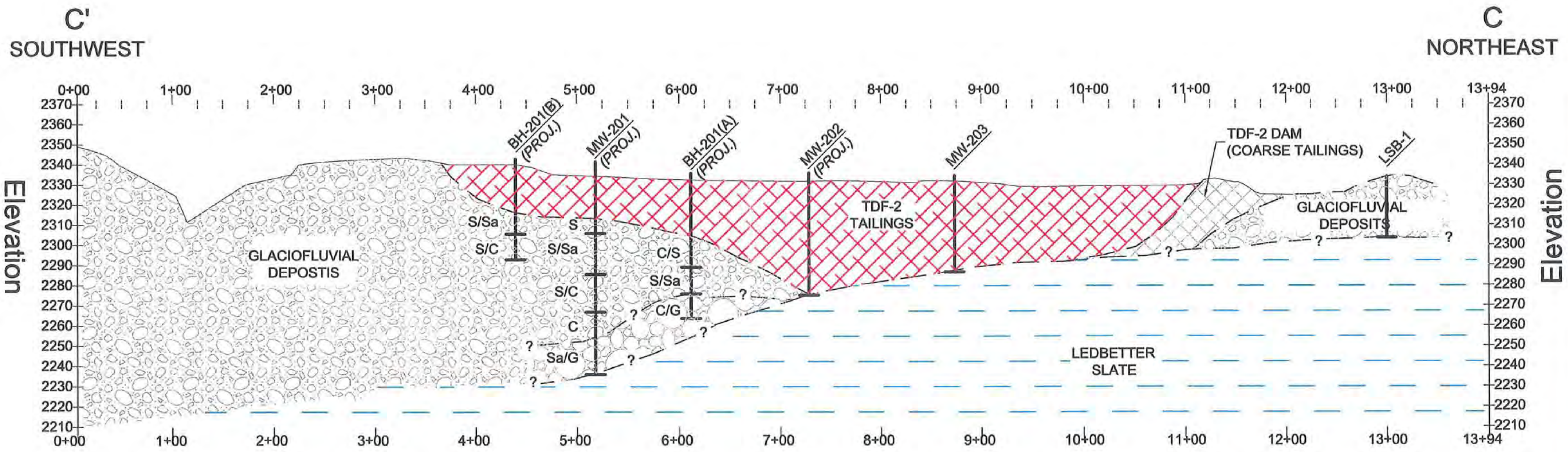


FIGURE **4-6**

GEOLOGIC CROSS-SECTION B'-B

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

Golder Associates



WELL / PIEZOMETER ⊥

KEY

Sa	SAND
G	GRAVEL
C	CLAY
S	SILT

☒	TDF-TAILINGS
☒	DAM
▨	SAND & GRAVEL
▨	GLACIOFLUVIAL DEPOSITS
▭	LEDBETTER SLATE

0 120 240
HORIZONTAL SCALE IN FEET

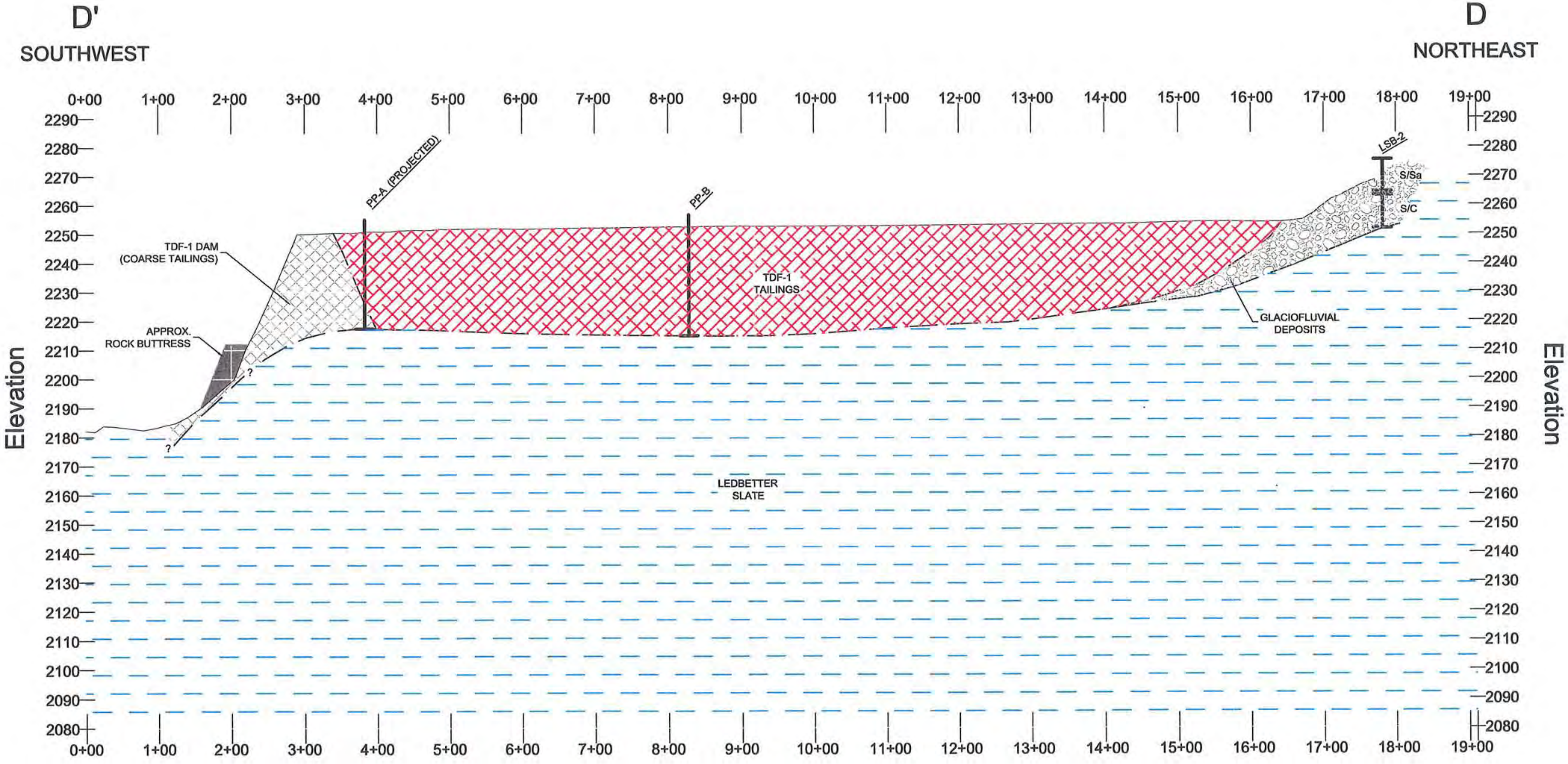
FIGURE **4-7**

GEOLOGIC CROSS-SECTION C'-C

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

Golder Associates

0431344516F11.dwg | Layout: C'-C | Modified: 10/05/2006, 15:41 | Plotted: 10/05/2006, 15:42



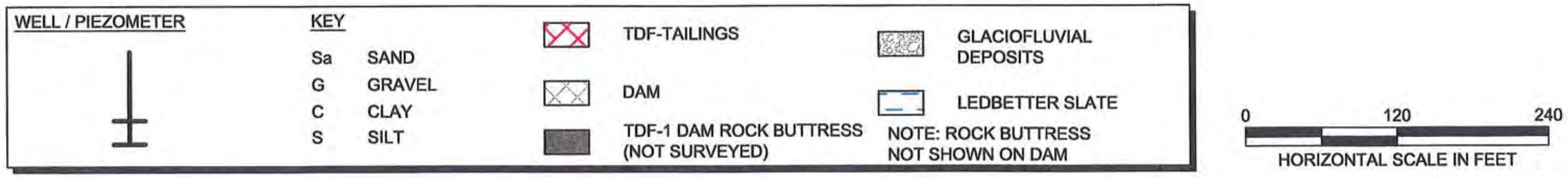


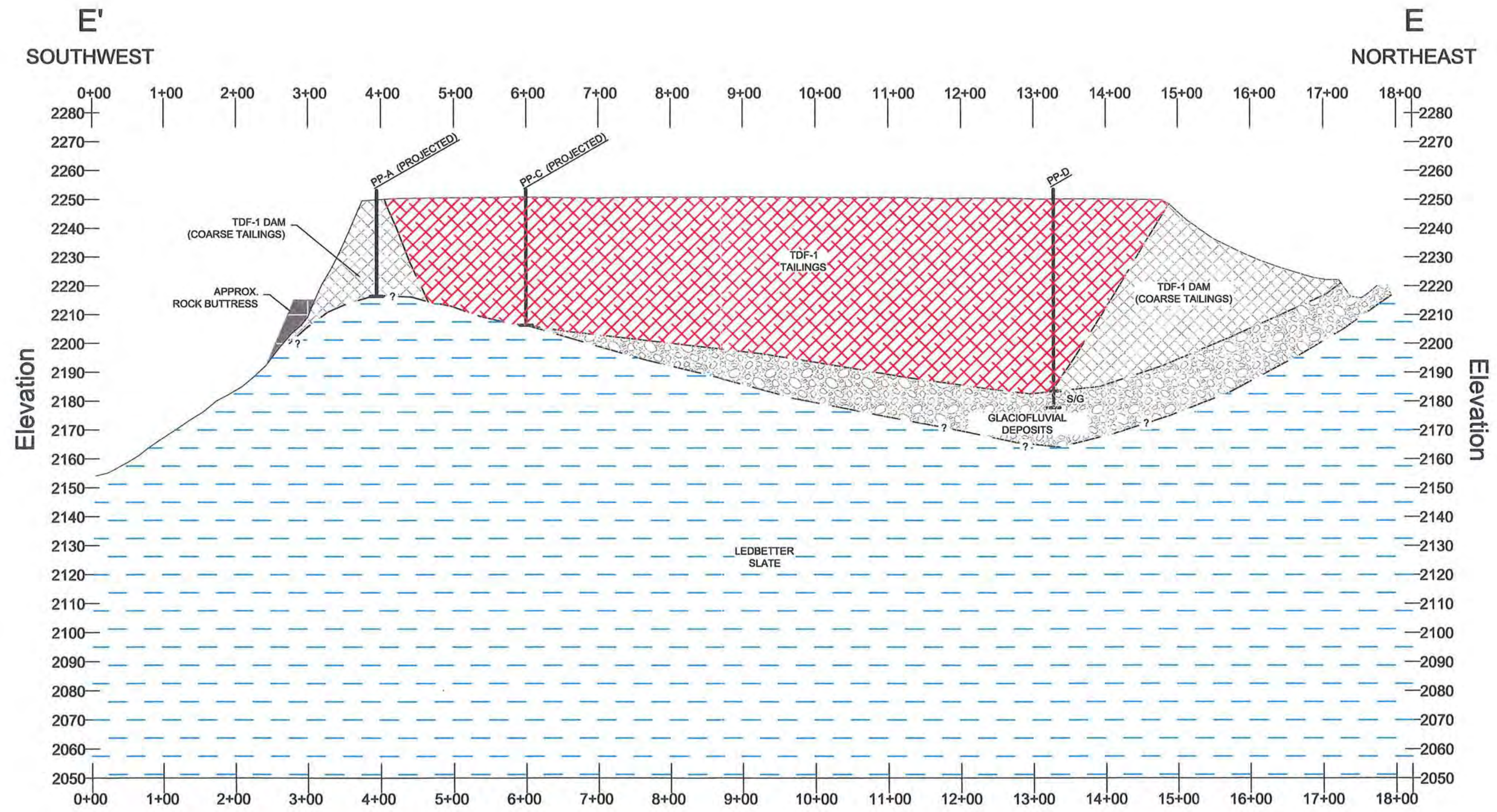
FIGURE **4-8**

GEOLOGIC CROSS-SECTION D'-D

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

Golder Associates

0431344516F11.dwg | Layout: D'-D | Modified: 10/05/2006, 15:41 | Plotted: 10/05/2006, 15:43



WELL / PIEZOMETER

KEY

Sa	SAND
G	GRAVEL
C	CLAY
S	SILT

☒ TDF-TAILINGS

☒ DAM

■ TDF-1 DAM ROCK BUTTRESS (NOT SURVEYED)

▨ GLACIOFLUVIAL DEPOSITS

▭ LEDBETTER SLATE

NOTE: ROCK BUTTRESS NOT SHOWN ON DAM

0 120 240
HORIZONTAL SCALE IN FEET

FIGURE **4-9**

GEOLOGIC CROSS-SECTION E'-E

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

0431344516F11.dwg | Layout: E'-E | Modified: 10/05/2006, 15:41 | Plotted: 10/05/2006, 15:43

Golder Associates

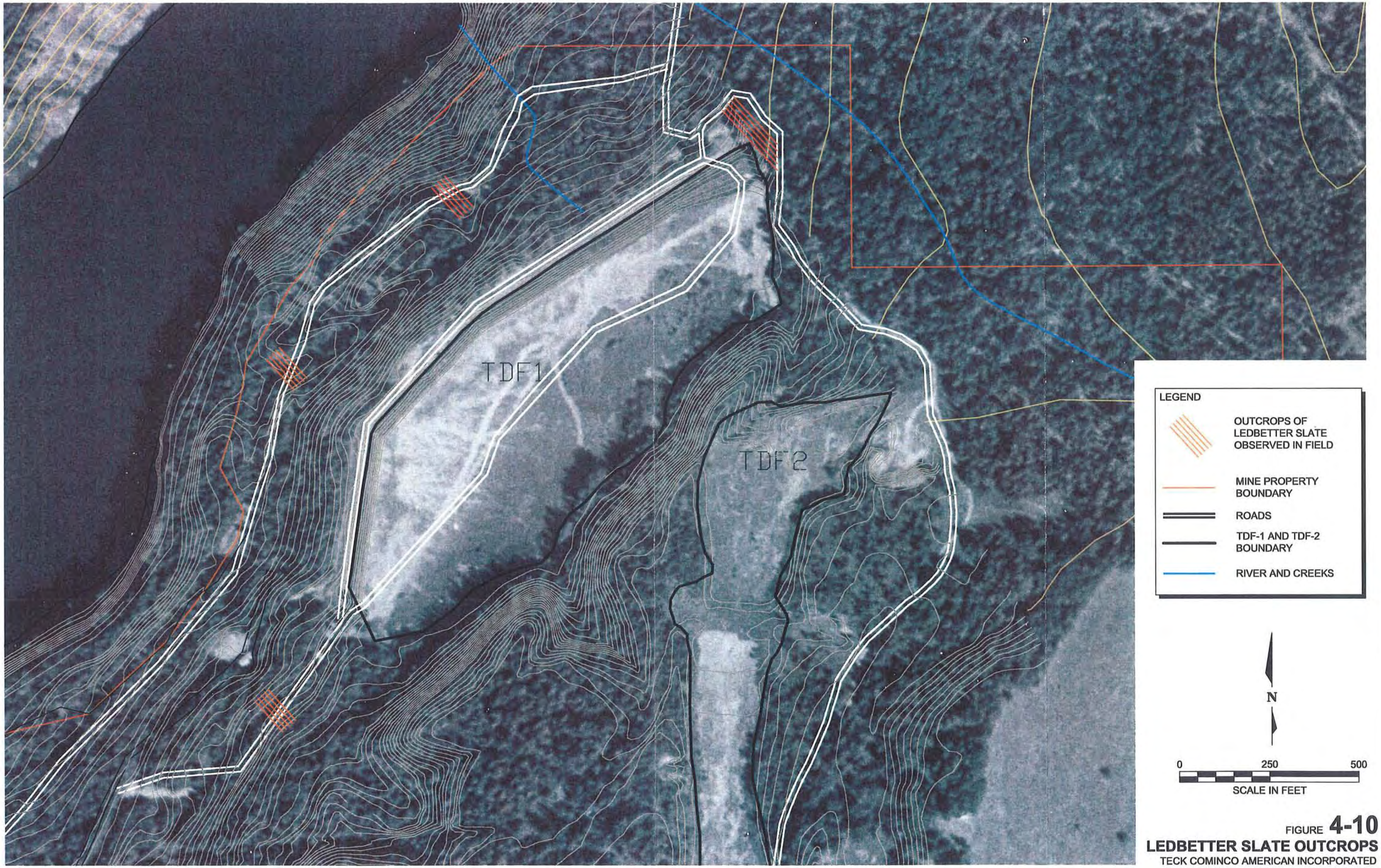
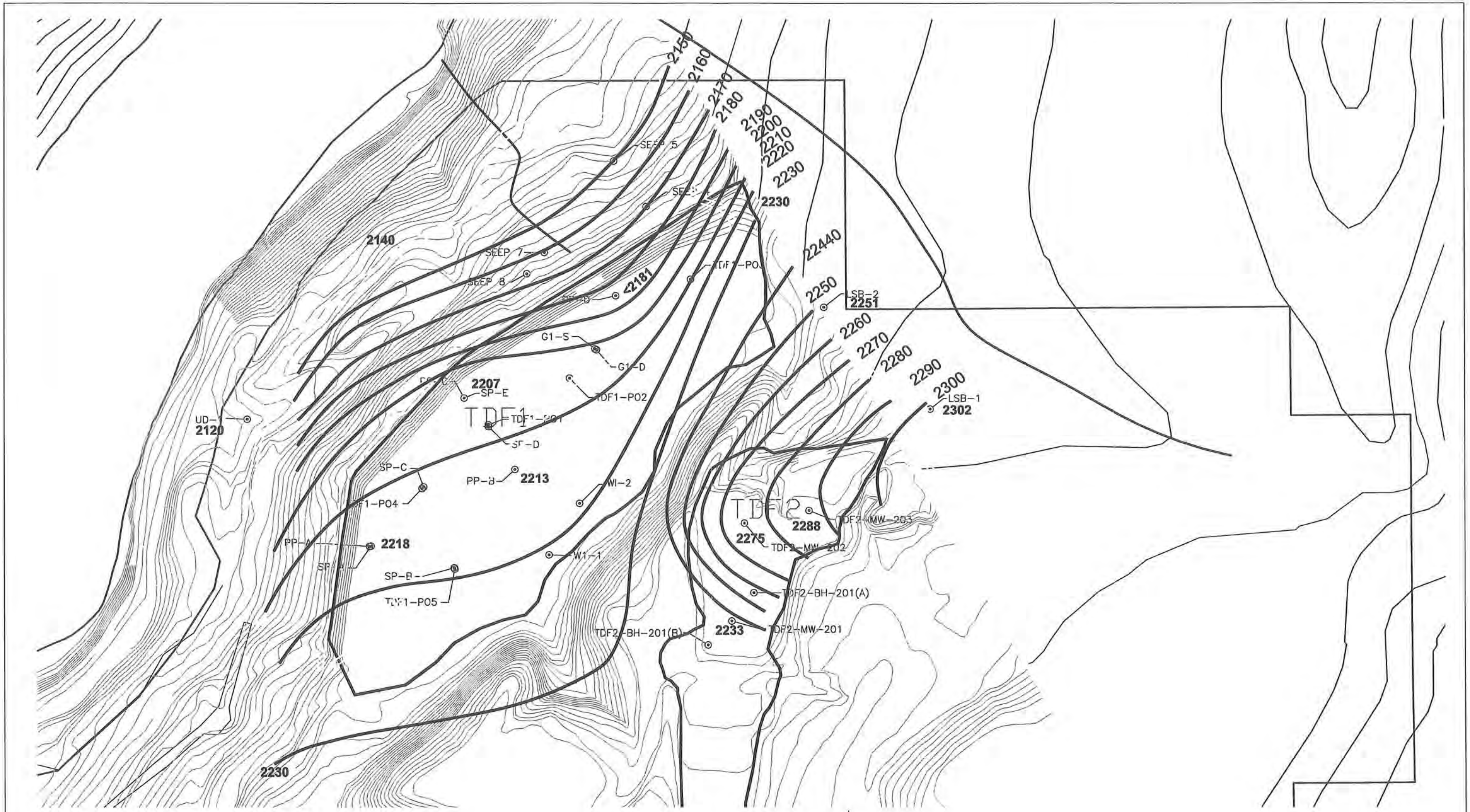


FIGURE **4-10**

LEDBETTER SLATE OUTCROPS

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS



LEGEND

—— 2250 LEDBETTER SLATE ELEVATION (FEET AMSL)

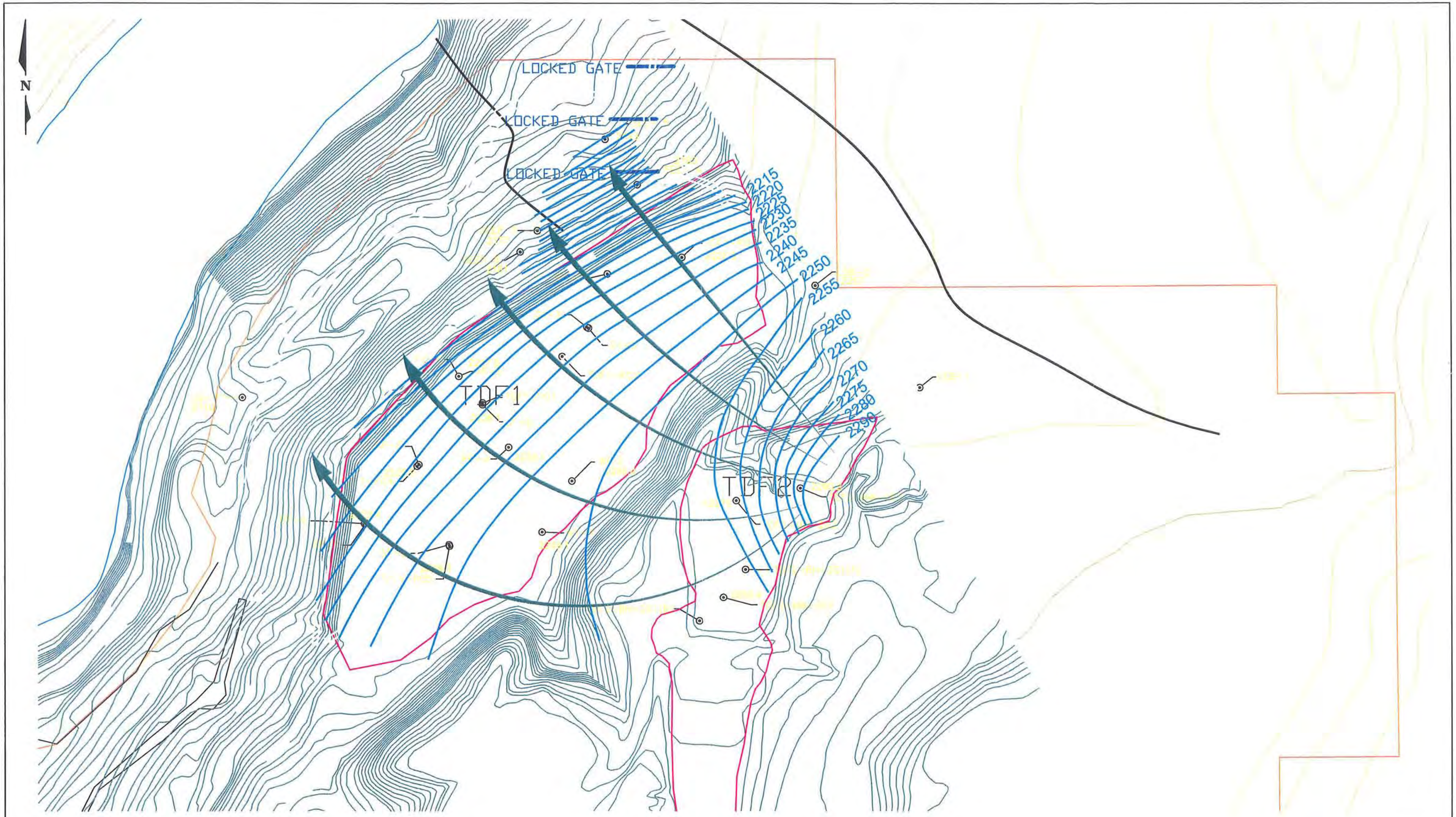
FIGURE **4-11**

LEDBETTER SLATE SURFACE ELEVATION MAP

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

0431344516F14.dwg | Layout: Aug'05 | Modified: 10/02/2006, 09:36 | Plotted: 10/05/2006, 15:44

Golder Associates



LEGEND

2255	GROUNDWATER POTENTIOMETRIC ISOPLETHS AND ELEVATION LABEL (AUGUST 2005)
	GROUND WATER FLOW DIRECTION

0 250 500
SCALE IN FEET

FIGURE **4-12**

GROUNDWATER POTENTIOMETRIC ISOPLETH MAP AUGUST 2005

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

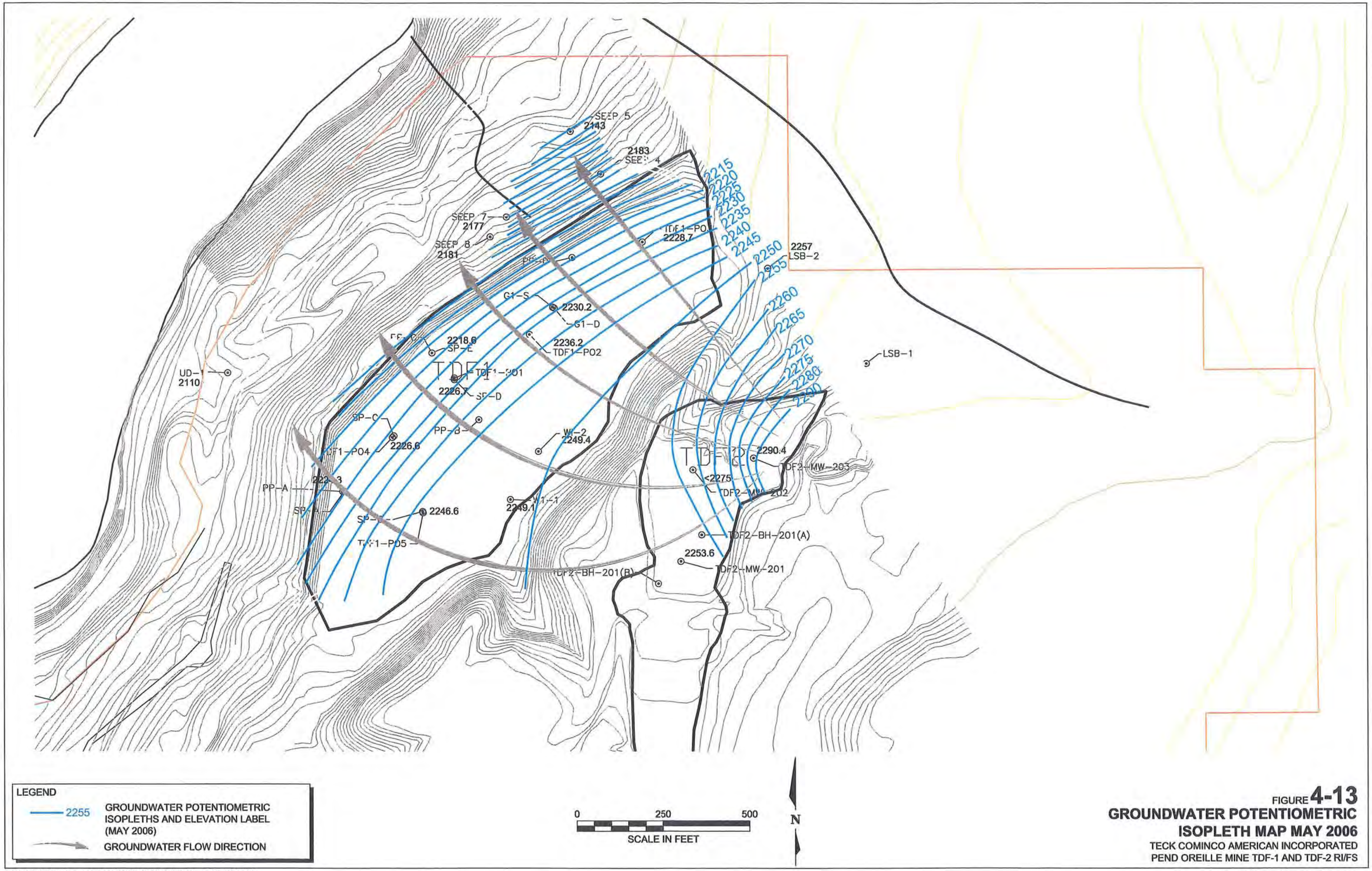


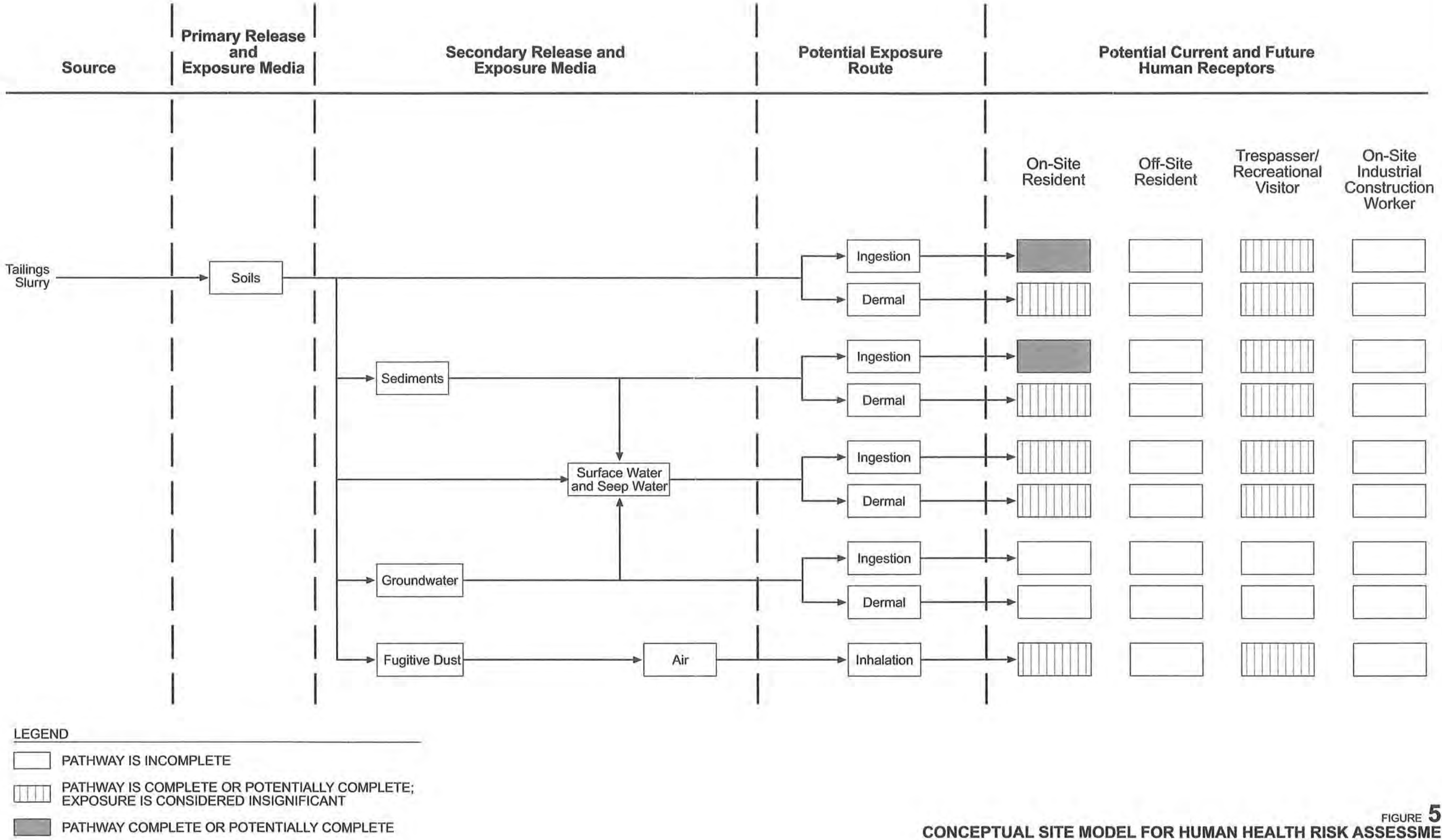
FIGURE **4-13**

GROUNDWATER POTENTIOMETRIC ISOPLETH MAP MAY 2006

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

0431344516F03.dwg | Layout: May'06 | Modified: 08/18/2006, 08:45 | Plotted: 08/18/2006, 08:47

Golder Associates



Secondary Release and Exposure Media	Potential Exposure Route	On-Site Resident	Off-Site Resident	Trespasser/ Recreational Visitor	On-Site Industrial Construction Worker
Soils	Ingestion	■	☐	▥	☐
	Dermal	▥	☐	▥	☐
Sediments	Ingestion	■	☐	▥	☐
	Dermal	▥	☐	▥	☐
Surface Water and Seep Water	Ingestion	▥	☐	▥	☐
	Dermal	▥	☐	▥	☐
Groundwater	Ingestion	☐	☐	☐	☐
	Dermal	☐	☐	☐	☐
Air	Inhalation	▥	☐	▥	☐

FIGURE **5-1**

CONCEPTUAL SITE MODEL FOR HUMAN HEALTH RISK ASSESSMENT

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

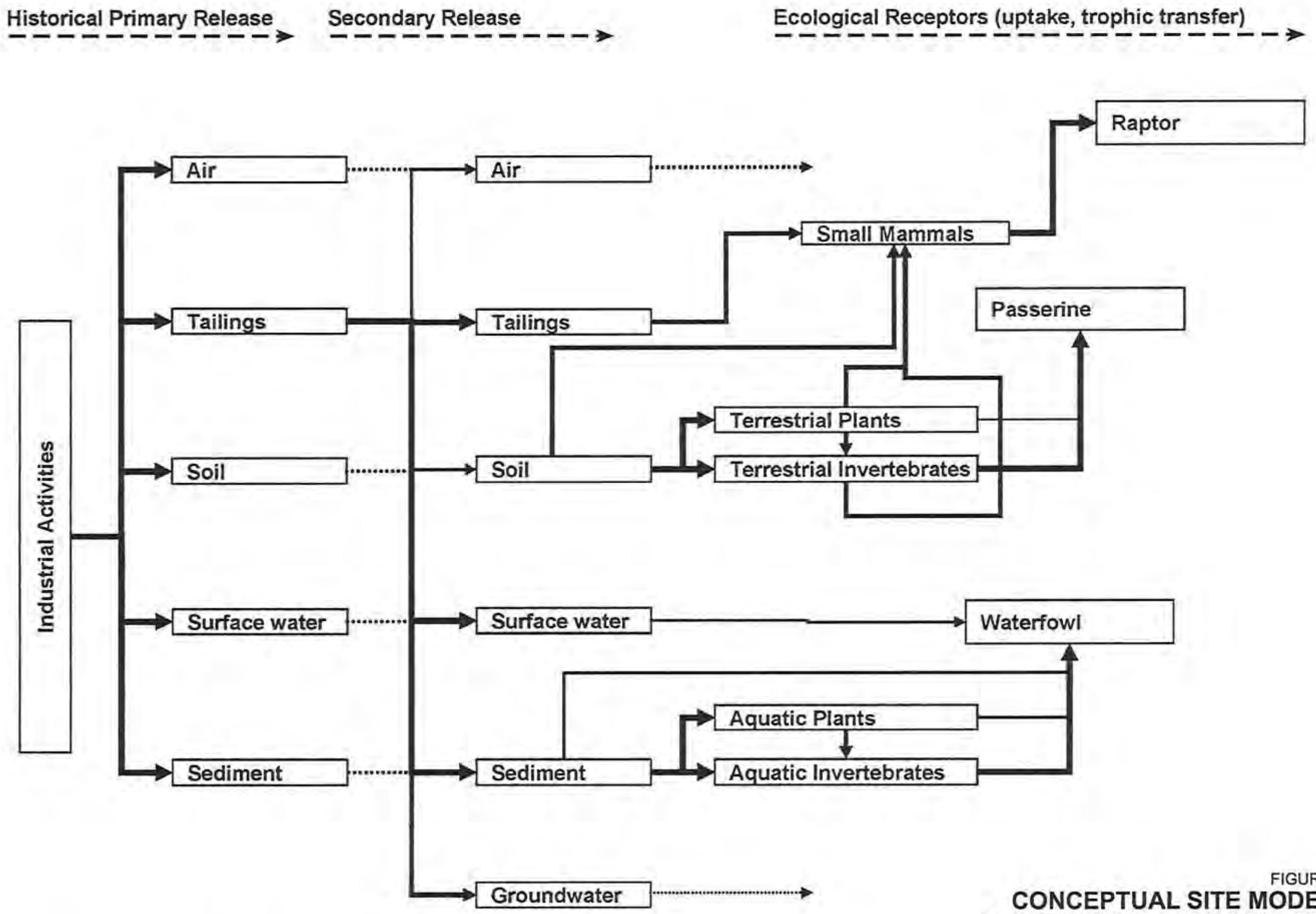


FIGURE **5-2**

CONCEPTUAL SITE MODEL FOR ECOLOGICAL RISK ASSESSMENT

TECK COMINCO AMERICAN INCORPORATED
PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

DRAWING NO. 04313445l6fg07.fh11 DATE 08/28/06 DRAWN BY JDD

Golder Associates

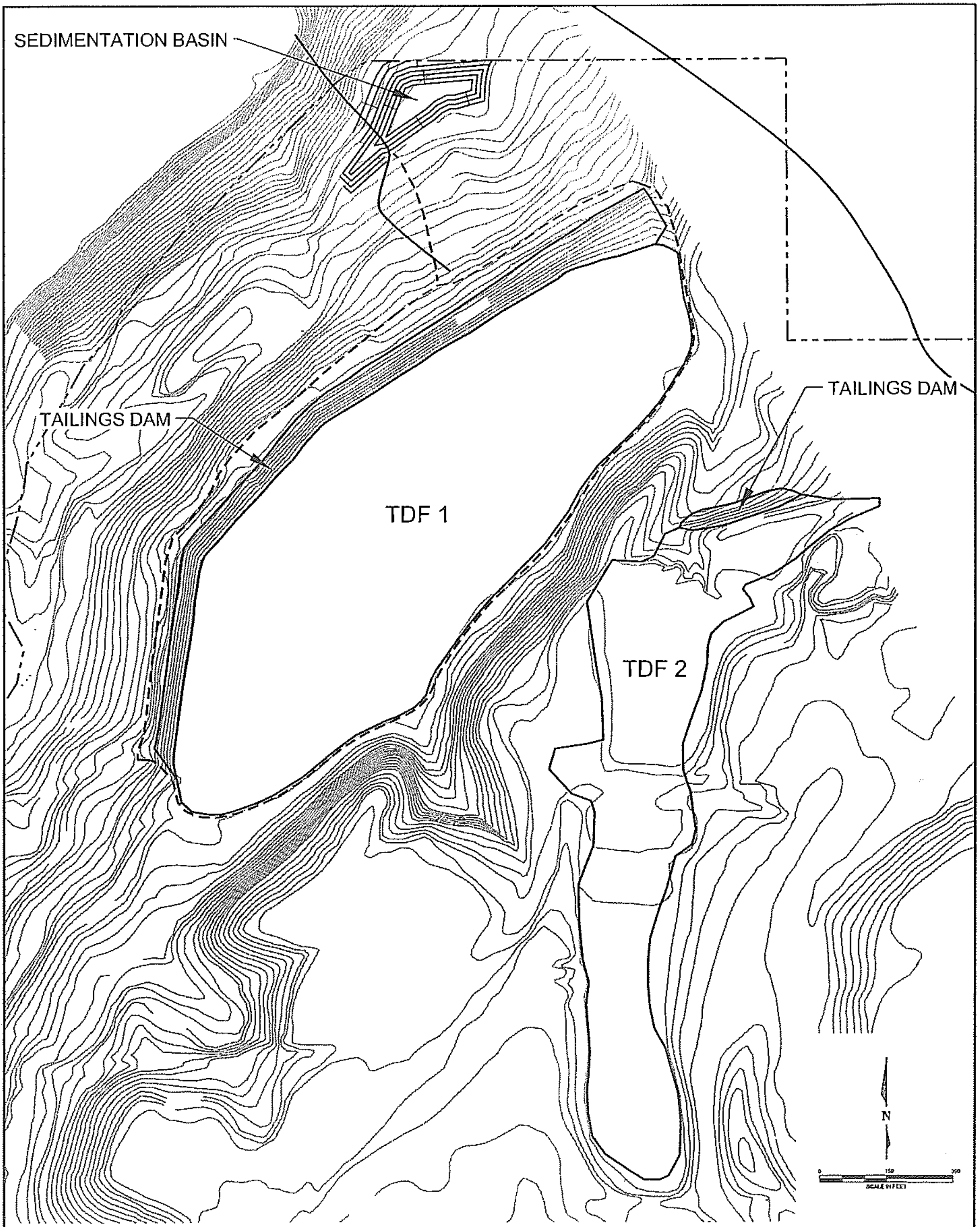


FIGURE 7-1

ALTERNATIVE 2: INSTITUTIONAL CONTROLS, SEDIMENT CAPTURE, AND MONITORING

TECK COMINCO AMERICAN INCORPORATED/PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

043_1344_302_F07_d3.dwg | Layout: Figure 1 | Modified: 10/25/2006, 09:59 | Plotted: 10/25/2006, 09:59

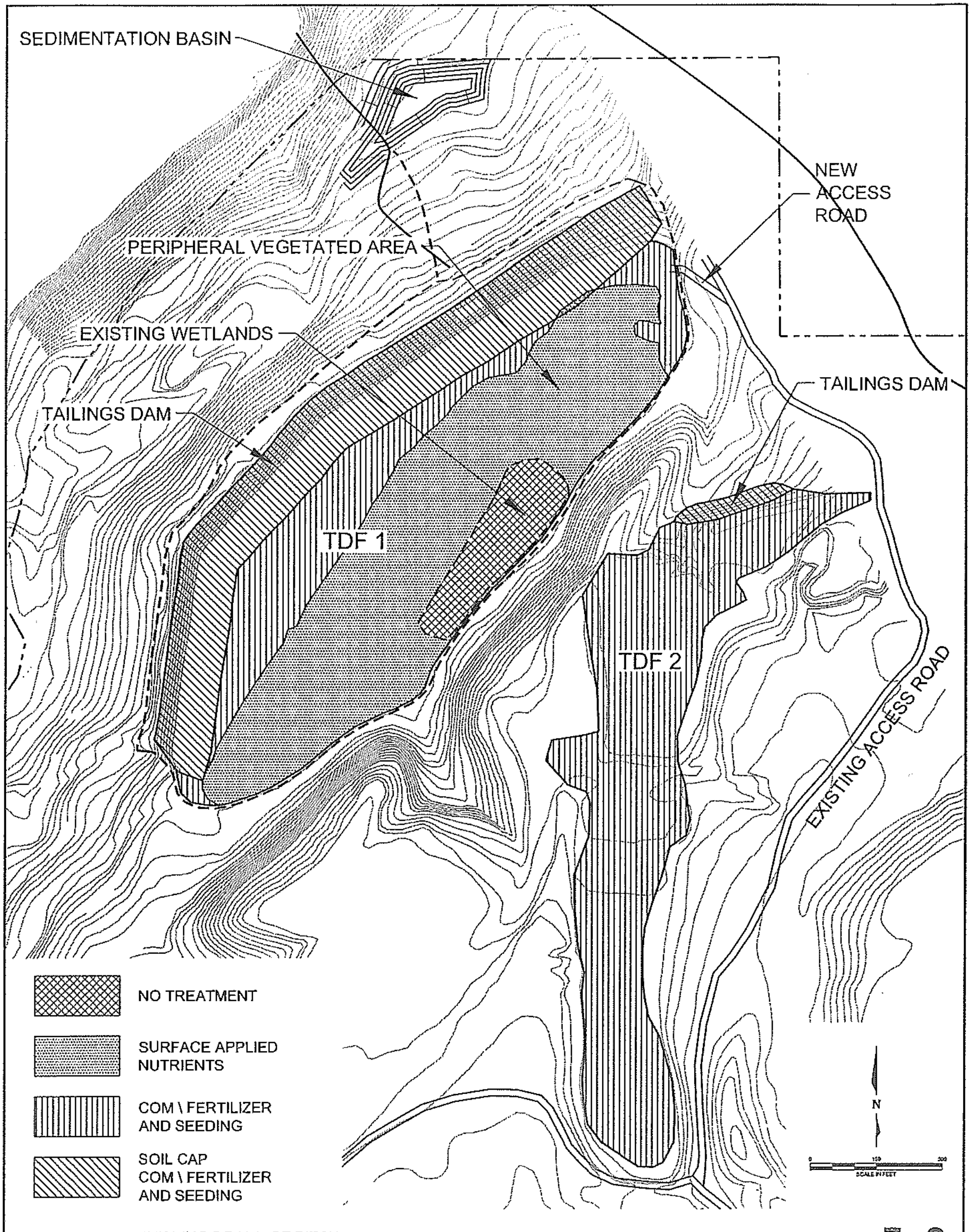


FIGURE 7- 2

ALTERNATIVE 3: TDF-1 SLOPE IMPROVEMENT (2.5H:1V) AND ACCELERATE RE-VEGETATION

TECK COMINCO AMERICAN INCORPORATED/PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

043_1344_302_F07_d3.dwg | Layout: Figure 2 | Modified: 10/25/2006, 09:59 | Plotted: 10/25/2006, 10:00

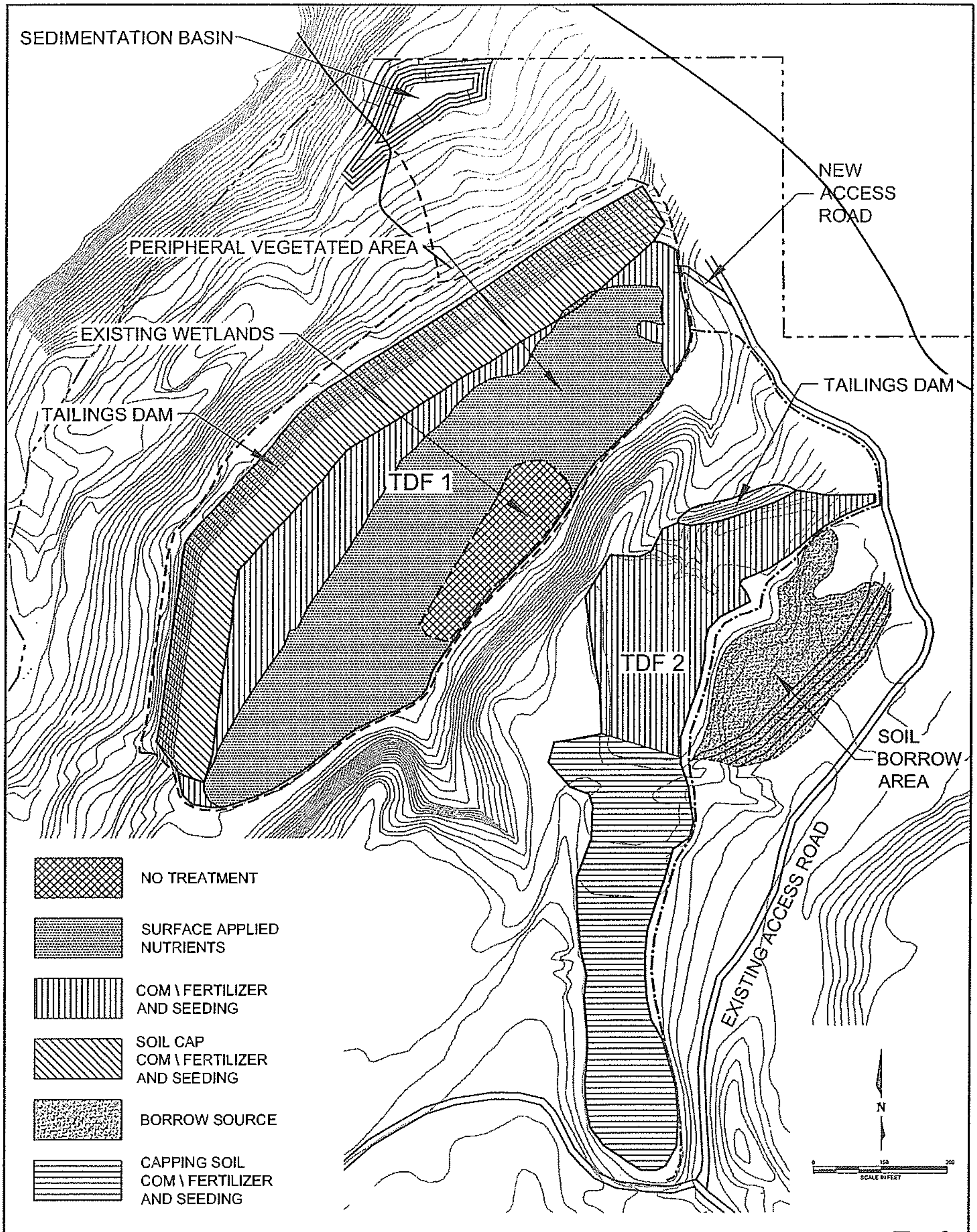


FIGURE **7-4**

ALTERNATIVE 4: TDF-1 SLOPE IMPROVEMENT (2.5H:1V), SOUTH HALF TDF-2 SOIL CAP, AND RE-VEGETATION

TECK COMINCO AMERICAN INCORPORATED/PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

043_1344_302_F07_d3.dwg | Layout: Figure 4 | Modified: 10/25/2006, 09:59 | Plotted: 10/25/2006, 10:00

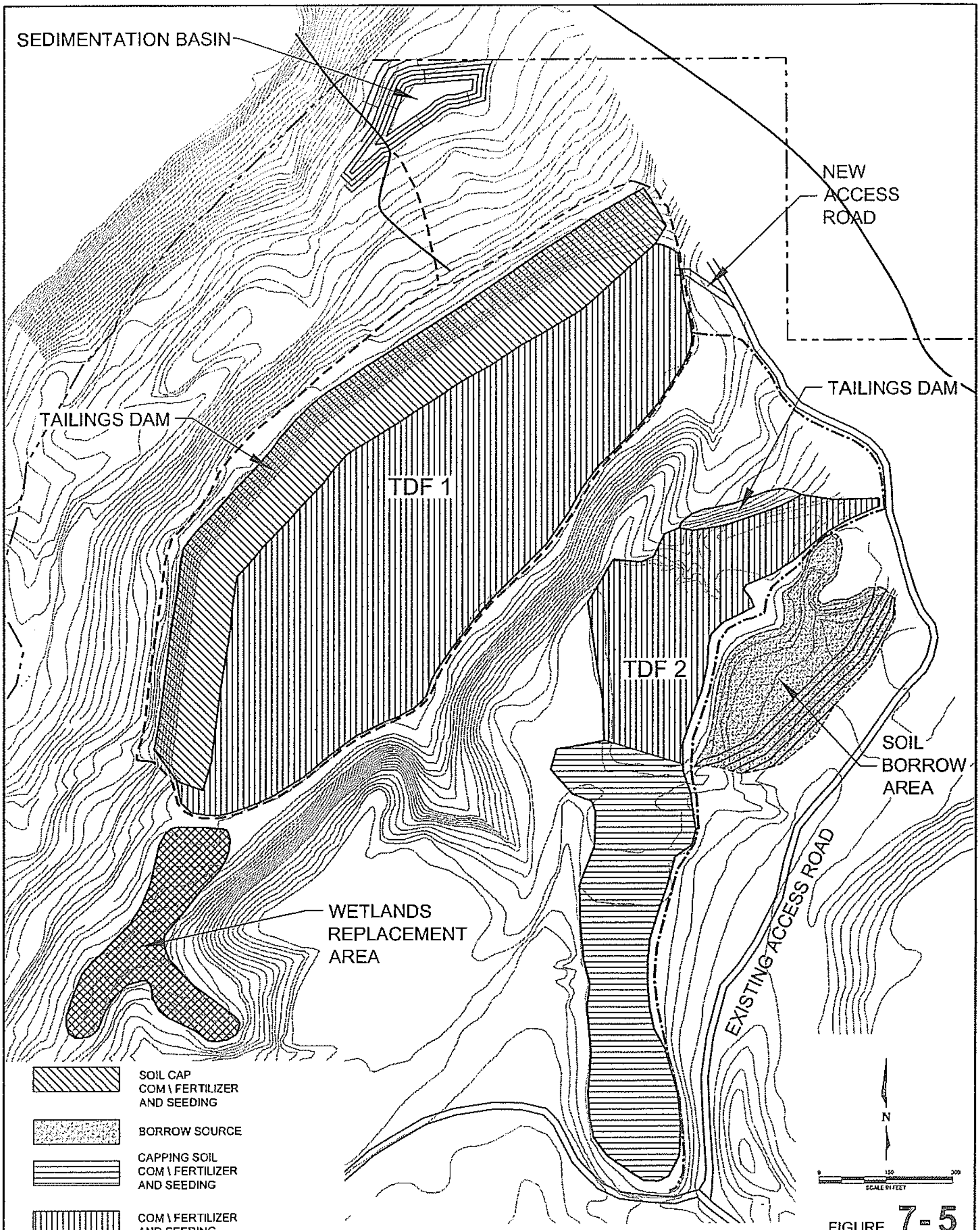


FIGURE 7-5

ALTERNATIVE 5:

TDF-1 SLOPE IMPROVEMENT (2.5H:1V), SOUTH HALF TDF-2 SOIL CAP, TDF-1 WETLAND MITIGATION, AND RE-VEGETATION

TECK COMINCO AMERICAN INCORPORATED/PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

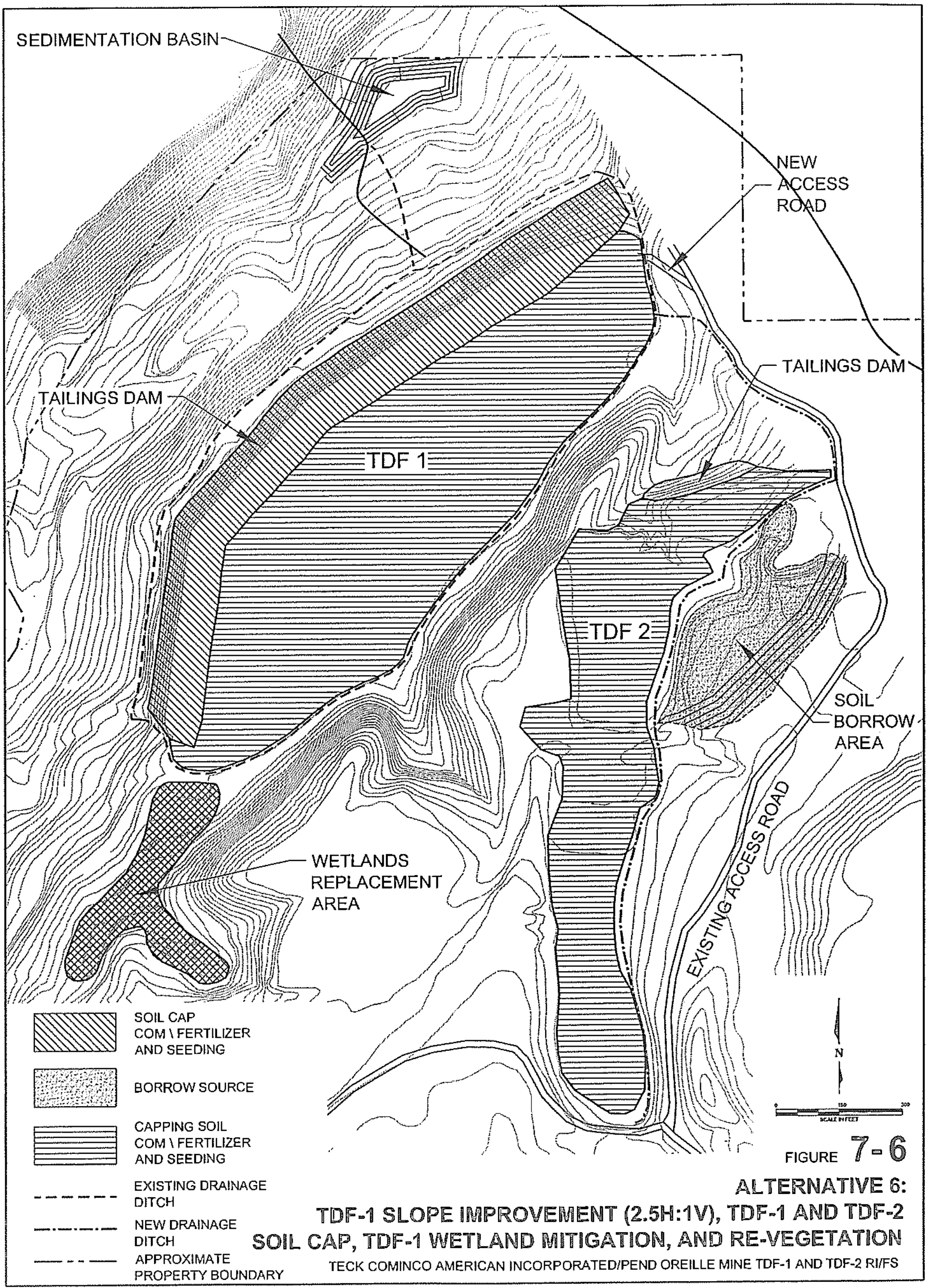


FIGURE **7-6**

ALTERNATIVE 6:
TDF-1 SLOPE IMPROVEMENT (2.5H:1V), TDF-1 AND TDF-2 SOIL CAP, TDF-1 WETLAND MITIGATION, AND RE-VEGETATION

TECK COMINCO AMERICAN INCORPORATED/PEND OREILLE MINE TDF-1 AND TDF-2 RI/FS

043_1344_302_F07_d3.dwg | Layout: Figure 6 | Modified: 10/25/2006, 09:59 | Plotted: 10/25/2006, 10:00

APPENDIX A

LABORATORY ANALYTICAL REPORTS (CD FORMAT)

SVL ANALYTICAL, INC.
One Government Gulch ▪ P.O. Box 929 ▪ Kellogg, Idaho 83837-0929 ▪ Phone: (208)784-1258 ▪ Fax: (208)783-0891

REPORT OF ANALYTICAL RESULTS

CLIENT : Golder Associates
PROJECT:

Sample Receipt: 8/16/05
Report Date: 8/29/05

Page 1 of 3
SVL JOB: 118402

SVL ID	CLIENT SAMPLE ID	Ag 200.7	As 200.8	Ba 200.7	Ca 200.7	Cd 200.8	Cr 200.7	Cu 200.8	Fe 200.7
W463735	PO-C2-2W ^T 8/10/05	***	***	***	***	***	***	***	***
W463736	PO-TDF1-S4 ^T 8/11/05	***	***	***	***	***	***	***	***
W463737	PO-TDF1-S1 ^T 8/11/05	***	***	***	***	***	***	***	***
W463738	PO-TDF1-S2 ^T 8/11/05	***	***	***	***	***	***	***	***
W463739	PO-TDF1-S3 ^T 8/11/05	***	***	***	***	***	***	***	***
W463740	PO-TDF1-S7 ^T 8/11/05	***	***	***	***	***	***	***	***
W463741	PO-TDF1-S8 ^T 8/11/05	***	***	***	***	***	***	***	***
W463742	PO-TDF1-S5 ^T 8/11/05	***	***	***	***	***	***	***	***
W463743	PO-C2-1W ^T 8/11/05	***	***	***	***	***	***	***	***
W463744	PO-W1-2W ^T 8/12/05	***	***	***	***	***	***	***	***
W463745	PO-W1-1W ^T 8/12/05	***	***	***	***	***	***	***	***
W463746	PO-UD-1W ^T 8/12/05	***	***	***	***	***	***	***	***
W463747	PO-C1-2W ^T 8/12/05	***	***	***	***	***	***	***	***
W463748	PO-C2-2W ^D 8/10/05	<0.0050mg/L	<0.0030mg/L	0.0603mg/L	99.2mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W463749	PO-TDF1-S4 ^D 8/11/05	<0.0050mg/L	0.00310mg/L	0.0603mg/L	184mg/L	0.00103mg/L	<0.0060mg/L	<0.0010mg/L	0.085mg/L
W463750	PO-TDF1-S1 ^D 8/11/05	<0.0050mg/L	<0.0030mg/L	0.0478mg/L	154mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W463751	PO-TDF1-S2 ^D 8/11/05	<0.0050mg/L	<0.0030mg/L	0.0575mg/L	95.9mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W463752	PO-TDF1-S3 ^D 8/11/05	<0.0050mg/L	<0.0030mg/L	0.0922mg/L	74.0mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W463753	PO-TDF1-S7 ^D 8/11/05	<0.0050mg/L	<0.0030mg/L	0.0605mg/L	106mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W463754	PO-TDF1-S8 ^D 8/11/05	<0.0050mg/L	<0.0030mg/L	0.139mg/L	201mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	0.083mg/L
W463755	PO-TDF1-S5 ^D 8/11/05	<0.0050mg/L	<0.0030mg/L	0.0811mg/L	154mg/L	0.00161mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W463756	PO-C2-1W ^D 8/11/05	<0.0050mg/L	<0.0030mg/L	0.0598mg/L	97.8mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W463757	PO-W1-2W ^D 8/12/05	<0.0050mg/L	<0.0030mg/L	0.0580mg/L	104mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W463758	PO-W1-1W ^D 8/12/05	<0.0050mg/L	<0.0030mg/L	0.0580mg/L	109mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W463759	PO-UD-1W ^D 8/12/05	<0.0050mg/L	<0.0030mg/L	0.0675mg/L	260mg/L	0.00042mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W463760	PO-C1-2W ^D 8/12/05	<0.0050mg/L	<0.0030mg/L	0.0655mg/L	114mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L

***: Not Requested

Certificate: WA C1268

Reviewed By: ______________________ Date: 8/29/05

CLIENT : Golder Associates
PROJECT:

Sample Receipt: 8/16/05
Report Date: 8/29/05

Page 2 of 3
SVL JOB: 118402

SVL ID	CLIENT SAMPLE ID	Mg 200.7	Mn 200.7	Pb 200.8	Se 200.8	Zn 200.7	Hg 245.1	C1 300.0	S04 300.0
W463735	PO-C2-2W ^T 8/10/05	***	***	***	***	***	***	3.05mg/L	134mg/L
W463736	PO-TDF1-S4 ^T 8/11/05	***	***	***	***	***	***	3.77mg/L	388mg/L
W463737	PO-TDF1-S1 ^T 8/11/05	***	***	***	***	***	***	3.58mg/L	433mg/L
W463738	PO-TDF1-S2 ^T 8/11/05	***	***	***	***	***	***	3.01mg/L	112mg/L
W463739	PO-TDF1-S3 ^T 8/11/05	***	***	***	***	***	***	3.39mg/L	71.5mg/L
W463740	PO-TDF1-S7 ^T 8/11/05	***	***	***	***	***	***	3.75mg/L	161mg/L
W463741	PO-TDF1-S8 ^T 8/11/05	***	***	***	***	***	***	3.40mg/L	595mg/L
W463742	PO-TDF1-S5 ^T 8/11/05	***	***	***	***	***	***	3.39mg/L	288mg/L
W463743	PO-C2-1W ^T 8/11/05	***	***	***	***	***	***	3.68mg/L	133mg/L
W463744	PO-W1-2W ^T 8/12/05	***	***	***	***	***	***	1.54mg/L	130mg/L
W463745	PO-W1-1W ^T 8/12/05	***	***	***	***	***	***	1.36mg/L	113mg/L
W463746	PO-UD-1W ^T 8/12/05	***	***	***	***	***	***	1.78mg/L	650mg/L
W463747	PO-C1-2W ^T 8/12/05	***	***	***	***	***	***	2.12mg/L	230mg/L
W463748	PO-C2-2W ^D 8/10/05	32.5mg/L	0.0076mg/L	<0.0030mg/L	<0.0030mg/L	0.024mg/L	<0.00020mg/L	***	***
W463749	PO-TDF1-S4 ^D 8/11/05	44.5mg/L	0.0375mg/L	0.0095mg/L	<0.0030mg/L	3.03mg/L	<0.00020mg/L	***	***
W463750	PO-TDF1-S1 ^D 8/11/05	68.8mg/L	0.103mg/L	<0.0030mg/L	<0.0030mg/L	0.745mg/L	<0.00020mg/L	***	***
W463751	PO-TDF1-S2 ^D 8/11/05	28.7mg/L	0.0127mg/L	<0.0030mg/L	<0.0030mg/L	0.012mg/L	<0.00020mg/L	***	***
W463752	PO-TDF1-S3 ^D 8/11/05	30.2mg/L	0.324mg/L	<0.0030mg/L	<0.0030mg/L	<0.010mg/L	<0.00020mg/L	***	***
W463753	PO-TDF1-S7 ^D 8/11/05	35.3mg/L	0.0811mg/L	<0.0030mg/L	<0.0030mg/L	0.606mg/L	<0.00020mg/L	***	***
W463754	PO-TDF1-S8 ^D 8/11/05	87.8mg/L	0.985mg/L	<0.0030mg/L	<0.0030mg/L	1.90mg/L	<0.00020mg/L	***	***
W463755	PO-TDF1-S5 ^D 8/11/05	38.0mg/L	0.0749mg/L	<0.0030mg/L	<0.0030mg/L	2.23mg/L	<0.00020mg/L	***	***
W463756	PO-C2-1W ^D 8/11/05	32.3mg/L	0.0171mg/L	<0.0030mg/L	<0.0030mg/L	0.025mg/L	<0.00020mg/L	***	***
W463757	PO-W1-2W ^D 8/12/05	30.0mg/L	0.0158mg/L	<0.0030mg/L	<0.0030mg/L	<0.010mg/L	<0.00020mg/L	***	***
W463758	PO-W1-1W ^D 8/12/05	31.4mg/L	0.151mg/L	<0.0030mg/L	<0.0030mg/L	0.020mg/L	<0.00020mg/L	***	***
W463759	PO-UD-1W ^D 8/12/05	60.8mg/L	0.0624mg/L	<0.0030mg/L	<0.0030mg/L	2.05mg/L	<0.00020mg/L	***	***
W463760	PO-C1-2W ^D 8/12/05	32.6mg/L	<0.0040mg/L	<0.0030mg/L	<0.0030mg/L	<0.010mg/L	<0.00020mg/L	***	***

***: Not Requested

Certificate: WA C1268
Reviewed By: ______________ Date: 8/29/05

CLIENT : Golder Associates
PROJECT:

Sample Receipt: 8/16/05
Report Date: 8/29/05

SVL JOB: 118402

SVL ID	CLIENT SAMPLE ID	ALK 2320B
W463735	PO-C2-2W ^T 8/10/05	251mg/L
W463736	PO-TDF1-S4 ^T 8/11/05	260mg/L
W463737	PO-TDF1-S1 ^T 8/11/05	251mg/L
W463738	PO-TDF1-S2 ^T 8/11/05	259mg/L
W463739	PO-TDF1-S3 ^T 8/11/05	251mg/L
W463740	PO-TDF1-S7 ^T 8/11/05	257mg/L
W463741	PO-TDF1-S8 ^T 8/11/05	300mg/L
W463742	PO-TDF1-S5 ^T 8/11/05	269mg/L
W463743	PO-C2-1W ^T 8/11/05	258mg/L
W463744	PO-W1-2W ^T 8/12/05	262mg/L
W463745	PO-W1-1W ^T 8/12/05	302mg/L
W463746	PO-UD-1W ^T 8/12/05	260mg/L
W463747	PO-C1-2W ^T 8/12/05	257mg/L
W463748	PO-C2-2W ^D 8/10/05	***
W463749	PO-TDF1-S4 ^D 8/11/05	***
W463750	PO-TDF1-S1 ^D 8/11/05	***
W463751	PO-TDF1-S2 ^D 8/11/05	***
W463752	PO-TDF1-S3 ^D 8/11/05	***
W463753	PO-TDF1-S7 ^D 8/11/05	***
W463754	PO-TDF1-S8 ^D 8/11/05	***
W463755	PO-TDF1-S5 ^D 8/11/05	***
W463756	PO-C2-1W ^D 8/11/05	***
W463757	PO-W1-2W ^D 8/12/05	***
W463758	PO-W1-1W ^D 8/12/05	***
W463759	PO-UD-1W ^D 8/12/05	***
W463760	PO-C1-2W ^D 8/12/05	***

***: Not Requested

Certificate: WA C1268
Reviewed By: ____________ Date: 8/29/05

Quality Control Report
Part I Prep Blank and Laboratory Control Sample

Client :Golder Associates

SVL JOB No: 118402

Analyte	Method	Matrix	Units	Prep Blank	True—LCS	—Found	LCS %R	Analysis Date
Silver	200.7	WATER	mg/L	<0.0050	0.0500	0.0519	103.8	8/26/05
Arsenic	200.8	WATER	mg/L	<0.0030	0.0250	0.0282	112.8	8/28/05
Barium	200.7	WATER	mg/L	<0.0020	1.00	0.979	97.9	8/26/05
Calcium	200.7	WATER	mg/L	<0.040	20.0	20.0	100.0	8/26/05
Cadmium	200.8	WATER	mg/L	<0.00020	0.0250	0.0267	106.8	8/28/05
Chromium	200.7	WATER	mg/L	<0.0060	1.00	1.02	102.0	8/26/05
Copper	200.8	WATER	mg/L	<0.0010	0.0250	0.0273	109.2	8/28/05
Iron	200.7	WATER	mg/L	<0.060	10.0	10.2	102.0	8/26/05
Magnesium	200.7	WATER	mg/L	<0.060	20.0	19.7	98.5	8/26/05
Manganese	200.7	WATER	mg/L	<0.0040	1.00	1.00	100.0	8/26/05
Lead	200.8	WATER	mg/L	<0.0030	0.0250	0.0255	102.0	8/28/05
Selenium	200.8	WATER	mg/L	<0.0030	0.0250	0.0278	111.2	8/28/05
Zinc	200.7	WATER	mg/L	<0.010	1.00	1.03	103.0	8/26/05
Mercury	245.1	WATER	mg/L	<0.00020	0.00500	0.00548	109.6	8/22/05
Chloride	300.0	WATER	mg/L	<0.20	4.96	4.78	96.4	8/25/05
Sulfate, SO4	300.0	WATER	mg/L	<0.30	9.97	9.79	98.2	8/25/05
ALKALINITY	2320B	WATER	mg/L	<1.0	56.4	55.9	99.1	8/19/05

LEGEND:

LCS = Laboratory Control Sample

LCS %R = LCS Percent Recovery

N/A = Not Applicable

SVL ANALYTICAL, INC.

Quality Control Report
Part II Duplicate and Spike Analysis

Client :Golder Associates SVL JOB No: 118402

Test	Method	Mtx	QC SAMPLE ID			Duplicate or MSD		Matrix Spike			Analysis
				Units	Result	Found	RPD%	Result	SPK ADD	%R	Date
Ag	200.7	W	1	mg/L	<0.0050	<0.0050	UDL	0.0528	0.0500	105.6	8/26/05
Ag	200.7	W	2	mg/L	<0.0050	N/A	N/A	0.0530	0.0500	106.0	8/26/05
As	200.8	W	1	mg/L	<0.0030	<0.0030	UDL	0.0280	0.0250	112.0	8/28/05
As	200.8	W	2	mg/L	<0.0030	N/A	N/A	0.0284	0.0250	113.6	8/28/05
Ba	200.7	W	1	mg/L	0.0603	0.0601	0.3	1.03	1.00	97.0	8/26/05
Ba	200.7	W	2	mg/L	0.0580	N/A	N/A	1.01	1.00	95.2	8/26/05
Ca	200.7	W	1	mg/L	99.2	97.2	2.0	115	20.0	79.0	8/26/05
Ca	200.7	W	2	mg/L	109	N/A	N/A	125	20.0	80.0	8/26/05
Cd	200.8	W	1	mg/L	<0.00020	<0.00020	UDL	0.0263	0.0250	105.2	8/28/05
Cd	200.8	W	2	mg/L	<0.00020	N/A	N/A	0.0256	0.0250	102.4	8/28/05
Cr	200.7	W	1	mg/L	<0.0060	<0.0060	UDL	1.01	1.00	101.0	8/26/05
Cr	200.7	W	2	mg/L	<0.0060	N/A	N/A	1.00	1.00	100.0	8/26/05
Cu	200.8	W	1	mg/L	<0.0010	<0.0010	UDL	0.0245	0.0250	98.0	8/28/05
Cu	200.8	W	2	mg/L	<0.0010	N/A	N/A	0.0248	0.0250	99.2	8/28/05
Fe	200.7	W	1	mg/L	<0.060	<0.060	UDL	9.96	10.0	99.6	8/26/05
Fe	200.7	W	2	mg/L	<0.060	N/A	N/A	9.98	10.0	99.8	8/26/05
Mg	200.7	W	1	mg/L	32.5	31.4	3.4	50.2	20.0	88.5	8/26/05
Mg	200.7	W	2	mg/L	31.4	N/A	N/A	49.9	20.0	92.5	8/26/05
Mn	200.7	W	1	mg/L	0.0076	0.0086	12.3	0.986	1.00	97.8	8/26/05
Mn	200.7	W	2	mg/L	0.151	N/A	N/A	1.13	1.00	97.9	8/27/05
Pb	200.8	W	1	mg/L	<0.0030	<0.0030	UDL	0.0249	0.0250	99.6	8/28/05
Pb	200.8	W	2	mg/L	<0.0030	N/A	N/A	0.0250	0.0250	100.0	8/28/05
Se	200.8	W	1	mg/L	<0.0030	<0.0030	UDL	0.0287	0.0250	114.8	8/28/05
Se	200.8	W	2	mg/L	<0.0030	N/A	N/A	0.0289	0.0250	115.6	8/28/05
Zn	200.7	W	1	mg/L	0.024	0.023	4.3	1.00	1.00	97.6	8/26/05
Zn	200.7	W	2	mg/L	0.020	N/A	N/A	0.988	1.00	96.8	8/26/05
Hg	245.1	W	1	mg/L	<0.00020	<0.00020	UDL	0.00106	0.0010	106.0	8/22/05
Hg	245.1	W	2	mg/L	<0.00020	N/A	N/A	0.00116	0.0010	116.0	8/22/05
Cl	300.0	W	3	mg/L	3.05	3.00	1.7	5.41	2.00	118.0	8/26/05
Cl	300.0	W	4	mg/L	1.36	N/A	N/A	3.76	2.00	120.0	8/26/05
SO4	300.0	W	3	mg/L	134	133	0.7	184	50.0	100.0	8/25/05
SO4	300.0	W	4	mg/L	113	N/A	N/A	163	50.0	100.0	8/25/05
ALK	2320B	W	3	mg/L	251	252	0.4	N/A	N/A	N/A	8/19/05

LEGEND:

RPD% = (|SAM - DUP|/((SAM + DUP)/2) * 100) UDL = Both SAM & DUP not detected. *Result or *Found: Interference required dilution.

RPD% = (|SPK - MSD|/((SPK + MSD)/2) * 100) M in Duplicate/MSD column indicates MSD.

SPIKE ADD column, A = Post Digest Spike; %R = Percent Recovery N/A = Not Analyzed; R > 4S = Result more than 4X the Spike Added

QC limits for MS recoveries apply only if the spike is at least 1/4 the concentration of the analyte in the sample.

Control limits for the RPD apply only if the concentration of the analyte in the sample is at least five times the reporting limit.

QC Sample 1:	SVL SAM No.: 463748	Client Sample ID: PO-C2-2W	^D
QC Sample 2:	SVL SAM No.: 463758	Client Sample ID: PO-W1-1W	^D
QC Sample 3:	SVL SAM No.: 463735	Client Sample ID: PO-C2-2W	^T
QC Sample 4:	SVL SAM No.: 463745	Client Sample ID: PO-W1-1W	^T

8/29/05 15:34

SVL ANALYTICAL

CHAIN OF COUSTODY RECORD

Page 1 of 2

Client: GOLDER ASSOCIATES
Contact: Doug Morell
Address: 18300 NE Union Hill Rd #209
Redmond, WA 98052
Phone Number: (425) 883-0777
FAX Number: 882-5498

NOTES:
1) Ensure proper container packaging.
2) Ship samples promptly following collection.
* 3) Designate Sample Reject Disposition
PO#:
Project Name: Teck Cominco RI/FS

Table 1. -- Matrix Type
1 = Surface Water, 2 = Ground Water
3 = Soil/Sediment, 4 = Rinsate, 5 = Oil
6 = Waste, 7 = Other (Specify) ________

Samplers Signature:

FOR SVL USE ONLY
SVL JOB #
118402

Lab Name: SVL Analytical, Inc. (208) 784-1258 FAX (208) 783-0891
Address: One Government Gulch, Kellogg, ID 83837-0929

	Collection		Miscellaneous				Preservative(s)						Analyses Required			
Sample ID	Date	Time	Collected by: (Init.)	Matrix Type From Table 1	No. of Containers	Sample Filtered ? Y/N	Unpreserved (Ice Only)	HNO3	HCL	H2SO4	NAOH	Other (Specify)	Dissolved Metals	Anions	Metals Ca, Mg	Comments
– 1. PO-C2-2W(10/08/05)	8/10/05	14:40	PVM	1	2	Y	X	X					X	X	As, Ba, Cd, Cr, Pb,	Hg, Se, Ag, Zn, Cu, Fe,
2. PO-TDF1-S4(11/08/05)	8/11/05	9:00	↓	2	↓	↓	↓	↓					↓	↓		
3. PO-TDF1-S1(11/08/05)	8/11/05	10:40	↓	2	↓	↓	↓	↓					↓	↓	ANIONS:	SO4, Cl, Alkali
4. PO-TDF1-S2(11/08/05)	8/11/05	10:50	↓	2	↓	↓	↓	↓					↓	↓		
5. PO-TDF1-S3(11/08/05)	8/11/05	11:00	↓	2	↓	↓	↓	↓					↓	↓		
6. PO-TDF1-S7(11/08/05)	8/11/05	11:30	↓	2	↓	↓	↓	↓					↓	↓		
7. PO-TDF1-S8(11/08/05)	8/11/05	12:30	↓	2	↓	↓	↓	↓					↓	↓		
* 8. PO-TDF1-S5(11/08/05)	8/11/05	14:30	↓	2	↓	↓	↓	↓					↓	↓		
– 9. PO-C2-1W(11/08/05)	8/11/05	15:30	↓	1	↓	↓	↓	↓					↓	↓		
– 10. PO-W1-2W(12/08/05)	8/12/05	9:00	↓	1	↓	↓	↓	↓					↓	↓		

* Bottle reads PO-TDF1-S5W 8/15/05 JSD

Relinquished by: Pal VanMiddlesworth	Date: 8/14/05	Time: 16:00	Received by: Alyssa Douglas	Date: 8/15/05	Time: 8:00AM
Relinquished by: Alyssa Douglas	Date: 8/15/05	Time: 10:35	Received by: CDA 8/15/05 1035/D.dardin	Date: 8/15/05	Time:

* Sample Reject: [ ] Return [ ] Dispose [ ] Store (30 Days)

White: LAB COPY Yellow: CUSTOMER COPY SVL-COC 12/95

CHAIN OF CUSTODY RECORD

Page 2 of 2

Client: GOLDER ASSOCIATES
Contact: Doug Morell
Address: 18300 NE Union Hill Rd. #200
Redmond, WA 98052
Phone Number: (425) 883-0777
FAX Number: 882-5498

NOTES:
1) Ensure proper container packaging.
2) Ship samples promptly following collection.
* 3) Designate Sample Reject Disposition
PO#:
Project Name: Teck Cominco RI/FS

Table 1. -- Matrix Type
1 = Surface Water, 2 = Ground Water
3 = Soil/Sediment, 4 = Rinsate, 5 = Oil
6 = Waste, 7 = Other (Specify) ________

FOR SVL USE ONLY
SVL JOB # 118402

Samplers Signature:

Lab Name: SVL Analytical, Inc. (208) 784-1258 FAX (208) 783-0891
Address: One Government Gulch, Kellogg, ID 83837-0929

Sample ID	Collection		Miscellaneous				Preservative(s)						Analyses Required									Comments
	Date	Time	Collected by: (Init.)	Matrix Type From Table 1	No. of Containers	Sample Filtered ? Y/N	Unpreserved (Ice Only)	HNO3	HCL	H2SO4	NAOH	Other (Specify)	Dissolved Metals	Anions								
1. PO-W1-1W(12/08/05)	8/12/05	10:30	PVM	1	2	Y	X	X					X	X								
2. PO-UD-1W(12/08/05)	8/12/05	11:30	↓	↓	↓	↓	↓	↓					↓	↓								
3. PO-C1-2W(12/08/05)	8/12/05	13:00	↓	↓	↓	↓	↓	↓					↓	↓								
4.																						
5.																						
6.																						
7.																						
8.																						
9.																						
10.																						

Relinquished by:	Date: 8/14/05	Time: 16:00	Received by: Alyssa Douglas	Date: 8/15/05	Time: 8:00 AM
Relinquished by: Alyssa Douglas	Date: 8/15/05	Time: 10:35	Received by: Juliann CDA 8/15/05 1035/[illegible]	Date: 8/15/05	Time:

* Sample Reject: [ ] Return [ ] Dispose [ ] Store (30 Days)

White: LAB COPY Yellow: CUSTOMER COPY

SVL ANALYTICAL, INC.
One Government Gulch ▪ P.O. Box 929 ▪ Kellogg, Idaho 83827-0929 ▪ Phone: (208)784-1258 ▪ Fax: (208)783-0891

REPORT OF ANALYTICAL RESULTS

CLIENT : Golder Associates
PROJECT:

Sample Receipt: 8/16/05
Report Date: 8/30/05

Page 1 of 2
SVL JOB: 118401

			As	Ba	Cd	Cu	Pb
SVL ID	CLIENT SAMPLE ID		6010B	6010B	6010B	6010B	6010B
S463726	PO-C2-2S	8/10/05	8.6mg/kg	52.9mg/kg	4.36mg/kg	14.1mg/kg	247mg/kg
S463727	PO-C2-1S	8/11/05	7.6mg/kg	54.8mg/kg	3.62mg/kg	18.5mg/kg	232mg/kg
S463728	PO-W1-2S	8/12/05	6.0mg/kg	44.8mg/kg	7.44mg/kg	48.7mg/kg	328mg/kg
S463729	PO-W1-1S	8/12/05	3.6mg/kg	44.7mg/kg	5.20mg/kg	36.8mg/kg	212mg/kg
S463730	PO-UD-1S	8/12/05	<2.5mg/kg	29.1mg/kg	1.58mg/kg	22.4mg/kg	64.9mg/kg
S463731	PO-C1-2S	8/12/05	<2.5mg/kg	28.0mg/kg	2.13mg/kg	8.3mg/kg	45.9mg/kg
S463732	PO-TDF1-S5-S	8/11/05	<2.5mg/kg	129mg/kg	2.58mg/kg	4.1mg/kg	32.5mg/kg

Soil Samples: As Received Basis

WA C1268

Reviewed By: Date: 8/30/05

RECEIVED
SEP 2 2005
Golder Associates

CLIENT : Golder Associates
PROJECT:

Sample Receipt: 8/16/05
Report Date: 8/30/05

Page 2 of 2
SVL JOB: 118401

			Se	Zn	Hg	% Sol.
SVL ID	CLIENT SAMPLE ID		6010B	6010B	7471A	999
S463726	PO-C2-2S	8/10/05	<4.0mg/kg	1050mg/kg	0.0767mg/kg	59.3%
S463727	PO-C2-1S	8/11/05	<4.0mg/kg	892mg/kg	0.0633mg/kg	47.5%
S463728	PO-W1-2S	8/12/05	<4.0mg/kg	1730mg/kg	0.152mg/kg	62.6%
S463729	PO-W1-1S	8/12/05	<4.0mg/kg	1270mg/kg	0.168mg/kg	41.9%
S463730	PO-UD-1S	8/12/05	<4.0mg/kg	197mg/kg	0.0550mg/kg	25.8%
S463731	PO-C1-2S	8/12/05	<4.0mg/kg	155mg/kg	<0.0330mg/kg	49.5%
S463732	PO-TDF1-S5-S	8/11/05	<4.0mg/kg	254mg/kg	<0.0330mg/kg	18.0%

Soil Samples: As Received Basis

Certificate: WA C1268

Reviewed By: ______________ Date: 8/30/05

SVL ANALYTICAL, INC.

Quality Control Report
Part I Prep Blank and Laboratory Control Sample

Client :Golder Associates

SVL JOB No: 118401

Analyte	Method	Matrix	Units	Prep Blank	True—LCS	—Found	LCS %R	Analysis Date
Arsenic	6010B	SOIL	mg/kg	<2.50	100	97.8	97.8	8/29/05
Barium	6010B	SOIL	mg/kg	<0.20	100	95.3	95.3	8/29/05
Cadmium	6010B	SOIL	mg/kg	<0.20	100	98.5	98.5	8/29/05
Copper	6010B	SOIL	mg/kg	<1.0	100	96.6	96.6	8/29/05
Lead	6010B	SOIL	mg/kg	<0.750	100	102	102.0	8/29/05
Selenium	6010B	SOIL	mg/kg	<4.0	100	94.6	94.6	8/29/05
Zinc	6010B	SOIL	mg/kg	<1.0	100	97.3	97.3	8/29/05
Mercury	7471A	SOIL	mg/kg	<0.0330	0.834	0.874	104.8	8/17/05

LEGEND:

LCS = Laboratory Control Sample LCS %R = LCS Percent Recovery N/A = Not Applicable

8/30/05 14:18

SVL ANALYTICAL, INC.

Quality Control Report
Part II Duplicate and Spike Analysis

Client :Golder Associates

SVL JOB No: 118401

Test	Method	Mtx	QC SAMPLE ID			Duplicate or MSD			Matrix Spike				Analysis
				Units	Result	Found		RPD%	Result	SPK ADD		%R	Date
As	6010B	S	1	mg/kg	8.58	108	M	0.0	108	100		99.4	8/29/05
Ba	6010B	S	1	mg/kg	52.9	154	M	2.6	150	100		97.1	8/29/05
Cd	6010B	S	1	mg/kg	4.36	93.5	M	0.2	93.7	100		89.3	8/29/05
Cu	6010B	S	1	mg/kg	14.1	115	M	0.0	115	100		100.9	8/29/05
Pb	6010B	S	1	mg/kg	247	322	M	1.3	318	100		71.0	8/29/05
Pb	6010B	S	1	mg/kg	247	N/A		N/A	317	100	A	70.0	8/29/05
Se	6010B	S	1	mg/kg	<4.0	93.6	M	0.4	93.2	100		93.2	8/29/05
Zn	6010B	S	1	mg/kg	1050	1090	M	3.7	1050	100		R >4S	8/29/05
Hg	7471A	S	1	mg/kg	0.0767	0.245	M	4.8	0.257	0.167		108.0	8/17/05
% Sol.	999	S	1	%	59.3	52.2		12.7	N/A	N/A		N/A	8/26/05

LEGEND:

RPD% = (|SAM - DUP|/((SAM + DUP)/2) * 100) UDL = Both SAM & DUP not detected. *Result or *Found: Interference required dilution.

RPD% = (|SPK - MSD|/((SPK + MSD)/2) * 100) M in Duplicate/MSD column indicates MSD.

SPIKE ADD column, A = Post Digest Spike; %R = Percent Recovery N/A = Not Analyzed; R > 4S = Result more than 4X the Spike Added

QC limits for MS recoveries apply only if the spike is at least 1/4 the concentration of the analyte in the sample.

Control limits for the RPD apply only if the concentration of the analyte in the sample is at least five times the reporting limit.

QC Sample 1: SVL SAM No.: 463726 Client Sample ID: PO-C2-2S

8/30/05 14:18

Cooler Temp 16.8 8/16/05 8:30

SVL ANALYTICAL

CHAIN OF CUSTODY RECORD

Page 3 of 3

Client: GOLDER ASSOCIATES
Contact: Doug Morrell
Address: 18300 NE Union Hill Rd., #200
Redmond, WA 98052
Phone Number: (425) 883-0777
FAX Number: (425) 882-5498

NOTES:

1) Ensure proper container packaging.
2) Ship samples promptly following collection.
* 3) Designate Sample Reject Disposition

PO#:

Project Name: Teck Cominco RI/FS

Table 1. -- Matrix Type
1 = Surface Water, 2 = Ground Water
3 = Soil/Sediment, 4 = Rinsate, 5 = Oil
6 = Waste, 7 = Other (Specify) ________

FOR SVL USE ONLY
SVL JOB # 118401

Samplers Signature:

Lab Name: SVL Analytical, Inc. (208) 784-1258 FAX (208) 783-0891
Address: One Government Gulch, Kellogg, ID 83837-0929

Sample ID	Collection		Miscellaneous				Preservative(s)						Analyses Required									Comments
	Date	Time	Collected by: (Init.)	Matrix Type From Table 1	No. of Containers	Sample Filtered ? Y/N	Unpreserved (Ice Only)	HNO3	HCL	H2SO4	NAOH	Other (Specify)	Metals									
1. PO-C2-2S(10/08/05)	8/10/05	14:40	PVM	3	1	N	X															As, Cd, Cu,
2. PO-C2-1S(11/08/05)	8/11/05	15:30	↓	↓	↓	↓	↓															Pb, Hg, ZN,
3. PO-W1-2S(12/08/05)	8/12/05	9:00																				Se, Ba
4. PO-W1-1S(12/08/05)	8/12/05	10:30																				
5. PO-UD-1S(12/08/05)	8/12/05	11:30																				per DM 8-16-05
6. PO-C1-2S(12/08/05)	8/12/05	13:00																				
7. PO-TDF1-S5-S(11/08/05)	8/11/05	14:30																				
8.																						
9.																						
10.																						

Relinquished by:	Date: 8/14/05	Time: 16:00	Received by: Alyssa Douglas	Date: 8/15/05	Time: 8:00
Relinquished by: Alyssa Douglas	Date: 8/15/05	Time: 10:35	Received by: Johann 8/15/05 1035 / [illegible]	Date: 8/15/05	Time:

* Sample Reject: [ ] Return [ ] Dispose [ ] Store (30 Days)

White: LAB COPY Yellow: CUSTOMER COPY SVL-COC 12/95

SVL ANALYTICAL, INC.

REPORT OF ANALYTICAL RESULTS

One Government Gulch ▪ P.O. Box 929 ▪ Kellogg, Idaho 83827-0929 ▪ Phone: (208)784-1258 ▪ Fax: (208)783-0891

CLIENT : Golder Associates
PROJECT:

Sample Receipt: 8/16/05
Report Date: 8/31/05

Page 1 of 2
SVL JOB: 118400

SVL ID	CLIENT SAMPLE ID		As 6010B	Ba 6010B	Cd 6010B	Cu 6010B	Pb 6010B
S463706	PO-TDF1-T1C	7/30/05	12.8mg/kg	8.35mg/kg	6.54mg/kg	19.3mg/kg	506mg/kg
S463707	PO-TDF1-T2C	7/30/05	19.0mg/kg	6.77mg/kg	17.4mg/kg	13.1mg/kg	406mg/kg
S463708	PO-TDF1-T3C	7/30/05	16.6mg/kg	7.42mg/kg	13.3mg/kg	23.9mg/kg	409mg/kg
S463709	PO-TDF1-T4C	7/30/05	13.8mg/kg	7.21mg/kg	14.2mg/kg	34.1mg/kg	360mg/kg
S463710	PO-TDF1-T5C	7/30/05	10.7mg/kg	8.83mg/kg	7.22mg/kg	25.7mg/kg	414mg/kg
S463711	PO-TDF1-T6C	7/30/05	10.9mg/kg	8.76mg/kg	5.08mg/kg	21.9mg/kg	291mg/kg
S463712	PO-TDF1-T7C	7/30/05	14.3mg/kg	10.6mg/kg	8.14mg/kg	50.8mg/kg	421mg/kg
S463713	PO-TDF1-T9C	7/30/05	7.8mg/kg	9.33mg/kg	10.2mg/kg	20.9mg/kg	352mg/kg
S463714	PO-TDF1-T10C	7/30/05	4.7mg/kg	10.5mg/kg	4.03mg/kg	19.6mg/kg	186mg/kg
S463715	PO-TDF1-T11C	7/30/05	13.9mg/kg	8.95mg/kg	7.77mg/kg	27.1mg/kg	505mg/kg
S463716	PO-TDF1-T12C	7/30/05	9.8mg/kg	10.8mg/kg	4.86mg/kg	33.2mg/kg	314mg/kg
S463717	PO-TDF2-T13C	7/29/05	12.4mg/kg	33.2mg/kg	25.4mg/kg	52.6mg/kg	563mg/kg
S463718	PO-TDF2-T14C	7/29/05	14.9mg/kg	19.4mg/kg	14.2mg/kg	27.1mg/kg	411mg/kg
S463719	PO-TDF2-T15C	7/29/05	10.3mg/kg	239mg/kg	9.22mg/kg	44.0mg/kg	375mg/kg
S463720	PO-TDF2-T16C	7/29/05	14.3mg/kg	168mg/kg	11.1mg/kg	41.5mg/kg	445mg/kg
S463721	PO-TDF2-T17C	7/29/05	15.7mg/kg	13.6mg/kg	12.1mg/kg	30.4mg/kg	471mg/kg
S463722	PO-TDF1-T18C	8/12/05	9.3mg/kg	49.7mg/kg	11.2mg/kg	69.2mg/kg	474mg/kg
S463723	PO-TDF1-T8C	8/12/05	10.2mg/kg	26.4mg/kg	11.8mg/kg	87.8mg/kg	935mg/kg

Soil Samples: As Received Basis

WA C1268

Reviewed By:______________________ Date: 8/31/05

SVL ANALYTICAL, INC.

REPORT OF ANALYTICAL RESULTS

One Government Gulch ▪ P.O. Box 929 ▪ Kellogg, Idaho 83827-0929 ▪ Phone: (208)784-1258 ▪ Fax: (208)783-0891

CLIENT : Golder Associates
PROJECT:

Sample Receipt: 8/16/05
Report Date: 8/31/05

Page 2 of 2
SVL JOB: 118400

			Se	Zn	Hg	% Sol.
SVL ID	CLIENT SAMPLE ID		6010B	6010B	7471A	999
S463706	PO-TDF1-T1C	7/30/05	<4.0mg/kg	988mg/kg	0.0984mg/kg	91.9%
S463707	PO-TDF1-T2C	7/30/05	<4.0mg/kg	2860mg/kg	0.302mg/kg	87.5%
S463708	PO-TDF1-T3C	7/30/05	<4.0mg/kg	2190mg/kg	0.165mg/kg	83.9%
S463709	PO-TDF1-T4C	7/30/05	<4.0mg/kg	2620mg/kg	0.122mg/kg	82.3%
S463710	PO-TDF1-T5C	7/30/05	<4.0mg/kg	1410mg/kg	0.125mg/kg	93.0%
S463711	PO-TDF1-T6C	7/30/05	<4.0mg/kg	870mg/kg	0.113mg/kg	90.1%
S463712	PO-TDF1-T7C	7/30/05	<4.0mg/kg	961mg/kg	0.0817mg/kg	88.1%
S463713	PO-TDF1-T9C	7/30/05	<4.0mg/kg	1260mg/kg	0.227mg/kg	90.3%
S463714	PO-TDF1-T10C	7/30/05	<4.0mg/kg	730mg/kg	0.107mg/kg	88.7%
S463715	PO-TDF1-T11C	7/30/05	<4.0mg/kg	968mg/kg	0.102mg/kg	88.3%
S463716	PO-TDF1-T12C	7/30/05	<4.0mg/kg	808mg/kg	0.113mg/kg	88.3%
S463717	PO-TDF2-T13C	7/29/05	<4.0mg/kg	4870mg/kg	0.578mg/kg	84.2%
S463718	PO-TDF2-T14C	7/29/05	<4.0mg/kg	2440mg/kg	0.233mg/kg	91.0%
S463719	PO-TDF2-T15C	7/29/05	<4.0mg/kg	1810mg/kg	0.185mg/kg	88.6%
S463720	PO-TDF2-T16C	7/29/05	<4.0mg/kg	1380mg/kg	0.142mg/kg	90.1%
S463721	PO-TDF2-T17C	7/29/05	<4.0mg/kg	1740mg/kg	0.145mg/kg	91.7%
S463722	PO-TDF1-T18C	8/12/05	<4.0mg/kg	2270mg/kg	0.233mg/kg	69.7%
S463723	PO-TDF1-T8C	8/12/05	<4.0mg/kg	2560mg/kg	0.253mg/kg	69.4%

Soil Samples: As Received Basis

Certificate: WA C1268

Reviewed By:__________ Date: 8/31/05

SVL ANALYTICAL, INC.

Quality Control Report
Part I Prep Blank and Laboratory Control Sample

Client :Golder Associates

SVL JOB No: 118400

Analyte	Method	Matrix	Units	Prep Blank	True—LCS	—Found	LCS %R	Analysis Date
Arsenic	6010B	SOIL	mg/kg	<2.50	100	96.7	96.7	8/30/05
Barium	6010B	SOIL	mg/kg	<0.20	100	97.0	97.0	8/30/05
Cadmium	6010B	SOIL	mg/kg	<0.20	100	97.8	97.8	8/30/05
Copper	6010B	SOIL	mg/kg	<1.0	100	95.2	95.2	8/30/05
Lead	6010B	SOIL	mg/kg	<0.750	100	99.1	99.1	8/30/05
Selenium	6010B	SOIL	mg/kg	<4.0	100	88.5	88.5	8/30/05
Zinc	6010B	SOIL	mg/kg	<1.0	100	95.5	95.5	8/30/05
Mercury	7471A	SOIL	mg/kg	<0.0330	0.834	0.857	102.8	8/17/05

LEGEND:

LCS = Laboratory Control Sample

LCS %R = LCS Percent Recovery

N/A = Not Applicable

Quality Control Report
Part II Duplicate and Spike Analysis

Client :Golder Associates SVL JOB No: 118400

			QC SAMPLE ID			Duplicate or MSD			Matrix Spike				Analysis
Test	Method	Mtx		Units	Result	Found		RPD%	Result	SPK ADD		%R	Date
As	6010B	S	1	mg/kg	12.8	120	M	0.8	119	100		106.2	8/30/05
As	6010B	S	2	mg/kg	9.78	N/A		N/A	117	100		107.2	8/30/05
Ba	6010B	S	1	mg/kg	8.35	105	M	1.0	104	100		95.7	8/30/05
Ba	6010B	S	2	mg/kg	10.8	N/A		N/A	109	100		98.2	8/30/05
Cd	6010B	S	1	mg/kg	6.54	98.0	M	0.6	97.4	100		90.9	8/30/05
Cd	6010B	S	2	mg/kg	4.86	N/A		N/A	96.8	100		91.9	8/30/05
Cu	6010B	S	1	mg/kg	19.3	132	M	1.5	130	100		110.7	8/30/05
Cu	6010B	S	2	mg/kg	33.2	N/A		N/A	140	100		106.8	8/30/05
Pb	6010B	S	1	mg/kg	506	568	M	14.2	655	100		R >4S	8/30/05
Pb	6010B	S	2	mg/kg	314	N/A		N/A	384	100		70.0	8/30/05
Pb	6010B	S	2	mg/kg	314	N/A		N/A	404	100	A	90.0	8/30/05
Se	6010B	S	1	mg/kg	<4.0	98.6	M	1.4	100	100		100.0	8/30/05
Se	6010B	S	2	mg/kg	<4.0	N/A		N/A	97.5	100		97.5	8/30/05
Zn	6010B	S	1	mg/kg	988	1130	M	4.3	1180	100		R >4S	8/30/05
Zn	6010B	S	2	mg/kg	808	N/A		N/A	855	100		R >4S	8/30/05
Hg	7471A	S	1	mg/kg	0.0984	0.262	M	0.8	0.260	0.167		96.8	8/17/05
Hg	7471A	S	2	mg/kg	0.113	N/A		N/A	0.278	0.167		98.8	8/17/05
% Sol.	999	S	1	%	91.9	92.7		0.9	N/A	N/A		N/A	8/26/05

LEGEND:

RPD% = (|SAM - DUP|/((SAM + DUP)/2) * 100) UDL = Both SAM & DUP not detected. *Result or *Found: Interference required dilution.

RPD% = (|SPK - MSD|/((SPK + MSD)/2) * 100) M in Duplicate/MSD column indicates MSD.

SPIKE ADD column, A = Post Digest Spike; %R = Percent Recovery N/A = Not Analyzed; R > 4S = Result more than 4X the Spike Added

QC limits for MS recoveries apply only if the spike is at least 1/4 the concentration of the analyte in the sample.

Control limits for the RPD apply only if the concentration of the analyte in the sample is at least five times the reporting limit.

QC Sample 1: SVL SAM No.: 463706 Client Sample ID: PO-TDF1-T1C

QC Sample 2: SVL SAM No.: 463716 Client Sample ID: PO-TDF1-T12C

Cooler Temp 16.8 8/16/05 8:50 JBN

SVL ANALYTICAL

CHAIN OF CUSTODY RECORD

Page 1 of 3

Client: GOLDER ASSOCIATES
Contact: Doug Morrell
Address: 18300 NE Union Hill Rd, #200
Redmond, WA 98052
Phone Number: (425) 883-0777
FAX Number: 882-5498

NOTES:
1) Ensure proper container packaging.
2) Ship samples promptly following collection.
* 3) Designate Sample Reject Disposition
PO#:
Project Name: Teck Cominco RI/FS

Table 1. -- Matrix Type
1 = Surface Water, 2 = Ground Water
3 = Soil/Sediment, 4 = Rinsate, 5 = Oil
6 = Waste, 7 = Other (Specify)

Samplers Signature:

FOR SVL USE ONLY
SVL JOB # 118400

Lab Name: SVL Analytical, Inc. (208) 784-1258 FAX (208) 783-0891
Address: One Government Gulch, Kellogg, ID 83837-0929

Sample ID	Collection		Miscellaneous				Preservative(s)						Analyses Required									Comments
	Date	Time	Collected by: (Init.)	Matrix Type From Table 1	No. of Containers	Sample Filtered ? Y/N	Unpreserved (Ice Only)	HNO3	HCL	H2SO4	NAOH	Other (Specify)	Metals							DD		
1. PO-TDF1-T1C	7/30/05	6:30	PVM	3	1	N	X															As, Cd, Cu
2. PO-TDF1-T2C		7:00																				Pb, Hg, Zn,
3. PO-TDF1-T3C		7:30																				Se, Ba
4. PO-TDF1-T4C		8:00																				
5. PO-TDF1-T5C		8:30																				per DM 8-16-05
6. PO-TDF1-T6C		9:30																				
7. PO-TDF1-T7C		10:30																				
8. PO-TDF1-T9C		11:00																				
9. PO-TDF1-T10C	↓	12:00																				
10. PO-TDF1-T11C		13:00	↓	↓	↓	↓	↓						↓									

Relinquished by: Paul VanMiddlesworth	Date: 8/14/05	Time: 16:00	Received by: Alyssa Douglas	Date: 8/15/05	Time: 8:00 AM
Relinquished by: Alyssa Douglas	Date: 8/15/05	Time: 10:35	Received by: J. Holmann CDA 8/15/05 1030/D. Harder	Date: 8/15/05	Time:

* Sample Reject: [ ] Return [ ] Dispose [ ] Store (30 Days)

White: LAB COPY Yellow: CUSTOMER COPY SVL-COC 12/95

SVL ANALYTICAL

CHAIN OF CUSTODY RECORD

Page 2 of 3

Client: Golder Associates
Contact: Doug Morrell
Address:

Phone Number: (425) 883-0777
FAX Number:

NOTES:

1) Ensure proper container packaging.
2) Ship samples promptly following collection.
* 3) Designate Sample Reject Disposition

PO#:
Project Name: Teck Cominco RI/FS

Table 1. -- Matrix Type

1 = Surface Water, 2 = Ground Water
3 = Soil/Sediment, 4 = Rinsate, 5 = Oil
6 = Waste, 7 = Other (Specify) ________

Samplers Signature:

FOR SVL USE ONLY
SVL JOB # 118400

Lab Name: SVL Analytical, Inc. (208) 784-1258 FAX (208) 783-0891
Address: One Government Gulch, Kellogg, ID 83837-0929

	Collection		Miscellaneous				Preservative(s)						Analyses Required									
Sample ID	Date	Time	Collected by: (Init.)	Matrix Type From Table 1	No. of Containers	Sample Filtered ? Y/N	Unpreserved (Ice Only)	HNO3	HCL	H2SO4	NAOH	Other (Specify)	Metals									Comments
1. PO-TDF1-T12C	7/30/05	14:00	PVM	3	1	N	X						↓									
2. PO-TDF2-T13C	7/29/05	9:00	↓	↓	↓	↓	↓						↓									
3. PO-TDF2-T14C	7/29/05	9:30	↓	↓	↓	↓	↓						↓									
4. PO-TDF2-T15C	7/29/05	9:55	↓	↓	↓	↓	↓						↓									
5. PO-TDF2-T16C	7/29/05	10:30	↓	↓	↓	↓	↓						↓									
6. PO-TDF2-T17C	7/29/05	11:30	↓	↓	↓	↓	↓						↓									
7. PO-TDF1-T18C	8/12/05	9:20	↓	↓	↓	↓	↓						↓									
8. PO-TDF1-T8C	8/12/05	9:00	↓	↓	↓	↓	↓						↓									
9.																						
10.																						

Relinquished by: Paul VanMiddlesworth	Date: 8/14/05	Time: 16:00	Received by: Alyssa Douglas	Date: 8/15/05	Time: 8:00
Relinquished by: Alyssa Douglas	Date: 8/15/05	Time: 10:35	Received by: [illegible] CDA 08/15/05 1035 / [illegible]	Date: 8/15/05	Time:

* Sample Reject: [ ] Return [ ] Dispose [ ] Store (30 Days)

White: LAB COPY Yellow: CUSTOMER COPY SVL-COC 12/95

SVL ANALYTICAL, INC. REPORT OF ANALYTICAL RESULTS

One Government Gulch ▪ P.O. Box 929 ▪ Kellogg, Idaho 83837-0929 ▪ Phone: (208)784-1258 ▪ Fax: (208)783-0891

CLIENT : Golder Associates
PROJECT: 043-1344

Sample Receipt: 8/23/05
Report Date: 9/07/05

Page 1 of 3
SVL JOB: 118535

SVL ID	CLIENT SAMPLE ID	Ag 200.7	As 200.8	Ba 200.7	Ca 200.7	Cd 200.8	Cr 200.7	Cu 200.8	Fe 200.7
W465243	PO-TDF2-MW201 ^T 8/15/05	<0.0050mg/L	<0.0030mg/L	0.0554mg/L	74.9mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W465244	PO-TDF2-MW203 ^T 8/15/05	***	***	***	***	***	***	***	***
W465245	PO-TDF2-MW211 ^T 8/15/05	<0.0050mg/L	<0.0030mg/L	0.0550mg/L	75.3mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W465246	PO-TDF1-P05 ^T 8/17/05	***	***	***	***	***	***	***	***
W465247	PO-TDF1-P04 ^T 8/17/05	***	***	***	***	***	***	***	***
W465248	PO-TDF1-P03 ^T 8/18/05	***	***	***	***	***	***	***	***
W465249	PO-TDF1-P02 ^T 8/18/05	<0.0050mg/L	0.0042mg/L	0.126mg/L	81.4mg/L	0.00023mg/L	<0.0060mg/L	0.0862mg/L	3.79mg/L
W465250	PO-TDF1-P01 ^T 8/18/05	***	***	***	***	***	***	***	***
W465251	PO-TDF1-G1-S ^T 8/19/05	***	***	***	***	***	***	***	***
W465252	PO-TDF1-G1-D ^T 8/19/05	***	***	***	***	***	***	***	***
W465253	2-PO-EB ^T 8/19/05	<0.0050mg/L	<0.0030mg/L	<0.0020mg/L	<0.040mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W465254	3-PO-TB ^T 8/19/05	<0.0050mg/L	<0.0030mg/L	<0.0020mg/L	<0.040mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W465255	PO-TDF2-MW201 ^D 8/15/05	<0.0050mg/L	<0.0030mg/L	0.0545mg/L	73.5mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W465256	PO-TDF2-MW203 ^D 8/15/05	<0.0050mg/L	<0.0030mg/L	0.100mg/L	77.4mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W465257	PO-TDF2-MW211 ^D 8/15/05	<0.0050mg/L	<0.0030mg/L	0.0556mg/L	74.0mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W465258	PO-TDF1-P05 ^D 8/17/05	<0.0050mg/L	0.0037mg/L	0.216mg/L	63.3mg/L	<0.00020mg/L	<0.0060mg/L	0.0019mg/L	<0.060mg/L
W465259	PO-TDF1-P04 ^D 8/17/05	<0.0050mg/L	<0.0030mg/L	0.0349mg/L	244mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	1.14mg/L
W465260	PO-TDF1-P03 ^D 8/18/05	<0.0050mg/L	<0.0030mg/L	0.0117mg/L	607mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	19.9mg/L
W465261	PO-TDF1-P02 ^D 8/18/05	<0.0050mg/L	<0.0030mg/L	0.116mg/L	77.1mg/L	<0.00020mg/L	<0.0060mg/L	0.0227mg/L	2.15mg/L
W465262	PO-TDF1-P01 ^D 8/18/05	<0.0050mg/L	<0.0030mg/L	0.0146mg/L	421mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W465263	PO-TDF1-G1-S ^D 8/19/05	<0.0050mg/L	<0.0030mg/L	0.0522mg/L	8.40mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W465264	PO-TDF1-G1-D ^D 8/19/05	<0.0050mg/L	<0.0030mg/L	0.140mg/L	85.7mg/L	<0.00020mg/L	<0.0060mg/L	0.0057mg/L	1.88mg/L
W465265	2-PO-EB ^D 8/19/05	<0.0050mg/L	<0.0030mg/L	<0.0020mg/L	<0.040mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L
W465266	3-PO-TB ^D 8/19/05	<0.0050mg/L	<0.0030mg/L	<0.0020mg/L	<0.040mg/L	<0.00020mg/L	<0.0060mg/L	<0.0010mg/L	<0.060mg/L

***: Not Requested

Certificate: WA C1268

Reviewed By: ______________________ Date: 9/7/05

CLIENT : Golder Associates
PROJECT: 043-1344

Sample Receipt: 8/23/05
Report Date: 9/07/05

SVL JOB: 118535

SVL ID	CLIENT SAMPLE ID	Mg 200.7	Mn 200.7	Pb 200.8	Se 200.8	Zn 200.7	Hg 245.1	C1 300.0	S04 300.0
W465243	PO-TDF2-MW201 ^T 8/15/05	21.6mg/L	0.0050mg/L	<0.0030mg/L	<0.0030mg/L	<0.010mg/L	<0.00020mg/L	4.23mg/L	31.9mg/L
W465244	PO-TDF2-MW203 ^T 8/15/05	***	***	***	***	***	***	0.24mg/L	58.8mg/L
W465245	PO-TDF2-MW211 ^T 8/15/05	21.8mg/L	0.0049mg/L	<0.0030mg/L	<0.0030mg/L	<0.010mg/L	<0.00020mg/L	4.37mg/L	33.1mg/L
W465246	PO-TDF1-P05 ^T 8/17/05	***	***	***	***	***	***	4.46mg/L	6.18mg/L
W465247	PO-TDF1-P04 ^T 8/17/05	***	***	***	***	***	***	3.26mg/L	791mg/L
W465248	PO-TDF1-P03 ^T 8/18/05	***	***	***	***	***	***	0.46mg/L	1620mg/L
W465249	PO-TDF1-P02 ^T 8/18/05	23.7mg/L	0.786mg/L	0.0237mg/L	<0.0030mg/L	0.109mg/L	<0.00020mg/L	4.24mg/L	40.6mg/L
W465250	PO-TDF1-P01 ^T 8/18/05	***	***	***	***	***	***	1.70mg/L	1660mg/L
W465251	PO-TDF1-G1-S ^T 8/19/05	***	***	***	***	***	***	3.39mg/L	20.7mg/L
W465252	PO-TDF1-G1-D ^T 8/19/05	***	***	***	***	***	***	3.70mg/L	22.4mg/L
W465253	2-PO-EB ^T 8/19/05	<0.060mg/L	<0.0040mg/L	<0.0030mg/L	<0.0030mg/L	<0.010mg/L	<0.00020mg/L	0.27mg/L	<0.30mg/L
W465254	3-PO-TB ^T 8/19/05	<0.060mg/L	<0.0040mg/L	<0.0030mg/L	<0.0030mg/L	<0.010mg/L	<0.00020mg/L	0.27mg/L	<0.30mg/L
W465255	PO-TDF2-MW201 ^D 8/15/05	21.3mg/L	0.0062mg/L	<0.0030mg/L	<0.0030mg/L	<0.010mg/L	<0.00020mg/L	***	***
W465256	PO-TDF2-MW203 ^D 8/15/05	23.6mg/L	0.143mg/L	<0.0030mg/L	<0.0030mg/L	<0.010mg/L	<0.00020mg/L	***	***
W465257	PO-TDF2-MW211 ^D 8/15/05	21.7mg/L	<0.0040mg/L	<0.0030mg/L	<0.0030mg/L	<0.010mg/L	<0.00020mg/L	***	***
W465258	PO-TDF1-P05 ^D 8/17/05	42.1mg/L	0.0320mg/L	<0.0030mg/L	<0.0030mg/L	0.019mg/L	<0.00020mg/L	***	***
W465259	PO-TDF1-P04 ^D 8/17/05	113mg/L	0.123mg/L	<0.0030mg/L	<0.0030mg/L	<0.010mg/L	<0.00020mg/L	***	***
W465260	PO-TDF1-P03 ^D 8/18/05	140mg/L	0.0376mg/L	<0.0030mg/L	<0.0030mg/L	0.093mg/L	<0.00020mg/L	***	***
W465261	PO-TDF1-P02 ^D 8/18/05	22.0mg/L	0.757mg/L	<0.0030mg/L	<0.0030mg/L	0.081mg/L	<0.00020mg/L	***	***
W465262	PO-TDF1-P01 ^D 8/18/05	222mg/L	0.0578mg/L	<0.0030mg/L	<0.0030mg/L	0.030mg/L	<0.00020mg/L	***	***
W465263	PO-TDF1-G1-S ^D 8/19/05	28.7mg/L	0.0042mg/L	<0.0030mg/L	<0.0030mg/L	<0.010mg/L	<0.00020mg/L	***	***
W465264	PO-TDF1-G1-D ^D 8/19/05	20.8mg/L	0.190mg/L	<0.0030mg/L	<0.0030mg/L	0.091mg/L	<0.00020mg/L	***	***
W465265	2-PO-EB ^D 8/19/05	<0.060mg/L	<0.0040mg/L	<0.0030mg/L	<0.0030mg/L	<0.010mg/L	<0.00020mg/L	***	***
W465266	3-PO-TB ^D 8/19/05	<0.060mg/L	<0.0040mg/L	<0.0030mg/L	<0.0030mg/L	<0.010mg/L	<0.00020mg/L	***	***

***: Not Requested

Certificate: WA C1268

Reviewed By: ______________________ Date: 9/7/05

SVL ANALYTICAL, INC. REPORT OF ANALYTICAL RESULTS

One Government Gulch ■ P.O. Box 929 ■ Kellogg, Idaho 83837-0929 ■ Phone: (208)784-1258 ■ Fax: (208)783-0891

CLIENT : Golder Associates
PROJECT: 043-1344

Sample Receipt: 8/23/05
Report Date: 9/07/05

Page 3 of 3
SVL JOB: 118535

SVL ID	CLIENT SAMPLE ID	ALK 2320B
W465243	PO-TDF2-MW201 ^T 8/15/05	260mg/L
W465244	PO-TDF2-MW203 ^T 8/15/05	253mg/L
W465245	PO-TDF2-MW211 ^T 8/15/05	254mg/L
W465246	PO-TDF1-P05 ^T 8/17/05	368mg/L
W465247	PO-TDF1-P04 ^T 8/17/05	270mg/L
W465248	PO-TDF1-P03 ^T 8/18/05	338mg/L
W465249	PO-TDF1-P02 ^T 8/18/05	270mg/L
W465250	PO-TDF1-P01 ^T 8/18/05	29.4mg/L
W465251	PO-TDF1-G1-S ^T 8/19/05	142mg/L
W465252	PO-TDF1-G1-D ^T 8/19/05	295mg/L
W465253	2-PO-EB ^T 8/19/05	<1.0mg/L
W465254	3-PO-TB ^T 8/19/05	1.0mg/L
W465255	PO-TDF2-MW201 ^D 8/15/05	***
W465256	PO-TDF2-MW203 ^D 8/15/05	***
W465257	PO-TDF2-MW211 ^D 8/15/05	***
W465258	PO-TDF1-P05 ^D 8/17/05	***
W465259	PO-TDF1-P04 ^D 8/17/05	***
W465260	PO-TDF1-P03 ^D 8/18/05	***
W465261	PO-TDF1-P02 ^D 8/18/05	***
W465262	PO-TDF1-P01 ^D 8/18/05	***
W465263	PO-TDF1-G1-S ^D 8/19/05	***
W465264	PO-TDF1-G1-D ^D 8/19/05	***
W465265	2-PO-EB ^D 8/19/05	***
W465266	3-PO-TB ^D 8/19/05	***

***: Not Requested

Certificate: WA C1268

Reviewed By: ______________ Date: 9/7/05

Quality Control Report
Part I Prep Blank and Laboratory Control Sample

Client :Golder Associates

SVL JOB No: 118535

Analyte	Method	Matrix	Units	Prep Blank	True——LCS	——Found	LCS %R	Analysis Date
Silver	200.7	WATERG	mg/L	<0.0050	0.0500	0.0548	109.6	9/05/05
Arsenic	200.8	WATERG	mg/L	<0.0030	0.0250	0.0262	104.8	9/01/05
Barium	200.7	WATERG	mg/L	<0.0020	1.00	1.02	102.0	9/05/05
Calcium	200.7	WATERG	mg/L	<0.040	20.0	20.1	100.5	9/05/05
Cadmium	200.8	WATERG	mg/L	<0.00020	0.0250	0.0258	103.2	9/01/05
Chromium	200.7	WATERG	mg/L	<0.0060	1.00	1.07	107.0	9/05/05
Copper	200.8	WATERG	mg/L	<0.0010	0.0250	0.0263	105.2	9/01/05
Iron	200.7	WATERG	mg/L	<0.060	10.0	10.1	101.0	9/05/05
Magnesium	200.7	WATERG	mg/L	<0.060	20.0	19.9	99.5	9/05/05
Manganese	200.7	WATERG	mg/L	<0.0040	1.00	1.04	104.0	9/05/05
Lead	200.8	WATERG	mg/L	<0.0030	0.0250	0.0257	102.8	9/01/05
Selenium	200.8	WATERG	mg/L	<0.0030	0.0250	0.0258	103.2	9/01/05
Zinc	200.7	WATERG	mg/L	<0.010	1.00	1.07	107.0	9/05/05
Mercury	245.1	WATERG	mg/L	<0.00020	0.00500	0.00532	106.4	8/24/05
Chloride	300.0	WATERG	mg/L	<0.20	4.96	4.68	94.4	9/01/05
Sulfate, SO4	300.0	WATERG	mg/L	<0.30	9.97	9.77	98.0	9/01/05
ALKALINITY	2320B	WATERG	mg/L	<1.0	56.4	58.0	102.8	8/28/05

LEGEND:

LCS = Laboratory Control Sample

LCS %R = LCS Percent Recovery

N/A = Not Applicable

SVL ANALYTICAL, INC.

Quality Control Report
Part II Duplicate and Spike Analysis

Client :Golder Associates SVL JOB No: 118535

			QC SAMPLE ID			Duplicate or MSD		Matrix Spike			Analysis
Test	Method	Mtx		Units	Result	Found	RPD%	Result	SPK ADD	%R	Date
Ag	200.7	W	1	mg/L	<0.0050	<0.0050	UDL	0.0564	0.0500	112.8	9/05/05
Ag	200.7	W	2	mg/L	<0.0050	<0.0050	UDL	0.0556	0.0500	111.2	9/05/05
Ag	200.7	W	3	mg/L	<0.0050	N/A	N/A	0.0500	0.0500	100.0	9/05/05
As	200.8	W	1	mg/L	<0.0030	<0.0030	UDL	0.0258	0.0250	103.2	9/01/05
As	200.8	W	2	mg/L	<0.0030	<0.0030	UDL	0.0285	0.0250	114.0	9/01/05
As	200.8	W	3	mg/L	<0.0030	N/A	N/A	0.0290	0.0250	116.0	9/01/05
Ba	200.7	W	1	mg/L	0.0554	0.0554	0.0	1.09	1.00	103.5	9/05/05
Ba	200.7	W	2	mg/L	0.100	0.102	2.0	1.11	1.00	101.0	9/05/05
Ba	200.7	W	3	mg/L	<0.0020	N/A	N/A	1.02	1.00	102.0	9/05/05
Ca	200.7	W	1	mg/L	74.9	74.2	0.9	96.9	20.0	110.0	9/05/05
Ca	200.7	W	2	mg/L	77.4	78.6	1.5	93.3	20.0	79.5	9/05/05
Ca	200.7	W	3	mg/L	<0.040	N/A	N/A	20.2	20.0	101.0	9/05/05
Cd	200.8	W	1	mg/L	<0.00020	<0.00020	UDL	0.0258	0.0250	103.2	9/01/05
Cd	200.8	W	2	mg/L	<0.00020	<0.00020	UDL	0.0269	0.0250	107.6	9/01/05
Cd	200.8	W	3	mg/L	<0.00020	N/A	N/A	0.0274	0.0250	109.6	9/01/05
Cr	200.7	W	1	mg/L	<0.0060	<0.0060	UDL	1.08	1.00	108.0	9/05/05
Cr	200.7	W	2	mg/L	<0.0060	<0.0060	UDL	1.06	1.00	106.0	9/05/05
Cr	200.7	W	3	mg/L	<0.0060	N/A	N/A	1.07	1.00	107.0	9/05/05
Cu	200.8	W	1	mg/L	<0.0010	<0.0010	UDL	0.0251	0.0250	100.4	9/01/05
Cu	200.8	W	2	mg/L	<0.0010	<0.0010	UDL	0.0234	0.0250	93.6	9/01/05
Cu	200.8	W	3	mg/L	<0.0010	N/A	N/A	0.0281	0.0250	112.4	9/01/05
Fe	200.7	W	1	mg/L	<0.060	<0.060	UDL	10.4	10.0	104.0	9/05/05
Fe	200.7	W	2	mg/L	<0.060	<0.060	UDL	9.65	10.0	96.5	9/05/05
Fe	200.7	W	3	mg/L	<0.060	N/A	N/A	10.1	10.0	101.0	9/05/05
Mg	200.7	W	1	mg/L	21.6	21.5	0.5	42.3	20.0	103.5	9/05/05
Mg	200.7	W	2	mg/L	23.6	24.0	1.7	41.7	20.0	90.5	9/05/05
Mg	200.7	W	3	mg/L	<0.060	N/A	N/A	19.6	20.0	98.0	9/05/05
Mn	200.7	W	1	mg/L	0.0050	0.0058	14.8	1.07	1.00	106.5	9/05/05
Mn	200.7	W	2	mg/L	0.143	0.141	1.4	1.12	1.00	97.7	9/06/05
Mn	200.7	W	3	mg/L	<0.0040	N/A	N/A	0.988	1.00	98.8	9/06/05
Pb	200.8	W	1	mg/L	<0.0030	<0.0030	UDL	0.0235	0.0250	94.0	9/01/05
Pb	200.8	W	2	mg/L	<0.0030	<0.0030	UDL	0.0266	0.0250	106.4	9/06/05
Pb	200.8	W	3	mg/L	<0.0030	N/A	N/A	0.0266	0.0250	106.4	9/06/05
Se	200.8	W	1	mg/L	<0.0030	<0.0030	UDL	0.0284	0.0250	113.6	9/01/05
Se	200.8	W	2	mg/L	<0.0030	<0.0030	UDL	0.0313	0.0250	125.2	9/01/05
Se	200.8	W	3	mg/L	<0.0030	N/A	N/A	0.0336	0.0250	134.4	9/01/05
Zn	200.7	W	1	mg/L	<0.010	<0.010	UDL	1.05	1.00	105.0	9/05/05
Zn	200.7	W	2	mg/L	<0.010	<0.010	UDL	1.02	1.00	102.0	9/05/05
Zn	200.7	W	3	mg/L	<0.010	N/A	N/A	1.09	1.00	109.0	9/05/05
Hg	245.1	W	1	mg/L	<0.00020	<0.00020	UDL	0.00105	0.0010	105.0	8/24/05
Hg	245.1	W	2	mg/L	<0.00020	<0.00020	UDL	0.00103	0.0010	103.0	8/24/05
Hg	245.1	W	3	mg/L	<0.00020	N/A	N/A	0.00108	0.0010	108.0	8/24/05
Cl	300.0	W	4	mg/L	0.24	0.25	4.1	1.92	2.00	84.0	9/02/05
Cl	300.0	W	5	mg/L	3.39	N/A	N/A	5.58	2.00	109.5	9/02/05
SO4	300.0	W	4	mg/L	58.8	58.6	0.3	82.9	25.0	96.4	9/02/05

LEGEND:

RPD% = (|SAM - DUP|/((SAM + DUP)/2) * 100) UDL = Both SAM & DUP not detected. *Result or *Found: Interference required dilution.

RPD% = (|SPK - MSD|/((SPK + MSD)/2) * 100) M in Duplicate/MSD column indicates MSD.

SPIKE ADD column, A = Post Digest Spike; %R = Percent Recovery N/A = Not Analyzed; R > 4S = Result more than 4X the Spike Added

QC limits for MS recoveries apply only if the spike is at least 1/4 the concentration of the analyte in the sample.

Control limits for the RPD apply only if the concentration of the analyte in the sample is at least five times the reporting limit.

QC Sample 1: SVL SAM No.: 465243 Client Sample ID: PO-TDF2-MW201 ^T
QC Sample 2: SVL SAM No.: 465256 Client Sample ID: PO-TDF2-MW203 ^D
QC Sample 3: SVL SAM No.: 465266 Client Sample ID: 3-PO-TB ^D
QC Sample 4: SVL SAM No.: 465244 Client Sample ID: PO-TDF2-MW203 ^T
QC Sample 5: SVL SAM No.: 465251 Client Sample ID: PO-TDF1-G1-S ^T

9/07/05 15:34

SVL ANALYTICAL, INC.

Quality Control Report
Part II Duplicate and Spike Analysis

Client :Golder Associates

SVL JOB No: 118535

Test	Method	Mtx	QC SAMPLE ID	Units	Result	Duplicate or MSD Found	MSD RPD%	Matrix Spike Result	Matrix Spike SPK ADD	Matrix Spike %R	Analysis Date
SO4	300.0	W	5	mg/L	20.7	N/A	N/A	30.2	10.0	95.0	9/02/05
ALK	2320B	W	4	mg/L	253	251	0.8	N/A	N/A	N/A	8/28/05

LEGEND:

RPD% = (|SAM - DUP|/((SAM + DUP)/2) * 100) UDL = Both SAM & DUP not detected. *Result or *Found: Interference required dilution.
RPD% = (|SPK - MSD|/((SPK + MSD)/2) * 100) M in Duplicate/MSD column indicates MSD.
SPIKE ADD column, A = Post Digest Spike; %R = Percent Recovery N/A = Not Analyzed; R > 4S = Result more than 4X the Spike Added
QC limits for MS recoveries apply only if the spike is at least 1/4 the concentration of the analyte in the sample.
Control limits for the RPD apply only if the concentration of the analyte in the sample is at least five times the reporting limit.

QC Sample 1:	SVL SAM No.: 465243	Client Sample ID: PO-TDF2-MW201	^T
QC Sample 2:	SVL SAM No.: 465256	Client Sample ID: PO-TDF2-MW203	^D
QC Sample 3:	SVL SAM No.: 465266	Client Sample ID: 3-PO-TB	^D
QC Sample 4:	SVL SAM No.: 465244	Client Sample ID: PO-TDF2-MW203	^T
QC Sample 5:	SVL SAM No.: 465251	Client Sample ID: PO-TDF1-G1-S	^T

(2) Cooler Temp 1.5 8/23/05 10:15
2.4

SVL ANALYTICAL

CHAIN OF CUSTODY RECORD

Page 1 of 2

Client: GOLDER ASSOCIATES
Contact: Doug Morell
Address: 18300 NE Union Hill Rd. #200
Redmond, WA 98052
Phone Number: (425) 883-0777
FAX Number: (425) 882-5498

NOTES:
1) Ensure proper container packaging.
2) Ship samples promptly following collection.
* 3) Designate Sample Reject Disposition
PO#: 043-1344 ph. 401
Project Name: Teck Cominco RI/FS

Table 1. -- Matrix Type
1 = Surface Water, 2 = Ground Water
3 = Soil/Sediment, 4 = Rinsate, 5 = Oil
6 = Waste, 7 = Other (Specify) ______

Samplers Signature:

FOR SVL USE ONLY
SVL JOB # 118535

Lab Name: SVL Analytical, Inc. (208) 784-1258 FAX (208) 783-0891
Address: One Government Gulch, Kellogg, ID 83837-0929

Sample ID	Collection		Miscellaneous				Preservative(s)						Analyses Required									Comments
	Date	Time	Collected by: (Init.)	Matrix Type From Table 1	No. of Containers	Sample Filtered ? Y/N	Unpreserved (Ice Only)	HNO3	HCL	H2SO4	NAOH	Other (Specify)	Dissolved Metals	Anions	Total Metals							*No time on sample
PO-1.TDF2-MW201(15/08/05)	8/15/05	13:00	PVM/AT	2		Y	X	X					X	X	X							
* PO-2.TDF2-MW203(15/08/05)	8/15/05	15:45	↓	↓		↓	↓	↓					X	X								(MS/MSD)
PO-3.TDF2-MW211(15/08/05)	8/15/05	14:40	↓	↓		↓	↓	↓					X	X	X							
PO-4.TDF1-P05 (17/08/05)	8/17/05	13:00	↓	↓		↓	↓	↓					X	X								
PO-5.TDF1-P04(17/08/05)	8/17/05	18:00	↓	↓		↓	↓	↓					X	X								
PO-6.TDF1-P03(18/08/05)	8/18/05	10:15	↓	↓		↓	↓	↓					X	X								
PO-7.TDF1-P02(18/08/05)	8/18/05	16:20	↓	↓		↓	↓	↓					X	X	X							
PO-8.TDF1-P01 (18/08/05)	8/18/05	17:00	↓	↓		↓	↓	↓					X	X								temp on arrival: 4°c
9.																						
10.																						

Relinquished by: Date: 8/22/05 Time: 14:20 Received by: DBurgess Date: 8/22/05 Time: 2:20
Relinquished by: DBurgess Date: 8/23/05 Time: 10:00 Received by: Date: 8/23/05 Time: 10:00

* Sample Reject: [ ] Return [ ] Dispose [ ] Store (30 Days)

White: LAB COPY Yellow: CUSTOMER COPY SVL-COC 12/95

SVL ANALYTICAL

CHAIN OF CUSTODY RECORD

Page 2 of 2

Client: GOLDER ASSOCIATES
Contact: Doug Morell
Address: 18300 NE Union Hill Rd. #200
Redmond, WA 98052
Phone Number: (425) 883-0777
FAX Number: 882-5498

NOTES:
1) Ensure proper container packaging.
2) Ship samples promptly following collection.
* 3) Designate Sample Reject Disposition
PO#:
Project Name: Teck Cominco RI/FS

Table 1. -- Matrix Type
1 = Surface Water, 2 = Ground Water
3 = Soil/Sediment, 4 = Rinsate, 5 = Oil
6 = Waste, 7 = Other (Specify)

Samplers Signature:

FOR SVL USE ONLY
SVL JOB #
118535

Lab Name: SVL Analytical, Inc. (208) 784-1258 FAX (208) 783-0891
Address: One Government Gulch, Kellogg, ID 83837-0929

Sample ID	Collection		Miscellaneous				Preservative(s)						Analyses Required									Comments
	Date	Time	Collected by: (Init.)	Matrix Type From Table 1	No. of Containers	Sample Filtered ? Y/N	Unpreserved (Ice Only)	HNO3	HCL	H2SO4	NAOH	Other (Specify)	Dissolved Metals	Anions	Total Metals							
PO - 1. TDF1-G1-S(19/08/05)	8/19/05	11:40	PVM/AT	2		Y	X	X					X	X								
PO - 2. TDF1-G1-D(19/08/05)	8/19/05	10:55	↓	↓		↓	↓	↓					X	X								
3. 2-PO-EB(19/08/05)	8/19/05	12:00	↓	↓		↓	↓	↓					X	X	X							
4. 3-PO-TB(19/08/05)	8/19/05	12:45	↓	↓		↓	↓	↓					X	X	X							
5.																						
6.																						
7.																						
8.																						Temp on arrival: 4°C
9.																						
10.																						

Relinquished by:	Date: 8/22/05	Time: 14:20	Received by: ABergquist	Date: 8/22/05	Time: 2:20
Relinquished by: ABergquist	Date: 8/23/05	Time: 10:00	Received by:	Date: 8/25/05	Time: 10:00

* Sample Reject: [ ] Return [ ] Dispose [ ] Store (30 Days)

White: LAB COPY Yellow: CUSTOMER COPY

SVL-COC 12/95

SVL ANALYTICAL, INC.
One Government Gulch ▪ P.O. Box 929 ▪ Kellogg, Idaho 83837-0929 ▪ Phone: (208)784-1258 ▪ Fax: (208)783-0891
Certificate: WA C1268

CLIENT : Golder Associates
PROJECT: 043-1344
CLIENT SAMPLE ID: PO-C1-1S(25/08/05)
Sample Collected: 8/25/08 13:05
Sample Receipt : 9/09/05
Date of Report : 9/21/05 As Received Basis

SVL JOB: 118821
SAMPLE: 468447
% Solids: 73.0%
Matrix: SOIL

Determination	Result	Units	Dilution	Method	Analyzed
Arsenic	4.9	mg/kg		6010B	9/20/05
Barium	92.1	mg/kg		6010B	9/20/05
Cadmium	1.01	mg/kg		6010B	9/20/05
Copper	19.0	mg/kg		6010B	9/20/05
Mercury	<0.0330	mg/kg		7471A	9/20/05
Lead	51.5	mg/kg		6010B	9/20/05
Selenium	<4.0	mg/kg		6010B	9/20/05
Zinc	173	mg/kg		6010B	9/20/05

Tests:GOLDER SOIL METALS|

Reviewed By:______________________ Date 9/21/05

9/21/05 14:43

AZ: AZ0538 CA: NO. 2080 CO: 8/18/04 ID: ID00019 NV: 7/31/04 WA: C1268

SVL ANALYTICAL, INC.

Quality Control Report
Part I Prep Blank and Laboratory Control Sample

Client :Golder Associates SVL JOB No: 118821

Analyte	Method	Matrix	Units	Prep Blank	True—LCS	—Found	LCS %R	Analysis Date
Arsenic	6010B	SOIL	mg/kg	<2.50	100	97.1	97.1	9/20/05
Barium	6010B	SOIL	mg/kg	<0.20	100	103	103.0	9/20/05
Cadmium	6010B	SOIL	mg/kg	<0.20	100	98.6	98.6	9/20/05
Copper	6010B	SOIL	mg/kg	<1.0	100	99.0	99.0	9/20/05
Lead	6010B	SOIL	mg/kg	<0.750	100	99.3	99.3	9/20/05
Selenium	6010B	SOIL	mg/kg	<4.0	100	96.4	96.4	9/20/05
Zinc	6010B	SOIL	mg/kg	<1.0	100	98.9	98.9	9/20/05
Mercury	7471A	SOIL	mg/kg	<0.0330	0.834	0.850	101.9	9/20/05

LEGEND:

LCS = Laboratory Control Sample LCS %R = LCS Percent Recovery N/A = Not Applicable

SVL ANALYTICAL, INC.

Quality Control Report
Part II Duplicate and Spike Analysis

Client :Golder Associates

SVL JOB No: 118821

Test	Method	Mtx	QC SAMPLE ID			Duplicate or MSD			Matrix Spike				Analysis
				Units	Result	Found		RPD%	Result	SPK ADD		%R	Date
As	6010B	S	1	mg/kg	4.88	107	M	1.9	109	100		104.1	9/20/05
Ba	6010B	S	1	mg/kg	92.1	233	M	10.9	209	100		116.9	9/20/05
Cd	6010B	S	1	mg/kg	1.01	101	M	0.0	101	100		100.0	9/20/05
Cu	6010B	S	1	mg/kg	19.0	128	M	1.6	126	100		107.0	9/20/05
Pb	6010B	S	1	mg/kg	51.5	161	M	4.4	154	100		102.5	9/20/05
Se	6010B	S	1	mg/kg	<4.0	98.8	M	2.2	101	100		101.0	9/20/05
Zn	6010B	S	1	mg/kg	173	302	M	17.2	359	100		186.0	9/20/05
Zn	6010B	S	1	mg/kg	173	N/A		N/A	267	100	A	94.0	9/20/05
Hg	7471A	S	1	mg/kg	<0.0330	0.182	M	0.0	0.182	0.167		109.0	9/20/05

LEGEND:

RPD% = (|SAM - DUP|/((SAM + DUP)/2) * 100) UDL = Both SAM & DUP not detected. *Result or *Found: Interference required dilution.

RPD% = (|SPK - MSD|/((SPK + MSD)/2) * 100) M in Duplicate/MSD column indicates MSD.

SPIKE ADD column, A = Post Digest Spike; %R = Percent Recovery N/A = Not Analyzed; R > 4S = Result more than 4X the Spike Added

QC limits for MS recoveries apply only if the spike is at least 1/4 the concentration of the analyte in the sample.

Control limits for the RPD apply only if the concentration of the analyte in the sample is at least five times the reporting limit.

QC Sample 1:   SVL SAM No.: 468447   Client Sample ID: PO-C1-1S(25/08/05)

7/9/05 8:45 Walk in - 10.

SVL ANALYTICAL

CHAIN OF CUSTODY RECORD

Page 1 of 1

Client: GOLDER ASSOCIATES
Contact: Doug Morrell
Address: 18300 NE Union Hill Rd. #200
Redmond, WA 98052
Phone Number: (425) 883-0777
FAX Number: (425) 882-5498

NOTES:

1) Ensure proper container packaging.
2) Ship samples promptly following collection.
* 3) Designate Sample Reject Disposition

PO#: 043-1344
Project Name: Teck Cominco RI/FS

Table 1. -- Matrix Type

1 = Surface Water, 2 = Ground Water
3 = Soil/Sediment, 4 = Rinsate, 5 = Oil
6 = Waste, 7 = Other (Specify) ________

FOR SVL USE ONLY
SVL JOB # 118821

Samplers Signature: Pal V Middl

Lab Name: SVL Analytical, Inc. (208) 784-1258 FAX (208) 783-0891
Address: One Government Gulch, Kellogg, ID 83837-0929

	Collection		Miscellaneous				Preservative(s)						Analyses Required									
Sample ID	Date	Time	Collected by: (Init.)	Matrix Type From Table 1	No. of Containers	Sample Filtered ? Y/N	Unpreserved (Ice Only)	HNO3	HCL	H2SO4	NAOH	Other (Specify)	Metals									Comments
1. PO-C1-15(25/08/05)	8/25/05	13:05	PVM	3	1	N	X						X									
2.																						
3.																						
4.																						
5.																						
6.																						
7.																						
8.																						
9.																						temp on arrival 9°C
10.																						

Relinquished by: Pal V Middl Date: 9/8/05 Time: 13:45 Received by: Johanna / D. Garden Date: 9/8/05 Time: 1345
Relinquished by: Date: Time: Received by: JB Duce Date: 9/9/05 Time: 8:45

* Sample Reject: [ ] Return [ ] Dispose [ ] Store (30 Days)

White: LAB COPY Yellow: CUSTOMER COPY SVL-COC 12/95

SVL ANALYTICAL, INC.
One Government Gulch ▪ P.O. Box 929 ▪ Kellogg, Idaho 83837-0929 ▪ Phone: (208)784-1258 ▪ Fax: (208)783-0891

REPORT OF ANALYTICAL RESULTS (TCLP)

CLIENT : Golder Associates
SVL JOB # : 119490
SVL SAMPLE # : 475994

CLIENT SAMPLE ID: PO-TDF2-T13C
Sample Collected: 7/29/05 9:00
Sample Receipt : 10/17/05
Date of Report : 10/28/05

Sample Matrix: Solid Waste
Extraction : TCLP **
Extracted: 10/25/05

Determination	Result	Units	TCLP Reg. Limit	Method	Analysis Date
Lead	1.15	mg/L Ext	5.0	6010B	10/27/05

** Sample extracted according to EPA method 1311 (TCLP).
Tests:TCLP-PB|
Certificate: WA C1268

Reviewed By:________________ Date 10/28/05
10/28/05 9:58

AZ: AZ0538 CA: NO. 2080 CO: 9/1/05 ID: ID00019 MT: 6/6/05 NV: 7/08/05 WA: C1268

SVL ANALYTICAL, INC.
One Government Gulch ▪ P.O. Box 929 ▪ Kellogg, Idaho 83837-0929 ▪ Phone: (208)784-1258 ▪ Fax: (208)783-0891

REPORT OF ANALYTICAL RESULTS (TCLP)

CLIENT : Golder Associates
SVL JOB # : 119490
SVL SAMPLE # : 475995

CLIENT SAMPLE ID: PO-TDF1-8C
Sample Collected: 8/12/05 9:00
Sample Receipt : 10/17/05
Date of Report : 10/28/05

Sample Matrix: Solid Waste
Extraction : TCLP **
Extracted: 10/25/05

Determination	Result	Units	TCLP Reg. Limit	Method	Analysis Date
Lead	6.06	mg/L Ext	5.0	6010B	10/27/05

** Sample extracted according to EPA method 1311 (TCLP).
Tests:TCLP-PB|
Certificate: WA C1268

Reviewed By: Date 10/28/05
10/28/05 9:58

AZ: AZ0538 CA: NO. 2080 CO: 9/1/05 ID: ID00019 MT: 6/6/05 NV: 7/08/05 WA: C1268

SVL ANALYTICAL, INC.

Quality Control Report
Part I Prep Blank and Laboratory Control Sample

Client :Golder Associates

SVL JOB No: 119490

Analyte	Method	Matrix	Units	Prep Blank	True——LCS	——Found	LCS %R	Analysis Date
Lead	6010B	ESOIL	mg/L Ext	<0.00750	1.00	0.941	94.1	10/27/05

LEGEND:

LCS = Laboratory Control Sample

LCS %R = LCS Percent Recovery

N/A = Not Applicable

Quality Control Report
Part II Duplicate and Spike Analysis

Client :Golder Associates

SVL JOB No: 119490

Test	Method	Mtx	QC SAMPLE ID Units	QC SAMPLE ID Result	Duplicate or MSD Found		MSD RPD%	Matrix Spike Result	Matrix Spike SPK ADD	Matrix Spike %R	Analysis Date
Pb	6010B	E 1	mg/L Ex	1.15	2.08	M	1.0	2.06	1.00	91.0	10/27/05

LEGEND:

RPD% = (|SAM - DUP|/((SAM + DUP)/2) * 100) UDL = Both SAM & DUP not detected. *Result or *Found: Interference required dilution.

RPD% = (|SPK - MSD|/((SPK + MSD)/2) * 100) M in Duplicate/MSD column indicates MSD.

SPIKE ADD column, A = Post Digest Spike; %R = Percent Recovery N/A = Not Analyzed; R > 4S = Result more than 4X the Spike Added

QC limits for MS recoveries apply only if the spike is at least 1/4 the concentration of the analyte in the sample.

Control limits for the RPD apply only if the concentration of the analyte in the sample is at least five times the reporting limit.

QC Sample 1: SVL SAM No.: 475994 Client Sample ID: PO-TDF2-T13C

SVL ANALYTICAL, INC.

One Government Gulch ▪ P.O. Box 929 ▪ Kellogg, Idaho 83827-0929 ▪ Phone: (208)784-1258 ▪ Fax: (208)783-0891

REPORT OF ANALYTICAL RESULTS

CLIENT : Golder Associates
PROJECT:

Sample Receipt: 1/26/06
Report Date: 2/07/06

Page 1 of 1
SVL JOB: 120979

SVL ID	CLIENT SAMPLE ID		Cd 6010B	Pb 6010B
E491518	PO-TDF1-T1C	7/30/05	0.134mg/L E	2.22mg/L E
E491519	PO-TDF1-T2C	7/30/05	0.128mg/L E	3.86mg/L E
E491520	PO-TDF1-T3C	7/30/05	0.119mg/L E	1.31mg/L E
E491521	PO-TDF1-T4C	7/30/05	0.0910mg/L E	2.23mg/L E
E491522	PO-TDF1-T5C	7/30/05	0.145mg/L E	0.790mg/L E
E491523	PO-TDF1-T6C	7/30/05	0.0750mg/L E	2.30mg/L E
E491524	PO-TDF1-T7C	7/30/05	0.114mg/L E	0.976mg/L E
E491525	PO-TDF1-T9C	7/30/05	0.217mg/L E	0.920mg/L E
E491526	PO-TDF1-T10C	7/30/05	0.0720mg/L E	1.84mg/L E
E491527	PO-TDF1-T11C	7/30/05	0.0980mg/L E	3.81mg/L E
E491528	PO-TDF1-T12C	7/30/05	0.105mg/L E	3.09mg/L E
E491529	PO-TDF2-T13C	7/29/05	0.598mg/L E	3.56mg/L E
E491530	PO-TDF2-T14C	7/29/05	0.130mg/L E	0.375mg/L E
E491531	PO-TDF2-T15C	7/29/05	0.104mg/L E	1.21mg/L E
E491532	PO-TDF2-T16C	7/29/05	0.134mg/L E	0.459mg/L E
E491533	PO-TDF2-T17C	7/29/05	0.101mg/L E	0.540mg/L E
E491534	PO-TDF1-T18C	8/12/05	0.0400mg/L E	2.81mg/L E
E491535	PO-TDF1-T8C	8/12/05	0.0350mg/L E	5.44mg/L E

Samples with SVL ID prefix 'E' were extracted according to: TCLP
Certificate: WA C1268
AZ: AZ0538 CA: NO. 2080 CO: 9/1/05 ID: ID00019 MT: 6/6/05 NV: 8/1/05 WA: C1268

Reviewed By: ____________________ Date: 2/7/06

SVL ANALYTICAL, INC.

Quality Control Report
Part I Prep Blank and Laboratory Control Sample

Client :Golder Associates

SVL JOB No: 120979

Analyte	Method	Matrix	Units	Prep Blank	True—LCS	—Found	LCS %R	Analysis Date
Cadmium	6010B	ESOIL	mg/L Ext	<0.010	1.00	0.916	91.6	2/06/06
Lead	6010B	ESOIL	mg/L Ext	<0.050	1.00	0.930	93.0	2/06/06

LEGEND:

LCS = Laboratory Control Sample

LCS %R = LCS Percent Recovery

N/A = Not Applicable

2/07/06 11:43

SVL ANALYTICAL, INC.

Quality Control Report
Part II Duplicate and Spike Analysis

Client :Golder Associates

SVL JOB No: 120979

Test	Method	Mtx	QC SAMPLE ID	Units	Result	Duplicate or MSD Found		RPD%	Matrix Spike Result	SPK ADD		%R	Analysis Date
Cd	6010B	E	1	mg/L Ex	0.134	0.294	M	2.1	0.288	0.200		77.0	2/06/06
Cd	6010B	E	2	mg/L Ex	0.105	N/A		N/A	0.266	0.200		80.5	2/06/06
Pb	6010B	E	1	mg/L Ex	2.22	3.12	M	1.9	3.06	1.00		84.0	2/06/06
Pb	6010B	E	2	mg/L Ex	3.09	N/A		N/A	3.73	1.00		64.0	2/06/06
Pb	6010B	E	2	mg/L Ex	3.09	N/A		N/A	3.58	1.00	A	49.0	2/06/06

LEGEND:

RPD% = (|SAM - DUP|/((SAM + DUP)/2) * 100) UDL = Both SAM & DUP not detected. *Result or *Found: Interference required dilution.

RPD% = (|SPK - MSD|/((SPK + MSD)/2) * 100) M in Duplicate/MSD column indicates MSD.

SPIKE ADD column, A = Post Digest Spike; %R = Percent Recovery N/A = Not Analyzed; R > 4S = Result more than 4X the Spike Added

QC limits for MS recoveries apply only if the spike is at least 1/4 the concentration of the analyte in the sample.

Control limits for the RPD apply only if the concentration of the analyte in the sample is at least five times the reporting limit.

QC Sample 1: SVL SAM No.: 491518 Client Sample ID: PO-TDF1-T1C

QC Sample 2: SVL SAM No.: 491528 Client Sample ID: PO-TDF1-T12C

2/07/06 11:43

TCLP Extraction Log

PART I

JOB#: 120979

SVL ANALYTICAL, INC.

CASE #: SAS #: SDG #:

SVL#	M	ClientID	Init. Wt.	mls H2O	Init. pH	mls 1N HCl	pH	mls ext. fluid/type	Sample Wt.	Final pH
pH 4 Buffer					4.01		4.01			4.00
pH 7 Buffer					7.00		7.00			7.00
~~491516~~	~~ES~~	~~EXTRACTION FLUID 1~~								
491517	ES	EXTRACTION FLUID 2								2.88
491518	ES	PO-TDF1-T1C	5g	96.5mls	8.54	3.5mls	5.31	2000mls#2	100g	5.80
491519	ES	PO-TDF1-T2C	5g	96.5mls	8.28	3.5mls	5.35	2000mls#2	100g	5.04
491520	ES	PO-TDF1-T3C	5g	96.5mls	8.10	3.5mls	5.31	2000mls#2	100g	5.18
491521	ES	PO-TDF1-T4C	5g	96.5mls	8.15	3.5mls	5.26	2000mls#2	100g	5.21
491522	ES	PO-TDF1-T5C	5g	96.5mls	8.61	3.5mls	5.25	2000mls#2	100g	6.02
491523	ES	PO-TDF1-T6C	5g	96.5mls	8.70	3.5mls	5.41	2000mls#2	100g	5.84
491524	ES	PO-TDF1-T7C	5g	96.5mls	7.99	3.5mls	5.63	2000mls#2	100g	5.33
491525	ES	PO-TDF1-T9C	5g	96.5mls	8.55	3.5mls	5.78	2000mls#2	100g	5.99
491526	ES	PO-TDF1-T10C	5g	96.5mls	8.63	3.5mls	5.31	2000mls#2	100g	5.69
491527	ES	PO-TDF1-T11C	5g	96.5mls	8.83	3.5mls	5.35	2000mls#2	100g	5.36
491528	ES	PO-TDF1-T12C	5g	96.5mls	8.84	3.5mls	5.74	2000mls#2	100g	5.74
491529	ES	PO-TDF2-T13C	5g	96.5mls	8.04	3.5mls	5.30	2000mls#2	100g	5.20
491530	ES	PO-TDF2-T14C	5g	96.5mls	8.25	3.5mls	5.30	2000mls#2	100g	5.96
491531	ES	PO-TDF2-T15C	5g	96.5mls	8.27	3.5mls	5.26	2000mls#2	100g	6.08
491532	ES	PO-TDF2-T16C	5g	96.5mls	8.13	3.5mls	5.12	2000mls#2	100g	5.73
491533	ES	PO-TDF2-T17C	5g	96.5mls	8.33	3.5mls	5.25	2000mls#2	100g	5.78
491534	ES	PO-TDF1-T18C	5g	96.5mls	8.39	3.5mls	5.77	1900mls#2	95g	5.67
491535	ES	PO-TDF1-T8C	5g	96.5mls	8.54	3.5mls	5.82	1860mls#2	93g	5.74

Extraction Started By: Ga Date/Time: 01/26/06 1700

Extraction Completed By: Ga Date/Time: 01/28/06 0800

Client: Golder Associates

Received: 1/26/06

v3.0

TCLP Extraction Log

PART II

JOB#: 120979

SVL ANALYTICAL, INC.

CASE #:
SAS #:
SDG #:

SVL#	M	ClientID	Ext. Fluid pH	Multi-phasic Y/N	% Solids Wet	Dry	%	Part Size Reduction Y/N	Sample Filtration	Air Temp.	RPM
~~491516~~	~~ES~~	~~EXTRACTION FLUID 1~~									
491517	ES	EXTRACTION FLUID 2	2.88								
491518	ES	PO-TDF1-T1C	2.88	N	—	—	100%	N	Y	22°c/24°c	30
491519	ES	PO-TDF1-T2C	2.88	N	—	—	100%	N	Y	22°c/24°c	30
491520	ES	PO-TDF1-T3C	2.88	N	—	—	100%	N	Y	22°c/24°c	30
491521	ES	PO-TDF1-T4C	2.88	N	—	—	100%	N	Y	22°c/24°c	30
491522	ES	PO-TDF1-T5C	2.88	N	—	—	100%	N	Y	22°c/24°c	30
491523	ES	PO-TDF1-T6C	2.88	N	—	—	100%	N	Y	22°c/24°c	30
491524	ES	PO-TDF1-T7C	2.88	N	—	—	100%	N	Y	22°c/24°c	30
491525	ES	PO-TDF1-T9C	2.88	N	—	—	100%	N	Y	22°c/24°c	30
491526	ES	PO-TDF1-T10C	2.88	N	—	—	100%	N	Y	22°c/24°c	30
491527	ES	PO-TDF1-T11C	2.88	N	—	—	100%	N	Y	22°c/24°c	30
491528	ES	PO-TDF1-T12C	2.88	N	—	—	100%	N	Y	22°c/24°c	30
491529	ES	PO-TDF2-T13C	2.88	N	—	—	100%	N	Y	22°c/24°c	30
491530	ES	PO-TDF2-T14C	2.88	N	—	—	100%	N	Y	22°c/24°c	30
491531	ES	PO-TDF2-T15C	2.88	N	—	—	100%	N	Y	22°c/24°c	30
491532	ES	PO-TDF2-T16C	2.88	N	—	—	100%	N	Y	22°c/24°c	30
491533	ES	PO-TDF2-T17C	2.88	N	—	—	100%	N	Y	22°c/24°c	30
491534	ES	PO-TDF1-T18C	2.88	Y	5	95	95%	N	Y	22°c/24°c	30
491535	ES	PO-TDF1-T8C	2.88	Y	7	93	93%	N	Y	22°c/24°c	30

Extraction Started By: Ga Date/Time: 01/26/06 1700

Extraction Completed By: Ga Date/Time: 01/28/06 0800

Client: Golder Associates

Received: 1/26/06

v3.0

SVL ANALYTICAL, INC.

REPORT OF ANALYTICAL RESULTS

One Government Gulch ▪ P.O. Box 929 ▪ Kellogg, Idaho 83837-0929 ▪ Phone: (208)784-1258 ▪ Fax: (208)783-0891

CLIENT : GOLDER & ASSOCIATES INC
PROJECT: 043-1344

Sample Receipt: 5/10/06
Report Date: 5/24/06

Page 1 of 3
SVL JOB: 122575

SVL ID	CLIENT SAMPLE ID	Ag 200.7	As 200.8	Ba 200.7	Ca 200.7	Cd 200.8	Cr 200.7	Cu 200.8	Fe 200.7
W505845	C1-2 ^T 5/04/06	---	---	---	---	---	---	---	---
W505846	C2-1 ^T 5/04/06	---	---	---	---	---	---	---	---
W505847	C2-2 ^T 5/04/06	<0.0050mg/L	<0.0030mg/L	0.0618mg/L	105mg/L	0.00042mg/L	<0.0060mg/L	0.0017mg/L	0.90mg/L
W505848	C2-22 ^T 5/04/06	<0.0050mg/L	<0.0030mg/L	0.0605mg/L	100mg/L	0.00031mg/L	<0.0060mg/L	0.0011mg/L	0.78mg/L
W505849	UD-1 ^T 5/04/06	---	---	---	---	---	---	---	---
W505850	W1-1 ^T 5/05/06	---	---	---	---	---	---	---	---
W505851	W1-2 ^T 5/05/06	---	---	---	---	---	---	---	---
W505852	W1-SEEP 1 ^T 5/05/06	---	---	---	---	---	---	---	---
W505853	W1-SEEP 2 ^T 5/05/06	---	---	---	---	---	---	---	---
W505854	P01 ^T 5/03/06	---	---	---	---	---	---	---	---
W505855	P02 ^T 5/03/06	<0.0050mg/L	0.0084mg/L	0.126mg/L	86.6mg/L	0.00135mg/L	<0.0060mg/L	1.04mg/L	5.30mg/L
W505856	P03 ^T 5/03/06	---	---	---	---	---	---	---	---
W505857	P04 ^T 5/03/06	---	---	---	---	---	---	---	---
W505858	P05 ^T 5/03/06	---	---	---	---	---	---	---	---
W505859	S-1 ^T 5/04/06	---	---	---	---	---	---	---	---
W505860	S-2 ^T 5/04/06	---	---	---	---	---	---	---	---
W505861	S-3 ^T 5/04/06	---	---	---	---	---	---	---	---
W505862	S-5 ^T 5/04/06	---	---	---	---	---	---	---	---
W505863	C1-2 ^D 5/04/06	<0.0050mg/L	<0.00300mg/L	0.0329mg/L	66.0mg/L	0.00053mg/L	<0.0060mg/L	<0.00100mg/L	<0.06mg/L
W505864	C2-1 ^D 5/04/06	<0.0050mg/L	<0.0030mg/L	0.0552mg/L	90.2mg/L	<0.00020mg/L	<0.0060mg/L	<0.00100mg/L	<0.06mg/L
W505865	C2-2 ^D 5/04/06	<0.0050mg/L	<0.0030mg/L	0.0586mg/L	98.9mg/L	<0.00020mg/L	<0.0060mg/L	<0.00100mg/L	<0.06mg/L
W505866	C2-22 ^D 5/04/06	<0.0050mg/L	<0.0030mg/L	0.0599mg/L	99.6mg/L	<0.00020mg/L	<0.0060mg/L	<0.00100mg/L	<0.06mg/L
W505867	UD-1 ^D 5/04/06	<0.0050mg/L	<0.0030mg/L	0.0586mg/L	205mg/L	0.00082mg/L	<0.0060mg/L	0.00127mg/L	<0.06mg/L
W505868	W1-1 ^D 5/05/06	<0.0050mg/L	<0.0030mg/L	0.0609mg/L	94.8mg/L	<0.00020mg/L	<0.0060mg/L	<0.00100mg/L	0.07mg/L
W505869	W1-2 ^D 5/05/06	<0.0050mg/L	<0.0030mg/L	0.0607mg/L	89.8mg/L	<0.00020mg/L	<0.0060mg/L	<0.00100mg/L	0.06mg/L
W505870	W1-SEEP 1 ^D 5/05/06	<0.0050mg/L	<0.0030mg/L	0.0387mg/L	97.4mg/L	<0.00020mg/L	<0.0060mg/L	<0.00100mg/L	<0.06mg/L
W505871	W1-SEEP 2 ^D 5/05/06	<0.0050mg/L	<0.0030mg/L	0.0502mg/L	92.6mg/L	<0.00020mg/L	<0.0060mg/L	<0.00100mg/L	<0.06mg/L
W505872	P01 ^D 5/03/06	<0.0050mg/L	<0.0030mg/L	0.0156mg/L	391mg/L	<0.00020mg/L	<0.0060mg/L	<0.00100mg/L	0.21mg/L
W505873	P02 ^D 5/03/06	<0.0050mg/L	0.0044mg/L	0.111mg/L	76.2mg/L	<0.00020mg/L	<0.0060mg/L	0.00126mg/L	2.22mg/L
W505874	P03 ^D 5/03/06	<0.0050mg/L	<0.0030mg/L	0.0120mg/L	557mg/L	<0.00020mg/L	<0.0060mg/L	<0.00100mg/L	22.7mg/L
W505875	P04 ^D 5/03/06	<0.0050mg/L	<0.0030mg/L	0.0263mg/L	249mg/L	<0.00020mg/L	<0.0060mg/L	0.00509mg/L	1.18mg/L
W505876	P05 ^D 5/03/06	<0.0050mg/L	<0.0030mg/L	0.248mg/L	82.3mg/L	<0.00020mg/L	<0.0060mg/L	<0.00100mg/L	0.41mg/L
W505877	S-1 ^D 5/04/06	<0.0050mg/L	<0.0030mg/L	0.0511mg/L	151mg/L	0.00024mg/L	<0.0060mg/L	<0.00100mg/L	0.53mg/L
W505878	S-2 ^D 5/04/06	<0.0050mg/L	<0.0030mg/L	0.0598mg/L	94.9mg/L	<0.00020mg/L	<0.0060mg/L	<0.00100mg/L	<0.06mg/L
W505879	S-3 ^D 5/04/06	<0.0050mg/L	<0.0030mg/L	0.0887mg/L	75.1mg/L	<0.00020mg/L	<0.0060mg/L	<0.00100mg/L	<0.06mg/L
W505880	S-5 ^D 5/04/06	<0.0050mg/L	<0.0030mg/L	0.0748mg/L	148mg/L	0.00097mg/L	<0.0060mg/L	<0.00100mg/L	<0.06mg/L

---: Not Requested

Certificate: ID ID00019

CLIENT : GOLDER & ASSOCIATES INC
PROJECT: 043-1344

Sample Receipt: 5/10/06
Report Date: 5/24/06

SVL JOB: 122575

SVL ID	CLIENT SAMPLE ID	Mg 200.7	Mn 200.7	Pb 200.8	Se 200.8	Zn 200.7	Hg 245.1	Cl 300.0	SO4 300.0
W505845	C1-2 ^T 5/04/06	---	---	---	---	---	---	0.42mg/L	56.0mg/L
W505846	C2-1 ^T 5/04/06	---	---	---	---	---	---	2.54mg/L	106mg/L
W505847	C2-2 ^T 5/04/06	36.2mg/L	0.063mg/L	0.0245mg/L	<0.0030mg/L	0.197mg/L	<0.00020mg/L	3.30mg/L	145mg/L
W505848	C2-22 ^T 5/04/06	33.6mg/L	0.040mg/L	0.0160mg/L	<0.0030mg/L	0.170mg/L	<0.00020mg/L	3.33mg/L	145mg/L
W505849	UD-1 ^T 5/04/06	---	---	---	---	---	---	2.05mg/L	491mg/L
W505850	W1-1 ^T 5/05/06	---	---	---	---	---	---	5.21mg/L	106mg/L
W505851	W1-2 ^T 5/05/06	---	---	---	---	---	---	4.03mg/L	93.4mg/L
W505852	W1-SEEP 1 ^T 5/05/06	---	---	---	---	---	---	3.95mg/L	126mg/L
W505853	W1-SEEP 2 ^T 5/05/06	---	---	---	---	---	---	4.06mg/L	100mg/L
W505854	P01 ^T 5/03/06	---	---	---	---	---	---	0.71mg/L	1750mg/L
W505855	P02 ^T 5/03/06	23.2mg/L	0.739mg/L	0.177mg/L	<0.0030mg/L	0.420mg/L	<0.00020mg/L	4.31mg/L	36.3mg/L
W505856	P03 ^T 5/03/06	---	---	---	---	---	---	0.35mg/L	1630mg/L
W505857	P04 ^T 5/03/06	---	---	---	---	---	---	2.21mg/L	835mg/L
W505858	P05 ^T 5/03/06	---	---	---	---	---	---	3.44mg/L	47.2mg/L
W505859	S-1 ^T 5/04/06	---	---	---	---	---	---	2.62mg/L	416mg/L
W505860	S-2 ^T 5/04/06	---	---	---	---	---	---	3.38mg/L	110mg/L
W505861	S-3 ^T 5/04/06	---	---	---	---	---	---	3.42mg/L	87.7mg/L
W505862	S-5 ^T 5/04/06	---	---	---	---	---	---	2.93mg/L	294mg/L
W505863	C1-2 ^D 5/04/06	15.6mg/L	<0.004mg/L	<0.00300mg/L	<0.00300mg/L	0.0333mg/L	<0.00020mg/L	---	---
W505864	C2-1 ^D 5/04/06	29.9mg/L	0.021mg/L	<0.00300mg/L	<0.0030mg/L	0.0803mg/L	<0.00020mg/L	---	---
W505865	C2-2 ^D 5/04/06	32.9mg/L	0.015mg/L	<0.00300mg/L	<0.0030mg/L	0.0964mg/L	<0.00020mg/L	---	---
W505866	C2-22 ^D 5/04/06	32.7mg/L	0.012mg/L	<0.00300mg/L	<0.0030mg/L	0.0979mg/L	<0.00020mg/L	---	---
W505867	UD-1 ^D 5/04/06	45.8mg/L	0.052mg/L	<0.00300mg/L	<0.0030mg/L	6.69mg/L	<0.00020mg/L	---	---
W505868	W1-1 ^D 5/05/06	27.0mg/L	0.055mg/L	<0.00300mg/L	<0.0030mg/L	0.0588mg/L	<0.00020mg/L	---	---
W505869	W1-2 ^D 5/05/06	25.7mg/L	0.029mg/L	<0.00300mg/L	<0.0030mg/L	<0.0100mg/L	<0.00020mg/L	---	---
W505870	W1-SEEP 1 ^D 5/05/06	31.4mg/L	0.011mg/L	<0.00300mg/L	<0.0030mg/L	<0.0100mg/L	<0.00020mg/L	---	---
W505871	W1-SEEP 2 ^D 5/05/06	27.2mg/L	0.005mg/L	<0.00300mg/L	<0.0030mg/L	<0.0100mg/L	<0.00020mg/L	---	---
W505872	P01 ^D 5/03/06	196mg/L	0.059mg/L	<0.0030mg/L	<0.0030mg/L	<0.0100mg/L	<0.00020mg/L	---	---
W505873	P02 ^D 5/03/06	21.2mg/L	0.714mg/L	<0.00300mg/L	<0.0030mg/L	<0.0100mg/L	<0.00020mg/L	---	---
W505874	P03 ^D 5/03/06	137mg/L	0.037mg/L	<0.0030mg/L	<0.0030mg/L	<0.0100mg/L	<0.00020mg/L	---	---
W505875	P04 ^D 5/03/06	112mg/L	0.108mg/L	<0.00300mg/L	<0.0030mg/L	<0.0100mg/L	<0.00020mg/L	---	---
W505876	P05 ^D 5/03/06	49.9mg/L	0.029mg/L	<0.00300mg/L	<0.0030mg/L	<0.0100mg/L	<0.00020mg/L	---	---
W505877	S-1 ^D 5/04/06	64.9mg/L	0.361mg/L	<0.00300mg/L	<0.0030mg/L	0.987mg/L	<0.00020mg/L	---	---
W505878	S-2 ^D 5/04/06	27.8mg/L	0.013mg/L	<0.00300mg/L	<0.0030mg/L	0.0534mg/L	<0.00020mg/L	---	---
W505879	S-3 ^D 5/04/06	29.6mg/L	0.344mg/L	<0.00300mg/L	<0.0030mg/L	0.0375mg/L	<0.00020mg/L	---	---
W505880	S-5 ^D 5/04/06	37.1mg/L	0.012mg/L	<0.00300mg/L	<0.0030mg/L	0.643mg/L	<0.00020mg/L	---	---

---: Not Requested

CLIENT : GOLDER & ASSOCIATES INC
PROJECT: 043-1344

Sample Receipt: 5/10/06
Report Date: 5/24/06

SVL JOB: 122575

SVL ID	CLIENT SAMPLE ID	ALK 2320B
W505845	C1-2 ^T 5/04/06	177mg/L
W505846	C2-1 ^T 5/04/06	192mg/L
W505847	C2-2 ^T 5/04/06	262mg/L
W505848	C2-22 ^T 5/04/06	254mg/L
W505849	UD-1 ^T 5/04/06	229mg/L
W505850	W1-1 ^T 5/05/06	256mg/L
W505851	W1-2 ^T 5/05/06	250mg/L
W505852	W1-SEEP 1 ^T 5/05/06	254mg/L
W505853	W1-SEEP 2 ^T 5/05/06	253mg/L
W505854	P01 ^T 5/03/06	12.4mg/L
W505855	P02 ^T 5/03/06	259mg/L
W505856	P03 ^T 5/03/06	331mg/L
W505857	P04 ^T 5/03/06	254mg/L
W505858	P05 ^T 5/03/06	390mg/L
W505859	S-1 ^T 5/04/06	212mg/L
W505860	S-2 ^T 5/04/06	249mg/L
W505861	S-3 ^T 5/04/06	225mg/L
W505862	S-5 ^T 5/04/06	246mg/L

Certificate: ID ID00019
AZ: AZ0538 CA: NO. 2080 CO: 9/1/05 ID: ID00019 MT: 6/6/05 NV: 8/1/05 WA: C1268

Reviewed By: ______ Date: 5/24/06

Quality Control Report
Part I Prep Blank and Laboratory Control Sample

Client :GOLDER & ASSOCIATES INC

SVL JOB No: 122575

Analyte	Method	Matrix	Units	Prep Blank	True——LCS	——Found	LCS %R	Analysis Date
Silver	200.7	WATER	mg/L	<0.0050	0.0500	0.0541	108.2	5/17/06
Arsenic	200.8	WATER	mg/L	<0.0030	0.0250	0.0257	102.8	5/15/06
Arsenic	200.8	WATER	mg/L	<0.00300	0.0250	0.0266	106.4	5/16/06
Barium	200.7	WATER	mg/L	<0.0020	1.00	1.05	105.0	5/17/06
Calcium	200.7	WATER	mg/L	<0.040	20.0	19.4	97.0	5/17/06
Cadmium	200.8	WATER	mg/L	<0.00020	0.0250	0.0260	104.0	5/15/06
Cadmium	200.8	WATER	mg/L	<0.00020	0.0250	0.0264	105.6	5/15/06
Chromium	200.7	WATER	mg/L	<0.0060	1.00	1.02	102.0	5/17/06
Copper	200.8	WATER	mg/L	<0.0010	0.0250	0.0249	99.6	5/16/06
Copper	200.8	WATER	mg/L	<0.00100	0.0250	0.0263	105.2	5/15/06
Iron	200.7	WATER	mg/L	<0.06	10.0	9.80	98.0	5/17/06
Magnesium	200.7	WATER	mg/L	<0.06	20.0	19.4	97.0	5/17/06
Manganese	200.7	WATER	mg/L	<0.004	1.00	1.01	101.0	5/17/06
Lead	200.8	WATER	mg/L	<0.0030	0.0250	0.0246	98.4	5/15/06
Lead	200.8	WATER	mg/L	<0.00300	0.0250	0.0262	104.8	5/15/06
Selenium	200.8	WATER	mg/L	<0.0030	0.0250	0.0260	104.0	5/15/06
Selenium	200.8	WATER	mg/L	<0.00300	0.0250	0.0259	103.6	5/16/06
Zinc	200.7	WATER	mg/L	<0.0100	1.00	1.00	100.0	5/17/06
Mercury	245.1	WATER	mg/L	<0.00020	0.00500	0.00571	114.2	5/11/06
Mercury	245.1	WATER	mg/L	<0.00020	0.00500	0.00524	104.8	5/11/06
Chloride	300.0	WATER	mg/L	<0.20	5.05	5.00	99.0	5/16/06
Sulfate, SO4	300.0	WATER	mg/L	<0.30	9.93	9.94	100.1	5/16/06
ALKALINITY	2320B	WATER	mg/L	<1.0	117	119	101.7	5/11/06

LEGEND:

LCS = Laboratory Control Sample
LCS %R = LCS Percent Recovery
N/A = Not Applicable

Quality Control Report
Part II Duplicate and Spike Analysis

Client :GOLDER & ASSOCIATES INC

SVL JOB No: 122575

			QC SAMPLE ID			Duplicate or	MSD	Matrix Spike			Analysis
Test	Method	Mtx		Units	Result	Found	RPD%	Result	SPK ADD	%R	Date
Ag	200.7	W	1	mg/L	<0.0050	<0.0050	UDL	0.0545	0.0500	109.0	5/17/06
Ag	200.7	W	2	mg/L	<0.0050	<0.0050	UDL	0.0535	0.0500	107.0	5/17/06
Ag	200.7	W	3	mg/L	<0.0050	N/A	N/A	0.0503	0.0500	100.6	5/17/06
As	200.8	W	1	mg/L	<0.0030	<0.0030	UDL	0.0276	0.0250	110.4	5/15/06
As	200.8	W	2	mg/L	<0.00300	<0.00300	UDL	0.0248	0.0250	99.2	5/15/06
As	200.8	W	3	mg/L	0.0044	N/A	N/A	0.0298	0.0250	101.6	5/16/06
Ba	200.7	W	1	mg/L	0.0618	0.0613	0.8	1.11	1.00	104.8	5/17/06
Ba	200.7	W	2	mg/L	0.0329	0.0327	0.6	1.07	1.00	103.7	5/17/06
Ba	200.7	W	3	mg/L	0.111	N/A	N/A	1.15	1.00	103.9	5/17/06
Ca	200.7	W	1	mg/L	105	105	0.0	122	20.0	85.0	5/17/06
Ca	200.7	W	2	mg/L	66.0	67.0	1.5	84.1	20.0	90.5	5/17/06
Ca	200.7	W	3	mg/L	76.2	N/A	N/A	93.8	20.0	88.0	5/17/06
Cd	200.8	W	1	mg/L	0.00042	0.00047	11.2	0.0262	0.0250	103.1	5/15/06
Cd	200.8	W	2	mg/L	0.00053	0.00054	1.9	0.0283	0.0250	111.1	5/15/06
Cd	200.8	W	3	mg/L	<0.00020	N/A	N/A	0.0276	0.0250	110.4	5/15/06
Cr	200.7	W	1	mg/L	<0.0060	<0.0060	UDL	1.03	1.00	103.0	5/17/06
Cr	200.7	W	2	mg/L	<0.0060	<0.0060	UDL	1.01	1.00	101.0	5/17/06
Cr	200.7	W	3	mg/L	<0.0060	N/A	N/A	1.02	1.00	102.0	5/17/06
Cu	200.8	W	1	mg/L	0.0017	0.0019	11.1	0.0260	0.0250	97.2	5/16/06
Cu	200.8	W	2	mg/L	<0.00100	<0.00100	UDL	0.0242	0.0250	96.8	5/15/06
Cu	200.8	W	3	mg/L	0.00126	N/A	N/A	0.0251	0.0250	95.4	5/15/06
Fe	200.7	W	1	mg/L	0.90	0.97	7.5	11.0	10.0	101.0	5/17/06
Fe	200.7	W	2	mg/L	<0.06	<0.06	UDL	9.89	10.0	98.9	5/17/06
Fe	200.7	W	3	mg/L	2.22	N/A	N/A	11.9	10.0	96.8	5/17/06
Mg	200.7	W	1	mg/L	36.2	35.6	1.7	55.3	20.0	95.5	5/17/06
Mg	200.7	W	2	mg/L	15.6	15.6	0.0	33.9	20.0	91.5	5/17/06
Mg	200.7	W	3	mg/L	21.2	N/A	N/A	40.4	20.0	96.0	5/17/06
Mn	200.7	W	1	mg/L	0.063	0.064	1.6	1.09	1.00	102.7	5/17/06
Mn	200.7	W	2	mg/L	<0.004	<0.004	UDL	1.01	1.00	101.0	5/17/06
Mn	200.7	W	3	mg/L	0.714	N/A	N/A	1.68	1.00	96.6	5/18/06
Pb	200.8	W	1	mg/L	0.0245	0.0261	6.3	0.0479	0.0250	93.6	5/15/06
Pb	200.8	W	2	mg/L	<0.00300	<0.00300	UDL	0.0245	0.0250	98.0	5/15/06
Pb	200.8	W	3	mg/L	<0.00300	N/A	N/A	0.0244	0.0250	97.6	5/15/06
Se	200.8	W	1	mg/L	<0.0030	<0.0030	UDL	0.0282	0.0250	112.8	5/15/06
Se	200.8	W	2	mg/L	<0.00300	<0.00300	UDL	0.0251	0.0250	100.4	5/15/06
Se	200.8	W	3	mg/L	<0.0030	N/A	N/A	0.0278	0.0250	111.2	5/16/06
Zn	200.7	W	1	mg/L	0.197	0.200	1.5	1.20	1.00	100.3	5/17/06
Zn	200.7	W	2	mg/L	0.0333	0.0345	3.5	1.05	1.00	101.7	5/17/06
Zn	200.7	W	3	mg/L	<0.0100	N/A	N/A	1.04	1.00	104.0	5/17/06
Hg	245.1	W	1	mg/L	<0.00020	<0.00020	UDL	0.00112	0.0010	112.0	5/11/06
Hg	245.1	W	2	mg/L	<0.00020	<0.00020	UDL	0.00118	0.0010	118.0	5/11/06
Hg	245.1	W	3	mg/L	<0.00020	N/A	N/A	0.00115	0.0010	115.0	5/11/06
Cl	300.0	W	1	mg/L	3.30	3.32	0.6	6.38	3.00	102.7	5/16/06
Cl	300.0	W	4	mg/L	2.21	N/A	N/A	5.28	3.00	102.3	5/17/06
SO4	300.0	W	1	mg/L	145	143	1.4	194	50.0	98.0	5/16/06
SO4	300.0	W	4	mg/L	835	N/A	N/A	1080	250	98.0	5/16/06

LEGEND:

RPD% = (|SAM - DUP|/((SAM + DUP)/2) * 100) UDL = Both SAM & DUP not detected. *Result or *Found: Interference required dilution.

RPD% = (|SPK - MSD|/((SPK + MSD)/2) * 100) M in Duplicate/MSD column indicates MSD.

SPIKE ADD column, A = Post Digest Spike; %R = Percent Recovery N/A = Not Analyzed; R > 4S = Result more than 4X the Spike Added

QC limits for MS recoveries apply only if the spike is at least 1/4 the concentration of the analyte in the sample.

Control limits for the RPD apply only if the concentration of the analyte in the sample is at least five times the reporting limit.

QC Sample 1: SVL SAM No.: 505847 Client Sample ID: C2-2 ^T
QC Sample 2: SVL SAM No.: 505863 Client Sample ID: C1-2 ^D
QC Sample 3: SVL SAM No.: 505873 Client Sample ID: P02 ^D
QC Sample 4: SVL SAM No.: 505857 Client Sample ID: P04 ^T

Quality Control Report
Part II Duplicate and Spike Analysis

Client :GOLDER & ASSOCIATES INC

SVL JOB No: 122575

Test	Method	Mtx	QC SAMPLE ID Units	QC SAMPLE ID Result	Duplicate or MSD Found	RPD%	Matrix Spike Result	Matrix Spike SPK ADD	Matrix Spike %R	Analysis Date
ALK	2320B	W 1	mg/L	262	255	2.7	N/A	N/A	N/A	5/11/06

LEGEND:

RPD% = (|SAM - DUP|/((SAM + DUP)/2) * 100) UDL = Both SAM & DUP not detected. *Result or *Found: Interference required dilution.
RPD% = (|SPK - MSD|/((SPK + MSD)/2) * 100) M in Duplicate/MSD column indicates MSD.
SPIKE ADD column, A = Post Digest Spike; %R = Percent Recovery N/A = Not Analyzed; R > 4S = Result more than 4X the Spike Added
QC limits for MS recoveries apply only if the spike is at least 1/4 the concentration of the analyte in the sample.
Control limits for the RPD apply only if the concentration of the analyte in the sample is at least five times the reporting limit.

QC Sample 1: SVL SAM No.: 505847 Client Sample ID: C2-2 ^T

SVL ANALYTICAL

Temp 3.3° / 3.1° KS 5-10-06

CHAIN OF CUSTODY RECORD

Page 1 of 2

Client: GOLDER Assoc.
Contact: Doug Morell
Address: 18300 NE Union Hill Rd. #200
Redmond, WA 98052
Phone Number: (425) 883-0777
FAX Number: (425) 882-5498

NOTES:

1) Ensure proper container packaging.
2) Ship samples promptly following collection.
3) Designate Sample Reject Disposition

PO#: 043-1344
Project Name: T.O. Mine RI/FS

Table 1. -- Matrix Type
1 = Surface Water, 2 = Ground Water
3 = Soil/Sediment, 4 = Rinsate, 5 = Oil
6 = Waste, 7 = Other (Specify) ______

FOR SVL USE ONLY
SVL JOB # 122575

Samplers Signature: Pal Va Mi

Lab Name: SVL Analytical, Inc. (208) 784-1258 FAX (208) 783-0891
Address: One Government Gulch, Kellogg, ID 83837-0929

Sample ID	Collection		Miscellaneous				Preservative(s)						Analyses Required									Comments
	Date	Time	Collected by: (Init.)	Matrix Type From Table 1	No. of Containers	Sample Filtered ? Y/N	Unpreserved (Ice Only)	HNO3	HCL	H2SO4	NAOH	Other (Specify)	Dissolved Metals	ANIONS	Total Metals							Temp 1°C
1. P01	5/3/06	10:00	PVM	2	2	1	1						1	1								
2. P02	5/3/06	9:15	↓	↓	3	2	1						1	1	1							
3. P03	5/3/06	8:30	↓	↓	2	1	1						1	1								
4. P04	5/3/06	10:30	↓	↓	2	1	1						1	1								
5. P05	5/3/06	14:45	↓	↓	2	1	1						1	1								
6. S-1	5/4/06	15:10	↓	↓	2	1	1						1	1								
7. S-2	5/4/06	15:05	↓	↓	2	1	1						1	1								
8. S-3	5/4/06	15:15	↓	↓	2	1	1						1	1								
9. S-5	5/4/06	12:05	↓	↓	2	1	1						1	1								
10.																						

Relinquished by: Pal Va Mi	Date: 5/9/06	Time: 16:50	Received by:	Date: 5/9/06	Time: 1650
Relinquished by:	Date: 5/10/06	Time: 1940	Received by:	Date: 5-10-06	Time: 9:45

* Sample Reject: [ ] Return [ ] Dispose [ ] Store (30 Days)

White: LAB COPY Yellow: CUSTOMER COPY SVL-COC 12/95

SVL ANALYTICAL

Temp 3.3° / 3.1° KS 5-10-06

CHAIN OF CUSTODY RECORD

Page 2 of 2

Client: Golder Assoc.
Contact: Doug Morell
Address:
— SAME —
Phone Number:
FAX Number:

NOTES:

1) Ensure proper container packaging.
2) Ship samples promptly following collection.
* 3) Designate Sample Reject Disposition

PO#: 043-1344
Project Name: P.O. Mine

Table 1. -- Matrix Type
1 = Surface Water, 2 = Ground Water
3 = Soil/Sediment, 4 = Rinsate, 5 = Oil
6 = Waste, 7 = Other (Specify)

FOR SVL USE ONLY
SVL JOB # 122575

Samplers Signature:

Lab Name: SVL Analytical, Inc. (208) 784-1258 FAX (208) 783-0891
Address: One Government Gulch, Kellogg, ID 83837-0929

Sample ID	Collection		Miscellaneous				Preservative(s)						Analyses Required									Comments
	Date	Time	Collected by: (Init.)	Matrix Type From Table 1	No. of Containers	Sample Filtered ? Y/N	Unpreserved (Ice Only)	HNO3	HCL	H2SO4	NAOH	Other (Specify)	Dissolved Metals	Anions	Total Metals							Temp 1°C
1. C1-2	5/4/06	13:00	PVM	1	2	1	1						1	1								
2. C2-1	5/4/06	15:00	↓	↓	↓	1	1						1	1								
3. C2-2	5/4/06	11:20			3	2	1						1	1	1							
4. C2-22	5/4/06	11:25			3	2	1						1	1	1							
5. UD-1	5/4/06	10:45				1	1						1	1								
6. W1-1	5/5/06	17:00				1	1						1	1								
7. W1-2	5/5/06	16:30				1	1						1	1								
8. W1-SEEP1	5/5/06	15:40		2		1	1						1	1								
9. W1-SEEP2	5/5/06	15:55		2		1	1						1	1								
10.																						

Relinquished by:		Date: 5/9/06	Time: 16:50	Received by:	Johann / D Hardin	Date: 5/9/06	Time: 1650
Relinquished by:	Johann	Date: 5/10/06	Time: 0740	Received by:	Kelli Seeg	Date: 5-10-06	Time: 9:45

* Sample Reject: [ ] Return [ ] Dispose [ ] Store (30 Days)

White: LAB COPY Yellow: CUSTOMER COPY SVL-COC 12/95

SVL ANALYTICAL, INC.
One Government Gulch ■ P.O. Box 929 ■ Kellogg, Idaho 83837-0929 ■ Phone: (208)784-1258 ■ Fax: (208)783-0891

Certificate: ID ID00019

CLIENT : GOLDER & ASSOCIATES INC
PROJECT: 043-1344
CLIENT SAMPLE ID: S-4
Sample Collected: 5/10/06 13:00
Sample Receipt : 5/12/06
Date of Report : 5/26/06

RECEIVED
JUN 1 - 2006
Golder Associates

SVL JOB: 122637
SAMPLE: 506541
TOT/DIS

Matrix: WATERG

	Determination	Result	Units	Dilution	Method	Analyzed
T	ALKALINITY	252	mg CaCO3/L		2320B	5/15/06
T	Chloride	2.91	mg/L		300.0	5/19/06
T	Sulfate, SO4	409	mg/L	25	300.0	5/18/06
D	Calcium	197	mg/L		200.7	5/22/06
D	Magnesium	41.7	mg/L		200.7	5/22/06
D	Silver	<0.0050	mg/L		200.7	5/22/06
D	Arsenic	<0.0030	mg/L	5	200.8	5/18/06
D	Barium	0.0493	mg/L		200.7	5/22/06
D	Cadmium	0.00227	mg/L		200.8	5/18/06
D	Chromium	<0.0060	mg/L		200.7	5/22/06
D	Copper	<0.00100	mg/L		200.8	5/18/06
D	Iron	<0.06	mg/L		200.7	5/22/06
D	Mercury	<0.00020	mg/L		245.1	5/16/06
D	Manganese	0.009	mg/L		200.7	5/22/06
D	Lead	0.0262	mg/L		200.8	5/18/06
D	Selenium	<0.00300	mg/L		200.8	5/18/06
D	Zinc	3.16	mg/L		200.7	5/22/06

Filtered fraction: 506550
Tests:GOLDER WATER|

Reviewed By:________________ Date 5/26/06
5/26/06 11:57

AZ: AZ0538 CA: NO. 2080 CO: 9/1/05 ID: ID00019 MT: 6/6/05 NV: 8/1/05 WA: C1268

SVL ANALYTICAL, INC.

Certificate: ID ID00019

One Government Gulch ▪ P.O. Box 929 ▪ Kellogg, Idaho 83837-0929 ▪ Phone: (208)784-1258 ▪ Fax: (208)783-0891

CLIENT : GOLDER & ASSOCIATES INC
PROJECT: 043-1344
CLIENT SAMPLE ID: S-7
Sample Collected: 5/10/06 13:30
Sample Receipt : 5/12/06
Date of Report : 5/26/06

SVL JOB: 122637
SAMPLE: 506542
TOT/DIS

Matrix: WATERG

	Determination	Result	Units	Dilution	Method	Analyzed
T	ALKALINITY	247	mg CaCO3/L		2320B	5/15/06
T	Chloride	3.37	mg/L		300.0	5/19/06
T	Sulfate, SO4	150	mg/L	5	300.0	5/18/06
D	Calcium	104	mg/L		200.7	5/22/06
D	Magnesium	31.2	mg/L		200.7	5/22/06
D	Silver	<0.0050	mg/L		200.7	5/22/06
D	Arsenic	<0.0030	mg/L	5	200.8	5/18/06
D	Barium	0.0601	mg/L		200.7	5/22/06
D	Cadmium	<0.00020	mg/L		200.8	5/18/06
D	Chromium	<0.0060	mg/L		200.7	5/22/06
D	Copper	<0.00100	mg/L		200.8	5/18/06
D	Iron	<0.06	mg/L		200.7	5/22/06
D	Mercury	<0.00020	mg/L		245.1	5/16/06
D	Manganese	0.014	mg/L		200.7	5/22/06
D	Lead	<0.00300	mg/L		200.8	5/18/06
D	Selenium	<0.00300	mg/L		200.8	5/18/06
D	Zinc	0.506	mg/L		200.7	5/22/06

Filtered fraction: 506551
Tests:GOLDER WATER|

Reviewed By:______________________ Date 5/26/06

5/26/06 11:57

AZ: AZ0538 CA: NO. 2080 CO: 9/1/05 ID: ID00019 MT: 6/6/05 NV: 8/1/05 WA: C1268

CLIENT : GOLDER & ASSOCIATES INC
PROJECT: 043-1344
CLIENT SAMPLE ID: S-8
Sample Collected: 5/10/06 14:00
Sample Receipt : 5/12/06
Date of Report : 5/26/06

SVL JOB: 122637
SAMPLE: 506543
TOT/DIS

Matrix: WATERG

	Determination	Result	Units	Dilution	Method	Analyzed
T	ALKALINITY	246	mg CaCO3/L		2320B	5/15/06
T	Chloride	2.90	mg/L		300.0	5/19/06
T	Sulfate, SO4	476	mg/L	25	300.0	5/18/06
D	Calcium	175	mg/L		200.7	5/22/06
D	Magnesium	70.1	mg/L		200.7	5/22/06
D	Silver	<0.0050	mg/L		200.7	5/22/06
D	Arsenic	<0.0030	mg/L	5	200.8	5/18/06
D	Barium	0.0866	mg/L		200.7	5/22/06
D	Cadmium	<0.00020	mg/L		200.8	5/18/06
D	Chromium	<0.0060	mg/L		200.7	5/22/06
D	Copper	<0.00100	mg/L		200.8	5/18/06
D	Iron	<0.06	mg/L		200.7	5/22/06
D	Mercury	<0.00020	mg/L		245.1	5/16/06
D	Manganese	0.168	mg/L		200.7	5/22/06
D	Lead	<0.00300	mg/L		200.8	5/18/06
D	Selenium	<0.00300	mg/L		200.8	5/18/06
D	Zinc	1.44	mg/L		200.7	5/22/06

Filtered fraction: 506552
Tests:GOLDER WATER|

Reviewed By:________________ Date 5/26/06
5/26/06 11:57

AZ: AZ0538 CA: NO. 2080 CO: 9/1/05 ID: ID00019 MT: 6/6/05 NV: 8/1/05 WA: C1268

SVL ANALYTICAL, INC.

Certificate: ID ID00019

One Government Gulch ▪ P.O. Box 929 ▪ Kellogg, Idaho 83837-0929 ▪ Phone: (208)784-1258 ▪ Fax: (208)783-0891

CLIENT : GOLDER & ASSOCIATES INC
PROJECT: 043-1344
CLIENT SAMPLE ID: MW-201
Sample Collected: 5/10/06 10:50
Sample Receipt : 5/12/06
Date of Report : 5/26/06

SVL JOB: 122637
SAMPLE: 506544
TOT/DIS

Matrix: WATERG

	Determination	Result	Units	Dilution	Method	Analyzed
T	ALKALINITY	240	mg CaCO3/L		2320B	5/15/06
T	Chloride	5.58	mg/L		300.0	5/19/06
T	Sulfate, SO4	29.5	mg/L		300.0	5/19/06
D	Calcium	72.0	mg/L		200.7	5/22/06
D	Magnesium	19.7	mg/L		200.7	5/22/06
D	Silver	<0.0050	mg/L		200.7	5/22/06
D	Arsenic	<0.0030	mg/L	5	200.8	5/18/06
D	Barium	0.0527	mg/L		200.7	5/22/06
D	Cadmium	<0.00020	mg/L		200.8	5/18/06
D	Chromium	<0.0060	mg/L		200.7	5/22/06
D	Copper	<0.00100	mg/L		200.8	5/18/06
D	Iron	<0.06	mg/L		200.7	5/22/06
D	Mercury	<0.00020	mg/L		245.1	5/16/06
D	Manganese	<0.004	mg/L		200.7	5/22/06
D	Lead	<0.00300	mg/L		200.8	5/18/06
D	Selenium	<0.00300	mg/L		200.8	5/18/06
D	Zinc	<0.0100	mg/L		200.7	5/22/06

Filtered fraction: 506553
Tests:GOLDER WATER|

Reviewed By:________________ Date 5/26/06

5/26/06 11:58

AZ: AZ0538 CA: NO. 2080 CO: 9/1/05 ID: ID00019 MT: 6/6/05 NV: 8/1/05 WA: C1268

SVL ANALYTICAL, INC.

Certificate: WA C1268

One Government Gulch ▪ P.O. Box 929 ▪ Kellogg, Idaho 83837-0929 ▪ Phone: (208)784-1258 ▪ Fax: (208)783-0891

CLIENT : GOLDER
PROJECT: 043-1344
CLIENT SAMPLE ID: MW-203
Sample Collected: 5/10/06 14:55
Sample Receipt : 5/12/06
Date of Report : 5/26/06

SVL JOB: 122637
SAMPLE: 506545
TOT/DIS

Matrix: WATERG

	Determination	Result	Units	Dilution	Method	Analyzed
T	ALKALINITY	250	mg CaCO3/L		2320B	5/15/06
T	Calcium	125	mg/L		200.7	5/22/06
T	Chloride	0.60	mg/L		300.0	5/19/06
T	Magnesium	39.0	mg/L		200.7	5/22/06
T	Sulfate, SO4	220	mg/L	10	300.0	5/18/06
T	Silver	<0.0050	mg/L		200.7	5/22/06
T	Arsenic	<0.0030	mg/L	2	200.8	5/18/06
T	Barium	0.0918	mg/L		200.7	5/22/06
T	Cadmium	<0.00020	mg/L		200.8	5/18/06
T	Chromium	<0.0060	mg/L		200.7	5/22/06
T	Copper	0.0019	mg/L		200.8	5/18/06
T	Iron	0.64	mg/L		200.7	5/22/06
T	Mercury	<0.00020	mg/L		245.1	5/16/06
T	Manganese	0.173	mg/L		200.7	5/22/06
T	Lead	<0.0030	mg/L		200.8	5/18/06
T	Selenium	<0.0030	mg/L		200.8	5/18/06
T	Zinc	<0.0100	mg/L		200.7	5/22/06
D	Calcium	145	mg/L		200.7	5/22/06
D	Magnesium	46.0	mg/L		200.7	5/22/06
D	Silver	<0.0050	mg/L		200.7	5/22/06
D	Arsenic	<0.0030	mg/L	5	200.8	5/18/06
D	Barium	0.0973	mg/L		200.7	5/22/06
D	Cadmium	0.00021	mg/L		200.8	5/18/06
D	Chromium	<0.0060	mg/L		200.7	5/22/06
D	Copper	<0.00100	mg/L		200.8	5/18/06
D	Iron	<0.06	mg/L		200.7	5/22/06
D	Mercury	<0.00020	mg/L		245.1	5/16/06
D	Manganese	0.121	mg/L		200.7	5/22/06
D	Lead	<0.00300	mg/L		200.8	5/18/06
D	Selenium	<0.00300	mg/L		200.8	5/18/06
D	Zinc	<0.0100	mg/L		200.7	5/22/06

Filtered fraction: 506554
Tests:GOLDER WATER

Reviewed By:________________ Date 5/26/06

5/26/06 12:51

AZ: AZ0538 CA: NO. 2080 CO: 9/1/05 ID: ID00019 MT: 6/6/05 NV: 8/1/05 WA: C1268

SVL ANALYTICAL, INC.

Certificate: WA C1268

One Government Gulch ▪ P.O. Box 929 ▪ Kellogg, Idaho 83837-0929 ▪ Phone: (208)784-1258 ▪ Fax: (208)783-0891

CLIENT : GOLDER
PROJECT: 043-1344
CLIENT SAMPLE ID: MW-2032
Sample Collected: 5/10/06 15:05
Sample Receipt : 5/12/06
Date of Report : 5/26/06

SVL JOB: 122637
SAMPLE: 506546
TOT/DIS

Matrix: WATERG

	Determination	Result	Units	Dilution	Method	Analyzed
T	ALKALINITY	250	mg CaCO3/L		2320B	5/15/06
T	Calcium	135	mg/L		200.7	5/22/06
T	Chloride	0.60	mg/L		300.0	5/19/06
T	Magnesium	42.4	mg/L		200.7	5/22/06
T	Sulfate, SO4	220	mg/L		300.0	5/18/06
T	Silver	<0.0050	mg/L		200.7	5/22/06
T	Arsenic	<0.0030	mg/L	2	200.8	5/18/06
T	Barium	0.0951	mg/L		200.7	5/22/06
T	Cadmium	0.00023	mg/L		200.8	5/18/06
T	Chromium	<0.0060	mg/L		200.7	5/22/06
T	Copper	0.0014	mg/L		200.8	5/18/06
T	Iron	0.48	mg/L		200.7	5/22/06
T	Mercury	<0.00020	mg/L		245.1	5/16/06
T	Manganese	0.160	mg/L		200.7	5/22/06
T	Lead	<0.0030	mg/L		200.8	5/18/06
T	Selenium	<0.0030	mg/L		200.8	5/18/06
T	Zinc	<0.0100	mg/L		200.7	5/22/06
D	Calcium	140	mg/L		200.7	5/22/06
D	Magnesium	44.0	mg/L		200.7	5/22/06
D	Silver	<0.0050	mg/L		200.7	5/22/06
D	Arsenic	<0.0030	mg/L	5	200.8	5/18/06
D	Barium	0.0871	mg/L		200.7	5/22/06
D	Cadmium	<0.00020	mg/L		200.8	5/18/06
D	Chromium	<0.0060	mg/L		200.7	5/22/06
D	Copper	<0.00100	mg/L		200.8	5/18/06
D	Iron	<0.06	mg/L		200.7	5/22/06
D	Mercury	<0.00020	mg/L		245.1	5/16/06
D	Manganese	0.116	mg/L		200.7	5/22/06
D	Lead	<0.00300	mg/L		200.8	5/18/06
D	Selenium	<0.00300	mg/L		200.8	5/18/06
D	Zinc	<0.0100	mg/L		200.7	5/22/06

Filtered fraction: 506555
Tests:GOLDER WATER|

Reviewed By:________________________ Date 5/26/06

5/26/06 12:52

SVL ANALYTICAL, INC. Certificate: ID ID00019

One Government Gulch ▪ P.O. Box 929 ▪ Kellogg, Idaho 83837-0929 ▪ Phone: (208)784-1258 ▪ Fax: (208)783-0891

CLIENT : GOLDER & ASSOCIATES INC
PROJECT: 043-1344
CLIENT SAMPLE ID: 2-PO-EB
Sample Collected: 5/10/06 17:50
Sample Receipt : 5/12/06
Date of Report : 5/26/06

SVL JOB: 122637
SAMPLE: 506547
TOT/DIS

Matrix: WATERG

	Determination	Result	Units	Dilution	Method	Analyzed
T	ALKALINITY	<1.0	mg CaCO3/L		2320B	5/15/06
T	Calcium	0.080	mg/L		200.7	5/22/06
T	Chloride	<0.20	mg/L		300.0	5/18/06
T	Magnesium	<0.06	mg/L		200.7	5/22/06
T	Sulfate, SO4	<0.30	mg/L		300.0	5/18/06
T	Silver	<0.0050	mg/L		200.7	5/22/06
T	Arsenic	<0.0030	mg/L	2	200.8	5/18/06
T	Barium	<0.0020	mg/L		200.7	5/22/06
T	Cadmium	<0.00020	mg/L		200.8	5/18/06
T	Chromium	<0.0060	mg/L		200.7	5/22/06
T	Copper	<0.0010	mg/L		200.8	5/18/06
T	Iron	<0.06	mg/L		200.7	5/22/06
T	Mercury	<0.00020	mg/L		245.1	5/16/06
T	Manganese	<0.004	mg/L		200.7	5/22/06
T	Lead	<0.0030	mg/L		200.8	5/18/06
T	Selenium	<0.0030	mg/L		200.8	5/18/06
T	Zinc	<0.0100	mg/L		200.7	5/22/06
D	Calcium	0.090	mg/L		200.7	5/22/06
D	Magnesium	<0.06	mg/L		200.7	5/22/06
D	Silver	<0.0050	mg/L		200.7	5/22/06
D	Arsenic	<0.0030	mg/L	5	200.8	5/18/06
D	Barium	<0.0020	mg/L		200.7	5/22/06
D	Cadmium	<0.00020	mg/L		200.8	5/18/06
D	Chromium	<0.0060	mg/L		200.7	5/22/06
D	Copper	<0.00100	mg/L		200.8	5/18/06
D	Iron	<0.06	mg/L		200.7	5/22/06
D	Mercury	<0.00020	mg/L		245.1	5/16/06
D	Manganese	<0.004	mg/L		200.7	5/22/06
D	Lead	<0.00300	mg/L		200.8	5/18/06
D	Selenium	<0.00300	mg/L		200.8	5/18/06
D	Zinc	<0.0100	mg/L		200.7	5/22/06

Filtered fraction: 506556
Tests:GOLDER WATER|

Reviewed By:______________________ Date 5/26/06

5/26/06 11:58

AZ: AZ0538 CA: NO. 2080 CO: 9/1/05 ID: ID00019 MT: 6/6/05 NV: 8/1/05 WA: C1268

SVL ANALYTICAL, INC. Certificate: ID ID00019
One Government Gulch ■ P.O. Box 929 ■ Kellogg, Idaho 83837-0929 ■ Phone: (208)784-1258 ■ Fax: (208)783-0891

CLIENT : GOLDER & ASSOCIATES INC
PROJECT: 043-1344
CLIENT SAMPLE ID: 3-PO-EB
Sample Collected: 5/10/06 18:00
Sample Receipt : 5/12/06
Date of Report : 5/26/06

SVL JOB: 122637
SAMPLE: 506548
TOT/DIS

Matrix: WATERG

	Determination	Result	Units	Dilution	Method	Analyzed
T	ALKALINITY	1.4	mg CaCO3/L		2320B	5/15/06
T	Calcium	0.350	mg/L		200.7	5/22/06
T	Chloride	<0.20	mg/L		300.0	5/18/06
T	Magnesium	0.11	mg/L		200.7	5/22/06
T	Sulfate, SO4	<0.30	mg/L		300.0	5/18/06
T	Silver	<0.0050	mg/L		200.7	5/22/06
T	Arsenic	<0.0030	mg/L	2	200.8	5/18/06
T	Barium	<0.0020	mg/L		200.7	5/22/06
T	Cadmium	<0.00020	mg/L		200.8	5/18/06
T	Chromium	<0.0060	mg/L		200.7	5/22/06
T	Copper	<0.0010	mg/L		200.8	5/18/06
T	Iron	<0.06	mg/L		200.7	5/22/06
T	Mercury	<0.00020	mg/L		245.1	5/16/06
T	Manganese	<0.004	mg/L		200.7	5/22/06
T	Lead	<0.0030	mg/L		200.8	5/18/06
T	Selenium	<0.0030	mg/L		200.8	5/18/06
T	Zinc	<0.0100	mg/L		200.7	5/22/06
D	Calcium	0.301	mg/L		200.7	5/22/06
D	Magnesium	0.10	mg/L		200.7	5/22/06
D	Silver	<0.0050	mg/L		200.7	5/22/06
D	Arsenic	<0.0030	mg/L	5	200.8	5/18/06
D	Barium	<0.0020	mg/L		200.7	5/22/06
D	Cadmium	<0.00020	mg/L		200.8	5/18/06
D	Chromium	<0.0060	mg/L		200.7	5/22/06
D	Copper	<0.00100	mg/L		200.8	5/18/06
D	Iron	<0.06	mg/L		200.7	5/22/06
D	Mercury	<0.00020	mg/L		245.1	5/16/06
D	Manganese	<0.004	mg/L		200.7	5/22/06
D	Lead	<0.00300	mg/L		200.8	5/18/06
D	Selenium	<0.00300	mg/L		200.8	5/18/06
D	Zinc	<0.0100	mg/L		200.7	5/22/06

CalcTDS:<10	TDS/Cond:	CATION SUM:	0.06meq/L	BALANCE
TDS/CalcTDS:	CalcTDS/Cond:	ANION SUM:	0.03meq/L	33.33%

Filtered fraction: 506557
Tests:GOLDER WATER|

Reviewed By:______________________ Date 5/26/06

5/26/06 11:58

AZ: AZ0538 CA: NO. 2080 CO: 9/1/05 ID: ID00019 MT: 6/6/05 NV: 8/1/05 WA: C1268

SVL ANALYTICAL, INC.
One Government Gulch ▪ P.O. Box 929 ▪ Kellogg, Idaho 83837-0929 ▪ Phone: (208)784-1258 ▪ Fax: (208)783-0891
Certificate: ID ID00019

CLIENT : GOLDER & ASSOCIATES INC
PROJECT: 043-1344
CLIENT SAMPLE ID: C1-1
Sample Collected: 5/10/06 14:30
Sample Receipt : 5/12/06
Date of Report : 5/26/06

SVL JOB: 122637
SAMPLE: 506549
TOT/DIS
Matrix: WATERG

	Determination	Result	Units	Dilution	Method	Analyzed
T	ALKALINITY	177	mg CaCO3/L		2320B	5/15/06
T	Chloride	0.31	mg/L		300.0	5/18/06
T	Sulfate, SO4	5.00	mg/L		300.0	5/18/06
D	Calcium	47.6	mg/L		200.7	5/22/06
D	Magnesium	13.8	mg/L		200.7	5/22/06
D	Silver	<0.0050	mg/L		200.7	5/22/06
D	Arsenic	<0.0030	mg/L	5	200.8	5/18/06
D	Barium	0.0248	mg/L		200.7	5/22/06
D	Cadmium	<0.00020	mg/L		200.8	5/18/06
D	Chromium	<0.0060	mg/L		200.7	5/22/06
D	Copper	<0.00100	mg/L		200.8	5/18/06
D	Iron	<0.06	mg/L		200.7	5/22/06
D	Mercury	<0.00020	mg/L		245.1	5/16/06
D	Manganese	0.006	mg/L		200.7	5/22/06
D	Lead	<0.00300	mg/L		200.8	5/18/06
D	Selenium	<0.00300	mg/L		200.8	5/18/06
D	Zinc	<0.0100	mg/L		200.7	5/22/06

Filtered fraction: 506558
Tests:GOLDER WATER|

Reviewed By:________________ Date 5/26/06
5/26/06 11:58

AZ: AZ0538 CA: NO. 2080 CO: 9/1/05 ID: ID00019 MT: 6/6/05 NV: 8/1/05 WA: C1268

SVL ANALYTICAL, INC.

Quality Control Report
Part I Prep Blank and Laboratory Control Sample

Client :GOLDER & ASSOCIATES INC

SVL JOB No: 122637

Analyte	Method	Matrix	Units	Prep Blank	True — LCS	— Found	LCS %R	Analysis Date
Silver	200.7	WATER	mg/L	<0.0050	0.0500	0.0530	106.0	5/22/06
Arsenic	200.8	WATER	mg/L	<0.0030	0.0250	0.0239	95.6	5/18/06
Barium	200.7	WATER	mg/L	<0.0020	1.00	1.03	103.0	5/22/06
Calcium	200.7	WATER	mg/L	<0.040	20.0	19.4	97.0	5/22/06
Cadmium	200.8	WATER	mg/L	<0.00020	0.0250	0.0255	102.0	5/18/06
Chromium	200.7	WATER	mg/L	<0.0060	1.00	1.01	101.0	5/22/06
Copper	200.8	WATER	mg/L	<0.0010	0.0250	0.0252	100.8	5/18/06
Iron	200.7	WATER	mg/L	<0.06	10.0	10.3	103.0	5/22/06
Magnesium	200.7	WATER	mg/L	<0.06	20.0	20.8	104.0	5/22/06
Manganese	200.7	WATER	mg/L	<0.004	1.00	0.991	99.1	5/22/06
Lead	200.8	WATER	mg/L	<0.0030	0.0250	0.0254	101.6	5/18/06
Selenium	200.8	WATER	mg/L	<0.0030	0.0250	0.0257	102.8	5/18/06
Zinc	200.7	WATER	mg/L	<0.0100	1.00	1.09	109.0	5/22/06
Mercury	245.1	WATER	mg/L	<0.00020	0.00500	0.00504	100.8	5/16/06
Chloride	300.0	WATER	mg/L	<0.20	5.05	4.98	98.6	5/18/06
Sulfate, SO4	300.0	WATER	mg/L	<0.30	9.93	9.93	100.0	5/18/06
ALKALINITY	2320B	WATER	mg/L	<1.0	117	121	103.4	5/15/06

LEGEND:

LCS = Laboratory Control Sample

LCS %R = LCS Percent Recovery

N/A = Not Applicable

SVL ANALYTICAL, INC.

Quality Control Report
Part II Duplicate and Spike Analysis

Client :GOLDER & ASSOCIATES INC

SVL JOB No: 122637

				QC SAMPLE ID		Duplicate or	MSD	Matrix Spike			Analysis
Test	Method	Mtx		Units	Result	Found	RPD%	Result	SPK ADD	%R	Date
Ag	200.7	W	1	mg/L	<0.0050	<0.0050	UDL	0.0525	0.0500	105.0	5/22/06
Ag	200.7	W	2	mg/L	<0.0050	<0.0050	UDL	0.0547	0.0500	109.4	5/22/06
As	200.8	W	1	mg/L	<0.0030	<0.0030	UDL	0.0267	0.0250	106.8	5/18/06
As	200.8	W	2	mg/L	<0.0030	<0.0030	UDL	0.0284	0.0250	113.6	5/18/06
Ba	200.7	W	1	mg/L	0.0918	0.0925	0.8	1.10	1.00	100.8	5/22/06
Ba	200.7	W	2	mg/L	0.0493	0.0491	0.4	1.07	1.00	102.1	5/22/06
Ca	200.7	W	1	mg/L	125	125	0.0	144	20.0	95.0	5/22/06
Ca	200.7	W	2	mg/L	197	195	1.0	208	20.0	R >4S	5/22/06
Cd	200.8	W	1	mg/L	<0.00020	0.00021	200.0	0.0256	0.0250	102.4	5/18/06
Cd	200.8	W	2	mg/L	0.00227	0.00221	2.7	0.0276	0.0250	101.3	5/18/06
Cr	200.7	W	1	mg/L	<0.0060	<0.0060	UDL	1.03	1.00	103.0	5/22/06
Cr	200.7	W	2	mg/L	<0.0060	<0.0060	UDL	1.02	1.00	102.0	5/22/06
Cu	200.8	W	1	mg/L	0.0019	0.0020	5.1	0.0258	0.0250	95.6	5/18/06
Cu	200.8	W	2	mg/L	<0.00100	<0.00100	UDL	0.0221	0.0250	88.4	5/18/06
Fe	200.7	W	1	mg/L	0.64	0.77	18.4	11.4	10.0	107.6	5/22/06
Fe	200.7	W	2	mg/L	<0.06	<0.06	UDL	10.5	10.0	105.0	5/22/06
Mg	200.7	W	1	mg/L	39.0	39.3	0.8	64.4	20.0	127.0	5/22/06
Mg	200.7	W	2	mg/L	41.7	42.2	1.2	65.6	20.0	119.5	5/22/06
Mn	200.7	W	1	mg/L	0.173	0.176	1.7	1.19	1.00	101.7	5/22/06
Mn	200.7	W	2	mg/L	0.009	0.009	0.0	1.03	1.00	102.1	5/22/06
Pb	200.8	W	1	mg/L	<0.0030	<0.0030	UDL	0.0249	0.0250	99.6	5/18/06
Pb	200.8	W	2	mg/L	0.0262	0.0267	1.9	0.0552	0.0250	116.0	5/18/06
Se	200.8	W	1	mg/L	<0.0030	<0.0030	UDL	0.0264	0.0250	105.6	5/18/06
Se	200.8	W	2	mg/L	<0.00300	<0.00300	UDL	0.0317	0.0250	126.8	5/18/06
Zn	200.7	W	1	mg/L	<0.0100	<0.0100	UDL	1.07	1.00	107.0	5/22/06
Zn	200.7	W	2	mg/L	3.16	3.18	0.6	4.12	1.00	96.0	5/22/06
Hg	245.1	W	1	mg/L	<0.00020	<0.00020	UDL	0.00109	0.0010	109.0	5/16/06
Hg	245.1	W	2	mg/L	<0.00020	<0.00020	UDL	0.00106	0.0010	106.0	5/16/06
Cl	300.0	W	1	mg/L	0.60	0.60	0.0	3.55	3.00	98.3	5/19/06
SO4	300.0	W	1	mg/L	220	220	0.0	327	100	107.0	5/18/06
ALK	2320B	W	1	mg/L	250	252	0.8	N/A	N/A	N/A	5/15/06

LEGEND:

RPD% = (|SAM - DUP|/((SAM + DUP)/2) * 100) UDL = Both SAM & DUP not detected. *Result or *Found: Interference required dilution.

RPD% = (|SPK - MSD|/((SPK + MSD)/2) * 100) M in Duplicate/MSD column indicates MSD.

SPIKE ADD column, A = Post Digest Spike; %R = Percent Recovery N/A = Not Analyzed; R > 4S = Result more than 4X the Spike Added

QC limits for MS recoveries apply only if the spike is at least 1/4 the concentration of the analyte in the sample.

Control limits for the RPD apply only if the concentration of the analyte in the sample is at least five times the reporting limit.

QC Sample 1: SVL SAM No.: 506545 Client Sample ID: MW-203 ^T
QC Sample 2: SVL SAM No.: 506550 Client Sample ID: S-4 ^D

5/26/06 11:57

SVL ANALYTICAL

CHAIN OF CUSTODY RECORD

Page _____ of _____

Client: GOLDER Assoc.
Contact: Doug Morell
Address: 18300 NE Union Hill Rd. #200
Redmond, WA 98052
Phone Number: (425) 883-0777
FAX Number: (425) 882-5498

NOTES:
1) Ensure proper container packaging.
2) Ship samples promptly following collection.
3) Designate Sample Reject Disposition
PO#: 043-1344
Project Name: P.O. Mine RI/FS

Table 1. -- Matrix Type
1 = Surface Water, 2 = Ground Water
3 = Soil/Sediment, 4 = Rinsate, 5 = Oil
6 = Waste, 7 = Other (Specify) ________

FOR SVL USE ONLY
SVL JOB # 122637

Samplers Signature: Pd Va Mill

Lab Name: SVL Analytical, Inc. (208) 784-1258 FAX (208) 783-0891
Address: One Government Gulch, Kellogg, ID 83837-0929

Sample ID	Collection		Miscellaneous				Preservative(s)						Analyses Required										temp on arrival 4°c Comments * noted on COC * as nonfiltered sample label Reads Filtered.
	Date	Time	Collected by: (Init.)	Matrix Type From Table 1	No. of Containers	Sample Filtered ? Y/N	Unpreserved (Ice Only)	HNO3	HCL	H2SO4	NAOH	Other (Specify)	Dissolved Metals	Anions	Total Metals								
X 1. S-4	5/10/06	13:00	PVM/AO	2	2	N	1	1					1	1									RS. 5.12.06
2. S-7	5/10/06	13:30		2	2	N	1	1					1	1									1X Sample ID
3. S-8	5/10/06	14:00		2	2	N	1	1					1	1									Read 3-PO-TB
X 4. MW-201	5/10/06	10:50		2	2	N	1	1					1	1									
5. MW-203	5/10/06	14:55		2	3	1	1	2					1	1	1								
6. MW-2032	5/10/06	15:05		2	3	1	1	2					1	1	1								
7. 2-PO-EB	5/10/06	17:50		2	3	1	1	2					1	1	1								
1X 8. 3-PO-EB	5/10/06	18:00		2	3	1	1	2					1	1	1								
* 9. C1-1	5/10/06	14:30		2	2	1	1	1					1	1									
10.																							

Relinquished by: Pd V Millw Date: 5/11/06 Time: 13:30 Received by: Johann / P. Sarden Date: 5/11/06 Time: 1330
Relinquished by: Date: Time: Received by: Robin Stribling Date: 5.12.06 Time: 8:45

* Sample Reject: [ ] Return [ ] Dispose [ ] Store (30 Days) White: LAB COPY Yellow: CUSTOMER COPY SVL-COC 12/95

* C1-1 added to COC per P. VanMiddlesworth ... gc 5/12/06

SVL ANALYTICAL, INC.
One Government Gulch ▪ P.O. Box 929 ▪ Kellogg, Idaho 83827-0929 ▪ Phone: (208)784-1258 ▪ Fax: (208)783-0891

REPORT OF ANALYTICAL RESULTS

CLIENT : GOLDER
PROJECT: 043-1344.413
Sample Receipt: 5/17/06
Report Date: 5/30/06
Page 1 of 2
SVL JOB: 122729

SVL ID	CLIENT SAMPLE ID		As 6010B	Ba 6010B	Cd 6010B	Cu 6010B	Pb 6010B
S507362	C1-2S	5/08/06	3.8mg/kg	35.3mg/kg	2.05mg/kg	15.9mg/kg	119mg/kg
S507363	S5-1S	5/08/06	<2.5mg/kg	268mg/kg	5.04mg/kg	5.9mg/kg	34.5mg/kg
S507364	S5-2S	5/08/06	2.7mg/kg	307mg/kg	6.11mg/kg	6.2mg/kg	36.0mg/kg
S507365	C2-2S	5/08/06	9.6mg/kg	31.6mg/kg	4.68mg/kg	18.7mg/kg	339mg/kg
S507366	C2-1S	5/08/06	22.5mg/kg	113mg/kg	5.06mg/kg	27.2mg/kg	301mg/kg
S507367	UD-1S	5/08/06	<2.5mg/kg	27.4mg/kg	1.92mg/kg	15.3mg/kg	59.0mg/kg
S507368	S4-S	5/10/06	4.0mg/kg	30.8mg/kg	1.91mg/kg	16.6mg/kg	193mg/kg
S507369	S7-S	5/10/06	2.8mg/kg	45.8mg/kg	1.56mg/kg	9.4mg/kg	97.1mg/kg
S507370	S8-S	5/10/06	<2.5mg/kg	33.7mg/kg	0.79mg/kg	3.1mg/kg	7.35mg/kg
S507371	C1-1S	5/10/06	<2.5mg/kg	16.3mg/kg	0.28mg/kg	4.0mg/kg	8.31mg/kg

Soil Samples: As Received Basis

Certificate: WA C1268
AZ: AZ0538 CA: NO. 2080 CO: 9/1/05 ID: ID00019 MT: 6/6/05 NV: 8/1/05 WA: C1268

Reviewed By: ______________ Date: 5/30/06

CLIENT : GOLDER
PROJECT: 043-1344.413
Sample Receipt: 5/17/06
Report Date: 5/30/06
Page 2 of 2
SVL JOB: 122729

SVL ID	CLIENT SAMPLE ID		Se 6010B	Zn 6010B	Hg 7471	% Sol. 999
S507362	C1-2S	5/08/06	<4mg/kg	282mg/kg	0.063mg/kg	50.3%
S507363	S5-1S	5/08/06	<4mg/kg	367mg/kg	0.038mg/kg	15.5%
S507364	S5-2S	5/08/06	<4mg/kg	405mg/kg	0.037mg/kg	15.4%
S507365	C2-2S	5/08/06	6mg/kg	878mg/kg	0.132mg/kg	74.0%
S507366	C2-1S	5/08/06	6mg/kg	1580mg/kg	0.117mg/kg	69.8%
S507367	UD-1S	5/08/06	<4mg/kg	190mg/kg	0.067mg/kg	20.2%
S507368	S4-S	5/10/06	<4mg/kg	738mg/kg	0.087mg/kg	45.4%
S507369	S7-S	5/10/06	5mg/kg	904mg/kg	0.055mg/kg	16.3%
S507370	S8-S	5/10/06	<4mg/kg	1930mg/kg	<0.033mg/kg	16.0%
S507371	C1-1S	5/10/06	<4mg/kg	39.7mg/kg	<0.033mg/kg	10.5%

Soil Samples: As Received Basis

Certificate: WA C1268
AZ: AZ0538 CA: NO. 2080 CO: 9/1/05 ID: ID00019 MT: 6/6/05 NV: 8/1/05 WA: C1268

Reviewed By: Date: 5/30/06

SVL ANALYTICAL, INC.

Quality Control Report
Part I Prep Blank and Laboratory Control Sample

Client :GOLDER

SVL JOB No: 122729

Analyte	Method	Matrix	Units	Prep Blank	True—LCS	—Found	LCS %R	Analysis Date
Arsenic	6010B	SOIL	mg/kg	<2.5	100	91.0	91.0	5/23/06
Barium	6010B	SOIL	mg/kg	<0.20	100	99.5	99.5	5/23/06
Cadmium	6010B	SOIL	mg/kg	<0.20	100	91.4	91.4	5/23/06
Copper	6010B	SOIL	mg/kg	<1.0	100	99.7	99.7	5/23/06
Lead	6010B	SOIL	mg/kg	<0.75	100	97.2	97.2	5/23/06
Selenium	6010B	SOIL	mg/kg	<4	100	88	88.0	5/23/06
Zinc	6010B	SOIL	mg/kg	<1.0	100	105	105.0	5/23/06
Mercury	7471	SOIL	mg/kg	<0.033	0.834	0.845	101.3	5/18/06

LEGEND:

LCS = Laboratory Control Sample

LCS %R = LCS Percent Recovery

N/A = Not Applicable

SVL ANALYTICAL, INC.

Quality Control Report
Part II Duplicate and Spike Analysis

Client :GOLDER

SVL JOB No: 122729

			QC SAMPLE ID			Duplicate or MSD			Matrix Spike			Analysis
Test	Method	Mtx		Units	Result	Found		RPD%	Result	SPK ADD	%R	Date
As	6010B	S	1	mg/kg	3.8	100	M	2.7	97.3	100	93.5	5/23/06
Ba	6010B	S	1	mg/kg	35.3	145	M	2.8	141	100	105.7	5/23/06
Cd	6010B	S	1	mg/kg	2.05	94.0	M	3.6	90.7	100	88.7	5/23/06
Cu	6010B	S	1	mg/kg	15.9	114	M	2.7	111	100	95.1	5/23/06
Pb	6010B	S	1	mg/kg	119	259	M	14.0	225	100	106.0	5/23/06
Se	6010B	S	1	mg/kg	<4	98	M	3.1	95	100	95.0	5/23/06
Zn	6010B	S	1	mg/kg	282	426	M	10.4	384	100	102.0	5/23/06
Hg	7471	S	1	mg/kg	0.063	0.248	M	2.0	0.243	0.167	107.8	5/18/06

LEGEND:

RPD% = (|SAM - DUP|/((SAM + DUP)/2) * 100) UDL = Both SAM & DUP not detected. *Result or *Found: Interference required dilution.
RPD% = (|SPK - MSD|/((SPK + MSD)/2) * 100) M in Duplicate/MSD column indicates MSD.
SPIKE ADD column, A = Post Digest Spike; %R = Percent Recovery N/A = Not Analyzed; R > 4S = Result more than 4X the Spike Added
QC limits for MS recoveries apply only if the spike is at least 1/4 the concentration of the analyte in the sample.
Control limits for the RPD apply only if the concentration of the analyte in the sample is at least five times the reporting limit.

QC Sample 1: SVL SAM No.: 507362 Client Sample ID: C1-2S

SVL ANALYTICAL

Cooler temp 4.0° 5.17.06 2:10 RS

CHAIN OF CUSTODY RECORD

Page 1 of 1

billing + results to →

Client: GOLDER
Contact: Doug Morell
Address: 18300 NE Union Hill Rd. #200
Redmond, WA 98052
Phone Number: (425) 883-0777
FAX Number: (425) 882-5448

NOTES:

1) Ensure proper container packaging.
2) Ship samples promptly following collection.
3) Designate Sample Reject Disposition *

PO#: 043-1344.413
Project Name: P.O. Mine RI/FS

Table 1. -- Matrix Type
1 = Surface Water, 2 = Ground Water
[✓ 3] = Soil/Sediment, 4 = Rinsate, 5 = Oil
6 = Waste, 7 = Other (Specify) ________

Samplers Signature: Paul V. Millsworth
(208) 755-3002

FOR SVL USE ONLY
SVL JOB # 122729

Lab Name: SVL Analytical, Inc. (208) 784-1258 FAX (208) 783-0891
Address: One Government Gulch, Kellogg, ID 83837-0929

Sample ID	Collection		Miscellaneous				Preservative(s)						Analyses Required									temp on arrival 4°C & Comments
	Date	Time	Collected by: (Init.)	Matrix Type From Table 1	No. of Containers	Sample Filtered ? Y/N	Unpreserved (Ice Only)	HNO3	HCL	H2SO4	NAOH	Other (Specify)	Total Metals									
1. C1-2S	5/8/06	12:50	PVM	3	1	N	X						1									~~* ID on Sample~~
* 2. S5-1S	5/8/06	11:46	↓	↓	1	↓	↓						1									~~Label Reads~~
3. S5-2S	5/8/06	12:06	↓	↓	1	↓	↓						1									~~S5-1S~~ RS
4. C2-2S	5/8/06	11:20	↓	↓	1	↓	↓						1									5.17.06
5. C2-1S	5/8/06	15:00	↓	↓	1	↓	↓						1									
6. UD-1S	5/8/06	10:40	↓	↓	1	↓	↓						1									
7. S4-S	5/10/06	12:45	↓	↓	1	↓	↓						1									
8. S7-S	5/10/06	13:16	↓	↓	1	↓	↓						1									
9. S8-S	5/10/06	13:35	↓	↓	1	↓	↓						1									
10. C1-1S	5/10/06	14:30	↓	↓	1	↓	↓						1									

Relinquished by:	Date:	Time:	Received by:	Date:	Time:
Paul V. Millsworth	5/16/06	16:35	Johanna Dauchta	5/16/06	1635
			Robert Stribling	5.17.06	2:10

* Sample Reject: [ ] Return [ ] Dispose [ ] Store (30 Days)

White: LAB COPY Yellow: CUSTOMER COPY SVL-COC 12/95

CLIENT : GOLDER & ASSOCIATES INC
PROJECT: 043-1344.413
Sample Receipt: 5/19/06
Report Date: 6/05/06
Page 1 of 2
SVL JOB: 122788

SVL ID	CLIENT SAMPLE ID		As 6010B	Ba 6010B	Cd 6010B	Cu 6010B	Pb 6010B
S508002	BEN-1	5/10/06	10.5mg/kg	7.70mg/kg	5.48mg/kg	68.6mg/kg	415mg/kg
S508003	BEN-2	5/10/06	13.1mg/kg	9.84mg/kg	6.73mg/kg	88.4mg/kg	578mg/kg
S508004	BEN-3	5/10/06	8.6mg/kg	47.0mg/kg	7.50mg/kg	71.1mg/kg	483mg/kg
S508005	BEN-4	5/10/06	8.7mg/kg	8.65mg/kg	7.30mg/kg	67.4mg/kg	1020mg/kg
S508006	BEN-5	5/10/06	10.7mg/kg	14.1mg/kg	15.0mg/kg	120mg/kg	1520mg/kg
S508007	BEN-6	5/10/06	9.7mg/kg	12.0mg/kg	5.07mg/kg	46.1mg/kg	822mg/kg
S508008	WI-1S	5/10/06	4.0mg/kg	47.3mg/kg	5.75mg/kg	39.2mg/kg	239mg/kg
S508009	WI-2S	5/10/06	8.9mg/kg	60.0mg/kg	10.7mg/kg	85.1mg/kg	564mg/kg

Soil Samples: As Received Basis

Certificate: ID ID00019
AZ: AZ0538 CA: NO. 2080 CO: 9/1/05 ID: ID00019 MT: 6/6/05 NV: 8/1/05 WA: C1268

Reviewed By:______________ Date: 6/5/06

REPORT OF ANALYTICAL RESULTS

CLIENT : GOLDER & ASSOCIATES INC
PROJECT: 043-1344.413
Sample Receipt: 5/19/06
Report Date: 6/05/06
Page 2 of 2
SVL JOB: 122788

SVL ID	CLIENT SAMPLE ID		Se 6010B	Zn 6010B	Hg 7471A	% Sol. 999
S508002	BEN-1	5/10/06	7mg/kg	1060mg/kg	<5.50mg/kg	75.5%
S508003	BEN-2	5/10/06	4mg/kg	1820mg/kg	<5.50mg/kg	78.1%
S508004	BEN-3	5/10/06	5mg/kg	2270mg/kg	<5.50mg/kg	43.4%
S508005	BEN-4	5/10/06	<4mg/kg	1250mg/kg	<5.50mg/kg	77.4%
S508006	BEN-5	5/10/06	<4mg/kg	2560mg/kg	<5.50mg/kg	75.9%
S508007	BEN-6	5/10/06	5mg/kg	1190mg/kg	<5.50mg/kg	67.5%
S508008	WI-1S	5/10/06	5mg/kg	1290mg/kg	<5.50mg/kg	45.3%
S508009	WI-2S	5/10/06	5mg/kg	2900mg/kg	<5.50mg/kg	77.9%

Soil Samples: As Received Basis

Certificate: ID ID00019
AZ: AZ0538 CA: NO. 2080 CO: 9/1/05 ID: ID00019 MT: 6/6/05 NV: 8/1/05 WA: C1268

Reviewed By:________________ Date: 6/5/06

Part I Prep Blank and Laboratory Control Sample

Client :GOLDER & ASSOCIATES INC

SVL JOB No: 122788

Analyte	Method	Matrix	Units	Prep Blank	LCS		LCS %R	Analysis Date
					True	Found		
Arsenic	6010B	SOIL	mg/kg	<2.5	100	96.7	96.7	6/02/06
Barium	6010B	SOIL	mg/kg	<0.20	100	97.5	97.5	6/02/06
Cadmium	6010B	SOIL	mg/kg	<0.20	100	95.8	95.8	6/02/06
Copper	6010B	SOIL	mg/kg	<1.0	100	104	104.0	6/02/06
Lead	6010B	SOIL	mg/kg	<0.75	100	106	106.0	6/02/06
Selenium	6010B	SOIL	mg/kg	<4	100	95	95.0	6/02/06
Zinc	6010B	SOIL	mg/kg	<1.0	100	97.3	97.3	6/02/06
Mercury	7471A	SOIL	mg/kg	<0.033	0.834	0.897	107.6	5/23/06

LEGEND:

LCS = Laboratory Control Sample

LCS %R = LCS Percent Recovery

N/A = Not Applicable

6/05/06 15:03

Part II Duplicate and Spike Analysis

Client :GOLDER & ASSOCIATES INC SVL JOB No: 122788

			QC SAMPLE ID			Duplicate or MSD			Matrix Spike			Analysis
Test	Method	Mtx		Units	Result	Found		RPD%	Result	SPK ADD	%R	Date
As	6010B	S	1	mg/kg	10.5	107	M	4.6	112	100	101.5	6/02/06
Ba	6010B	S	1	mg/kg	7.70	106	M	0.0	106	100	98.3	6/02/06
Cd	6010B	S	1	mg/kg	5.48	95.8	M	0.0	95.8	100	90.3	6/02/06
Cu	6010B	S	1	mg/kg	68.6	172	M	6.7	184	100	115.4	6/02/06
Pb	6010B	S	1	mg/kg	415	579	M	1.6	570	100	R >4S	6/02/06
Se	6010B	S	1	mg/kg	7	101	M	2.9	104	100	97.0	6/02/06
Zn	6010B	S	1	mg/kg	1060	1300	M	1.6	1280	100	R >4S	6/02/06
Hg	7471A	S	1	mg/kg	0.175	0.360	M	1.4	0.355	0.167	107.8	5/23/06

LEGEND:

RPD% = (|SAM - DUP|/((SAM + DUP)/2) * 100) UDL = Both SAM & DUP not detected. *Result or *Found: Interference required dilution.

RPD% = (|SPK - MSD|/((SPK + MSD)/2) * 100) M in Duplicate/MSD column indicates MSD.

SPIKE ADD column, A = Post Digest Spike; %R = Percent Recovery N/A = Not Analyzed; R > 4S = Result more than 4X the Spike Added

QC limits for MS recoveries apply only if the spike is at least 1/4 the concentration of the analyte in the sample.

Control limits for the RPD apply only if the concentration of the analyte in the sample is at least five times the reporting limit.

QC Sample 1: SVL SAM No.: 508002 Client Sample ID: BEN-1

SVL ANALYTICAL

Cooler temp 6.0° 5.19.06 9:10

CHAIN OF CUSTODY RECORD

Page 1 of 1

Client: GOLDER Assoc.
Contact: Doug Morell
Address: 18300 NE ~~Red~~ Union Hill Rd #200
Redmond, WA 98052
Phone Number: (425) 883-0777
FAX Number: (425) 882-5498

NOTES:
1) Ensure proper container packaging.
2) Ship samples promptly following collection.
3) Designate Sample Reject Disposition
PO#: 043-1344.413
Project Name: P.O. Mine RI/FS

Table 1. -- Matrix Type
1 = Surface Water, 2 = Ground Water
[✓ 3 =] Soil/Sediment, 4 = Rinsate, 5 = Oil
6 = Waste, 7 = Other (Specify) ______

FOR SVL USE ONLY
SVL JOB # 122788

Samplers Signature: Pal Va Middlemist
(208) 755-3002 cell

Lab Name: SVL Analytical, Inc. (208) 784-1258 FAX (208) 783-0891
Address: One Government Gulch, Kellogg, ID 83837-0929

	Collection		Miscellaneous				Preservative(s)						Analyses Required									
Sample ID	Date	Time	Collected by: (Init.)	Matrix Type From Table 1	No. of Containers	Sample Filtered ? Y/N	Unpreserved (Ice Only)	HNO3	HCL	H2SO4	NAOH	Other (Specify)	Metals									Temp on arrival 6°C J Comments
1. BEN-1	5/10/06	13:00	PVM	3	1	N	1						1									
2. BEN-2	↓	13:15	↓	↓	1	↓	1						1									
3. BEN-3		13:30			1		1						1									
4. BEN-4		14:00			1		1						1									
5. BEN-5		14:15			1		1						1									
6. BEN-6		14:30			1		1						1									
7. W1-1S		15:30			1		1						1									
8. W1-2S		16:30			1		1						1									
9.																						
10.																						

Relinquished by: Pal Va Middlemist	Date: 5/18/06	Time: 16:20	Received by: Johann P Garden	Date: 5/18/06	Time: 1620
Relinquished by:	Date:	Time:	Received by: Robin Stribling	Date: 5.19.06	Time: 9:10

* Sample Reject: [ ] Return [ ] Dispose [ ] Store (30 Days)

White: LAB COPY Yellow: CUSTOMER COPY

SVL-COC 12/95

INTER-MOUNTAIN LABORATORIES

G O L D E R
Received
SEP 29 2005
D E N V E R

September 23, 2005

Mr. Mike Bellito
Golder Associates Inc.
44 Union Blvd., Suite 300
Lakewood, Colorado 80228

Dear Mr. Bellito:

Enclosed are the results for the soil samples our laboratory received on September 2 and August 16. The analyses were run according to methods described in USDA Handbook 60 and the American Society of Agronomy monographs.

Always feel free to contact me at your convenience if you have any questions or concerns.

Sincerely,

Joey Sheeley
Mining Soils

xc: File
Encl.

Inter-Mountain Laboratories, Inc.

1633 Terra Avenue
Sheridan, WY 82801

Report ID: 010507837

Soil Analysis Report

Golder Associates, Inc.
44 Union Blvd.
Suite 300
Lakewood, CO 80228

Client Project ID: Pend Oreille Mine

Date Received: 09/02/05

Set #0105S07837

Report Date: 09/23/05

Lab Id	Sample Id	Depths (Inches)	pH s.u.	EC @ 25°C dS/m	Sand %	Silt %	Clay %	Texture	Organic Matter %
0105S07837	PO-051-AG	6 - 18	6.5	0.15	74.0	18.0	8.0	SANDY LOAM	1.5
0105S07838	PO-052-AG	6 - 18	6.5	0.18	60.0	30.0	10.0	SANDY LOAM	2.8
0105S07839	PO-053-AG	6 - 18	6.3	0.11	74.0	18.0	8.0	SANDY LOAM	1.0
0105S07840	PO-054-AG	6 - 18	6.0	0.12	49.0	41.0	10.0	LOAM	1.9
0105S07841	PO-055-AG	6 - 18	6.1	0.09	76.0	16.0	8.0	SANDY LOAM	1.0
0105S07842	PO-TDF2-BPS (24/08/05)	N/A	7.4	0.16	26.0	64.0	10.0	SILT LOAM	0.5

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: Joey Shealey

Joey Shealey, Soils Lab Supervisor

Report ID: 010507837

1633 Terra Avenue
Sheridan, WY 82801

Page 2 of 6

Soil Analysis Report

Golder Associates, Inc.
44 Union Blvd.
Suite 300
Lakewood, CO 80228

Client Project ID: Pend Oreille Mine

Date Received: 09/02/05

Set #0105S07837

Report Date: 09/23/05

Lab Id	Sample Id	Depths (Inches)	Nitrogen Nitrate ppm	TKN %	Phosphorus ppm	Potassium ppm	Available As ppm	Total As ppm	Available Cd ppm	Total Cd ppm	Available Cu ppm	Total Cu ppm
0105S07837	PO-051-AG	6 - 18	0.14	<0.01	11.3	120	<0.05	5.7	<0.05	<2.5	0.30	21.0
0105S07838	PO-052-AG	6 - 18	0.18	0.09	18.2	179	0.16	8.2	<0.05	<2.5	0.24	24.5
0105S07839	PO-053-AG	6 - 18	0.20	0.04	29.8	102	0.21	5.1	<0.05	<2.5	0.18	18.0
0105S07840	PO-054-AG	6 - 18	0.26	0.05	45.3	206	0.15	6.7	<0.05	<2.5	0.36	28.5
0105S07841	PO-055-AG	6 - 18	0.14	0.02	5.89	73.4	0.07	5.6	<0.05	<2.5	0.28	26.0
0105S07842	PO-TDF2-BPS (24/08/05)	N/A	0.12	0.06	4.30	76.8	0.67	3.8	<0.05	<2.5	0.52	52.5

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: Joey Sheeley

Joey Sheeley, Soils Lab Supervisor

Report ID: 010507837

1633 Terra Avenue
Sheridan, WY 82801

Soil Analysis Report

Golder Associates, Inc.
44 Union Blvd.
Suite 300
Lakewood, CO 80228

Client Project ID: Pend Oreille Mine

Date Received: 09/02/05

Set #0105S07837

Report Date: 09/23/05

Lab Id	Sample Id	Depths (Inches)	Available Pb ppm	Total Pb ppm	Available Zn ppm	Total Zn ppm
0105S07837	PO-051-AG	6 - 18	0.22	<10	0.18	104
0105S07838	PO-052-AG	6 - 18	0.24	<10	0.35	120
0105S07839	PO-053-AG	6 - 18	<0.05	<10	0.09	94
0105S07840	PO-054-AG	6 - 18	0.22	<10	0.24	157
0105S07841	PO-055-AG	6 - 18	0.18	<10	<0.05	71
0105S07842	PO-TDF2-BPS (24/08/05)	N/A	11.8	<10	0.13	123

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: Joey Sheeley

Joey Sheeley, Soils Lab Supervisor

Report ID: 010507837

1633 Terra Avenue
Sheridan, WY 82801

Soil Analysis Report

Golder Associates, Inc.
44 Union Blvd.
Suite 300
Lakewood, CO 80228

Client Project ID: Pend Oreille Mine
Date Received: 09/02/05

Set #0105S07837
Report Date: 09/23/05

Lab Id	Sample Id	Depths (Inches)	pH s.u.	EC @ 25°C dS/m	Sand %	Silt %	Clay %	Texture	Organic Matter %
0105S07839	PO-053-AG	6 - 18	6.3	0.11	74.0	18.0	8.0	SANDY LOAM	1.0
0105S07839D	PO-053-AG	6 - 18	6.2	0.10	72.0	20.0	8.0	SANDY LOAM	1.1

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: Joey Sheeley

Joey Sheeley, Soils Lab Supervisor

Report ID: 010507837

1633 Terra Avenue
Sheridan, WY 82801

Soil Analysis Report

Golder Associates, Inc.
44 Union Blvd.
Suite 300
Lakewood, CO 80228

Client Project ID: Pend Oreille Mine

Date Received: 09/02/05

Set #0105S07837

Report Date: 09/23/05

Lab Id	Sample Id	Depths (Inches)	Nitrogen Nitrate ppm	TKN %	Phosphorus ppm	Potassium ppm	Available As ppm	Total As ppm	Available Cd ppm	Total Cd ppm	Available Cu ppm	Total Cu ppm
0105S07839	PO-053-AG	6 - 18	0.20	0.04	29.8	102	0.21	5.1	<0.05	<2.5	0.18	18.0
0105S07839D	PO-053-AG	6 - 18	0.22	0.03	25.7	97.4	0.21	4.7	<0.05	<2.5	0.20	17.0

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: Joey Sheeley

Joey Sheeley, Soils Lab Supervisor

Report ID: 010507837

1633 Terra Avenue
Sheridan, WY 82801

Soil Analysis Report

Golder Associates, Inc.
44 Union Blvd.
Suite 300
Lakewood, CO 80228

Client Project ID: Pend Oreille Mine
Date Received: 09/02/05

Set #0105S07837
Report Date: 09/23/05

Lab Id	Sample Id	Depths (Inches)	Available Pb ppm	Total Pb ppm	Available Zn ppm	Total Zn ppm
0105S07839	PO-053-AG	6 - 18	<0.05	<10	0.09	94
0105S07839D	PO-053-AG	6 - 18	0.18	<10	0.10	90

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: Joey Sheeley

Joey Sheeley, Soils Lab Supervisor

Inter-Mountain Laboratories, Inc.

1633 Terra Avenue
Sheridan, WY 82801

Report ID: 010506986

Soil Analysis Report

Golder Associates, Inc.
44 Union Blvd.
Suite 300
Lakewood, CO 80228

Client Project ID: Topsoil
Date Received: 08/16/05

Set #0105S06986
Report Date: 09/23/05

Lab Id	Sample Id	Depths (Inches)	pH s.u.	EC @ 25°C dS/m	Sand %	Silt %	Clay %	Texture	Organic Matter %
0105S06986	PO-TDF1-T8	3 - 6	6.9	1.62	19.0	69.0	12.0	SILT LOAM	3.1
0105S06987	PO-TDF1-T8	6 - 12	6.8	1.92	15.0	76.0	9.0	SILT LOAM	4.7
0105S06988	PO-TDF1-T8	12 - 24	6.8	1.82	17.0	68.0	15.0	SILT LOAM	4.2
0105S06989	PO-TDF1-T18	3 - 6	6.8	1.33	31.0	60.0	9.0	SILT LOAM	3.4
0105S06990	PO-TDF1-T18	6 - 12	6.8	2.47	16.0	72.0	12.0	SILT LOAM	4.7
0105S06991	PO-TDF1-T18	12 - 24	6.8	2.18	9.0	73.0	18.0	SILT LOAM	4.8
0105S06992	PO-TDF1-T4AG	6 - 12	7.0	2.34	32.0	59.0	9.0	SILT LOAM	3.8

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: Joey Sheeley
Joey Sheeley, Soils Lab Supervisor

Report ID: 010506986

1633 Terra Avenue
Sheridan, WY 82801

Soil Analysis Report

Golder Associates, Inc.
44 Union Blvd.
Suite 300
Lakewood, CO 80228

Client Project ID: Topsoil
Date Received: 08/16/05

Set #0105S06986
Report Date: 09/23/05

Lab Id	Sample Id	Depths (Inches)	Nitrogen Nitrate ppm	TKN %	Phosphorus ppm	Potassium	Available As ppm	Total As ppm	Available Cd ppm	Total Cd ppm	Available Cu ppm	Total Cu ppm
0105S06986	PO-TDF1-T8	3 - 6	0.22	0.05	0.21	79.1	0.25	10.4	1.1	8.5	14.9	80.5
0105S06987	PO-TDF1-T8	6 - 12	0.18	0.08	0.21	81.8	0.33	8.6	0.5	8.5	12.2	76.5
0105S06988	PO-TDF1-T8	12 - 24	0.16	0.03	<0.01	62.9	0.17	10.7	0.3	8.0	22.8	81.5
0105S06989	PO-TDF1-T18	3 - 6	0.12	0.04	<0.01	75.2	0.25	9.8	0.3	4.0	7.76	36.5
0105S06990	PO-TDF1-T18	6 - 12	0.12	0.08	0.02	82.1	0.17	9.6	0.4	9.0	8.90	82.0
0105S06991	PO-TDF1-T18	12 - 24	0.16	0.02	0.40	69.6	0.26	11.5	0.5	14.0	48.6	130
0105S06992	PO-TDF1-T4AG	6 - 12	0.16	0.01	<0.01	70.1	0.08	10.1	0.9	10.5	9.06	36.5

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Joey Sheeley, Soils Lab Supervisor

Report ID: 010506986

1633 Terra Avenue
Sheridan, WY 82801

Soil Analysis Report
Golder Associates, Inc.
44 Union Blvd.
Suite 300
Lakewood, CO 80228

Client Project ID: Topsoil
Date Received: 08/16/05

Set #0105S06986
Report Date: 09/23/05

Lab Id	Sample Id	Depths (Inches)	Available Pb ppm	Total Pb ppm	Available Zn ppm	Total Zn ppm
0105S06986	PO-TDF1-T8	3 - 6	288	910	280	2200
0105S06987	PO-TDF1-T8	6 - 12	164	605	115	2690
0105S06988	PO-TDF1-T8	12 - 24	268	880	102	2480
0105S06989	PO-TDF1-T18	3 - 6	189	460	99	1490
0105S06990	PO-TDF1-T18	6 - 12	127	570	113	3050
0105S06991	PO-TDF1-T18	12 - 24	486	1240	194	4400
0105S06992	PO-TDF1-T4AG	6 - 12	43	355	258	3510

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
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Reviewed By: Joey Sheeley

Joey Sheeley, Soils Lab Supervisor

Report ID: 010506986

1633 Terra Avenue
Sheridan, WY 82801

Soil Analysis Report

Golder Associates, Inc.
44 Union Blvd.
Suite 300
Lakewood, CO 80228

Client Project ID: Topsoil
Date Received: 08/16/05

Set #0105S06986
Report Date: 09/23/05

Lab Id	Sample Id	Depths (Inches)	pH s.u.	EC @ 25°C dS/m	Sand %	Silt %	Clay %	Texture	Organic Matter %
0105S06991	PO-TDF1-T18	12 - 24	6.8	2.18	9.0	73.0	18.0	SILT LOAM	4.8
0105S06991D	PO-TDF1-T18	12 - 24	6.9	2.12	9.0	73.0	18.0	SILT LOAM	4.8

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: Joey Sheeley

Joey Sheeley, Soils Lab Supervisor

Report ID: 010506986

1633 Terra Avenue
Sheridan, WY 82801

Soil Analysis Report

Golder Associates, Inc.
44 Union Blvd.
Suite 300
Lakewood, CO 80228

Client Project ID: Topsoil
Date Received: 08/16/05

Set #0105S06986
Report Date: 09/23/05

Lab Id	**Sample Id**	**Depths** (Inches)	Nitrogen Nitrate ppm	TKN %	Phosphorus ppm	Potassium	Available As ppm	Total As ppm	Available Cd ppm	Total Cd ppm	Available Cu ppm	Total Cu ppm
0105S06991	PO-TDF1-T18	12 - 24	0.16	0.02	0.40	69.6	0.26	11.5	0.5	14.0	48.6	130
0105S06991D	PO-TDF1-T18	12 - 24	0.16	0.02	0.13	65.2	0.21	11.3	0.5	15.5	47.8	137

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: Joey Sheeley

Joey Sheeley, Soils Lab Supervisor

Report ID: 010506986

1633 Terra Avenue
Sheridan, WY 82801

Soil Analysis Report

Golder Associates, Inc.
44 Union Blvd.
Suite 300
Lakewood, CO 80228

Client Project ID: Topsoil

Date Received: 08/16/05

Set #0105S06986

Report Date: 09/23/05

Lab Id	Sample Id	Depths (Inches)	Available Pb ppm	Total Pb ppm	Available Zn ppm	Total Zn ppm
0105S06991	PO-TDF1-T18	12 - 24	486	1240	194	4400
0105S06991D	PO-TDF1-T18	12 - 24	482	1310	192	4690

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: Joey Sheeley

Joey Sheeley, Soils Lab Supervisor

Inter-Mountain Laboratories, Inc.

Report ID: 010505890

1633 Terra Avenue
Sheridan, WY 82801

Page 1 of 9

Soil Analysis Report

Golder Associates, Inc.
Golder Associates, Inc. /canada
1000 940-6th Ave. S.W.
Calgary, AB T2P 3T1

Client Project ID: Topsoil
Date Received: 08/08/05

Set #0105S05890
Report Date: 11/01/05

Lab Id	Sample Id	Depths (Inches)	pH s.u.	EC @ 25°C dS/m	Sand %	Silt %	Clay %	Texture	Organic Matter %
0105S05890	PO-TDF1-T1-AG	0 - 4	7.1	2.35	66.0	30.0	4.0	SANDY LOAM	1.4
0105S05891	PO-TDF1-T1-AG	4 - 12	7.3	2.12	69.0	27.0	4.0	SANDY LOAM	1.6
0105S05892	PO-TDF1-T1-AG	12 - 24	7.5	2.25	82.0	10.0	8.0	LOAMY SAND	1.5
0105S05893	PO-TDF1-T2-AG	0 - 8	7.4	2.26	32.0	62.0	6.0	SILT LOAM	2.4
0105S05894	PO-TDF1-T2-AG	8 - 12	7.3	2.14	66.0	30.0	4.0	SANDY LOAM	2.9
0105S05895	PO-TDF1-T2-AG	12 - 24	7.4	2.15	76.0	16.0	8.0	SANDY LOAM	2.9
0105S05896	PO-TDF1-T3-AG	0 - 3	7.4	1.43	30.0	62.0	8.0	SILT LOAM	2.9
0105S05897	PO-TDF1-T3-AG	3 - 12	7.5	2.35	46.0	48.0	6.0	SANDY LOAM	2.7
0105S05898	PO-TDF1-T3-AG	12 - 24	7.5	2.23	72.0	22.0	6.0	SANDY LOAM	2.7
0105S05899	PO-TDF1-T4-AG	0 - 6	7.6	2.21	46.0	48.0	6.0	SANDY LOAM	1.8
0105S05900	PO-TDF1-T4-AG	6 - 12	7.2	2.36	24.0	67.0	9.0	SILT LOAM	4.0
0105S05901	PO-TDF1-T4-AG	12 - 24	7.4	2.59	28.0	61.0	11.0	SILT LOAM	3.9
0105S05902	PO-TDF1-T5-AG	0 - 6	7.8	0.90	62.0	32.0	6.0	SANDY LOAM	0.9
0105S05903	PO-TDF1-T5-AG	6 - 12	8.0	0.56	81.0	15.0	4.0	LOAMY SAND	0.9
0105S05904	PO-TDF1-T5-AG	12 - 24	7.6	2.24	69.0	27.0	4.0	SANDY LOAM	2.2
0105S05905	PO-TDF1-T6-AG	0 - 6	7.5	2.00	50.0	46.0	4.0	SANDY LOAM	1.5
0105S05906	PO-TDF1-T6-AG	6 - 12	7.6	2.30	62.0	30.0	8.0	SANDY LOAM	2.2
0105S05907	PO-TDF1-T6-AG	12 - 24	7.4	2.31	12.0	76.0	12.0	SILT LOAM	2.6
0105S05908	PO-TDF1-T7-AG	0 - 4	7.6	1.61	51.0	47.0	2.0	SANDY LOAM	1.7
0105S05909	PO-TDF1-T7-AG	4 - 12	7.6	2.21	59.0	37.0	4.0	SANDY LOAM	1.9
0105S05910	PO-TDF1-T7-AG	12 - 24	7.6	2.20	17.0	71.0	12.0	SILT LOAM	2.5
0105S05911	PO-TDF1-T9-AG	0 - 8	7.5	2.21	50.0	35.0	15.0	LOAM	2.3
0105S05912	PO-TDF1-T9-AG	8 - 12	7.6	2.16	40.0	51.0	9.0	SILT LOAM	3.5
0105S05913	PO-TDF1-T9-AG	12 - 24	7.6	2.17	70.0	23.0	7.0	SANDY LOAM	2.9
0105S05914	PO-TDF1-T10-AG	0 - 3	7.5	2.08	22.0	69.0	9.0	SILT LOAM	3.7
0105S05915	PO-TDF1-T10-AG	3 - 12	7.6	1.79	46.0	48.0	6.0	SANDY LOAM	1.1
0105S05916	PO-TDF1-T10-AG	12 - 24	7.7	2.29	16.0	74.0	10.0	SILT LOAM	1.2

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: Joey Sheeley

Joey Sheeley, Soils Lab Supervisor

Report ID: 010505890

1633 Terra Avenue
Sheridan, WY 82801

Soil Analysis Report

Golder Associates, Inc.
Golder Associates, Inc. /canada
1000 940-6th Ave. S.W.
Calgary, AB T2P 3T1

Client Project ID: Topsoil
Date Received: 08/08/05

Set #0105S05890
Report Date: 11/01/05

Lab Id	Sample Id	Depths (Inches)	Nitrogen Nitrate ppm	TKN %	Phosphorus ppm	Potassium ppm	Available As ppm	Total As ppm	Available Cd ppm	Total Cd ppm	Available Cu ppm	Total Cu ppm
0105S05890	PO-TDF1-T1-AG	0 - 4	0.88	0.01	0.44	8.20	0.19	4.6	0.8	12.5	3.94	20.5
0105S05891	PO-TDF1-T1-AG	4 - 12	0.32	<0.01	<0.01	6.00	0.15	4.7	0.9	11.0	4.82	17.0
0105S05892	PO-TDF1-T1-AG	12 - 24	0.26	<0.01	<0.01	8.40	0.22	4.7	1.1	11.0	4.70	17.0
0105S05893	PO-TDF1-T2-AG	0 - 8	0.32	<0.01	2.34	7.90	0.16	7.0	3.2	21.0	6.94	76.0
0105S05894	PO-TDF1-T2-AG	8 - 12	0.26	<0.01	<0.01	7.60	0.13	5.5	13.0	31.5	4.70	42.5
0105S05895	PO-TDF1-T2-AG	12 - 24	0.26	<0.01	<0.01	9.50	0.11	34.8	7.7	36.0	1.94	28.0
0105S05896	PO-TDF1-T3-AG	0 - 3	0.40	0.06	2.11	29.0	<0.05	7.0	1.0	14.0	14.1	77.0
0105S05897	PO-TDF1-T3-AG	3 - 12	0.36	<0.01	<0.01	9.50	0.16	6.5	1.6	16.5	3.98	31.5
0105S05898	PO-TDF1-T3-AG	12 - 24	0.28	<0.01	<0.01	11.0	0.09	5.5	2.1	21.0	1.14	16.5
0105S05899	PO-TDF1-T4-AG	0 - 6	0.46	<0.01	<0.01	12.2	0.15	6.0	1.4	14.5	5.12	32.5
0105S05900	PO-TDF1-T4-AG	6 - 12	0.30	<0.01	<0.01	7.10	0.21	5.0	1.2	17.0	62.0	75.0
0105S05901	PO-TDF1-T4-AG	12 - 24	0.26	<0.01	0.28	7.30	0.25	6.5	<0.5	13.5	52.0	59.5
0105S05902	PO-TDF1-T5-AG	0 - 6	0.90	0.01	0.81	8.80	0.23	5.5	0.7	7.5	5.84	23.5
0105S05903	PO-TDF1-T5-AG	6 - 12	0.26	<0.01	3.22	8.20	0.22	3.5	0.7	7.5	3.72	7.5
0105S05904	PO-TDF1-T5-AG	12 - 24	0.26	<0.01	<0.01	8.00	0.18	22.5	3.1	22.0	3.02	25.5
0105S05905	PO-TDF1-T6-AG	0 - 6	2.82	0.04	0.83	11.3	0.25	5.0	<0.5	11.0	3.44	32.5
0105S05906	PO-TDF1-T6-AG	6 - 12	0.24	<0.01	<0.01	10.4	0.19	4.5	<0.5	9.0	2.32	13.0
0105S05907	PO-TDF1-T6-AG	12 - 24	0.48	<0.01	<0.01	13.6	0.24	4.0	5.2	15.5	123	160
0105S05908	PO-TDF1-T7-AG	0 - 4	0.38	<0.01	0.20	18.6	0.19	4.0	1.0	8.5	3.88	13.0
0105S05909	PO-TDF1-T7-AG	4 - 12	0.22	<0.01	<0.01	13.3	0.25	4.0	0.9	7.5	2.60	12.0
0105S05910	PO-TDF1-T7-AG	12 - 24	1.04	<0.01	<0.01	15.2	0.22	4.5	3.2	14.5	54.0	113
0105S05911	PO-TDF1-T9-AG	0 - 8	0.34	0.01	0.17	11.0	0.18	4.0	3.5	22.0	6.30	26.0
0105S05912	PO-TDF1-T9-AG	8 - 12	0.28	<0.01	<0.01	12.0	0.18	6.0	14.6	50.5	13.4	90.0
0105S05913	PO-TDF1-T9-AG	12 - 24	0.36	<0.01	<0.01	10.2	0.20	6.5	4.2	18.0	2.00	13.0
0105S05914	PO-TDF1-T10-AG	0 - 3	0.26	0.02	0.86	43.2	0.25	6.0	2.7	24.5	19.1	129
0105S05915	PO-TDF1-T10-AG	3 - 12	0.82	<0.01	0.33	15.7	0.33	4.0	0.6	11.0	15.1	50.0
0105S05916	PO-TDF1-T10-AG	12 - 24	0.40	<0.01	<0.01	13.5	0.23	3.5	1.8	10.5	40.6	127

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: Joey Sheeley

Joey Sheeley, Soils Lab Supervisor

Report ID: 010505890

1633 Terra Avenue
Sheridan, WY 82801

Soil Analysis Report

Golder Associates, Inc.

Golder Associates, Inc. /canada
1000 940-6th Ave. S.W.
Calgary, AB T2P 3T1

Client Project ID: Topsoil
Date Received: 08/08/05

Set #0105S05890
Report Date: 11/01/05

Lab Id	**Sample Id**	Depths (Inches)	Available Pb ppm	Total Pb ppm	Available Zn ppm	Total Zn ppm
0105S05890	PO-TDF1-T1-AG	0 - 4	44.8	510	72.3	1040
0105S05891	PO-TDF1-T1-AG	4 - 12	74.8	363	160	990
0105S05892	PO-TDF1-T1-AG	12 - 24	62.2	383	47.5	1030
0105S05893	PO-TDF1-T2-AG	0 - 8	56.4	505	205	2960
0105S05894	PO-TDF1-T2-AG	8 - 12	75.8	426	345	4770
0105S05895	PO-TDF1-T2-AG	12 - 24	84.6	462	434	7200
0105S05896	PO-TDF1-T3-AG	0 - 3	24.0	530	118	2160
0105S05897	PO-TDF1-T3-AG	3 - 12	33.4	338	144	2160
0105S05898	PO-TDF1-T3-AG	12 - 24	33.8	275	203	3910
0105S05899	PO-TDF1-T4-AG	0 - 6	31.4	330	216	2730
0105S05900	PO-TDF1-T4-AG	6 - 12	262	305	334	4000
0105S05901	PO-TDF1-T4-AG	12 - 24	240	306	88.4	2770
0105S05902	PO-TDF1-T5-AG	0 - 6	47.4	303	70.1	715
0105S05903	PO-TDF1-T5-AG	6 - 12	36.4	85.5	35.6	222
0105S05904	PO-TDF1-T5-AG	12 - 24	103	735	121	1410
0105S05905	PO-TDF1-T6-AG	0 - 6	19.6	476	40.5	1130
0105S05906	PO-TDF1-T6-AG	6 - 12	37.6	273	120	995
0105S05907	PO-TDF1-T6-AG	12 - 24	690	955	586	3880
0105S05908	PO-TDF1-T7-AG	0 - 4	26.0	319	99.2	945
0105S05909	PO-TDF1-T7-AG	4 - 12	40.2	254	79.6	790
0105S05910	PO-TDF1-T7-AG	12 - 24	186	545	394	2660
0105S05911	PO-TDF1-T9-AG	0 - 8	54.8	525	251	2660
0105S05912	PO-TDF1-T9-AG	8 - 12	103	970	830	11400
0105S05913	PO-TDF1-T9-AG	12 - 24	74.2	300	426	3680
0105S05914	PO-TDF1-T10-AG	0 - 3	31.8	725	351	5350
0105S05915	PO-TDF1-T10-AG	3 - 12	272	815	138	1030
0105S05916	PO-TDF1-T10-AG	12 - 24	374	885	309	1520

These results only apply to the samples tested.

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Reviewed By: Joey Sheeley

Joey Sheeley, Soils Lab Supervisor

Inter-Mountain Laboratories, Inc.

Report ID: 010505890

1633 Terra Avenue
Sheridan, WY 82801

Page 4 of 9

Soil Analysis Report

Golder Associates, Inc.
Golder Associates, Inc. /canada
1000 940-6th Ave. S.W.
Calgary, AB T2P 3T1

Client Project ID: Topsoil
Date Received: 08/08/05

Set #0105S05890
Report Date: 11/01/05

Lab Id	Sample Id	Depths (Inches)	pH s.u.	EC @ 25°C dS/m	Sand %	Silt %	Clay %	Texture	Organic Matter %
0105S05917	PO-TDF1-T11-AG	0 - 6	7.7	0.45	26.0	66.0	8.0	SILT LOAM	2.9
0105S05918	PO-TDF1-T11-AG	6 - 12	8.0	0.48	10.0	77.0	13.0	SILT LOAM	1.1
0105S05919	PO-TDF1-T11-AG	12 - 24	7.8	0.64	54.0	40.0	6.0	SANDY LOAM	3.2
0105S05920	PO-TDF1-T12-AG	0 - 3	7.7	0.53	32.0	61.0	7.0	SILT LOAM	2.2
0105S05921	PO-TDF1-T12-AG	3 - 12	7.8	0.86	26.0	64.0	10.0	SILT LOAM	1.6
0105S05922	PO-TDF1-T12-AG	12 - 24	7.9	0.83	42.0	52.0	6.0	SILT LOAM	1.6
0105S05923	PO-TDF2-T13-AG	0 - 6	7.7	1.41	23.0	67.0	10.0	SILT LOAM	2.9
0105S05924	PO-TDF2-T13-AG	6 - 12	7.6	2.15	62.0	33.0	5.0	SANDY LOAM	3.2
0105S05925	PO-TDF2-T13-AG	12 - 24	7.5	2.17	22.0	64.0	14.0	SILT LOAM	3.5
0105S05926	PO-TDF2-T14-AG	0 - 4	7.5	1.76	32.0	62.0	6.0	SILT LOAM	3.4
0105S05927	PO-TDF2-T14-AG	4 - 12	7.6	2.12	42.0	52.0	6.0	SILT LOAM	2.9
0105S05928	PO-TDF2-T14-AG	12 - 24	7.6	2.14	67.0	25.0	8.0	SANDY LOAM	2.4
0105S05929	PO-TDF2-T15-AG	0 - 6	7.7	2.44	8.0	77.0	15.0	SILT LOAM	4.0
0105S05930	PO-TDF2-T15-AG	6 - 12	7.5	3.05	18.0	68.0	14.0	SILT LOAM	6.0
0105S05931	PO-TDF2-T15-AG	12 - 24	7.4	2.80	18.0	69.0	13.0	SILT LOAM	4.3
0105S05932	PO-TDF2-T16-AG	0 - 6	7.6	2.19	36.0	56.0	8.0	SILT LOAM	3.4
0105S05933	PO-TDF2-T16-AG	6 - 12	7.5	2.09	51.0	43.0	6.0	SANDY LOAM	2.5
0105S05934	PO-TDF2-T16-AG	12 - 24	7.3	2.51	12.0	76.0	12.0	SILT LOAM	6.2
0105S05935	PO-TDF2-T17-AG	0 - 6	7.7	2.26	50.0	45.0	5.0	SANDY LOAM	3.4
0105S05936	PO-TDF2-T17-AG	6 - 12	7.7	2.06	40.0	54.0	6.0	SILT LOAM	5.5
0105S05937	PO-TDF2-T17-AG	12 - 24	7.6	2.06	36.0	54.0	10.0	SILT LOAM	4.1

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed By: Joey Sheeley

Joey Sheeley, Soils Lab Supervisor

Report ID: 010505890

1633 Terra Avenue
Sheridan, WY 82801

Soil Analysis Report

Golder Associates, Inc.
Golder Associates, Inc. /canada
1000 940-6th Ave. S.W.
Calgary, AB T2P 3T1

Client Project ID: Topsoil
Date Received: 08/08/05

Set #0105S05890
Report Date: 11/01/05

Lab Id	Sample Id	Depths (Inches)	Nitrogen Nitrate ppm	TKN %	Phosphorus ppm	Potassium ppm	Available As ppm	Total As ppm	Available Cd ppm	Total Cd ppm	Available Cu ppm	Total Cu ppm
0105S05917	PO-TDF1-T11-AG	0 - 6	0.46	0.04	1.64	66.4	0.22	5.5	2.8	21.5	20.2	114
0105S05918	PO-TDF1-T11-AG	6 - 12	0.24	<0.01	0.06	10.8	0.58	4.5	3.8	18.0	72.2	164
0105S05919	PO-TDF1-T11-AG	12 - 24	0.32	<0.01	<0.01	23.3	0.12	7.0	4.5	15.0	8.40	26.0
0105S05920	PO-TDF1-T12-AG	0 - 3	0.46	0.02	1.10	18.3	0.09	5.5	2.1	17.0	9.08	83.5
0105S05921	PO-TDF1-T12-AG	3 - 12	0.32	0.01	0.14	12.3	0.14	4.5	0.8	13.0	22.6	82.0
0105S05922	PO-TDF1-T12-AG	12 - 24	0.34	<0.01	0.33	8.50	0.14	4.5	0.7	8.0	10.8	42.5
0105S05923	PO-TDF2-T13-AG	0 - 6	0.38	0.02	0.12	26.7	0.13	7.5	8.4	42.0	29.8	244
0105S05924	PO-TDF2-T13-AG	6 - 12	0.36	<0.01	<0.01	18.6	0.06	7.0	20.4	54.0	5.24	42.0
0105S05925	PO-TDF2-T13-AG	12 - 24	0.44	0.01	<0.01	13.7	0.08	6.5	14.0	38.0	57.4	191
0105S05926	PO-TDF2-T14-AG	0 - 4	0.50	0.04	1.99	23.3	0.11	6.5	7.0	35.5	9.52	76.5
0105S05927	PO-TDF2-T14-AG	4 - 12	0.84	<0.01	<0.01	11.9	0.10	5.5	10.6	48.5	9.58	44.5
0105S05928	PO-TDF2-T14-AG	12 - 24	0.34	<0.01	<0.01	10.5	0.09	6.0	8.2	22.5	8.76	31.5
0105S05929	PO-TDF2-T15-AG	0 - 6	0.40	0.01	<0.01	16.1	0.08	7.5	5.0	30.0	39.0	242
0105S05930	PO-TDF2-T15-AG	6 - 12	0.34	0.01	<0.01	20.0	0.10	8.0	11.2	58.5	83.0	323
0105S05931	PO-TDF2-T15-AG	12 - 24	0.42	<0.01	<0.01	17.2	0.13	6.0	8.1	38.5	126	222
0105S05932	PO-TDF2-T16-AG	0 - 6	0.50	<0.01	<0.01	9.80	0.14	5.5	4.4	21.0	26.8	112
0105S05933	PO-TDF2-T16-AG	6 - 12	0.38	<0.01	<0.01	7.90	0.12	17.0	4.4	19.0	9.94	61.5
0105S05934	PO-TDF2-T16-AG	12 - 24	0.50	<0.01	<0.01	12.6	0.15	20.9	7.1	53.0	136	303
0105S05935	PO-TDF2-T17-AG	0 - 6	0.36	<0.01	0.04	7.90	0.14	6.0	1.8	16.0	6.30	39.0
0105S05936	PO-TDF2-T17-AG	6 - 12	0.44	<0.01	0.41	11.0	0.06	7.5	11.8	30.5	6.18	61.0
0105S05937	PO-TDF2-T17-AG	12 - 24	0.40	<0.01	<0.01	11.5	<0.05	5.0	8.4	22.5	28.8	111

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed By: Joey Sheeley

Joey Sheeley, Soils Lab Supervisor

Report ID: 010505890

1633 Terra Avenue
Sheridan, WY 82801

Soil Analysis Report

Golder Associates, Inc.
Golder Associates, Inc. /canada
1000 940-6th Ave. S.W.
Calgary, AB T2P 3T1

Client Project ID: Topsoil
Date Received: 08/08/05

Set #0105S05890
Report Date: 11/01/05

Lab Id	Sample Id	Depths (Inches)	Available Pb ppm	Total Pb ppm	Available Zn ppm	Total Zn ppm
0105S05917	PO-TDF1-T11-AG	0 - 6	64.6	625	312	4010
0105S05918	PO-TDF1-T11-AG	6 - 12	628	1680	421	1830
0105S05919	PO-TDF1-T11-AG	12 - 24	286	497	193	985
0105S05920	PO-TDF1-T12-AG	0 - 3	37.6	497	267	3580
0105S05921	PO-TDF1-T12-AG	3 - 12	282	890	104	935
0105S05922	PO-TDF1-T12-AG	12 - 24	123	379	99.3	590
0105S05923	PO-TDF2-T13-AG	0 - 6	70.4	1180	648	8300
0105S05924	PO-TDF2-T13-AG	6 - 12	9.2	472	623	13700
0105S05925	PO-TDF2-T13-AG	12 - 24	183	1740	777	9300
0105S05926	PO-TDF2-T14-AG	0 - 4	25.6	545	630	7050
0105S05927	PO-TDF2-T14-AG	4 - 12	13.1	427	987	11500
0105S05928	PO-TDF2-T14-AG	12 - 24	96.0	379	514	4170
0105S05929	PO-TDF2-T15-AG	0 - 6	132	1390	590	5050
0105S05930	PO-TDF2-T15-AG	6 - 12	159	1570	816	13700
0105S05931	PO-TDF2-T15-AG	12 - 24	478	965	640	8300
0105S05932	PO-TDF2-T16-AG	0 - 6	140	935	311	2140
0105S05933	PO-TDF2-T16-AG	6 - 12	80.4	615	258	1970
0105S05934	PO-TDF2-T16-AG	12 - 24	340	1500	841	14900
0105S05935	PO-TDF2-T17-AG	0 - 6	58.2	535	88.8	1210
0105S05936	PO-TDF2-T17-AG	6 - 12	82.2	520	415	3770
0105S05937	PO-TDF2-T17-AG	12 - 24	132	540	602	4620

These results only apply to the samples tested.

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Reviewed By: Joey Sheeley

Joey Sheeley, Soils Lab Supervisor

Inter·Mountain Laboratories, Inc.

Report ID: 010505890

1633 Terra Avenue
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Soil Analysis Report

Golder Associates, Inc.

Golder Associates, Inc. /canada
1000 940-6th Ave. S.W.
Calgary, AB T2P 3T1

Client Project ID: Topsoil

Date Received: 08/08/05

Set #0105S05890

Report Date: 11/01/05

Lab Id	Sample Id	Depths (Inches)	pH s.u.	EC @ 25°C dS/m	Sand %	Silt %	Clay %	Texture	Organic Matter %
0105S05900	PO-TDF1-T4-AG	6 - 12	7.2	2.36	24.0	67.0	9.0	SILT LOAM	4.0
0105S05900D	PO-TDF1-T4-AG	6 - 12	7.3	2.37	26.0	65.0	9.0	SILT LOAM	3.9
0105S05915	PO-TDF1-T10-AG	3 - 12	7.6	1.79	46.0	48.0	6.0	SANDY LOAM	1.1
0105S05915D	PO-TDF1-T10-AG	3 - 12	7.6	1.85	44.0	50.0	6.0	SANDY LOAM	1.2
0105S05925	PO-TDF2-T13-AG	12 - 24	7.5	2.17	22.0	64.0	14.0	SILT LOAM	3.5
0105S05925D	PO-TDF2-T13-AG	12 - 24	7.5	2.19	24.0	63.0	13.0	SILT LOAM	3.3
0105S05928	PO-TDF2-T14-AG	12 - 24	7.6	2.14	67.0	25.0	8.0	SANDY LOAM	2.4
0105S05928D	PO-TDF2-T14-AG	12 - 24	7.6	2.18	66.0	25.0	9.0	SANDY LOAM	2.6
0105S05933	PO-TDF2-T16-AG	6 - 12	7.5	2.09	51.0	43.0	6.0	SANDY LOAM	2.5
0105S05933D	PO-TDF2-T16-AG	6 - 12	7.5	2.19	50.0	43.0	7.0	LOAM	2.8

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Soil Analysis Report

Golder Associates, Inc.

Golder Associates, Inc. /canada
1000 940-6th Ave. S.W.
Calgary, AB T2P 3T1

Client Project ID: Topsoil

Date Received: 08/08/05

Set #0105S05890

Report Date: 11/01/05

Lab Id	Sample Id	Depths (Inches)	Nitrogen Nitrate ppm	TKN %	Phosphorus ppm	Potassium ppm	Available As ppm	Total As ppm	Available Cd ppm	Total Cd ppm	Available Cu ppm	Total Cu ppm
0105S05900	PO-TDF1-T4-AG	6 - 12	0.30	<0.01	<0.01	7.10	0.21	5.0	1.2	17.0	62.0	75.0
0105S05900D	PO-TDF1-T4-AG	6 - 12	0.28	<0.01	0.15	7.60	0.19	5.0	1.2	15.5	51.8	68.5
0105S05915	PO-TDF1-T10-AG	3 - 12	0.82	<0.01	0.33	15.7	0.33	4.0	0.6	11.0	15.1	50.0
0105S05915D	PO-TDF1-T10-AG	3 - 12	0.88	<0.01	0.06	14.6	0.25	3.5	0.6	10.5	15.4	46.5
0105S05925	PO-TDF2-T13-AG	12 - 24	0.44	0.01	<0.01	13.7	0.08	6.5	14.0	38.0	57.4	191
0105S05925D	PO-TDF2-T13-AG	12 - 24	0.44	0.01	<0.01	13.8	0.05	5.5	14.3	38.5	57.2	201
0105S05928	PO-TDF2-T14-AG	12 - 24	0.34	<0.01	<0.01	10.5	0.09	6.0	8.2	22.5	8.76	31.5
0105S05928D	PO-TDF2-T14-AG	12 - 24	0.36	<0.01	<0.01	9.50	0.12	5.5	7.4	22.0	13.0	25.5
0105S05933	PO-TDF2-T16-AG	6 - 12	0.38	<0.01	<0.01	7.90	0.12	17.0	4.4	19.0	9.94	61.5
0105S05933D	PO-TDF2-T16-AG	6 - 12	0.36	<0.01	<0.01	10.8	<0.05	15.5	4.9	21.0	13.6	75.0

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: Joey Sheeley

Joey Sheeley, Soils Lab Supervisor

Report ID: 010505890

1633 Terra Avenue
Sheridan, WY 82801

Soil Analysis Report

Golder Associates, Inc.
Golder Associates, Inc. /canada
1000 940-6th Ave. S.W.
Calgary, AB T2P 3T1

Client Project ID: Topsoil
Date Received: 08/08/05

Set #0105S05890
Report Date: 11/01/05

Lab Id	Sample Id	Depths (Inches)	Available Pb ppm	Total Pb ppm	Available Zn ppm	Total Zn ppm
0105S05900	PO-TDF1-T4-AG	6 - 12	262	305	334	4000
0105S05900D	PO-TDF1-T4-AG	6 - 12	238	294	313	3740
0105S05915	PO-TDF1-T10-AG	3 - 12	272	815	138	1030
0105S05915D	PO-TDF1-T10-AG	3 - 12	274	765	140	945
0105S05925	PO-TDF2-T13-AG	12 - 24	183	1740	777	9300
0105S05925D	PO-TDF2-T13-AG	12 - 24	184	1810	790	9500
0105S05928	PO-TDF2-T14-AG	12 - 24	96.0	379	514	4170
0105S05928D	PO-TDF2-T14-AG	12 - 24	107	374	493	3740
0105S05933	PO-TDF2-T16-AG	6 - 12	80.4	615	258	1970
0105S05933D	PO-TDF2-T16-AG	6 - 12	90.4	740	321	2370

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: Joey Sheeley

Joey Sheeley, Soils Lab Supervisor

Analysis Report

CANTEST LTD.

Professional
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4606 Canada Way
Burnaby, B.C.
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Fax: 604 731 2386

Tel: 604 734 7276

1 800 665 8566

Original

REPORT ON: Analysis of Soil Samples

REPORTED TO:
Golder Associates Ltd.
201 Columbia Avenue
Castlegar, B.C.
V1N 1A2

Att'n: Carissa Canning

CHAIN OF CUSTODY: 191290, 191286
PROJECT NAME: Pend Oreille Mine
PROJECT NUMBER: 043-1344

NUMBER OF SAMPLES: 7

REPORT DATE: October 31, 2005

DATE SUBMITTED: September 9, 2005

GROUP NUMBER: 61021109

SAMPLE TYPE: Soil

NOTE: Results contained in this report refer only to the testing of samples as submitted. Other information is available on request.

TEST METHODS:

pH in Soil or Solid - analysis was performed based on procedures described in the Manual on Soil Sampling and Methods of Analysis, published by the Canadian Society of Soil Science,1993. The test was performed using a deionized water leach with measurement by pH meter.

Arsenic in Soil - analysis was performed using Inductively Coupled Plasma Mass Spectrometry (ICP/MS).

Cadmium in Soil - analysis was performed using Inductively Coupled Plasma Mass Spectrometry (ICP/MS).

Mercury in Soil - analysis was performed using Cold Vapour Atomic Fluorescence.

Strong Acid Leachable Metals in Soil - analysis was performed using B.C. MOELP Method "Strong Acid Leachable Metals in Soil, Version 1.0". The method involves drying the sample at 60 C, sieving using a 2 mm (10 mesh) sieve and digestion using a mixture of hydrochloric and nitric acids. Analysis was performed using Inductively Coupled Argon Plasma Spectroscopy (ICAP) or by specific techniques as described.

TEST RESULTS:

(See following pages)

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PG

Richard S. Jornitz
Supervisor, Inorganic Testing

REPORTED TO: Golder Associates Ltd.

REPORT DATE: October 31, 2005

GROUP NUMBER: 61021109

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Conventional Parameters in Soil

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CANTEST ID	pH
PO-TDF1-T8-C-155f-Hg	Jul 26/05	510210529	7.3
PO-TDF1-T8-C-155-Hg	Jul 26/05	510210538	7.4
PO-OS-AP1a-C-21s-Hg	Jul 26/05	510210539	6.3
PO-OS-AP1b-C-23s-Hg	Jul 26/05	510210540	6.9
PO-OS-AP1c-C-22s-Hg	Jul 26/05	510210541	6.6
PO-OS-AP2a-C-25s-Hg	Jul 26/05	510210542	6.6
PO-OS-AP2b-C-25s-Hg	Jul 26/05	510210545	6.2
DETECTION LIMIT			0.1
UNITS			pH units

Strong Acid Soluble Metals in Soil

CLIENT SAMPLE IDENTIFICATION:		**PO-TDF1-T8 -C-155f-Hg**	**PO-TDF1-T8 -C-155-Hg**	**PO-OS-AP1a -C-21s-Hg**	**PO-OS-AP1b -C-23s-Hg**	DETECTION LIMIT
DATE SAMPLED:		Jul 26/05	Jul 26/05	Jul 26/05	Jul 26/05	
CANTEST ID:		510210529	510210538	510210539	510210540	
Arsenic	As	14.7	15.2	5.8	4.4	0.1
Cadmium	Cd	6.7	11.2	0.6	0.4	0.2
Copper	Cu	39	144	25	15	1
Lead	Pb	743	996	18.9	20.0	0.2
Mercury	Hg	0.10	0.22	0.01	0.01	0.01
Zinc	Zn	1650	2900	116	90	1

Results expressed as micrograms per gram, on a dry weight basis. (μg/g)

Strong Acid Soluble Metals in Soil

CLIENT SAMPLE IDENTIFICATION:		**PO-OS-AP1c -C-22s-Hg**	**PO-OS-AP2a -C-25s-Hg**	**PO-OS-AP2b -C-25s-Hg**	
DATE SAMPLED:		Jul 26/05	Jul 26/05	Jul 26/05	
CANTEST ID:		510210541	510210542	510210545	DETECTION LIMIT
Arsenic	As	5.4	5.1	5.0	0.1
Cadmium	Cd	0.7	0.4	0.3	0.2
Copper	Cu	23	22	21	1
Lead	Pb	33.3	18.2	13.6	0.2
Mercury	Hg	0.01	<	<	0.01
Zinc	Zn	132	76	65	1

Results expressed as micrograms per gram, on a dry weight basis. (µg/g)
< = Less than detection limit

Analysis Report

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1 800 665 8566

REPORT ON: Analysis of Soil Samples

REPORTED TO:
Golder Associates Ltd.
201 Columbia Avenue
Castlegar, B.C.
V1N 1A2

Att'n: Carissa Canning

Original

CHAIN OF CUSTODY: 191286
PROJECT NAME: Pend Oreille Mine
PROJECT NUMBER: 043-1344C

NUMBER OF SAMPLES: 4

REPORT DATE: December 14, 2005

DATE SUBMITTED: September 9, 2005

GROUP NUMBER: 61207064

SAMPLE TYPE: Soil

NOTE: Results contained in this report refer only to the testing of samples as submitted. Other information is available on request.

TEST METHODS:

pH in Soil or Solid - analysis was performed based on procedures described in the Manual on Soil Sampling and Methods of Analysis, published by the Canadian Society of Soil Science,1993. The test was performed using a deionized water leach with measurement by pH meter.

Arsenic in Soil - analysis was performed using Inductively Coupled Plasma Mass Spectrometry (ICP/MS).

Cadmium in Soil - analysis was performed using Inductively Coupled Plasma Mass Spectrometry (ICP/MS).

Mercury in Soil - analysis was performed using Cold Vapour Atomic Fluorescence.

Strong Acid Leachable Metals in Soil - analysis was performed using B.C. MOELP Method "Strong Acid Leachable Metals in Soil, Version 1.0". The method involves drying the sample at 60 C, sieving using a 2 mm (10 mesh) sieve and digestion using a mixture of hydrochloric and nitric acids. Analysis was performed using Inductively Coupled Argon Plasma Spectroscopy (ICAP) or by specific techniques as described.

TEST RESULTS:

(See following pages)

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AS PER
Richard S. Jornitz
Supervisor, Inorganic Testing

Conventional Parameters in Soil

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CANTEST ID	pH
PO-OS-B01-C-6s-Hg	Jul 25/05	512070215	8.2
PO-OS-B02-C-7s-Hg	Jul 25/05	512070217	8.1
PO-OS-DT-C-20aS-Hg	Jul 25/05	512070218	8.3
PO-OS-DT-C-20s-Hg	Jul 25/05	512070219	8.5
DETECTION LIMIT			0.1
UNITS			pH units

Strong Acid Soluble Metals in Soil

CLIENT SAMPLE IDENTIFICATION:		**PO-OS-B01-C-6s-Hg**	**PO-OS-B02-C-7s-Hg**	**PO-OS-DT-C-20aS-Hg**	**PO-OS-DT-C-20s-Hg**	
DATE SAMPLED:		Jul 25/05	Jul 25/05	Jul 25/05	Jul 25/05	DETECTION LIMIT
CANTEST ID:		512070215	512070217	512070218	512070219	
Arsenic	As	11.4	10.1	7.6	40.5	0.1
Cadmium	Cd	10.7	8.5	3.0	5.9	0.2
Copper	Cu	44	40	17	32	1
Lead	Pb	382	390	31.4	365	0.2
Mercury	Hg	0.201	0.169	0.072	0.109	0.01
Zinc	Zn	2680	1950	321	3280	1

Results expressed as micrograms per gram, on a dry weight basis. (μg/g)

Analysis Report

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REPORT ON: Analysis of Tissue Sample

REPORTED TO:
Golder Associates Ltd.
201 Columbia Avenue
Castlegar, B.C.
V1N 1A2

Att'n: Carissa Canning

CHAIN OF CUSTODY: 183091, 191284, 191285, 191291, 183090
PROJECT NAME: Pend Oreille Mine
PROJECT NUMBER: 043-1344

NUMBER OF SAMPLES: 24

REPORT DATE: December 28, 2005

DATE SUBMITTED: December 13, 2005

GROUP NUMBER: 61213086

SAMPLE TYPE: Tissue

NOTE: Results contained in this report refer only to the testing of samples as submitted. Other information is available on request.

TEST METHODS:

Mercury in Tissue - samples were digested using a nitric acid-hydrogen peroxide digestion procedure based on EPA Method 200.3. Analysis was performed using Cold Vapour Atomic Absorption Spectrophotometry or Cold Vapour Atomic Fluorescence Spectrophotometry.

Metals in Tissue - samples were digested using a nitric acid-hydrogen peroxide digestion procedure based on EPA Method 200.3. Analysis was performed using Inductively Coupled Argon Plasma Spectroscopy (ICP), ICP Mass Spectrometry (ICP/MS), or Atomic Absorption techniques.

TEST RESULTS:

(See following pages)

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Richard S. Jornitz
Supervisor, Inorganic Testing

Metals Analysis in Tissue

CLIENT SAMPLE IDENTIFICATION:		**PO-TDF1-T1 2-Act-55V**	**PO-TDF1-T1 2-PI-57V**	**PO-TDF2-T1 3-PI-10V**	**PO-TDF2-T1 3-Act-11V**	
DATE SAMPLED:		Jul 26/05	Jul 26/05	Jul 25/05	Jul 25/05	DETECTION LIMIT
CANTEST ID:		512130416	512130418	512130419	512130420	
Arsenic	As	<	<	<	<	0.1
Cadmium	Cd	6.37	0.69	1.42	7.29	0.02
Copper	Cu	5.8	2.9	3.3	9.5	0.1
Lead	Pb	0.5	0.3	0.2	0.6	0.1
Mercury	Hg	<	<	<	<	0.01
Zinc	Zn	1160	166	168	1150	0.5

Results expressed as micrograms per gram, dry basis (μg/g)
< = Less than detection limit

REPORTED TO: Golder Associates Ltd.

REPORT DATE: December 28, 2005

GROUP NUMBER: 61213086

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Metals Analysis in Tissue

CLIENT SAMPLE IDENTIFICATION:		**PO-TDF2-T13-GR-12V**	**PO-TDF2-T14-Act-2V**	**PO-TDF2-T14-GR-3V**	**PO-TDF2-T16-GR-8V**	DETECTION LIMIT
DATE SAMPLED:		Jul 25/05	Jul 25/05	Jul 25/05	Jul 25/05	
CANTEST ID:		512130422	512130423	512130424	512130425	
Arsenic	As	<	<	<	<	0.1
Cadmium	Cd	0.13	7.09	0.02	0.11	0.02
Copper	Cu	3.9	7.2	4.0	4.9	0.1
Lead	Pb	0.6	0.3	0.4	2.8	0.1
Mercury	Hg	<	<	<	<	0.01
Zinc	Zn	196	903	111	178	0.5

Results expressed as micrograms per gram, dry basis (μg/g)
< = Less than detection limit

REPORTED TO: Golder Associates Ltd.

REPORT DATE: December 28, 2005

GROUP NUMBER: 61213086

CANTEST®

Metals Analysis in Tissue

CLIENT SAMPLE IDENTIFICATION:		**PO-TDF2-T17-Act-5V**	**PO-TDF2-T17-GR-6V**	**PO-TDF2-T17-PI-7V**	**PO-TDF1-T1-Act-19V**	
DATE SAMPLED:		Jul 25/05	Jul 25/05	Jul 26/05	Jul 26/05	DETECTION LIMIT
CANTEST ID:		512130426	512130428	512130429	512130430	
Arsenic	As	0.1	<	<	0.5	0.1
Cadmium	Cd	6.18	0.05	0.12	4.53	0.02
Copper	Cu	10.5	4.3	2.9	10.9	0.1
Lead	Pb	3.4	1.1	0.3	14.2	0.1
Mercury	Hg	<	<	<	<	0.01
Zinc	Zn	990	124	60.2	1090	0.5

Results expressed as micrograms per gram, dry basis (μg/g)
< = Less than detection limit

Metals Analysis in Tissue

CLIENT SAMPLE IDENTIFICATION:		**PO-TDF1-T1 -GR-20V**	**PO-TDF1-T2 -GR-22V**	**PO-TDF1-T3 -GR-26V**	**PO-TDF1-T4 -PI-27V**	
DATE SAMPLED:		Jul 26/05	Jul 26/05	Jul 26/05	Jul 26/05	DETECTION LIMIT
CANTEST ID:		512130431	512130432	512130434	512130435	
Arsenic	As	<	<	<	<	0.1
Cadmium	Cd	0.16	0.09	0.03	0.24	0.02
Copper	Cu	5.9	3.8	2.8	1.8	0.1
Lead	Pb	2.9	1.4	1.0	0.4	0.1
Mercury	Hg	<	<	<	<	0.01
Zinc	Zn	191	130	74.1	103	0.5

Results expressed as micrograms per gram, dry basis (μg/g)
< = Less than detection limit

Metals Analysis in Tissue

CLIENT SAMPLE IDENTIFICATION:		**PO-TDF1-T4 -Act-29V**	**PO-TDF1-T7 -PI-36V**	**PO-TDF1-T7 -Act-37V**	**PO-TDF1-T7 -GR-38V**	
DATE SAMPLED:		Jul 26/05	Jul 26/05	Jul 26/05	Jul 26/05	DETECTION LIMIT
CANTEST ID:		512130436	512130437	512130438	512130439	
Arsenic	As	<	<	<	<	0.1
Cadmium	Cd	6.92	0.30	5.97	0.05	0.02
Copper	Cu	6.3	2.7	8.3	5.0	0.1
Lead	Pb	1.1	0.2	0.6	0.7	0.1
Mercury	Hg	<	<	<	<	0.01
Zinc	Zn	1260	121	1120	157	0.5

Results expressed as micrograms per gram, dry basis (μg/g)
< = Less than detection limit

Metals Analysis in Tissue

CLIENT SAMPLE IDENTIFICATION:		**PO-TDF1-T8-TY-31V**	**PO-TDF1-T8-TY-80V**	**PO-TDF1-T10-PI-47V**	**PO-TDF1-T10-Act-48V**	
DATE SAMPLED:		Jul 23/05	Jul 23/05	Jul 26/05	Jul 26/05	
CANTEST ID:		512130440	512130441	512130442	512130443	DETECTION LIMIT
Arsenic	As	<	<	<	<	0.1
Cadmium	Cd	0.03	0.03	0.21	3.75	0.02
Copper	Cu	0.6	1.2	2.7	6.3	0.1
Lead	Pb	0.3	0.3	0.3	0.5	0.1
Mercury	Hg	<	<	<	<	0.01
Zinc	Zn	17.7	32.0	126	999	0.5

Results expressed as micrograms per gram, dry basis (µg/g)
< = Less than detection limit

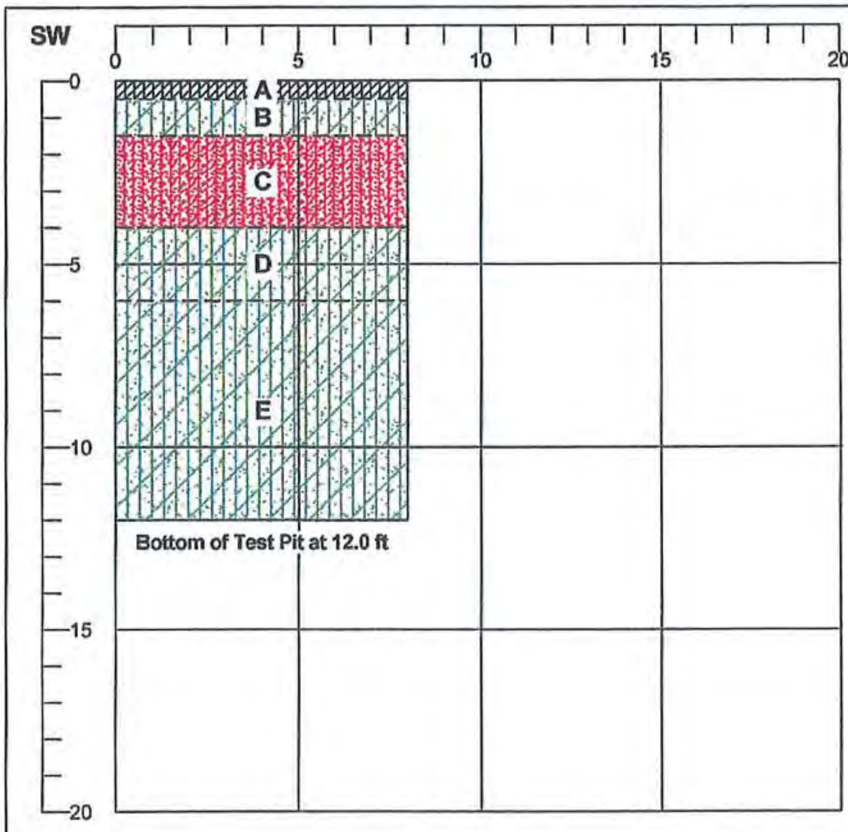
APPENDIX B

TDF-1 AND TDF-2 TEST PIT LOGS

LOG OF TEST PIT: TP-01

Golder Associates

Temp 95 °F Weather Sunny, Clear
Engineer Paul VanMiddlesworth
Operator Dan Bishop
Equipment CAT 416 TLB Excavator
Contractor Randall Contracting
Date 7/26/05
Elevation 2253.3 ft
Datum Geodetic
Job 043-1344
Location Pend Oreille Mine TDF-1



SAMPLES	
NO.	Depth Interval (ft bgs)
T01-AG-1	0 - 0.3'
T01-AG-2	0.3' - 1'
T01-AG-3	1' - 2'
T01-COMP	(0 - 1'), (5 - 6'), (10 - 12')

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 0.5 ft: Light brown, Silt (TAILINGS), dry, loose

B 0.5 - 1.5 ft: Light Gray, Sandy Silt (TAILINGS), dry, medium dense

C 1.5 - 4.0 ft: Reddish-brown, medium dense, Silty Sand with brownish mottling, moist, interbedded with lenses of dry, light gray, Silty Clay (TAILINGS)

D 4.0 - 6.0 ft: Light gray, Sandy Silt (TAILINGS), moist, loose

E 6.0 - 12.0 ft: Light gray, loose to medium dense, Sandy Silt (TAILINGS), moist, interbedded with layers of light brown Silty Clay, medium dense, dry

TIME			DEPTH TO SEEPAGE (ft)

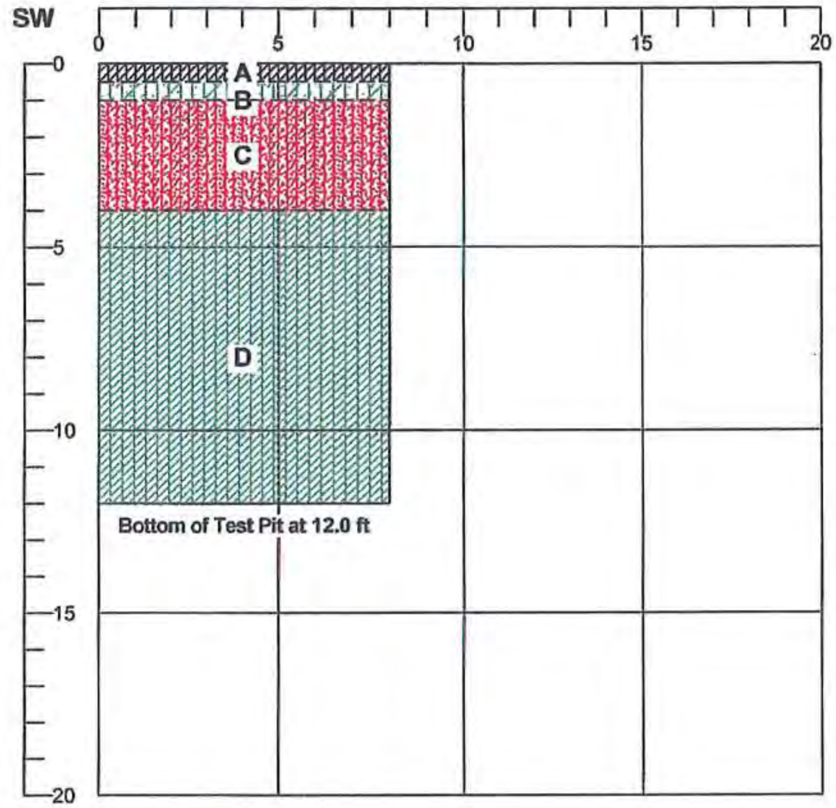
SPECIAL NOTES:

No wet zones encountered,
Tailings Dry to total depth of 12' bgs.

Composite Sample for Metals Analysis Collected from 0-1', 5-6' and 10-12' depth intervals

LOG OF TEST PIT: TP-02

Temp 95 °F Weather Sunny, Clear
Engineer Paul VanMiddlesworth
Operator Dan Bishop
Equipment CAT 416 TLB Excavator
Contractor Randall Contracting
Date 7/26/05
Elevation 2252.1 ft
Datum Geodetic
Job 043-1344
Location Pend Oreille Mine TDF-1



SAMPLES	
NO.	Depth Interval (ft bgs)
T02-AG-1	0 - 0.6'
T02-AG-2	0.6' - 1'
T02-AG-3	1' - 2'
T02-COMP	(0 - 1'), (5 - 6'), (10 - 12')

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 0.5 ft: Light brown, Silt (TAILINGS), dry, loose

B 0.5 - 1.0 ft: Light Gray, Sandy Silt (TAILINGS), dry, medium dense

C 1.0 - 4.0 ft: Reddish-brown, medium dense, Silty Sand with brownish mottling, moist, interbedded with lenses of light gray, Silty Clay (TAILINGS), soft, wet, high plasticity, thixotropic

D 4.0 - 12.0 ft: Dark gray, Silty Clay (TAILINGS), loose, moist, fining downwards

TIME			DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

No wet zones encountered,
Tailings Dry to total depth of 12' bgs.

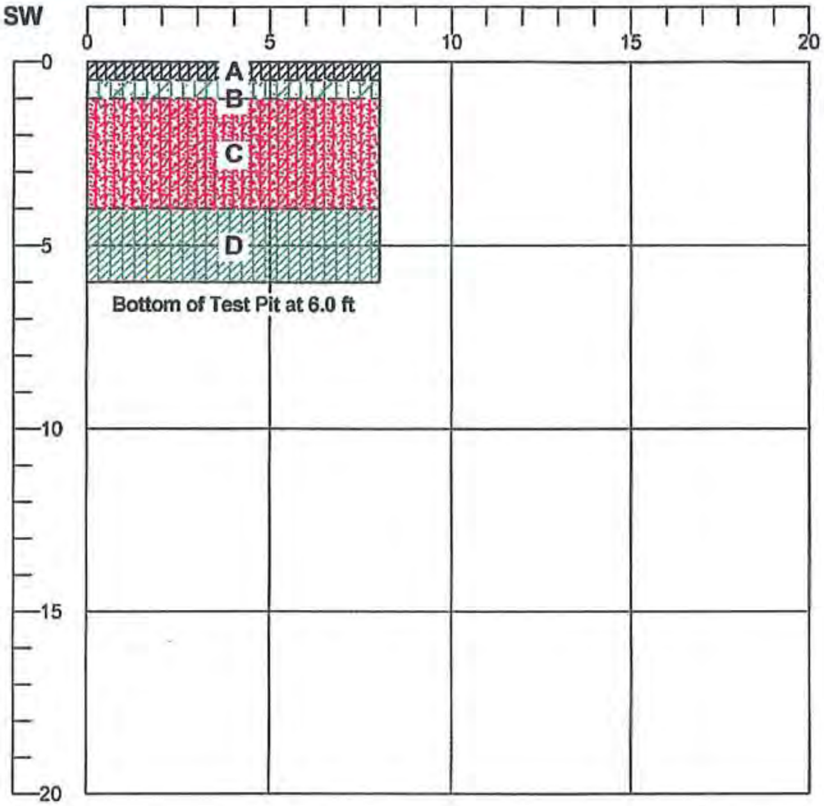
Hole caving-in on sides below 4' depth with slow, plastic movement

Composite Sample for Metals Analysis Collected from 0-1', 5-6' and 10-12' depth intervals

Golder Associates

LOG OF TEST PIT: TP-03

Temp 95 °F Weather Sunny, Clear Engineer Paul VanMiddlesworth Operator Dan Bishop
Equipment CAT 416 TLB Excavator Contractor Randall Contracting Date 7/26/05
Elevation 2251.9 ft Datum Geodetic Job 043-1344
Location Pend Oreille Mine TDF-1



SAMPLES	
NO.	Depth Interval (ft bgs)
T03-AG-1	0 - 0.25'
T03-AG-2	0.25' - 1'
T03-AG-3	1' - 2'
T03-COMP	(0 - 1'), (5 - 6')

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 0.5 ft: Light brown, Silt (TAILINGS), dry, loose

B 0.5 - 1.0 ft: Light Gray, Sandy Silt (TAILINGS), dry, medium dense

C 1.0 - 4.0 ft: Reddish-brown, medium dense, Silty Sand with brownish mottling, moist, interbedded with lenses of light gray, Silty Clay (TAILINGS), soft, wet, high plasticity, thixotropic

D 4.0 - 6.0 ft: Dark gray Silty Clay (TAILINGS), medium dense, saturated, high plasticity, thixotropic

TIME			DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

Wet/Saturated silty clay tailings encountered below 4' bgs,
Water emerging in test pit at 4' bgs,
Total Depth of Test Pit = 6' bgs.

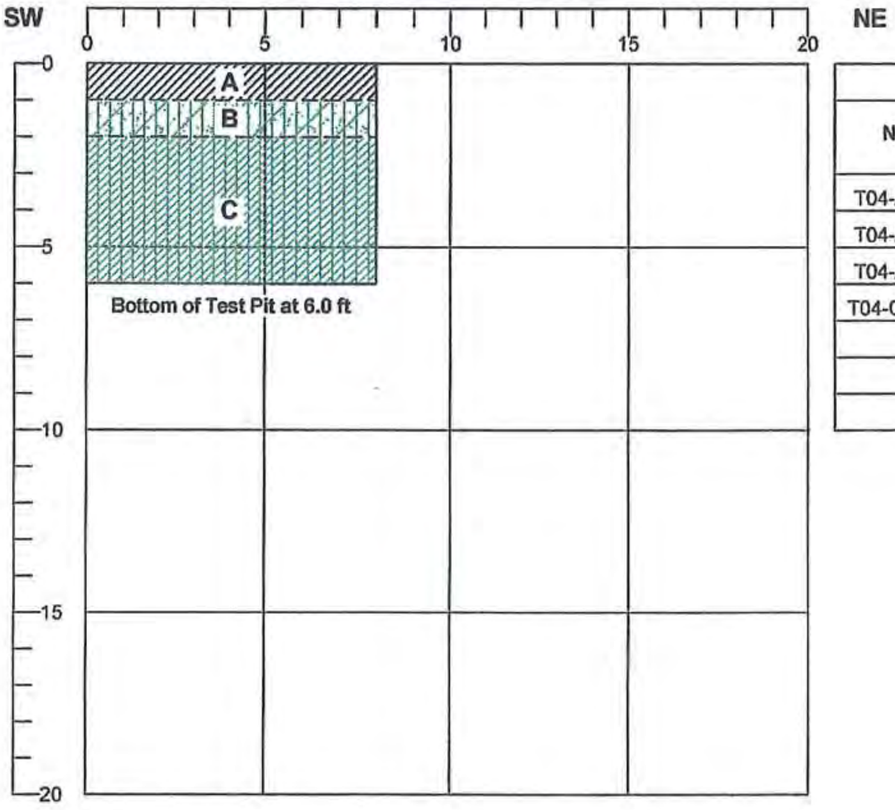
Hole caving-in on sides at 4-6' depth interval, peeling-off in large sheets with slow, plastic movement, thixotropic

Composite Sample for Metals Analysis Collected from 0-1' and 5-6' depth intervals

LOG OF TEST PIT: TP-04

Golder Associates

Temp 95 °F Weather Sunny, Clear Engineer Paul VanMiddlesworth Operator Dan Bishop
Equipment CAT 416 TLB Excavator Contractor Randall Contracting Date 7/26/05
Elevation 2251.0 ft Datum Geodetic Job 043-1344
Location Pend Oreille Mine TDF-1



SAMPLES

NO.	Depth Interval (ft bgs)
T04-AG-1	0 - 0.5'
T04-AG-2	0.5' - 1'
T04-AG-3	1' - 2'
T04-COMP	(0 - 1'), (5 - 6')

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 1.0 ft: Reddish-brown, Silt (TAILINGS), moist, medium dense

B 1.0 - 2.0 ft: Light gray, Sandy Silt (TAILINGS), soft, wet, patches/lenses of very fine, disseminated pyrite flakes

C 2.0 - 6.0 ft: Dark gray, Silty Clay (TAILINGS), soft, wet, high plasticity, thixotropic

TIME			DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

Wet/Saturated silty clay tailings encountered below 3' bgs,
Water emerging in test pit at 3' bgs.
Total Depth of Test Pit = 6' bgs.

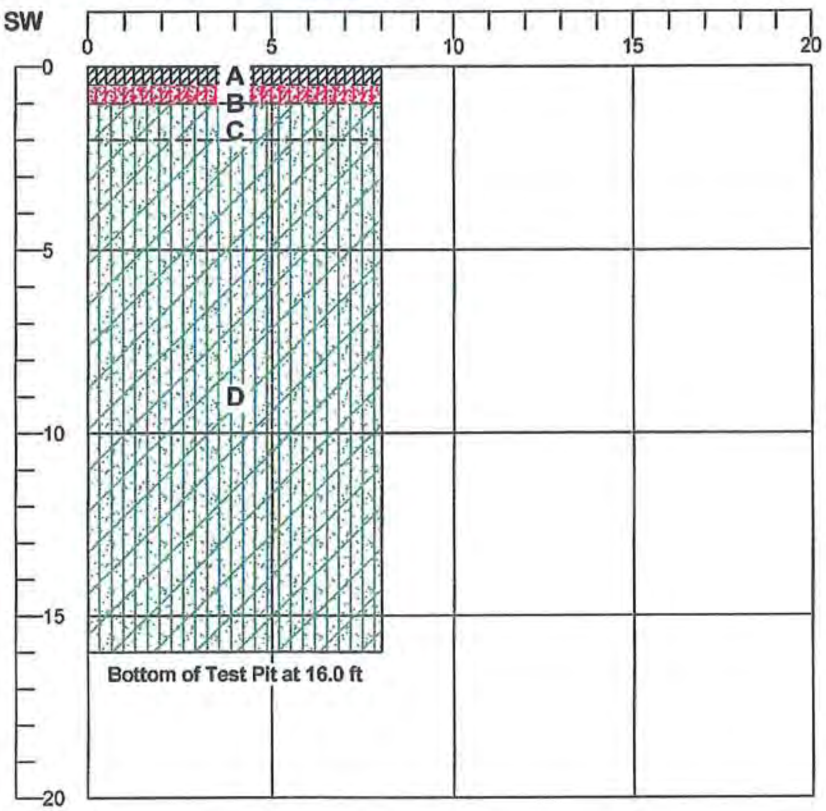
Hole caving-in on sides at 3-6' depth interval, peeling-off in large sheets with slow, plastic movement, thixotropic

Composite Sample for Metals Analysis Collected from 0-1' and 5-6' depth intervals

Golder Associates

LOG OF TEST PIT: TP-05

Temp 95 °F Weather Sunny, Clear
Engineer Paul VanMiddlesworth
Operator Dan Bishop
Equipment CAT 416 TLB Excavator
Contractor Randall Contracting
Date 7/26/05
Elevation 2253.6 ft
Datum Geodetic
Job 043-1344
Location Pend Oreille Mine TDF-1



SAMPLES	
NO.	Depth Interval (ft bgs)
T05-AG-1	0 - 0.5'
T05-AG-2	0.5' - 1'
T05-AG-3	1' - 2'
T05-COMP	(0 - 1'), (5 - 6'), (10 - 12')

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 0.5 ft: Light brown, Silt (TAILINGS), dry, loose

B 0.5 - 1.0 ft: Reddish-brown, medium dense Silty Sand, dry, with lenses of dark gray, dry Silty Clay (TAILINGS)

C 1.0 - 2.0 ft: Light Gray, Sandy Silt (TAILINGS), dry, medium dense, patches/lenses of very fine, disseminated pyrite flakes

D 2.0 - 16.0 ft: Light gray, loose to medium dense, Sandy Silt (TAILINGS), dry, interbedded with layers of light brown Silty Clay, medium dense

(moisture and sand content increasing with depth)

TIME			DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

No wet/saturated zones encountered to 16' bgs.

No caving/slumping of test pit walls to total depth of 16' bgs.

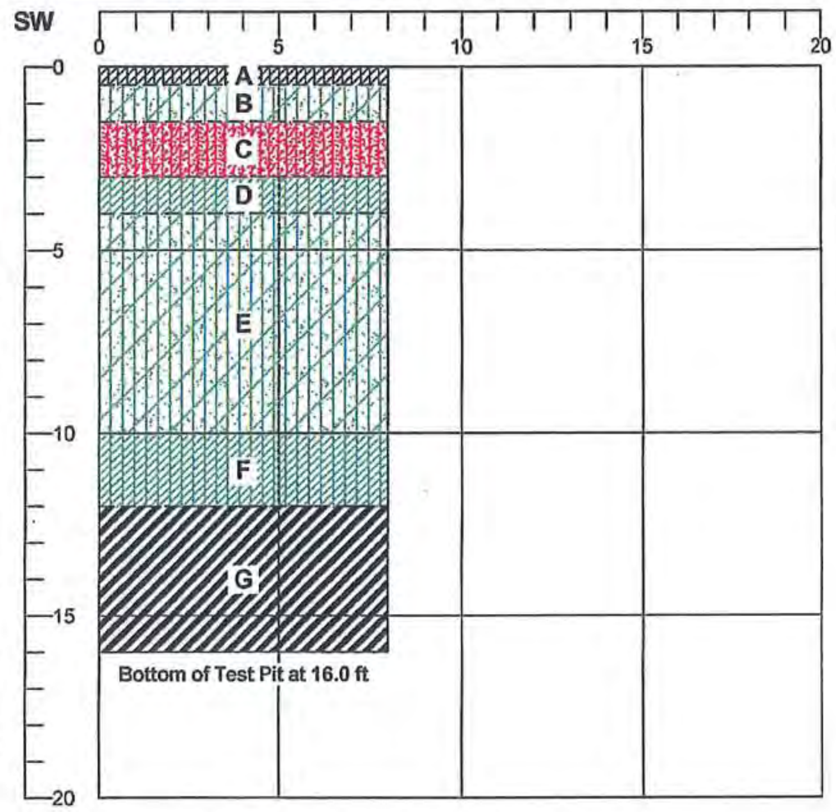
Composite Sample for Metals Analysis Collected from 0-1', 5-6' and 10-12' depth intervals

LOG OF TEST PIT TDF-1 TEST PIT LOGS_PVM.GPJ GLDR_WA.GDT 10/2/05

Golder Associates

LOG OF TEST PIT: TP-06

Temp 95 °F Weather Sunny, Clear
Engineer Paul VanMiddlesworth
Operator Dan Bishop
Equipment CAT 416 TLB Excavator
Contractor Randall Contracting
Date 7/26/05
Elevation 2251.6 ft
Datum Geodetic
Job 043-1344
Location Pend Oreille Mine TDF-1



SAMPLES	
NO.	Depth Interval (ft bgs)
T06-AG-1	0 - 0.5'
T06-AG-2	0.5' - 1'
T06-AG-3	1' - 2'
T06-COMP	(0 - 1'), (5 - 6'), (10 - 12')

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 0.5 ft: Light brown, Silt (TAILINGS), dry, loose

B 0.5 - 1.5 ft: Light gray, Sandy Silt (TAILINGS), dry, loose

C 1.5 - 3.0 ft: Reddish-brown, dense Silty Sand, dry, with lenses of dark gray, dry Silty Clay (TAILINGS)

D 3.0 - 4.0 ft: Dark gray, stiff Clay (TAILINGS), wet, high plasticity, interbedded with fine lenses of dry Silty Clay (TAILINGS)

E 4.0 - 10.0 ft: Light gray Sandy Silt (TAILINGS), moist, loose

F 10.0 - 12.0 ft: Dark gray, Silty Clay (TAILINGS), soft, wet, high plasticity, thixotropic

G 12.0 - 16.0 ft: Dark gray, very soft Clay (TAILING SLUDGE), strong reduced odor, high plasticity, interbedded with layers of dry, loose Silty Clay (TAILINGS)

TIME			DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

Wet/saturated zone of tailings encountered below 10' bgs.

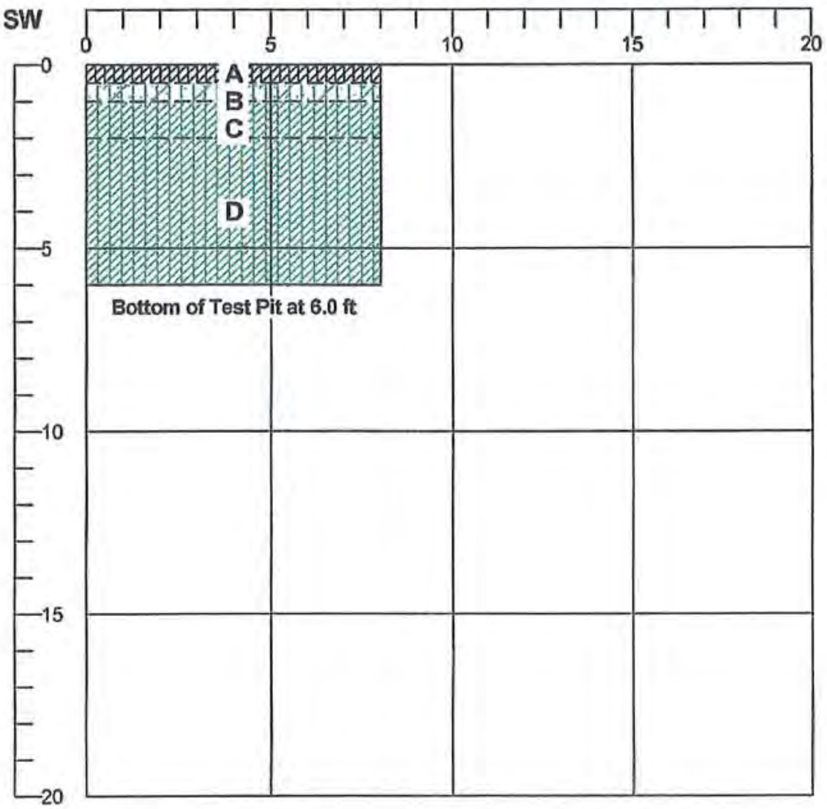
No caving/slumping of test pit walls to total depth of 16' bgs.

Composite Sample for Metals Analysis Collected from 0-1', 5-6' and 10-12' depth intervals

Golder Associates

LOG OF TEST PIT: TP-07

Temp 95 °F Weather Sunny, Clear Engineer Paul VanMiddlesworth Operator Dan Bishop
Equipment CAT 416 TLB Excavator Contractor Randall Contracting Date 7/26/05
Elevation 2250.3 ft Datum Geodetic Job 043-1344
Location Pend Oreille Mine TDF-1



SAMPLES	
NO.	Depth Interval (ft bgs)
T07-AG-1	0 - 0.3'
T07-AG-2	0.3' - 1'
T07-AG-3	1' - 2'
T07-COMP	(0 - 1'), (3 - 4')

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 0.5 ft: Medium brown, Silt (TAILINGS), dry, loose

B 0.5 - 1.0 ft: Light gray, Sandy Silt (TAILINGS), dry, loose

C 1.0 - 2.0 ft: Grayish-brown, medium dense Silty Clay (TAILINGS)

D 2.0 - 6.0 ft: Dark gray, soft Silty Clay (TAILINGS), wet, high plasticity, interbedded with fine lenses of dry, firm Sandy Clay (TAILINGS)

[Vertical cracks in dry silty/sandy clay filled with reddish-brown mottling and patches of pyrite-flakes within shiny precipitates on crack surfaces, appear to be ancient mudcracks on surface of tailings pond sediments during active use of TDF-1.]

TIME			DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

Wet/Saturated silty clay tailings encountered below 4' bgs,
Water emerging in test pit at 4' bgs,
Total Depth of Test Pit = 6' bgs.

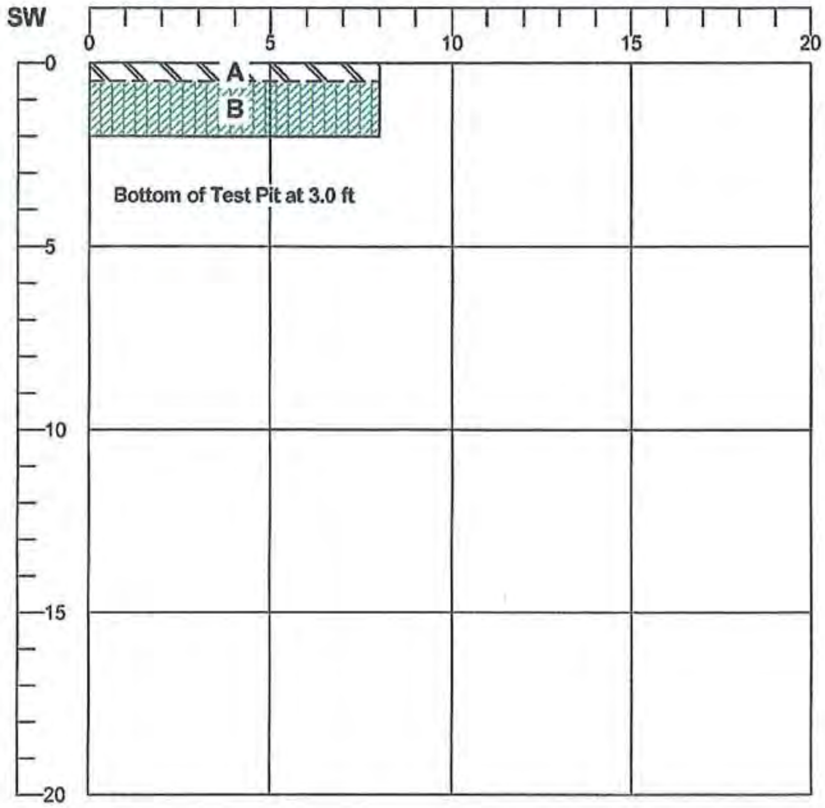
Hole caving-in on sides at 3-6' depth interval, peeling-off in large sheets with slow, plastic movement, thixotropic

Composite Sample for Metals Analysis Collected from 0-1' and 3-4' depth intervals

Golder Associates

LOG OF TEST PIT: TP-08

Temp 95 °F Weather Sunny, Clear Engineer Paul VanMiddlesworth Operator Dan Bishop
Equipment CAT 416 TLB Excavator Contractor Randall Contracting Date 7/26/05
Elevation 2249.2 ft Datum Geodetic Job 043-1344
Location Pend Oreille Mine TDF-1



SAMPLES	
NO.	Depth Interval (ft bgs)
T08-AG-1	0.25' - 0.5
T08-AG-2	0. 5' - 1'
T08-AG-3	1' - 2'
T08-COMP	(0 - 1'), (1 - 2')
T18-AG-1	0.25' - 0.5 (DUPLICATE)
T18-AG-2	0. 5' - 1' (DUPLICATE)
T18-AG-3	1' - 2' (DUPLICATE)

T18-COMP(0 - 1'), (1 - 2') (DUPLICATE)

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 0.5 ft: Dark brown to black organic Clay (wetland sediments), swamp soils with roots and cattails, saturated with standing water appx. 8" deep.

B 0.5 - 2.0 ft: Light gray, saturated, soft Sitly Clay (TAILINGS), cattail roots to 24" depth, high plasticity, reduced odor.

TIME			DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

Hand-auger Test Pit within saturated wetland with 12" standing water,

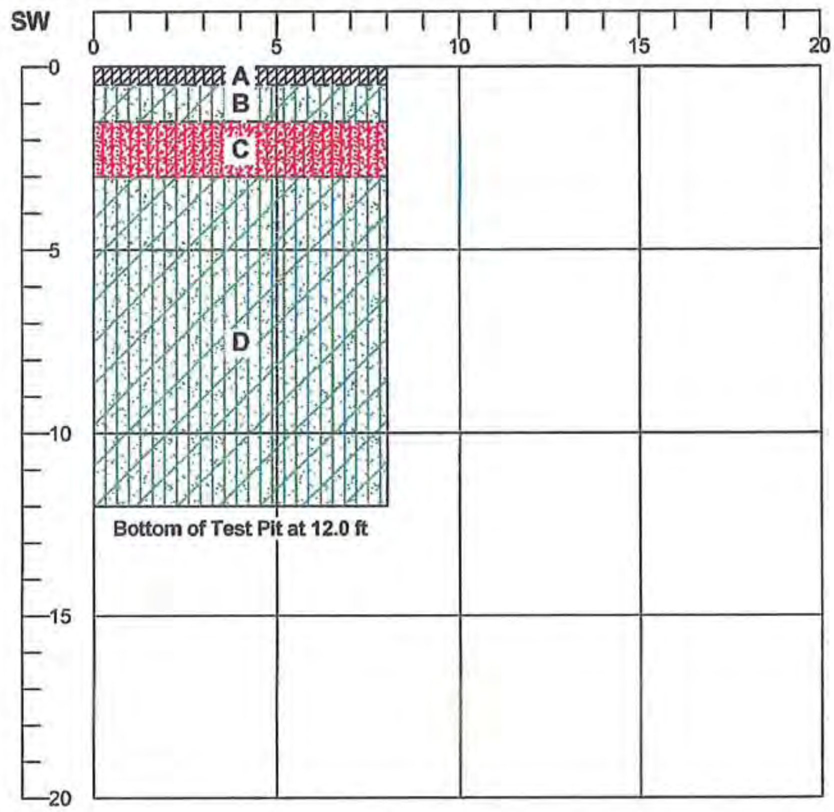
Saturated wetland sediments encountered to total depth of 2' bgs.

Composite Sample for Metals Analysis Collected from 0-1' and 1-2' depth intervals

[Duplicate Samples collected from Test Pit TP-08, labeled and submitted to laboratory as T18-samples listed above]

LOG OF TEST PIT: TP-09

Temp 95 °F Weather Sunny, Clear
Engineer Paul VanMiddlesworth
Operator Dan Bishop
Equipment CAT 416 TLB Excavator
Contractor Randall Contracting
Date 7/26/05
Elevation 2252.6 ft
Datum Geodetic
Job 043-1344
Location Pend Oreille Mine TDF-1



SAMPLES	
NO.	Depth Interval (ft bgs)
T09-AG-1	0 - 0.6'
T09-AG-2	0.6' - 1'
T09-AG-3	1' - 2'
T09-COMP	(0 - 1'), (5 - 6'), (10 - 12')

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 0.5 ft: Light brown, Silt (TAILINGS), dry, loose

B 0.5 - 1.5 ft: Light gray, Sandy Silt (TAILINGS), dry, dense

C 1.5 - 3.0 ft: Reddish-brown, dense Silty Sand, dry, with lenses of dark gray, dry Silty Clay (TAILINGS), reddish-orange cross-bedding and reddish mottling features

D 3.0 - 12.0 ft: Dark gray, medium dense Sandy Silt (TAILINGS), dry, interbedded with layers of light gray, moist, highly plastic Silty Clay (TAILINGS)

TIME			DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

No wet/saturated zones encountered to 12' bgs.

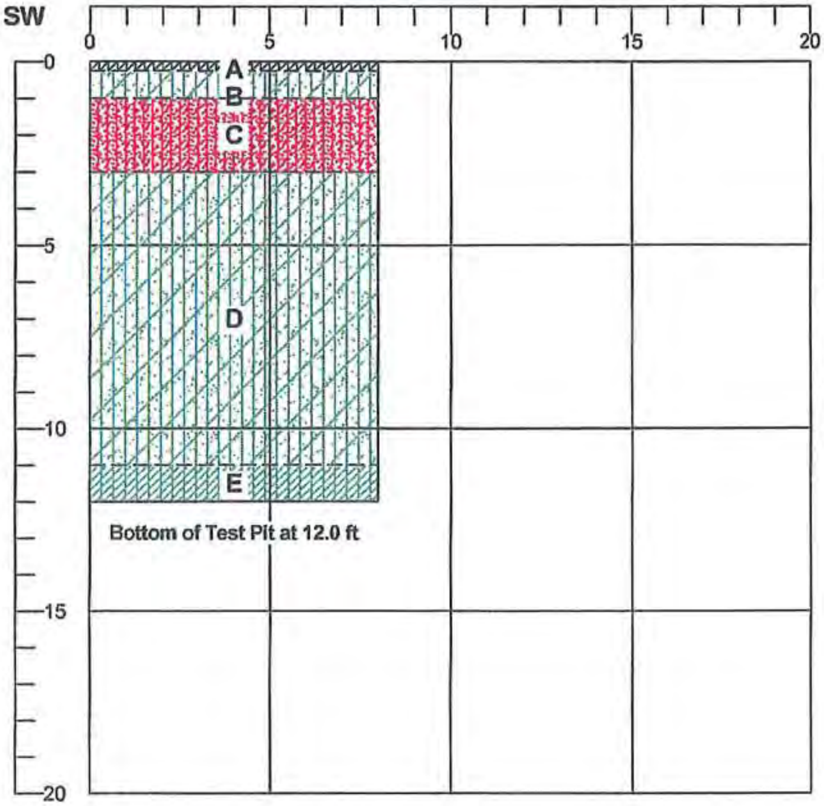
No caving/slumping of test pit walls to total depth of 12' bgs.

Composite Sample for Metals Analysis Collected from 0-1', 5-6' and 10-12' depth intervals

Golder Associates

LOG OF TEST PIT: TP-10

Temp 95 °F Weather Sunny, Clear
Engineer Paul VanMiddlesworth
Operator Dan Bishop
Equipment CAT 416 TLB Excavator
Contractor Randall Contracting
Date 7/26/05
Elevation 2252.2 ft
Datum Geodetic
Job 043-1344
Location Pend Oreille Mine TDF-1



SAMPLES	
NO.	Depth Interval (ft bgs)
T10-AG-1	0 - 0.25'
T10-AG-2	0.25' - 1'
T10-AG-3	1' - 2'
T10-COMP	(0 - 1'), (5 - 6'), (10 - 12')

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 0.3 ft: Medium brown, Silt (TAILINGS), damp, medium dense

B 0.3 - 1.0 ft: Light gray, medium dense Sandy Silt (TAILINGS), moist, (rootlets up to 10" bgs), interbedded with thin lenses of brownish, dry, dense Silty Clay

C 1.0 - 3.0 ft: Reddish-brown, medium dense Silty Sand, dry, with lenses of dark gray, moist, soft Silty Clay (TAILINGS)

D 3.0 - 11.0 ft: Light gray, loose Sandy Silt (TAILINGS), dry, interbedded with layers of dark gray, saturated, highly plastic Silty Clay (TAILINGS), thixotropic

E 11.0 - 12.0 ft: Dark gray, wet, soft Silty Clay (TAILINGS), thixotropic

[increasing water content in silty clays with increasing depth]

TIME			DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

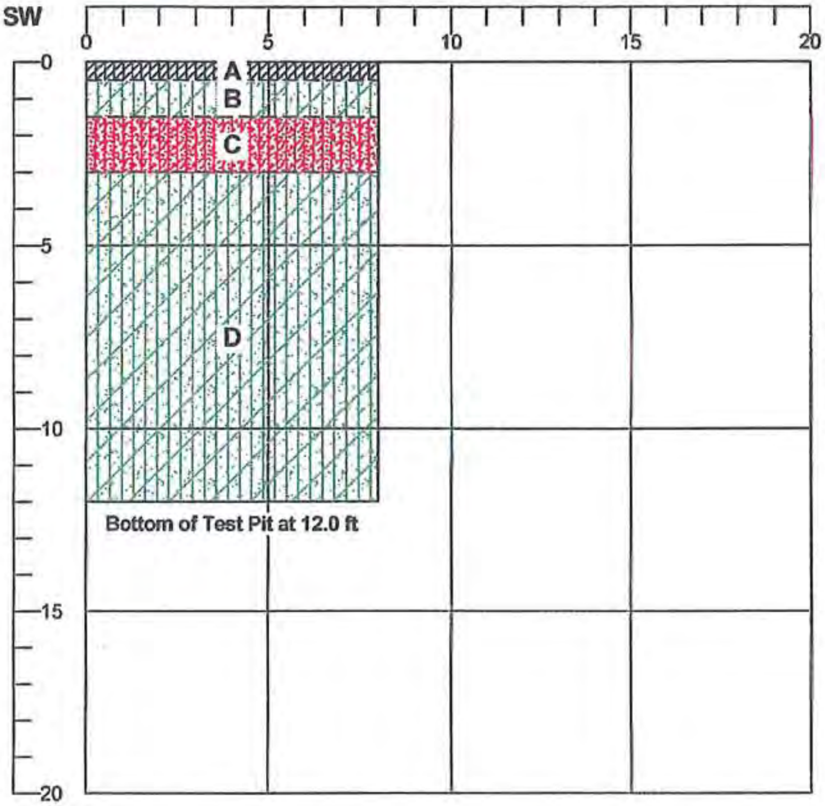
No caving/slumping of test pit walls to total depth of 12' bgs.

Composite Sample for Metals Analysis Collected from 0-1', 5-6' and 10-12' depth intervals

Golder Associates

LOG OF TEST PIT: TP-11

Temp 95 °F Weather Sunny, Clear Engineer Paul VanMiddlesworth Operator Dan Bishop
Equipment CAT 416 TLB Excavator Contractor Randall Contracting Date 7/26/05
Elevation 2251.9 ft Datum Geodetic Job 043-1344
Location Pend Oreille Mine TDF-1



SAMPLES	
NO.	Depth Interval (ft bgs)
T11-AG-1	0 - 0.5'
T11-AG-2	0.5' - 1'
T11-AG-3	1' - 2'
T11-COMP	(0 - 1'), (5 - 6'), (10 - 12')

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 0.5 ft: Medium brown, Silt (TAILINGS), moist, medium dense

B 0.5 - 1.5 ft: Light gray, medium dense Sandy Silt (TAILINGS), moist, interbedded with thin lenses of brownish, dry, dense Silty Clay

C 1.5 - 3.0 ft: Reddish-brown, dense Silty Sand, moist, with lenses of light gray, moist, soft Silty Clay (TAILINGS), (rootlets up to 18" bgs)

D 3.0 - 12.0 ft: Light gray, loose to medium dense Sandy Silt (TAILINGS), damp, interbedded with layers of dark gray, moist to wet, highly plastic Silty Clay (TAILINGS)

TIME			DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

Wet/saturated zone of silty clay tailings encountered below 8' bgs.

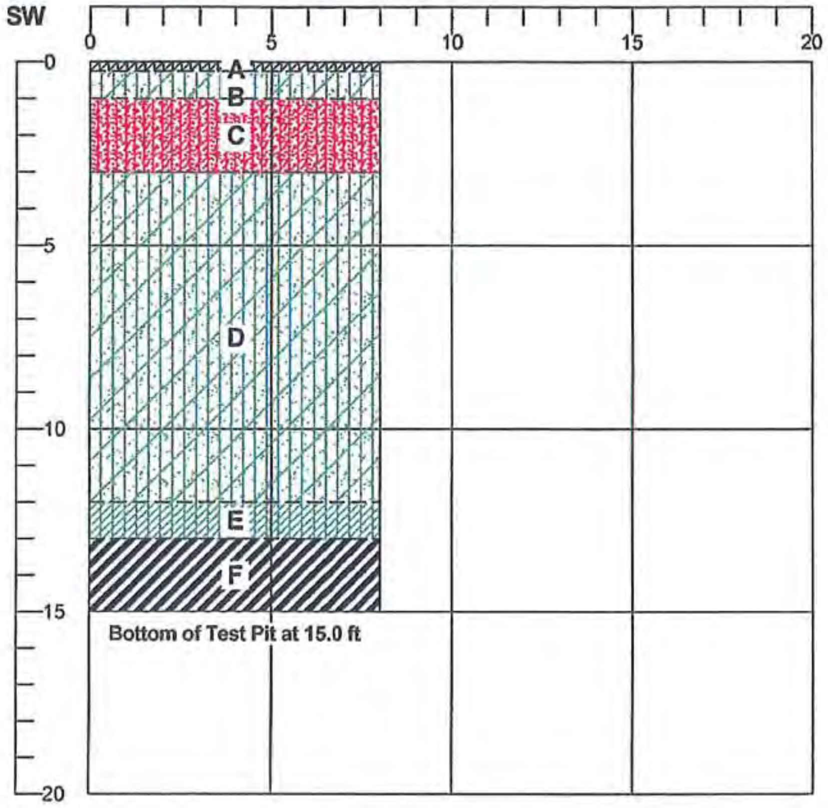
Caving of test pit walls at 8' bgs after reaching total depth of 12' bgs.

Composite Sample for Metals Analysis Collected from 0-1', 5-6' and 10-12' depth intervals

Golder Associates

LOG OF TEST PIT: TP-12

Temp 95 °F Weather Sunny, Clear Engineer Paul VanMiddlesworth Operator Dan Bishop
Equipment CAT 416 TLB Excavator Contractor Randall Contracting Date 7/26/05
Elevation 2252.3 ft Datum Geodetic Job 043-1344
Location Pend Oreille Mine TDF-1



SAMPLES	
NO.	Depth Interval (ft bgs)
T12-AG-1	0 - 0.25'
T12-AG-2	0.25' - 1'
T12-AG-3	1' - 2'
T12-COMP	(0 - 1'), (5 - 6'), (10 - 12')

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 0.3 ft: Medium brown, Silt (TAILINGS), moist, loose

B 0.3 - 1.0 ft: Light gray, medium dense Sandy Silt (TAILINGS)

C 1.0 - 3.0 ft: Reddish-brown, dense Silty Sand, dry, with lenses of light gray, damp, loose Silty Clay (TAILINGS)

D 3.0 - 12.0 ft: Light gray, loose to medium dense Sandy Silt (TAILINGS), damp to moist

E 12.0 - 13.0 ft: Dark gray, Silty Clay (TAILINGS), soft, wet, high plasticity, thixotropic

F 13.0 - 15.0 ft: Light gray, very soft Clay (TAILING SLUDGE), strong reduced odor, high plasticity, interbedded with layers of dry, loose Silty Clay (TAILINGS)

TIME			DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

Wet/saturated zone of silty clay tailings encountered below 8' bgs.

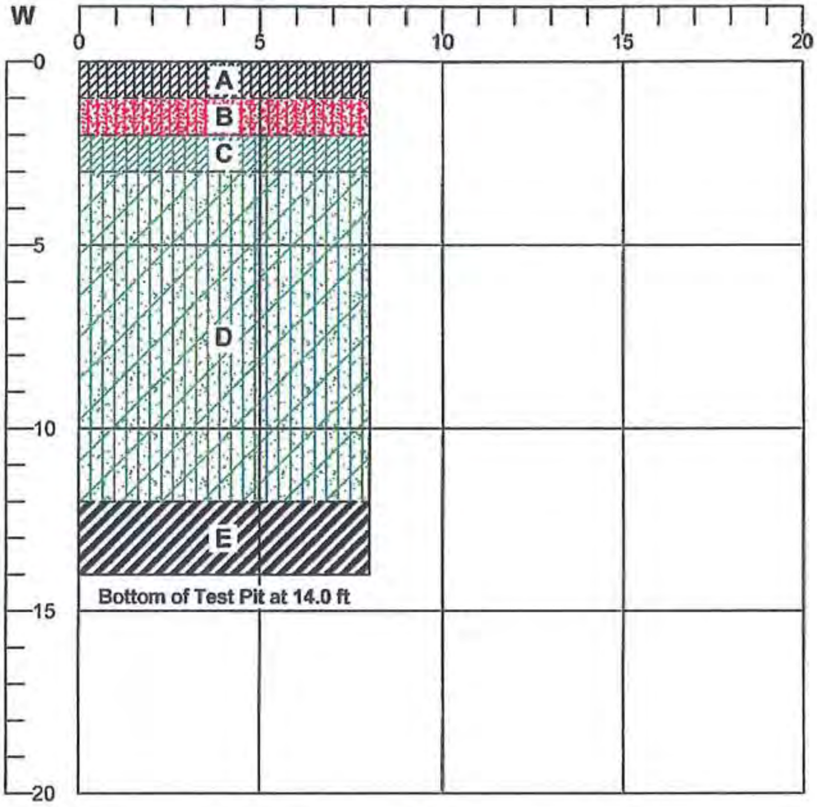
No caving/slumping of test pit walls to total depth of 15' bgs.

Composite Sample for Metals Analysis Collected from 0-1', 5-6' and 10-12' depth intervals

Golder Associates

LOG OF TEST PIT: TP-13

Temp 95 °F Weather Sunny, Clear Engineer Paul VanMiddlesworth Operator Dan Bishop
Equipment CAT 416 TLB Excavator Contractor Randall Contracting Date 7/25/05
Elevation 2329.7 ft Datum Geodetic Job 043-1344
Location Pend Oreille Mine TDF-2



SAMPLES	
NO.	Depth Interval (ft bgs)
T13-AG-1	0 - 0.5'
T13-AG-2	0.5 - 1'
T13-AG-3	1 - 2'
T13-COMP	(0 - 1'), (5 - 6'), (10 - 12')

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 1.0 ft: Dark brown, Silt (TAILINGS), moist, loose (rootlets to 10" depth)

B 1.0 - 2.0 ft: Reddish-brown, damp, dense Silty Sand, with thin lenses of dark gray, highly plastic, wet Silty Clay (TAILINGS)

C 2.0 - 3.0 ft: Dark gray Silty Clay (TAILINGS), highly plastic, wet, thixotropic

D 3.0 - 12.0 ft: Light gray, damp, loose Sandy Silt, interbedded with layers of dark gray, highly plastic, wet Silty Clay (TAILINGS), thixotropic

E 12.0 - 14.0 ft: Dark gray, very soft Clay (TAILINGS), sludge-like texture, strong reduced odor, high plasticity, thixotropic

TIME			DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

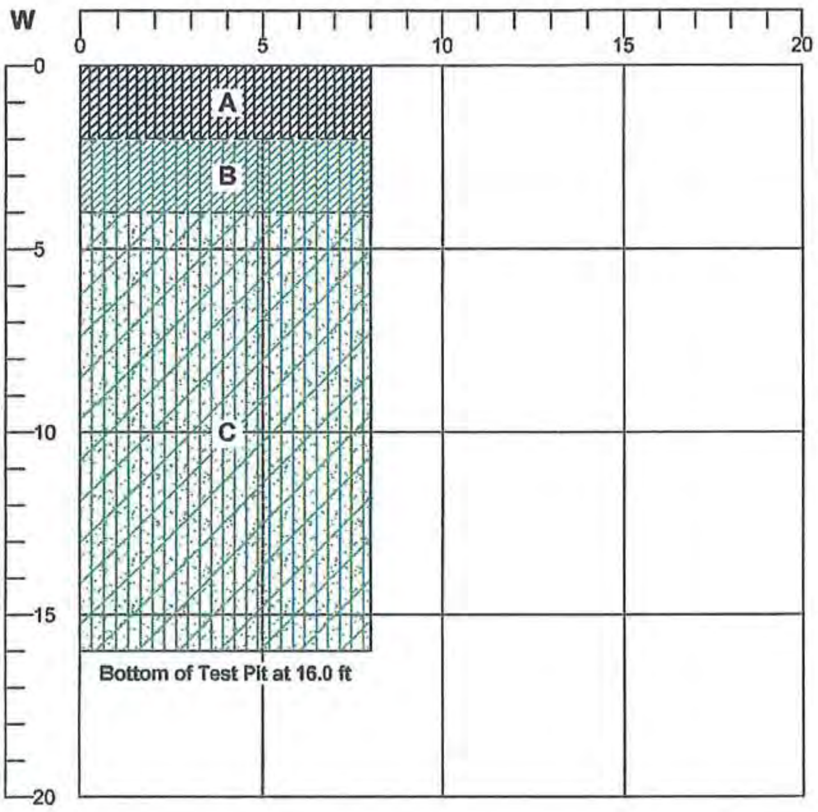
Wet/saturated zone of silty clay tailings encountered below 4' bgs.

No caving/slumping of test pit walls to total depth of 14' bgs.

Composite Sample for Metals Analysis Collected from 0-1', 5-6' and 10-12' depth intervals

LOG OF TEST PIT: TP-14

Temp 95 °F Weather Sunny, Clear
Equipment CAT 416 TLB Excavator
Elevation 2331.2 ft
Location Pend Oreille Mine TDF-2
Engineer Paul VanMiddlesworth
Contractor Randall Contracting
Datum Geodetic
Operator Dan Bishop
Date 7/25/05
Job 043-1344



SAMPLES	
NO.	Depth Interval (ft bgs)
T14-AG-1	0 - 0.3'
T14-AG-2	0.3' - 1'
T14-AG-3	1' - 2'
T14-COMP	(0 - 1'), (5' - 6'), (10' - 12')

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 2.0 ft: Gray, Silt (TAILINGS), dry, medium dense

B 2.0 - 4.0 ft: Light brown, moist, dense Silty Clay (TAILINGS)

C 4.0 - 16.0 ft: Dark gray, moist, loose Sandy Silt (TAILINGS), interbedded with layers of dark gray, wet, highly plastic Silty Clay (TAILINGS), thixotropic

TIME			DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

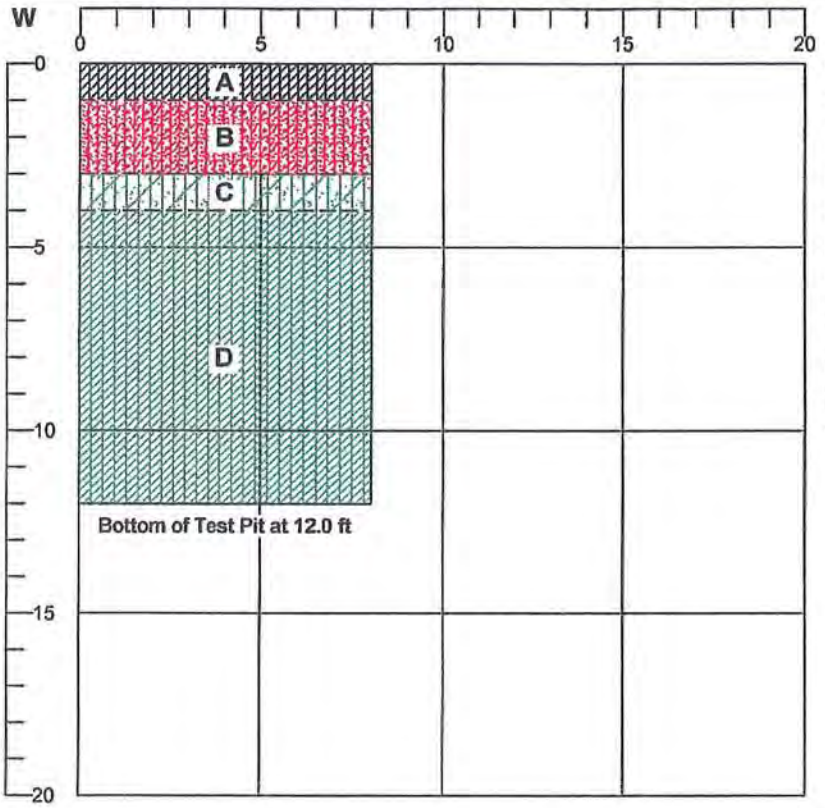
Wet/saturated zone of silty clay tailings encountered below 5' bgs.

No caving/slumping of test pit walls to total depth of 16' bgs.

Composite Sample for Metals Analysis Collected from 0-1', 5-6' and 10-12' depth intervals

LOG OF TEST PIT: TP-15

Temp 95 °F Weather Sunny, Clear Engineer Paul VanMiddlesworth Operator Dan Bishop
Equipment CAT 416 TLB Excavator Contractor Randall Contracting Date 7/25/05
Elevation 2342.6 ft Datum Geodetic Job 043-1344
Location Pend Oreille Mine TDF-2



SAMPLES	
NO.	Depth Interval (ft bgs)
T15-AG-1	0.25' - 0.5'
T15-AG-2	0.5' - 1'
T15-AG-3	1' - 2'
T15-COMP	(0 - 1'), (5' - 6'), (10' - 12')

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 1.0 ft: Light brown, Silt (TAILINGS), dry, very dense

B 1.0 - 3.0 ft: Reddish-brown, dry, very dense Silty Sand, rusty-orange mottling, interbedded with lenses of dark gray, dry, dense Silty Clay (TAILINGS), (vertical cracks in dry clay with deposits of rusty-orange precipitates and patches of pyrite flakes)

C 3.0 - 4.0 ft: Light gray, dry, loose Sandy Silt (TAILINGS)

D 4.0 - 12.0 ft: Light gray, damp, medium dense Sandy Silt (TAILINGS), interbedded with lenses of dark gray, wet, highly plastic Silty Clay (TAILINGS), thixotropic

TIME			DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

Wet/saturated zone of silty clay tailings encountered below 8' bgs.

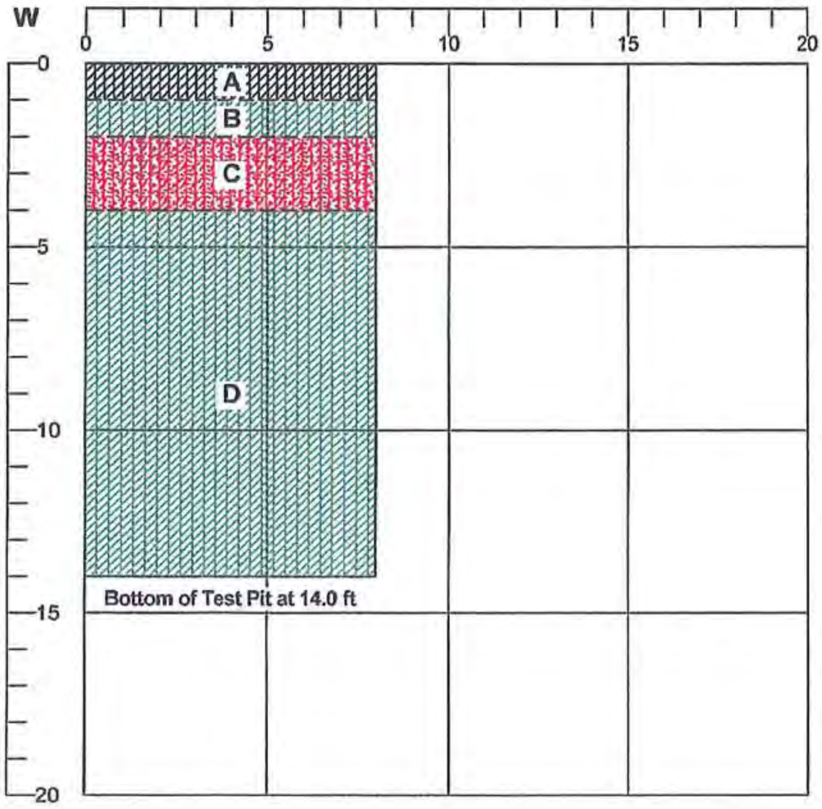
No caving/slumping of test pit walls to total depth of 12' bgs.

Composite Sample for Metals Analysis Collected from 0-1', 5-6' and 10-12' depth intervals

Golder Associates

LOG OF TEST PIT: TP-16

Temp 95 °F Weather Sunny, Clear Engineer Paul VanMiddlesworth Operator Dan Bishop
Equipment CAT 416 TLB Excavator Contractor Randall Contracting Date 7/25/05
Elevation 2347.7 ft Datum Geodetic Job 043-1344
Location Pend Oreille Mine TDF-2



SAMPLES	
NO.	Depth Interval (ft bgs)
T16-AG-1	0.25' - 0.5'
T16-AG-2	0.5' - 1'
T16-AG-3	1' - 2'
T16-COMP	(0 - 1'), (5' - 6'), (10' - 12')

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 1.0 ft: Light gray, Silt (TAILINGS), dry, loose

B 1.0 - 2.0 ft: Reddish-brown dry, dense Silty Clay (TAILINGS)

C 2.0 - 4.0 ft: Reddish-brown, dry, very dense Silty Sand, interbedded with thin lenses of dark gray, wet, highly plastic Silty Clay (TAILINGS), (patches/lenses of very fine pyrite flakes with fine cross-bedding and penecontemporaneous deformation features)

D 4.0 - 14.0 ft: Dark gray, wet, highly plastic Silty Clay (TAILINGS), thixotropic, interbedded with lenses of dry, loose Sandy Silt (TAILINGS)

TIME			DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

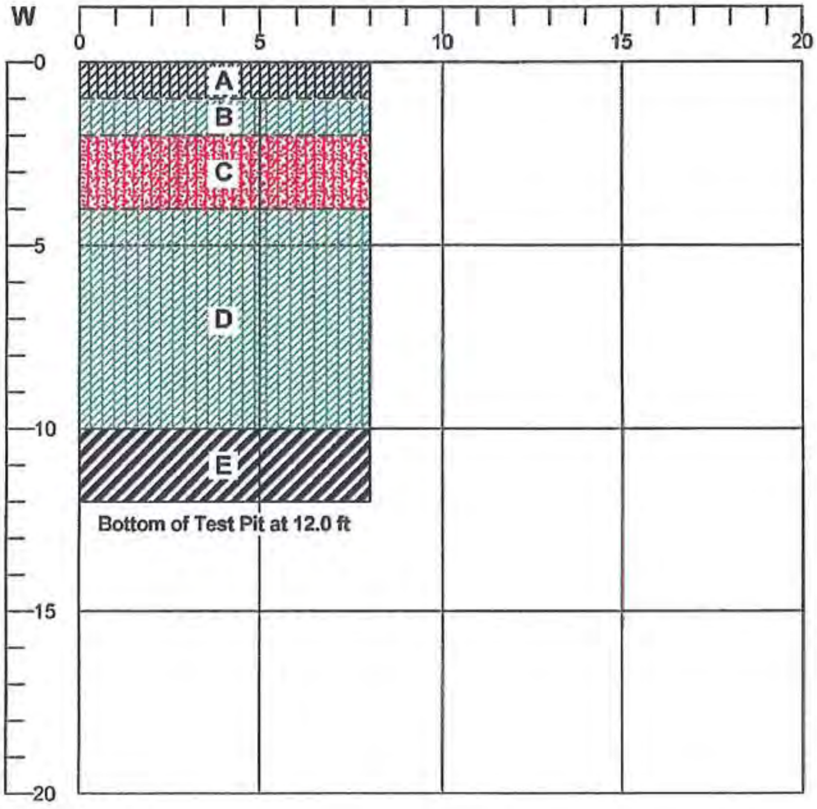
Wet/saturated zone of silty clay tailings encountered below 8' bgs.

No caving/slumping of test pit walls to total depth of 14' bgs.

Composite Sample for Metals Analysis Collected from 0-1', 5-6' and 10-12' depth intervals

LOG OF TEST PIT: TP-17

Temp 95 °F Weather Sunny, Clear
Engineer Paul VanMiddlesworth
Operator Dan Bishop
Equipment CAT 416 TLB Excavator
Contractor Randall Contracting
Date 7/25/05
Elevation 2348.2 ft
Datum Geodetic
Job 043-1344
Location Pend Oreille Mine TDF-2



SAMPLES	
NO.	Depth Interval (ft bgs)
T17-AG-1	0.25' - 0.5'
T17-AG-2	0.5' - 1'
T17-AG-3	1' - 2'
T17-COMP	(0 - 1'), (5' - 6'), (10' - 12')

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 1.0 ft: Light gray, Silt (TAILINGS), dry, loose

B 1.0 - 2.0 ft: Light brown dry, dense Silty Clay (TAILINGS)

C 2.0 - 4.0 ft: Reddish-brown, dry, very dense Silty Sand, interbedded with thin lenses of dark gray, wet, highly plastic Silty Clay (TAILINGS), thixotropic

D 4.0 - 10.0 ft: Dark gray, wet, highly plastic Silty Clay (TAILINGS), thixotropic, interbedded with lenses of dry, loose Sandy Silt (TAILINGS), patches/lenses of very fine pyrite flakes with fine cross-bedding and penecontemporaneous deformation features)

E 10.0 - 12.0 ft: Dark gray, very soft Clay (TAILINGS), sludge-like texture, strong reduced odor, high plasticity, thixotropic

TIME			DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

Wet/saturated zone of silty clay tailings encountered below 8' bgs.

No caving/slumping of test pit walls to total depth of 12' bgs.

Composite Sample for Metals Analysis Collected from 0-1', 5-6' and 10-12' depth intervals

APPENDIX C

SITE BOREHOLE AND WELL CONSTRUCTION DIAGRAMS

RECORD OF BOREHOLE MW-201

SHEET 1 of 3

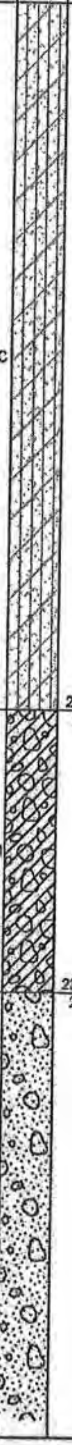
PROJECT: Pend Oreille Mine RI/FS
PROJECT NUMBER: 043-1344.401
LOCATION: TDF-2

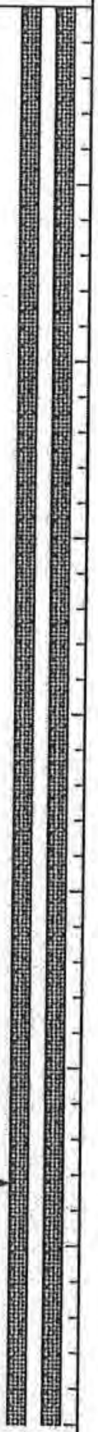
DRILLING METHOD: Air Rotary
DRILLING DATE: 8/1/05
DRILL RIG: T300E

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 53,596.00 E: 57,548.59

ELEVATION: 2332.33
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft ■ 10 20 30 40 WATER CONTENT (PERCENT) Wp ⊢ ○W ⊣ Wl	NOTES WATER LEVELS GRAPHIC
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT		
0 5 10 15		0.0 - 20.0 Light gray, fine, Sandy Silt (TAILINGS), loose to medium dense, damp, interbedded with dark gray, Silty Clay (Fine TAILINGS), wet, high plasticity, thixotropic [increasing water content with depth]	SP-SC									
20 25		20.0 - 28.0 Light brown, dense Clayey Silt with Coarse Gravels, subrounded, unsorted, damp	GP-GM		2312.3 20.0							
30 35 40		28.0 - 50.0 Medium brown, dense Silty Sand with Coarse Gravels, well rounded, unsorted, moist Log continued on next page	GP		2304.3 28.0							AquaGuard Bentonite Grout





1 in to 5 ft

DRILLING CONTRACTOR: Environmental West Exploration
DRILLER: Ron Sink

LOGGED: Paul VanMiddlesworth
CHECKED: D. Morell
DATE: 8/25/2006

Golder Associates

RECORD OF BOREHOLE MW-201

SHEET 2 of 3

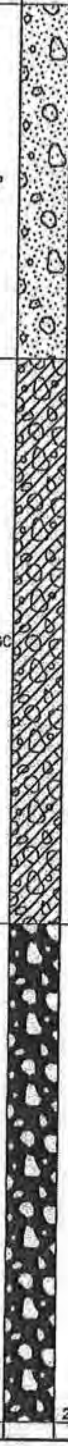
PROJECT: Pend Oreille Mine RI/FS
PROJECT NUMBER: 043-1344.401
LOCATION: TDF-2

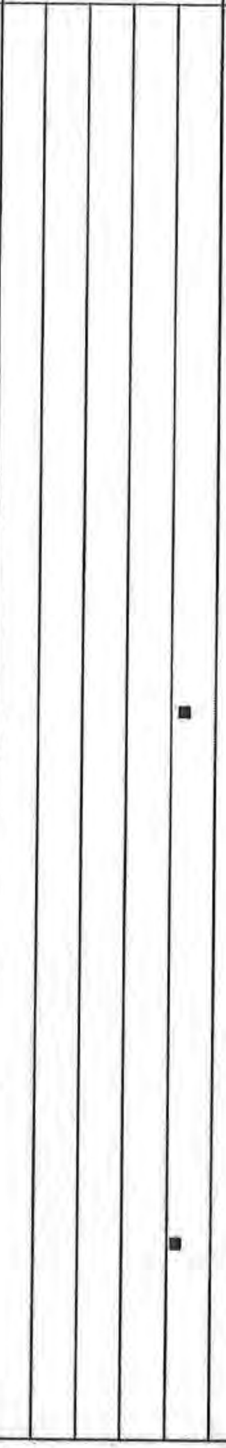
DRILLING METHOD: Air Rotary
DRILLING DATE: 8/1/05
DRILL RIG: T300E

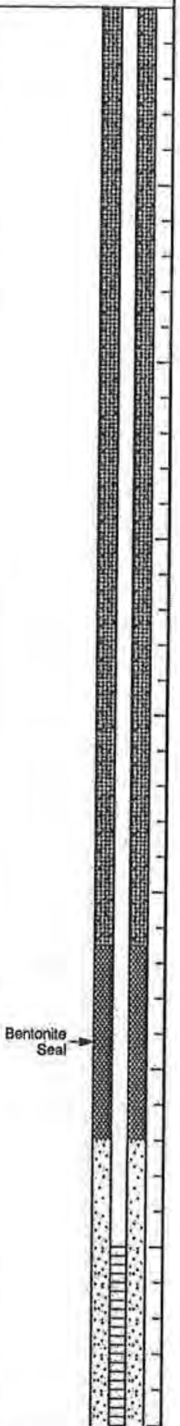
DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 53,596.00 E: 57,648.59

ELEVATION: 2332.33
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) / WATER CONTENT (PERCENT) W_p ⊢—○W—⊣ W_l	NOTES WATER LEVELS / GRAPHIC
40		28.0 - 50.0 Medium brown, dense Silty Sand with Coarse Gravels, well rounded, unsorted, moist *(Continued)*	GP									
50		50.0 - 66.0 Brownish-grey, very dense Silty Clay with Coarse Gravels, well rounded, sorted, moist	GW-GC		2282.3 50.0							
60						1	SS	14-17-26	43	1.5/1.5	■	
66		66.0 - 80.0 Light Brown, dense Clay with Fine to Coarse Gravels, subangular to well rounded, poorly sorted, moist (fragments of broken cobbles > 3" dia.)	GC		2266.3 66.0							Bentonite Seal
75						2	SS	15-19-23	42	1.4/1.5	■	
80		Log continued on next page			2252.3							







1 in to 5 ft
DRILLING CONTRACTOR: Environmental West Exploration
DRILLER: Ron Sink

LOGGED: Paul VanMiddlesworth
CHECKED: D. Morell
DATE: 8/25/2006

Golder Associates

RECORD OF BOREHOLE MW-201

SHEET 3 of 3

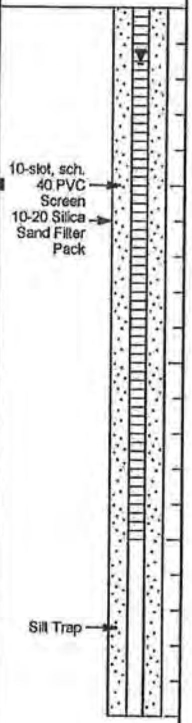
PROJECT: Pend Oreille Mine RI/FS
PROJECT NUMBER: 043-1344.401
LOCATION: TDF-2

DRILLING METHOD: Air Rotary
DRILLING DATE: 8/1/05
DRILL RIG: T300E

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 53,596.00 E: 57,548.59

ELEVATION: 2332.33
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft ■ 10 20 30 40 WATER CONTENT (PERCENT) Wp ⊢—○W—⊣ Wl	NOTES WATER LEVELS GRAPHIC
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT		
80		80.0 - 83.0 Light gray, loose to medium dense Coarse Sand, well sorted, wet	SW		80.0 2249.3							
85		83.0 - 86.0 Light Brown, dense Sandy Silt, poorly sorted, wet	SM		83.0 2246.3	3	SS	19-26-50	>50	1.2/1.5	>>■	
90 95		86.0 - 96.5 Very Coarse Gravels with minor fines, very dense, well sorted, well-rounded, wet (fragments of broken cobbles > 3" dia.)	GW		86.0 2235.8	4	SS	250	250	0.2/1.5		
		96.5 - 100.0 Black, very hard, angular fragments of slate with thin bedding planes (LEDBETTER SLATE)			96.5 2232.3							
100 105 110 115 120		Boring completed at 100.0 ft.			100.0							



1 in to 5 ft

DRILLING CONTRACTOR: Environmental West Exploration
DRILLER: Ron Sink

LOGGED: Paul VanMiddlesworth
CHECKED: D. Morell
DATE: 8/25/2006

Golder Associates

RECORD OF BOREHOLE BH-201 (A)

SHEET 1 of 2

PROJECT: Pend Oreille Mine RI/FS
PROJECT NUMBER: 043-1344.401
LOCATION: TDF-2

DRILLING METHOD: HSA
DRILLING DATE: 7/28/05
DRILL RIG: T300E

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 53,672.82 E: 57,608.72

ELEVATION: 2330.96
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) / WATER CONTENT (PERCENT) W_p ⊢—○W—⊣ W_l	NOTES WATER LEVELS
0		0.0 - 25.0 Light gray, fine, Sandy Silt (TAILINGS), loose to medium dense, damp, interbedded with dark gray, Silty Clay (Fine TAILINGS), wet, high plasticity, thixotropic [increasing water content with depth]	SP-SC									
5												
10												
						1	SH			1.9/2.0		
15												
20						2	SS	3-7-21	28	1.1/1.5	■	
25		25.0 - 41.0 Light brown, dense Clayey Silt, damp, with unsorted Coarse Gravels, rounded to well-rounded	GP-GM		2306.0 25.0	3	SH			0.5/0.5		
						4	SS	3-50	50	0.6/1.5		
						5	SS	50	50	0.4/1.5		
30						6	SS	145	145	0.5/1.5		
						7	GRAB			4.0		
35						8	SS	15-42-50	>50	1.2/1.5	>>■	
40		Log continued on next page									■	

1 in to 5 ft
DRILLING CONTRACTOR: Environmental West Exploration
DRILLER: Ron Sink

LOGGED: Paul VanMiddlesworth
CHECKED: D. Morell
DATE: 8/25/2006

Golder Associates

RECORD OF BOREHOLE BH-201 (A)

SHEET 2 of 2

PROJECT: Pend Oreille Mine RI/FS
PROJECT NUMBER: 043-1344.401
LOCATION: TDF-2

DRILLING METHOD: HSA
DRILLING DATE: 7/28/05
DRILL RIG: T300E

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 53,672.82 E: 57,608.72

ELEVATION: 2330.96
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft ■ 10 20 30 40 WATER CONTENT (PERCENT) Wp ⊢—○W—⊣ Wl	NOTES WATER LEVELS
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT		
40											■	
			GP-GM		2290.0 41.0	9	SS	32-30-18	48	1.5		
		41.0 - 56.0 Medium brown, dense Silty Sand with Coarse Gravels, well rounded, sorted, moist										
45												
						10	SS	28-50	50	1.1/1.5		
			GP									
50											>>■	
						11	SS	28-30-32	>50	1.3/1.5		
55												
					2275.0 56.0	12	SS	18-60	60	0.8/1.5		
		56.0 - 68.0 Brownish-gray, Silty Clay with Gravels, well rounded, sorted, moist, very dense										
60											>>■	
		(Drilling becoming increasingly difficult)				13	SS	28-45-50	>50	1.1/1.5		
			GW-GC									
65												
		[Auger bound-up in coarse gravels @ 68', Unable to advance HSA to Ledbetter Slate, No groundwater in borehole after 2.5 hours; Move drill rig SW 200' to redrill borehole]			2263.0 68.0							
		Boring completed at 68.0 ft.										
70												
75												
80												

1 in to 5 ft
DRILLING CONTRACTOR: Environmental West Exploration
DRILLER: Ron Sink

LOGGED: Paul VanMiddlesworth
CHECKED: D. Morell
DATE: 8/25/2006

Golder Associates

RECORD OF BOREHOLE BH-201 (B)

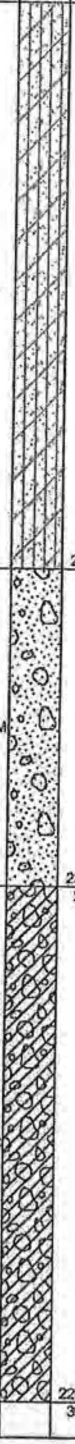
SHEET 1 of 1

PROJECT: Pend Oreille Mine RI/FS
PROJECT NUMBER: 043-1344.401
LOCATION: TDF-2

DRILLING METHOD: HSA
DRILLING DATE: 7/29/05
DRILL RIG: T300E

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 53,531.45 E: 57,483.07

ELEVATION: 2332.77
INCLINATION: -90



DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ 10 20 30 40 WATER CONTENT (PERCENT) W_p ├── Θ^W ──┤ W_l	NOTES WATER LEVELS
0 5 10 15		0.0 - 16.0 Light gray, fine, Sandy Silt (TAILINGS), loose to medium dense, damp, interbedded with dark gray, Silty Clay (Fine TAILINGS), wet, high plasticity, thixotropic [increasing water content with depth]	CL								
		16.0 - 25.0 Light brown, very dense Silty Sand with Coarse Gravels, angular to rounded, unsorted, damp	GP-GM	2316.8 16.0	1	SH			1.0/2.0		
20					2	SS	18-50	50	0.8/1.5		
25		25.0 - 39.5 Brownish-gray, very dense Silty Clay with Gravels, subrounded to well rounded, sorted, moist	GW-GC	2307.8 25.0	3	SS	50	50	0.2/1.5		
		(fragments of broken cobbles > 2" dia.)									
30		(Drilling becoming increasingly difficult)			4	SS	40-50	50	0.6/1.5		
35					5	SS	20-50	50	0.7/1.5		
		[Auger bound-up in coarse gravels @ 39.5', Unable to advance HSA to Ledbetter Slate, No groundwater in borehole after 1.5 hours, Must redrill borehole using Air Rotary]			6	SS	25-50	50	0.7/1.5		
40		Boring completed at 39.5 ft.		2293.3 39.5							

1 in to 5 ft

DRILLING CONTRACTOR: Environmental West Exploration
DRILLER: Ron Sink

LOGGED: Paul VanMiddlesworth
CHECKED: D. Morell
DATE: 8/25/2006

RECORD OF BOREHOLE MW-202

SHEET 1 of 2

PROJECT: Pend Oreille Mine RI/FS
PROJECT NUMBER: 043-1344.401
LOCATION: TDF-2

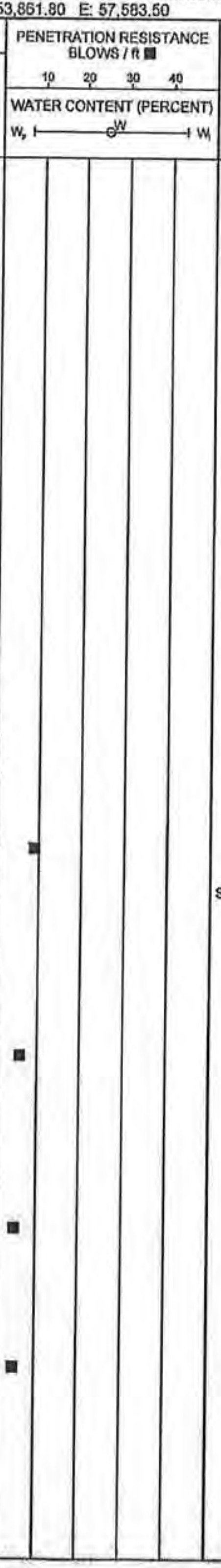
DRILLING METHOD: HSA
DRILLING DATE: 7/27/05
DRILL RIG: T300E

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 53,861.80 E: 57,583.50

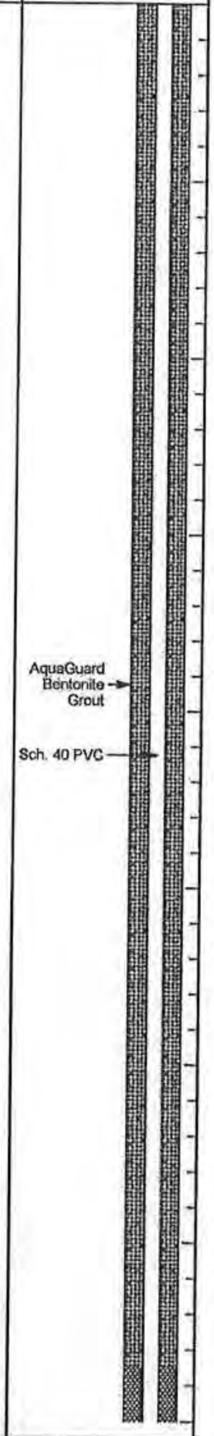
ELEVATION: 2330.04
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0		0.0 - 10.0 Light gray, fine, Sandy Silt (TAILINGS), medium dense, dry, loose	SM							
10		10.0 - 36.0 Light gray, fine, Sandy Silt (TAILINGS), dry, loose, interbedded with dark gray, Silty Clay (VERY FINE TAILINGS), moist, loose to compact, thixotropic, high plasticity	SP-SC		2320.0 10.0					
16						1	SH			1.5/2.5
21						2	SS	4-5-4	9	1.5/1.5
26						3	SH			0.1/1.0
27						4	SS	3-4-2	6	1.5/1.5
31						5	SH			0.1/1.0
32						6	SS	2-3-2	5	1.5/1.5
36		36.0 - 41.0 Light brown, Clayey Silt (TAILINGS), medium dense, moist	CL-ML		2294.0 36.0	7	SS	2-3-2	5	1.5/1.5
40		Log continued on next page								

PENETRATION RESISTANCE BLOWS / ft ■ — WATER CONTENT (PERCENT)



NOTES WATER LEVELS GRAPHIC



1 in to 5 ft

DRILLING CONTRACTOR: Environmental West Exploration
DRILLER: Ron Sink

LOGGED: Paul VanMiddlesworth
CHECKED: D. Morell
DATE: 8/25/2006

Golder Associates

RECORD OF BOREHOLE MW-202

SHEET 2 of 2

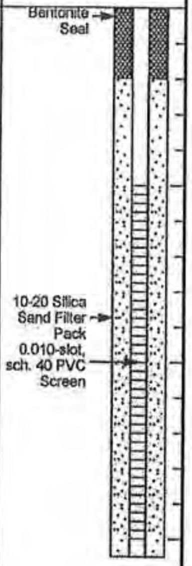
PROJECT: Pend Oreille Mine RI/FS
PROJECT NUMBER: 043-1344.401
LOCATION: TDF-2

DRILLING METHOD: HSA
DRILLING DATE: 7/27/05
DRILL RIG: T300E

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 53,861.80 E: 57,583.50

ELEVATION: 2330.04
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) / WATER CONTENT (PERCENT) Wp ⊢ ⊖W ⊣ Wl	NOTES WATER LEVELS GRAPHIC
40			CL-ML		2289.0							Bentonite Seal
		41.0 - 55.0 Dark-gray to greenish-gray, Silty Clay (TAILINGS), loose to compact, moist, thicksotropic			41.0	8	SH			1.5/3.0		
45						9	SS	3-6-7	13	1.5/1.5	■	
50			CL			10	SS	4-10-8	18	1.5/1.5	■	10-20 Silica Sand Filter Pack 0.010-slot, sch. 40 PVC Screen
55					2275.0							
		55.0 - 55.5 Black, very hard, angular fragments of slate with thin bedding planes (LEDBETTER SLATE)			2274.5 55.5	11	SS	170	170	0.5/0.5		
		Boring completed at 55.5 ft.										
60												
65												
70												
75												
80												



1 in to 5 ft
DRILLING CONTRACTOR: Environmental West Exploration
DRILLER: Ron Sink

LOGGED: Paul VanMiddlesworth
CHECKED: D. Morell
DATE: 8/25/2006

Golder Associates

RECORD OF BOREHOLE MW-203

SHEET 1 of 1

PROJECT: Pend Oreille Mine RI/FS
PROJECT NUMBER: 043-1344.401
LOCATION: TDF-2

DRILLING METHOD: HSA
DRILLING DATE: 7/27/05
DRILL RIG: T300E

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 53,895.83 E: 57,768.54

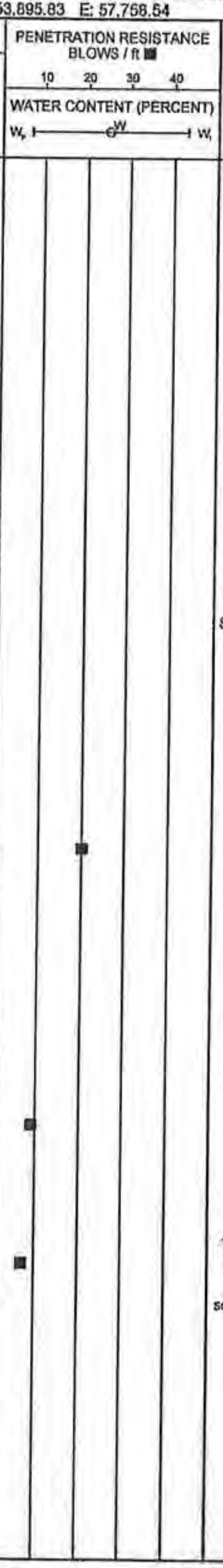
ELEVATION: 2330.45
INCLINATION: -90

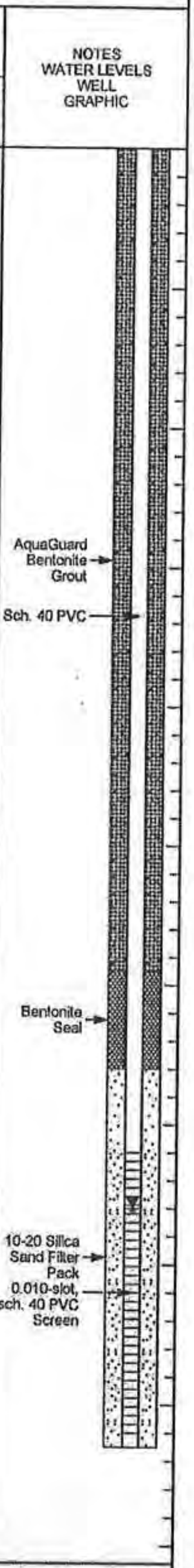
SOIL PROFILE

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)
0.0 - 4.0	Light gray, fine, Sandy Silt (TAILINGS), medium dense, dry, loose	SM	2326.5 4.0
4.0 - 15.0	Light gray, fine, Sandy Silt (TAILINGS), dry, loose, Interbedded with dark gray, Silty Clay (Very Fine TAILINGS), wet, loose to compact, thixotropic, high plasticity	SP-SC	2315.5 15.0
15.0 - 30.0	Light brown, Silty Clay (TAILINGS), medium dense, interbedded with medium brown Silty Sand with trace Gravel, medium dense	CL-ML	2300.5 30.0
30.0 - 35.0	Light brown Sandy Silt, compact to medium dense, Interbedded with light gray, soft Silty Clay (TAILINGS), high plasticity	SP-SC	2295.5 35.0
35.0 - 43.0	Dark brown Silty Clay (TAILINGS), loose to compact, thixotropic, high plasticity, interbedded with lenses of medium dense, reddish-brown Silt	CH	2287.5 43.0
43.0 - 46.5	Black, angular fragments of platy slate fragments (LEDBETTER SLATE)		2284.0 46.5
	Boring completed at 46.5 ft.		

SAMPLES

NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
1	SH			$\frac{0.5}{2.5}$
2	SH			$\frac{1.8}{2.5}$
3	SS	50	50	$\frac{0.4}{1.5}$
4	SS	7-9-11	20	$\frac{1.5}{1.5}$
5	SH			$\frac{2.0}{2.0}$
6	SS	5-4-5	9	$\frac{1.5}{1.5}$
7	SS	3-3-4	7	$\frac{1.5}{1.5}$
8	SS	12-50	50	$\frac{1.5}{1.5}$





1 in to 6 ft

DRILLING CONTRACTOR: Environmental West Exploration
DRILLER: Ron Sink

LOGGED: Paul VanMiddlesworth
CHECKED: D. Morell
DATE:

Golder Associates

RECORD OF BOREHOLE LSB-1

SHEET 1 of 1

PROJECT: Pend Oreille Mine RI/FS
PROJECT NUMBER: 043-1344.401
LOCATION: Access Road, NE of TDF-2

DRILLING METHOD: HSA
DRILLING DATE: 7/29/06
DRILL RIG: T300E

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 54,171.90 E: 58,085.83

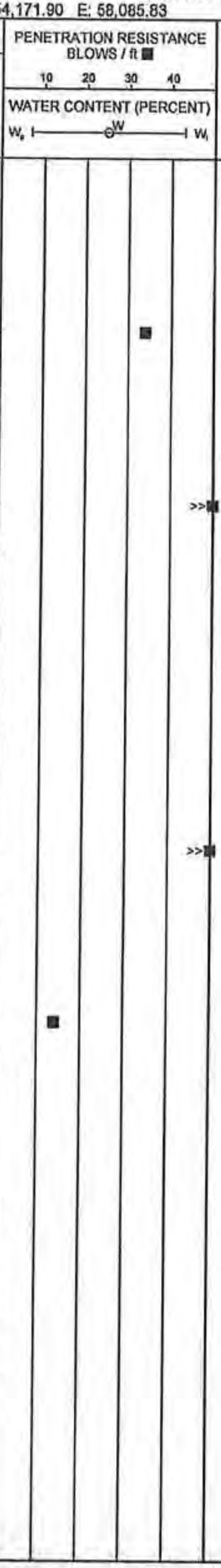
ELEVATION: 2334.75
INCLINATION: -90

SOIL PROFILE

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)
0	0.0 - 21.0 Light brown to reddish-brown, fine to medium Sand, little to no silt, compact, damp, poorly sorted, angular to subangular sand grains	SP	2313.8 21.0
21	21.0 - 28.0 Light brown Silty Sand, moist, loose, sorted, subangular fine sand grains	SM	2306.8 28.0
28	28.0 - 32.0 Dark brownish-gray, hard Clay with medium Gravels, rounded to well-rounded, poorly sorted	GC	2302.8 32.0
32	32.0 - 35.0 Slate fragments (LEDBETTER SLATE), hard, black slate bedrock, large fragments with thin bedding planes (No water encountered to Total Depth) (Refusal of auger at 35')		2299.8 35.0
35	Boring completed at 35.0 ft.		

SAMPLES

NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
1	SS	13-16-18	34	1.2/1.5
2	SS	10-33-22	>50	1.2/1.5
3	SS	30-50	50	0.8/1.5
4	SS	7-18-46	>50	0.8/1.5
5	SS	8-8-6	14	1.3/1.5
6	SS	16-50	50	0.6/1.5
7	SS	100	100	0.1/1.5



NOTES
WATER LEVELS

1 in to 5 ft

DRILLING CONTRACTOR: Environmental West Exploration
DRILLER: Ron Sink

LOGGED: Paul VanMiddlesworth
CHECKED: D. Morell
DATE: 8/25/2006

Golder Associates

RECORD OF BOREHOLE LSB-2

SHEET 1 of 1

PROJECT: Pend Oreille Mine RI/FS
PROJECT NUMBER: 043-1344.401
LOCATION: Access Road, North of TDF-2

DRILLING METHOD: HSA
DRILLING DATE: 7/29/06
DRILL RIG: T300E

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 54,449.81 E: 57,800.04

ELEVATION: 2276
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40); WATER CONTENT (PERCENT) W_p ⊢ ⊖W ⊣ W_l	NOTES WATER LEVELS
0		0.0 - 10.0 Light brown to reddish-brown Sandy Silt, medium dense, moist, low plasticity, reddish iron staining and mottling	SP-SM	▒								
5				▒		1	SS	12-17-18	35	1.2/1.5	■	
10		10.0 - 23.0 Dark gray, loose, Silty Clay, wet, high plasticity, thixotropic	CL	▨	2266.0 10.0	2	SS	7-14-21	35	1.3/1.5	■	
15				▨		3	SS	4-5-7	12	1.5/1.5	■	
20				▨		4	SS	3-7-7	14	1.4/1.5	■	▼
		23.0 - 25.5 Slate fragments (LEDBETTER SLATE), hard, black slate bedrock, large fragments with thin bedding planes (Refusal of auger at 25.5')		≈	2253.0 23.0							
25				≈		5	SS	150	150	0.2/1.5		
		Boring completed at 25.5 ft.			2250.5 25.5							
30												
35												
40												

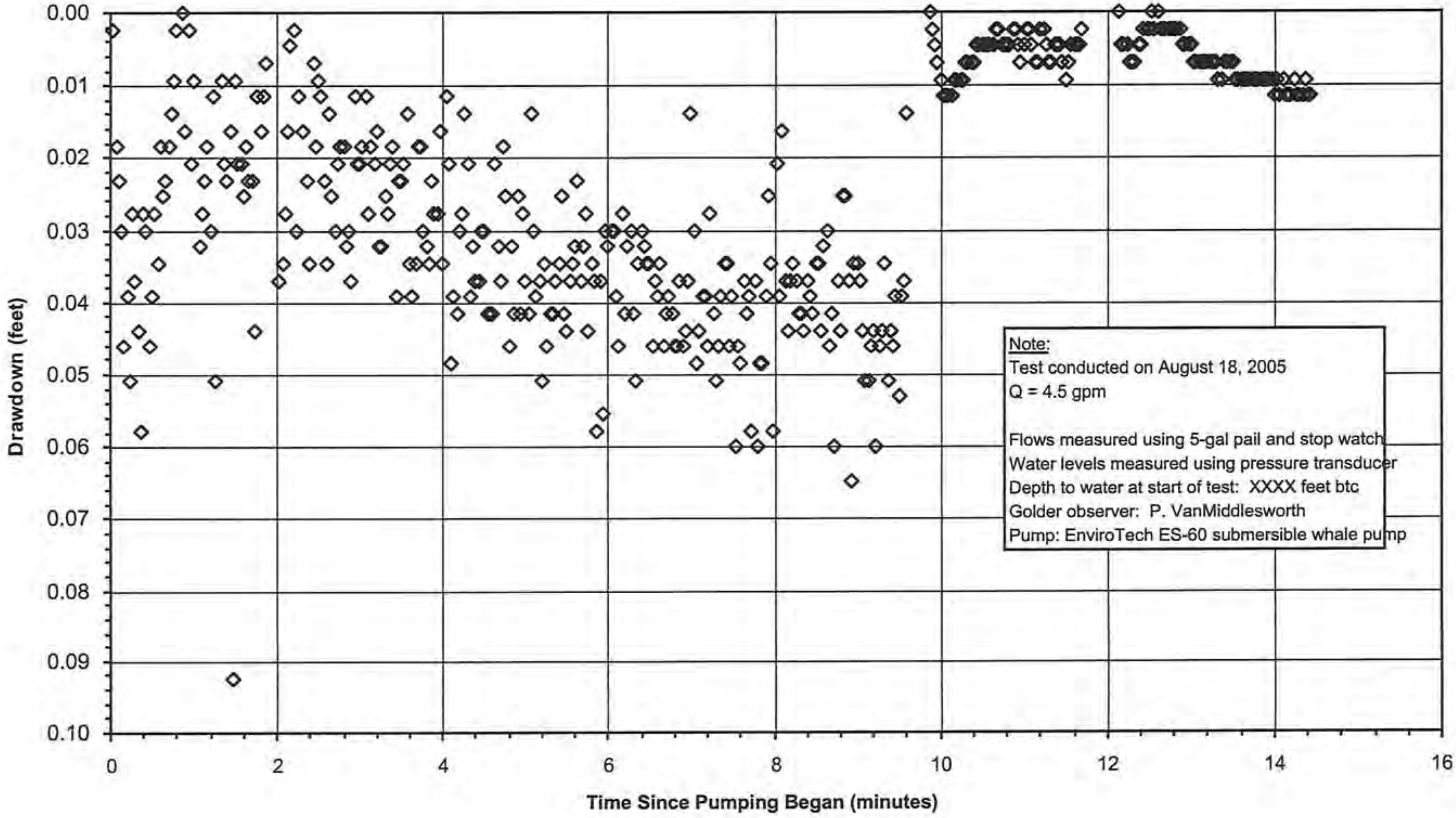
1 in to 5 ft
DRILLING CONTRACTOR: Environmental West Exploration
DRILLER: Ron Sink

LOGGED: Paul VanMiddlesworth
CHECKED: D. Morell
DATE: 8/25/2006

Golder Associates

APPENDIX D

HYDRAULIC PUMP TEST ANALYSIS



Note:
Test conducted on August 18, 2005
Q = 4.5 gpm

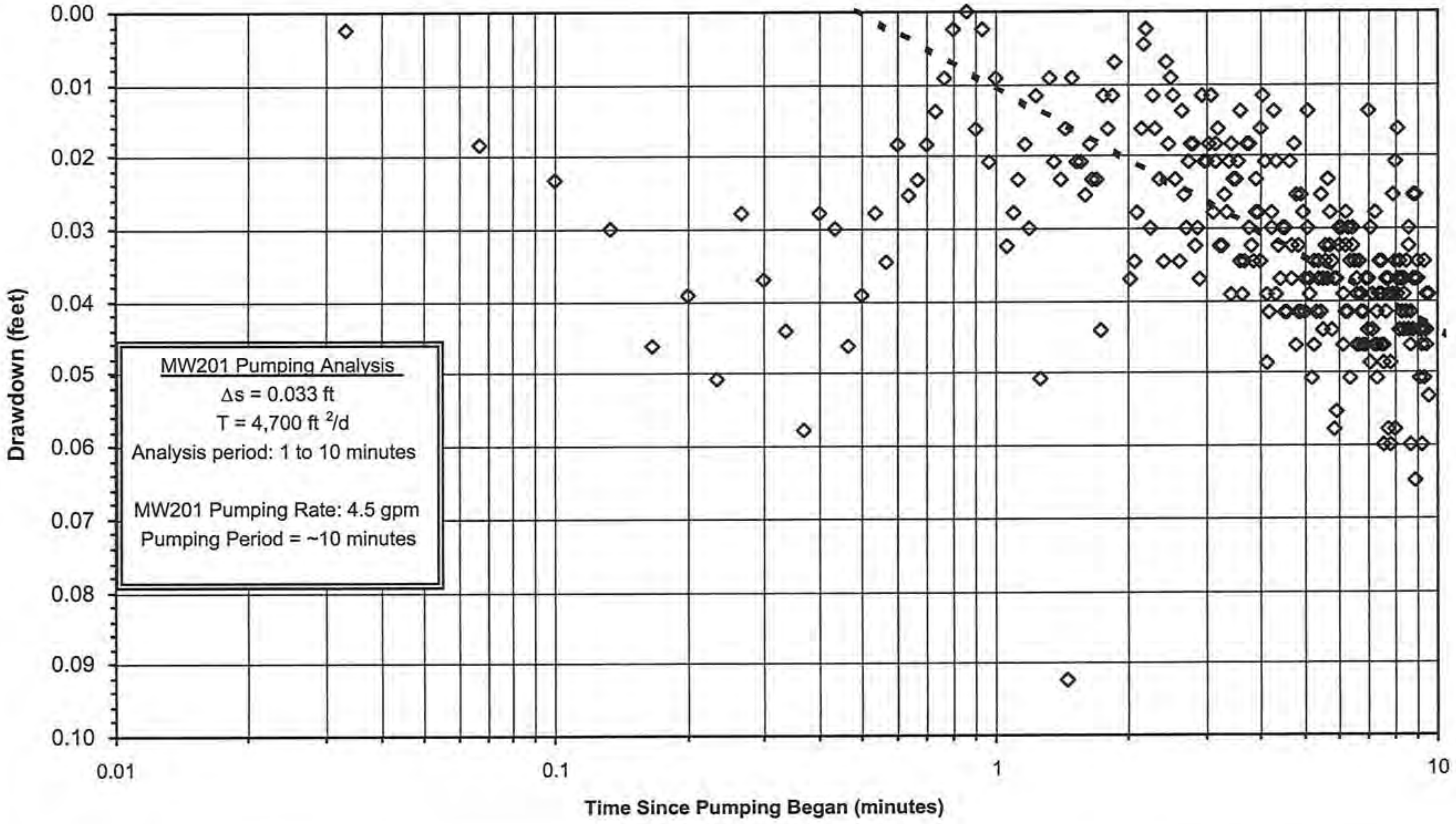
Flows measured using 5-gal pail and stop watch
Water levels measured using pressure transducer
Depth to water at start of test: XXXX feet btc
Golder observer: P. VanMiddlesworth
Pump: EnviroTech ES-60 submersible whale pump

Golder Associates

PEND OREILLE MINE
RI/FS WELL TESTING

TITLE
MW201 Constant Discharge Hydrograph - Short Test

DRAWN	TW	DATE	Aug-06	JOB NO.	993-1683.006
CHECKED		SCALE	na	DWG. NO.	na
REVIEWED		FILE NAME	MW2-3_Pump.xls	FIGURE NO.	1



MW201 Pumping Analysis

Δs = 0.033 ft

T = 4,700 ft ^{2}/d

Analysis period: 1 to 10 minutes

MW201 Pumping Rate: 4.5 gpm

Pumping Period = ~10 minutes

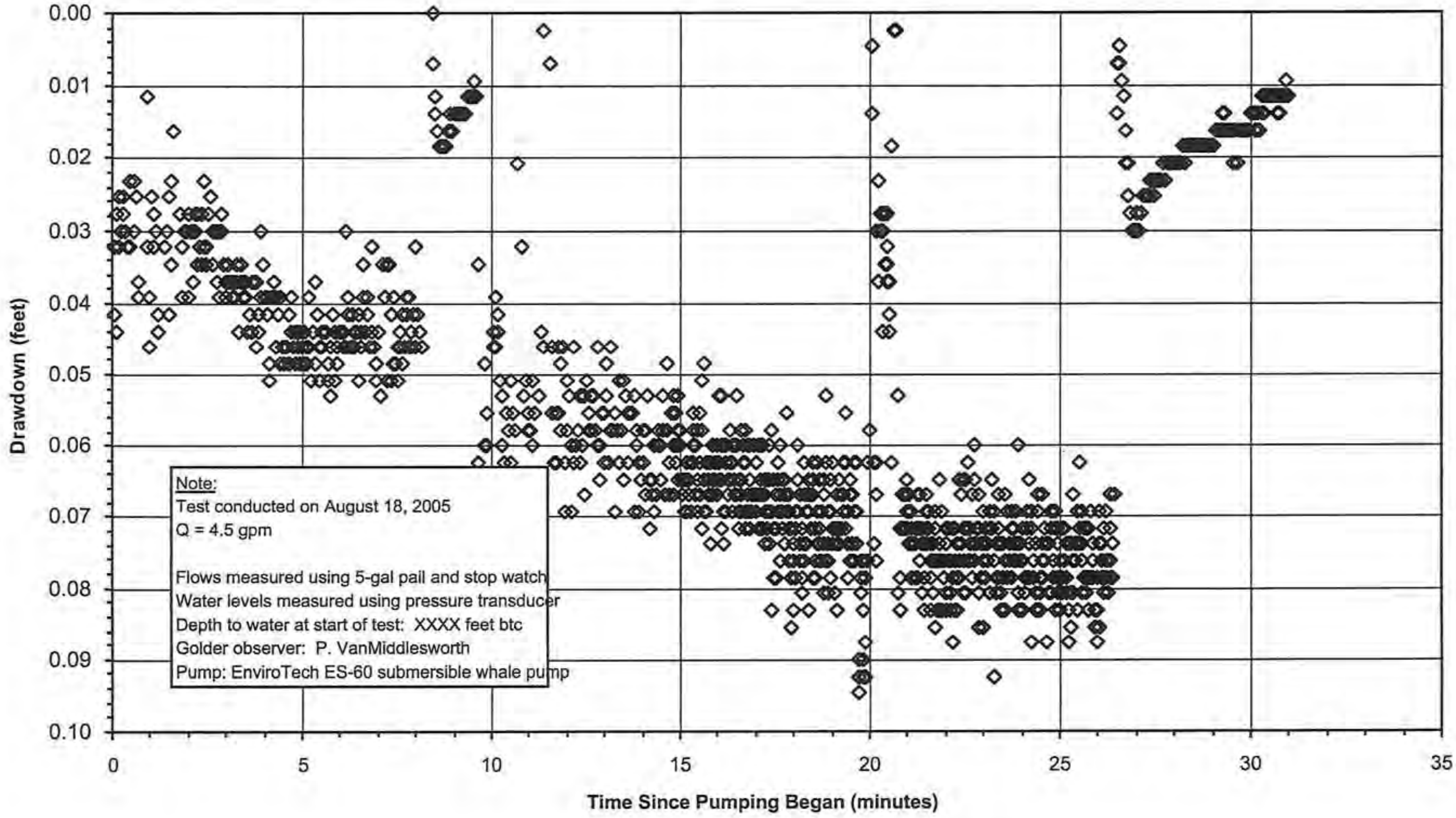
Golder Associates

TITLE

MW201 Constant Discharge Semilog Hydrograph - Short Test

PEND OREILLE MINE
RI/FS WELL TESTING

DRAWN	TW	DATE	Aug-06	JOB NO.	993-1683.006
CHECKED		SCALE	na	DWG. NO.	na
REVIEWED		FILE NAME	MW2-3_Pump.xls	FIGURE NO.	2



Note:
Test conducted on August 18, 2005
Q = 4.5 gpm

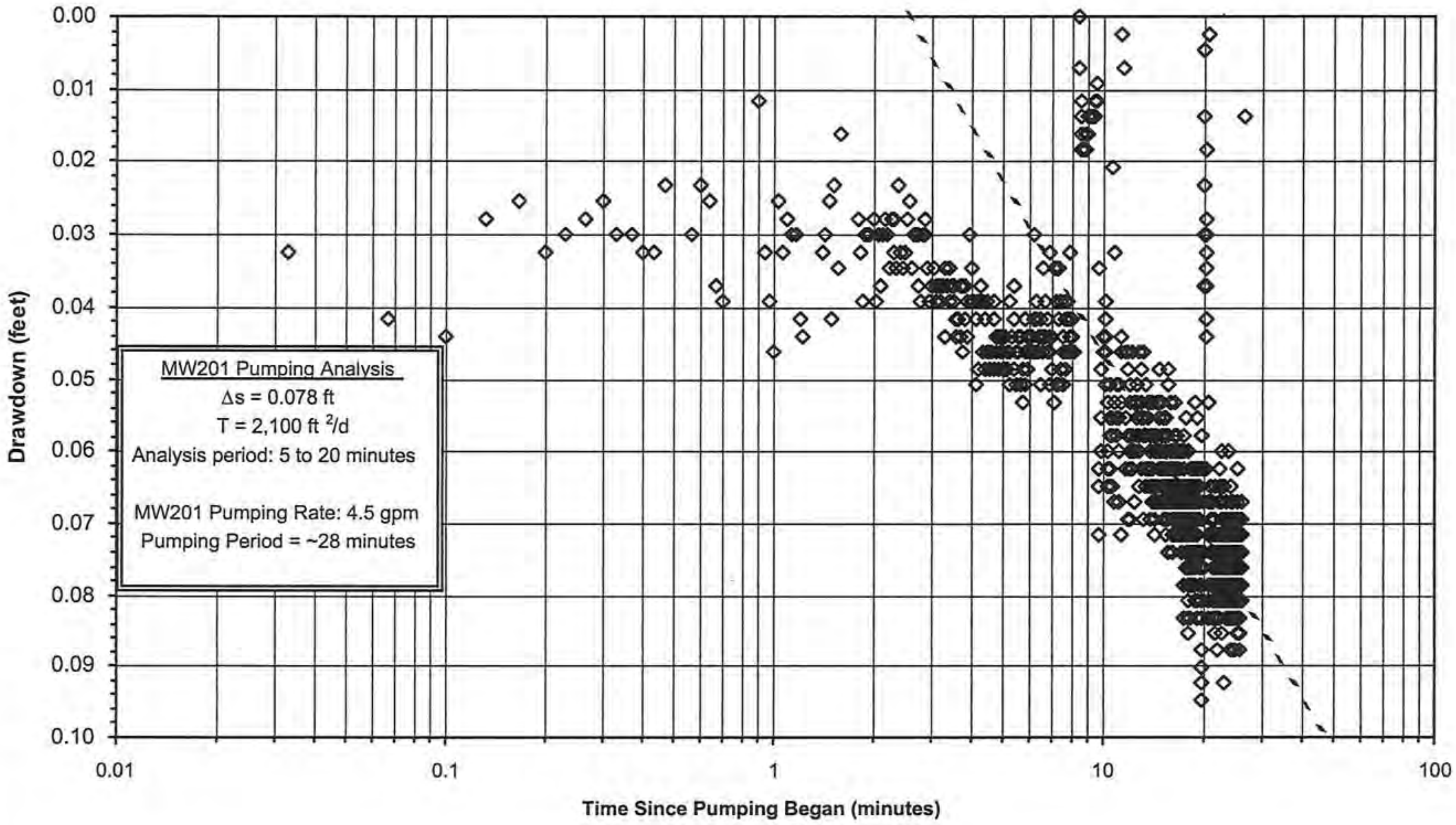
Flows measured using 5-gal pail and stop watch
Water levels measured using pressure transducer
Depth to water at start of test: XXXX feet btc
Golder observer: P. VanMiddlesworth
Pump: EnviroTech ES-60 submersible whale pump

Golder Associates

PEND OREILLE MINE
RI/FS WELL TESTING

TITLE
MW201 Constant Discharge Hydrograph - Long Test

DRAWN	TW	DATE	Aug-06	JOB NO.	993-1683.006
CHECKED		SCALE	na	DWG. NO.	na
REVIEWED		FILE NAME	MW2-3_Pump.xls	FIGURE NO.	3



MW201 Pumping Analysis

$\Delta s = 0.078$ ft

$T = 2,100$ ft ^{2}/d

Analysis period: 5 to 20 minutes

MW201 Pumping Rate: 4.5 gpm

Pumping Period = ~28 minutes

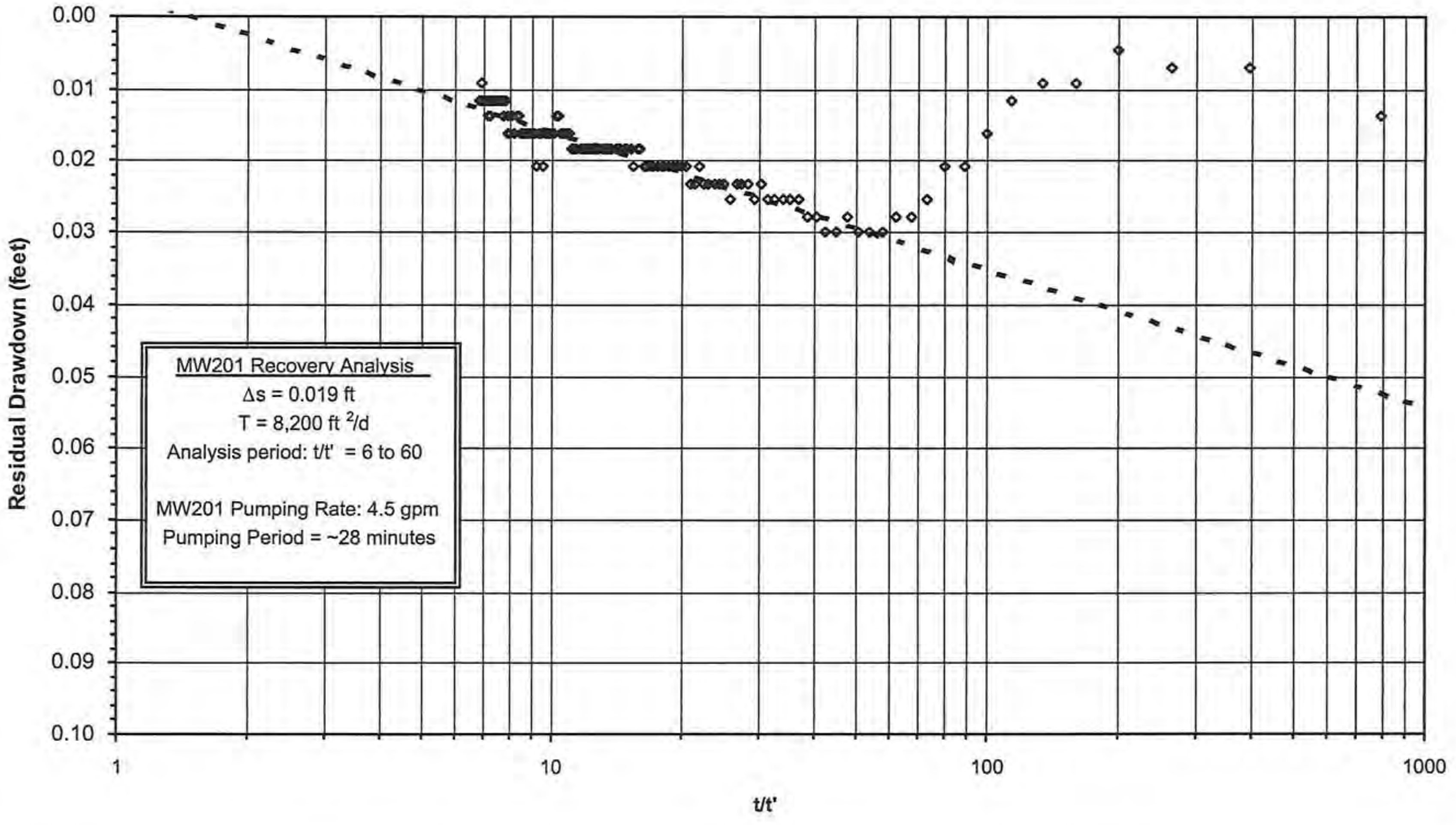
Golder Associates

PEND OREILLE MINE
RI/FS WELL TESTING

TITLE

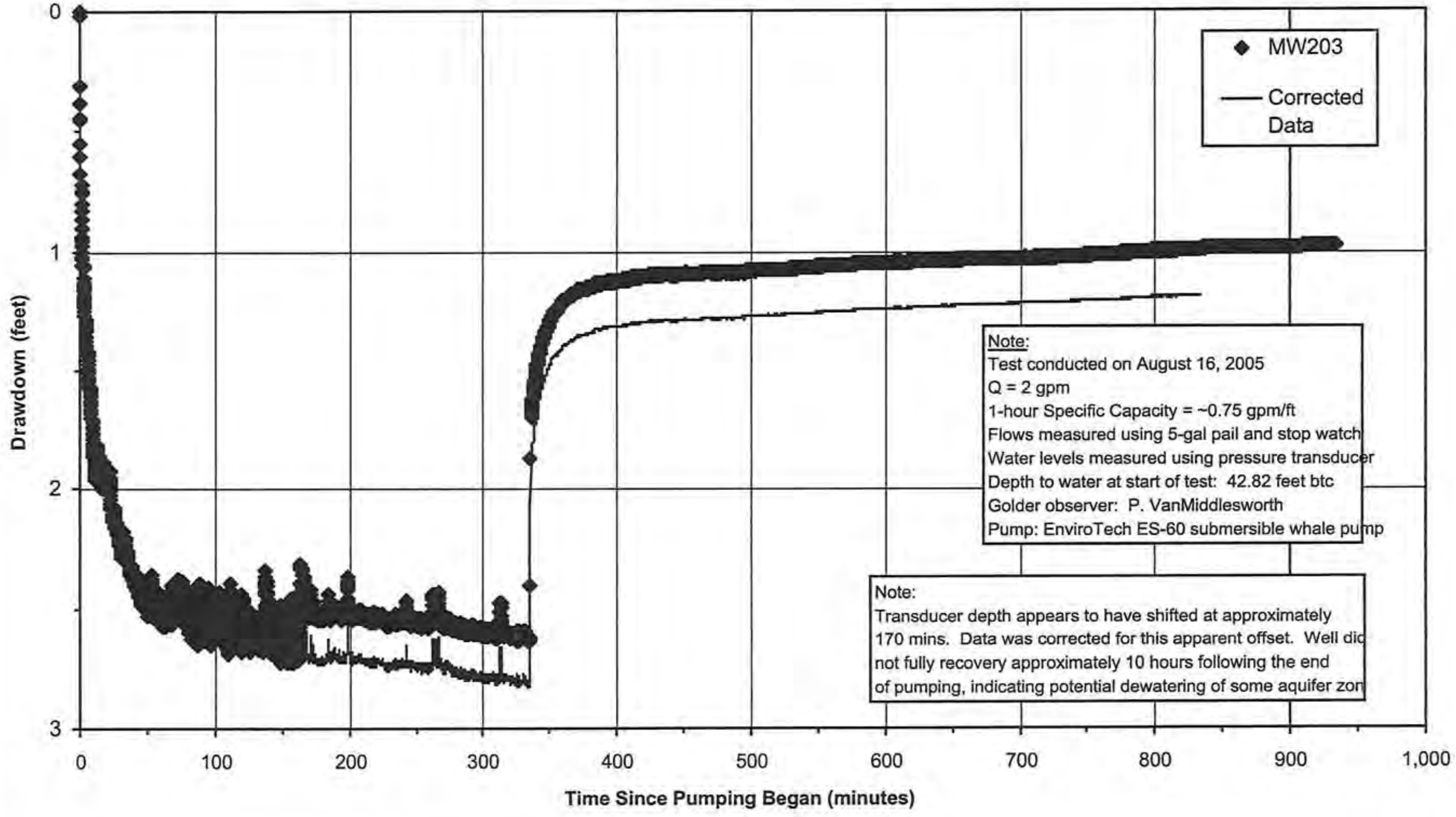
MW201 Constant Discharge Semilog Hydrograph - Long Test

DRAWN	TW	DATE	Aug-06	JOB NO.	993-1683.006
CHECKED		SCALE	na	DWG. NO.	na
REVIEWED		FILE NAME	MW2-3_Pump.xls	FIGURE NO.	4



Golder Associates

PEND OREILLE MINE RI/FS WELL TESTING	TITLE	**MW201 Constant Discharge Recovery Hydrograph - Long Test**				
	DRAWN	TW	DATE	Aug-06	JOB NO.	993-1683.006
	CHECKED		SCALE	na	DWG. NO.	na
	REVIEWED		FILE NAME	MW2-3_Pump.xls	FIGURE NO.	5



Note:
Test conducted on August 16, 2005
Q = 2 gpm
1-hour Specific Capacity = ~0.75 gpm/ft
Flows measured using 5-gal pail and stop watch
Water levels measured using pressure transducer
Depth to water at start of test: 42.82 feet btc
Golder observer: P. VanMiddlesworth
Pump: EnviroTech ES-60 submersible whale pump

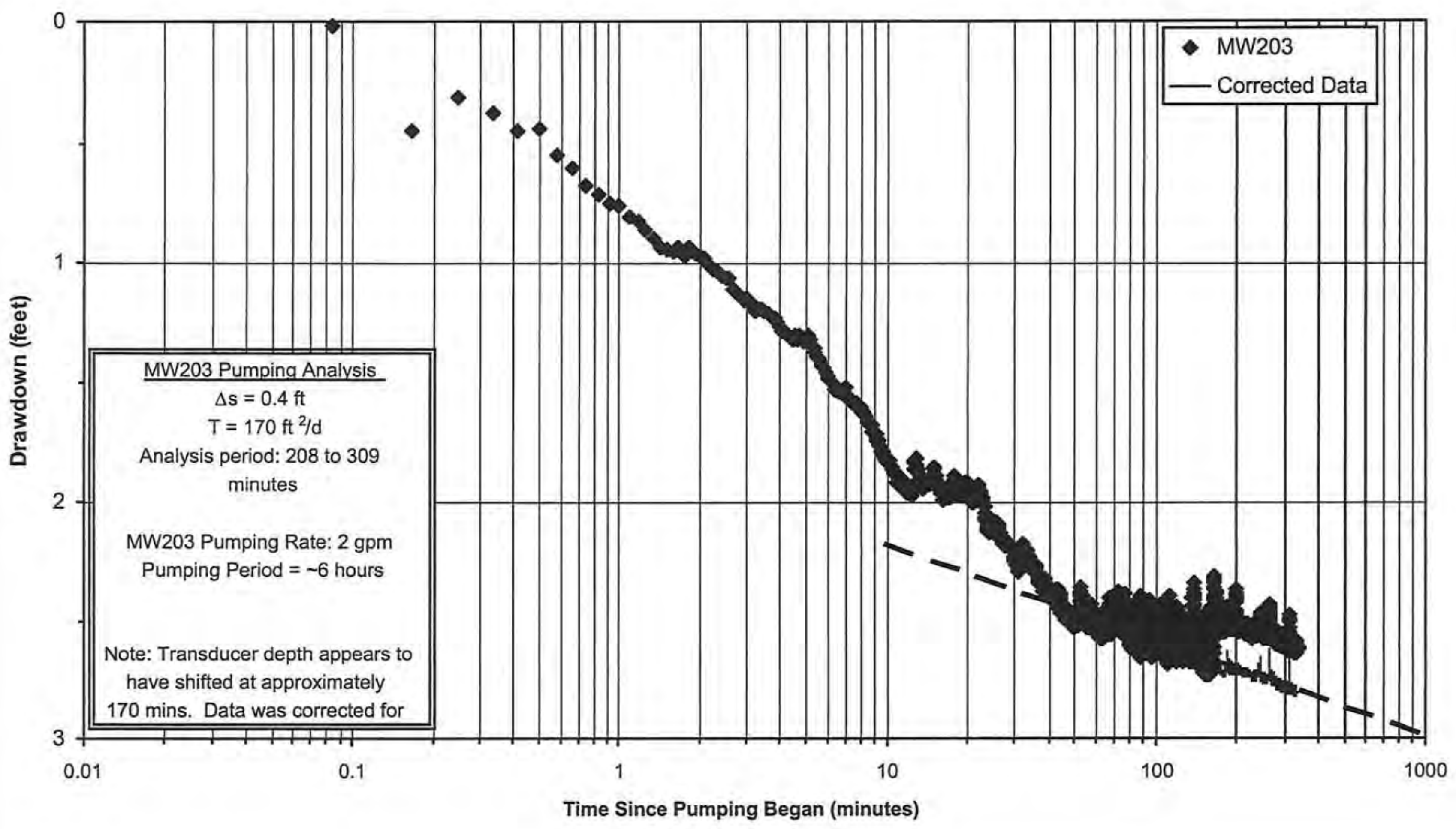
Note:
Transducer depth appears to have shifted at approximately 170 mins. Data was corrected for this apparent offset. Well did not fully recovery approximately 10 hours following the end of pumping, indicating potential dewatering of some aquifer zon

Golder Associates

PEND OREILLE MINE
RI/FS WELL TESTING

TITLE
MW203 Constant Discharge Hydrograph

DRAWN	TW	DATE	Aug-06	JOB NO.	993-1683.006
CHECKED		SCALE	na	DWG. NO.	na
REVIEWED		FILE NAME	MW2-3_Pump.xls	FIGURE NO.	1



MW203 Pumping Analysis

Δs = 0.4 ft

T = 170 ft ^{2}/d

Analysis period: 208 to 309 minutes

MW203 Pumping Rate: 2 gpm

Pumping Period = ~6 hours

Note: Transducer depth appears to have shifted at approximately 170 mins. Data was corrected for

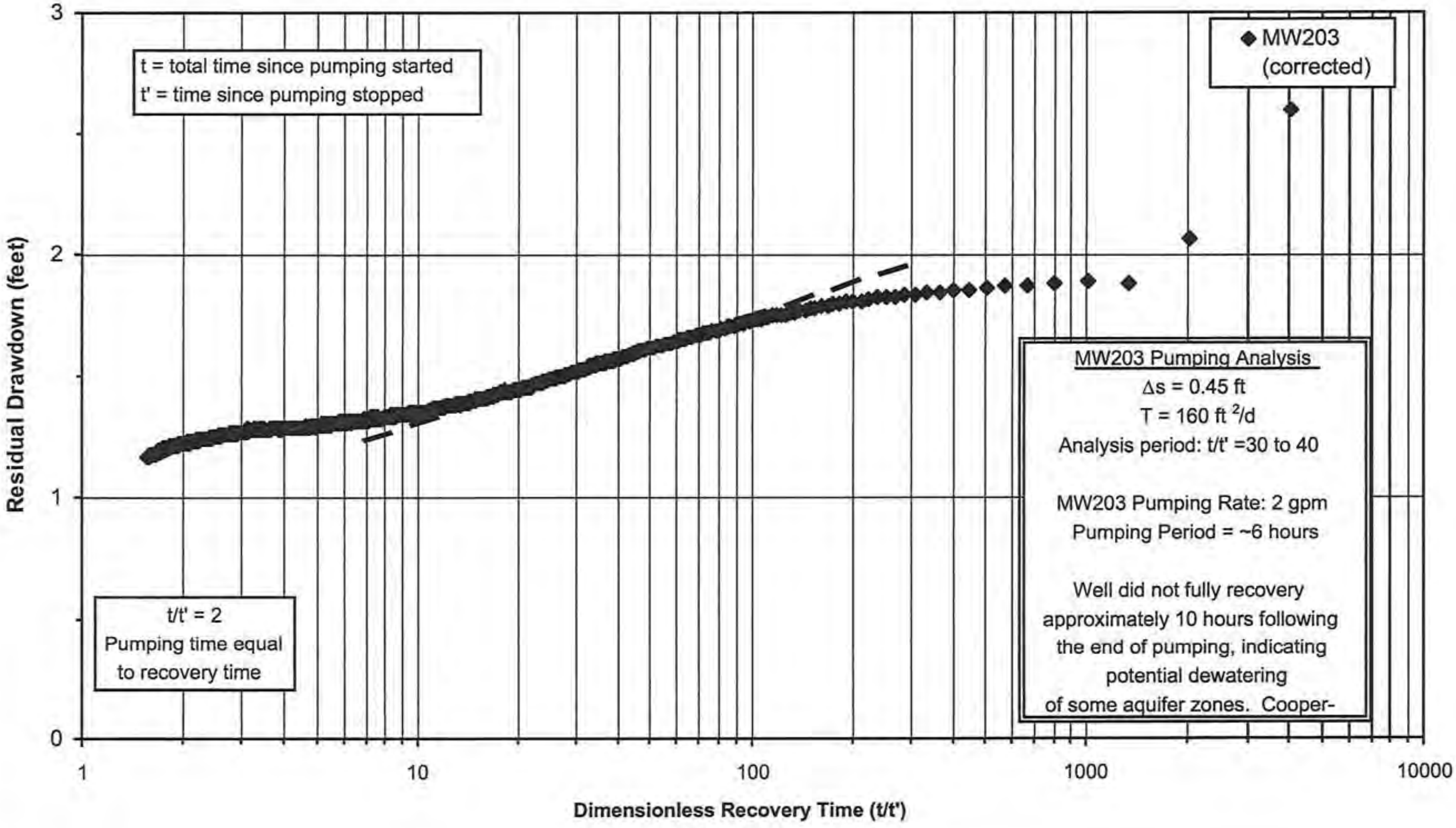
Golder Associates

TITLE

MW203 Constant Discharge Semilog Hydrograph

PEND OREILLE MINE
RI/FS WELL TESTING

DRAWN	TW	DATE	Aug-06	JOB NO.	993-1683.006
CHECKED		SCALE	na	DWG. NO.	na
REVIEWED		FILE NAME	MW2-3_Pump.xls	FIGURE NO.	**2**



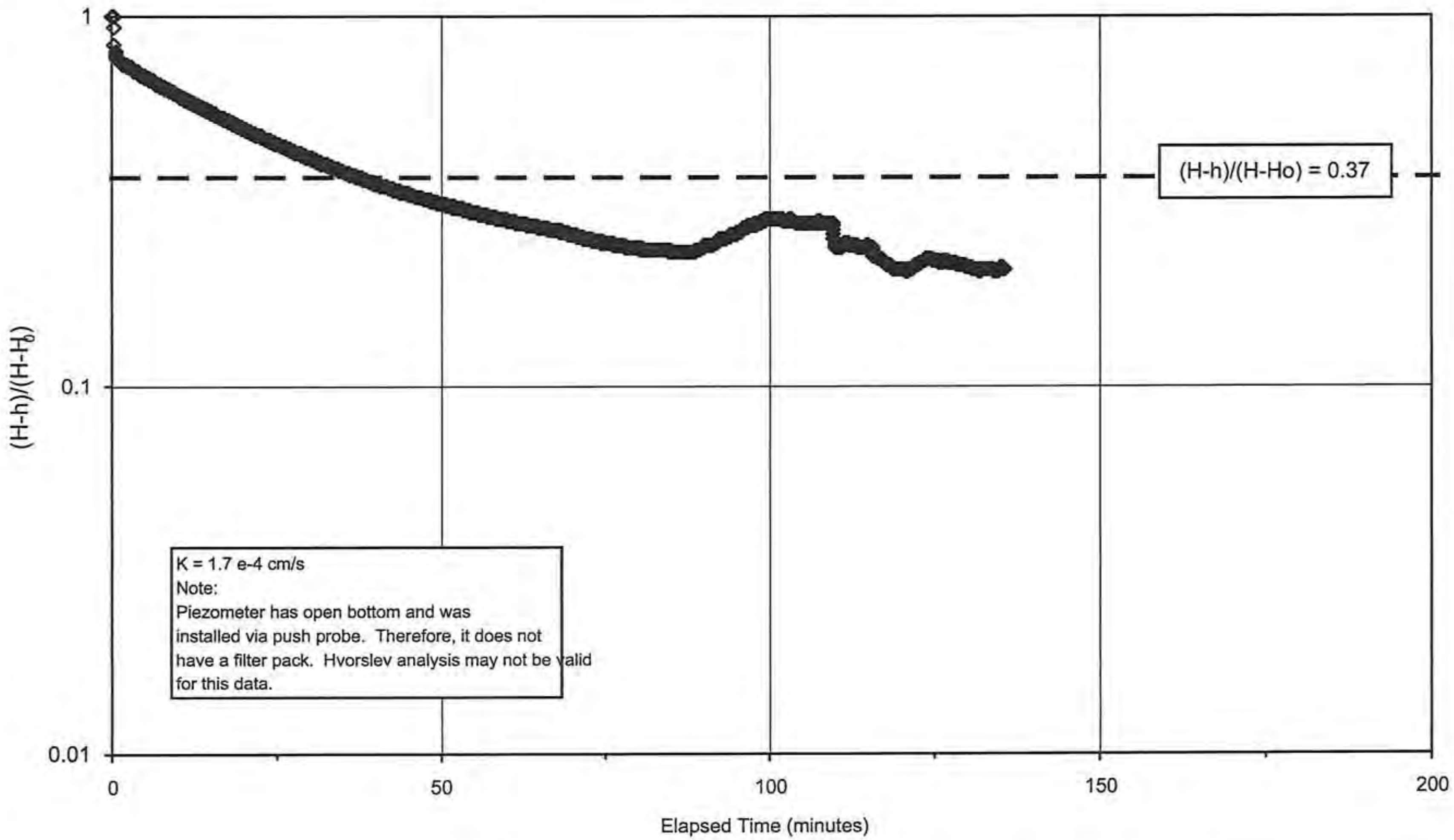
Golder Associates

PEND OREILLE MINE
RI/FS WELL TESTING

TITLE

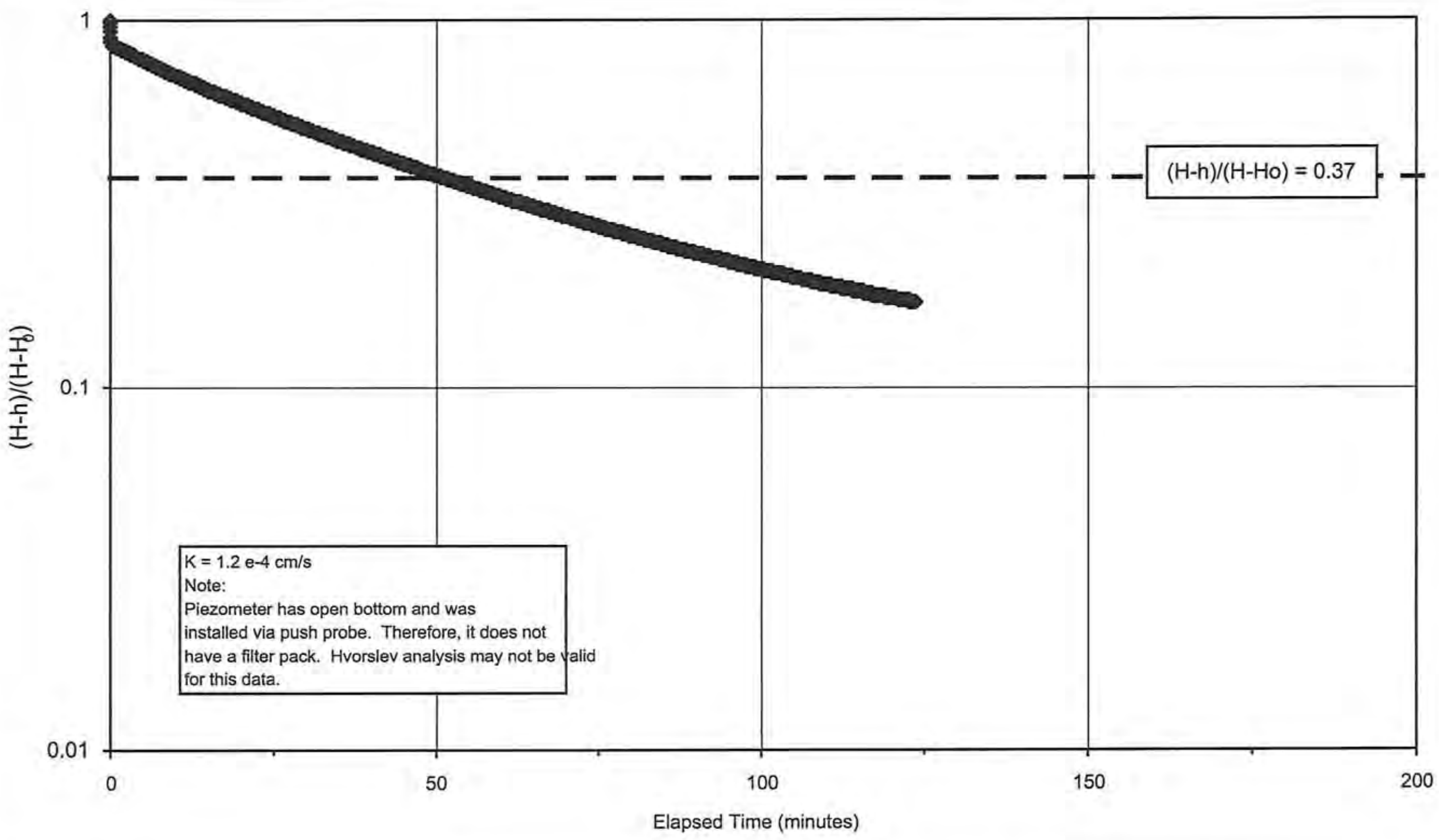
MW203 Constant Discharge Recovery Hydrograph

DRAWN	TW	DATE	Aug-06	JOB NO.	993-1683.006
CHECKED		SCALE	na	DWG. NO.	na
REVIEWED		FILE NAME	MW2-3_Pump.xls	FIGURE NO.	3



K = 1.7 e-4 cm/s
Note:
Piezometer has open bottom and was installed via push probe. Therefore, it does not have a filter pack. Hvorslev analysis may not be valid for this data.

Golder Associates	TITLE	P01 Slug Test Hydrograph - Hvorslev Analysis				
TECK COMINCO PEND OREILLE SLUG TESTING	DRAWN	TW	DATE	Nov-05	JOB NO.	043-1344.402
	CHECKED	DM	SCALE	na	DWG. NO.	na
	REVIEWED	DM	FILE NAME	P01Slug.xls	FIGURE NO.	1



K = 1.2 e-4 cm/s
Note:
Piezometer has open bottom and was installed via push probe. Therefore, it does not have a filter pack. Hvorslev analysis may not be valid for this data.

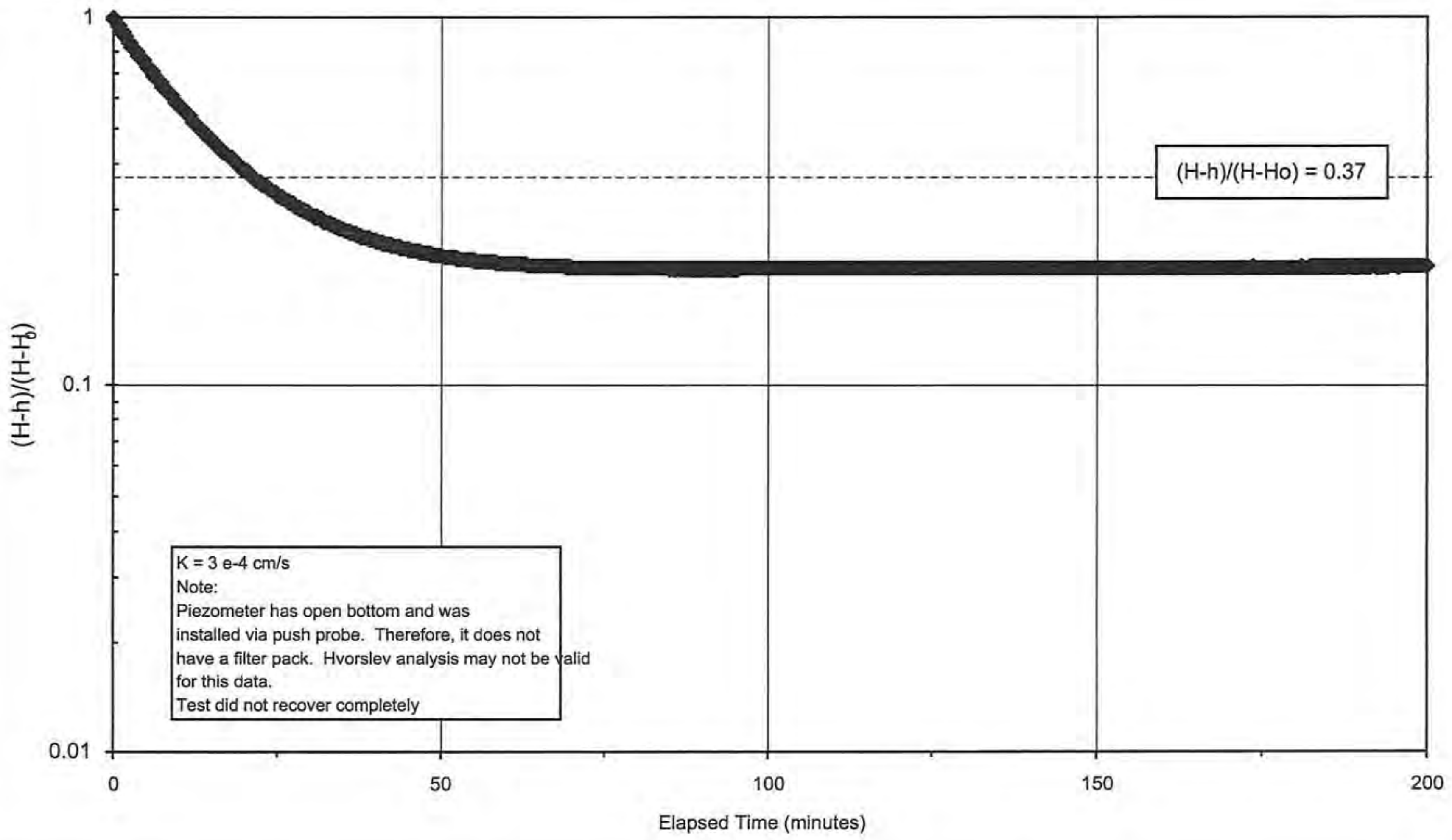
Golder Associates

TECK COMINCO
PEND OREILLE SLUG TESTING

TITLE

P02 Slug Test Hydrograph - Hvorslev Analysis

DRAWN	TW	DATE	Nov-05	JOB NO.	043-1344.402
CHECKED	DM	SCALE	na	DWG. NO.	na
REVIEWED	DM	FILE NAME	P02Slug.xls	FIGURE NO.	1



K = 3 e-4 cm/s
Note:
Piezometer has open bottom and was installed via push probe. Therefore, it does not have a filter pack. Hvorslev analysis may not be valid for this data.
Test did not recover completely

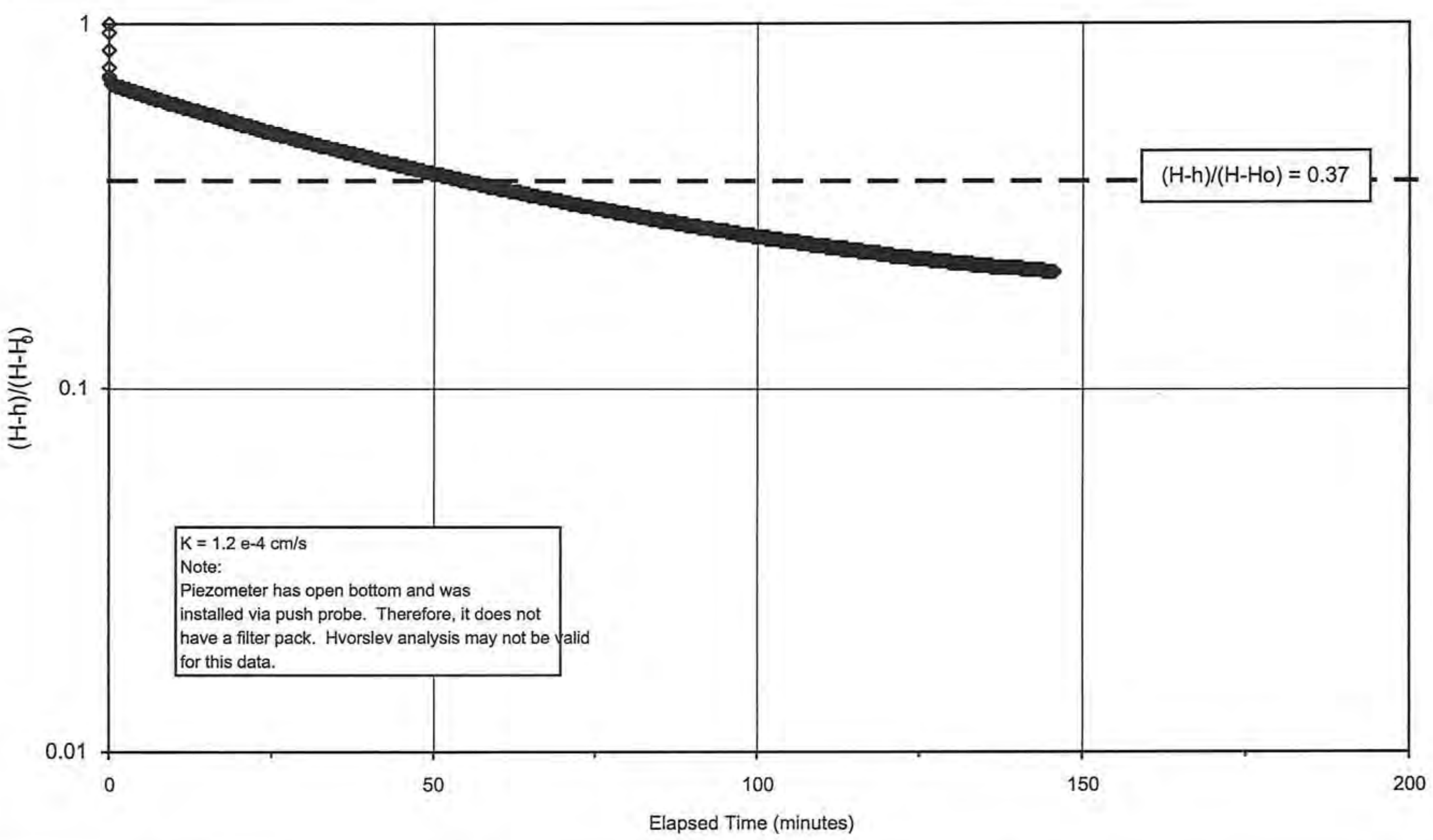
Golder Associates

TECK COMINCO
PEND OREILLE SLUG TESTING

TITLE

P03 Slug Test Hydrograph - Hvorslev Analysis

DRAWN	TW	DATE	Nov-05	JOB NO.	043-1344.402
CHECKED	DM	SCALE	na	DWG. NO.	na
REVIEWED	DM	FILE NAME	P01Slug.xls	FIGURE NO.	1



K = 1.2 e-4 cm/s
Note:
Piezometer has open bottom and was installed via push probe. Therefore, it does not have a filter pack. Hvorslev analysis may not be valid for this data.

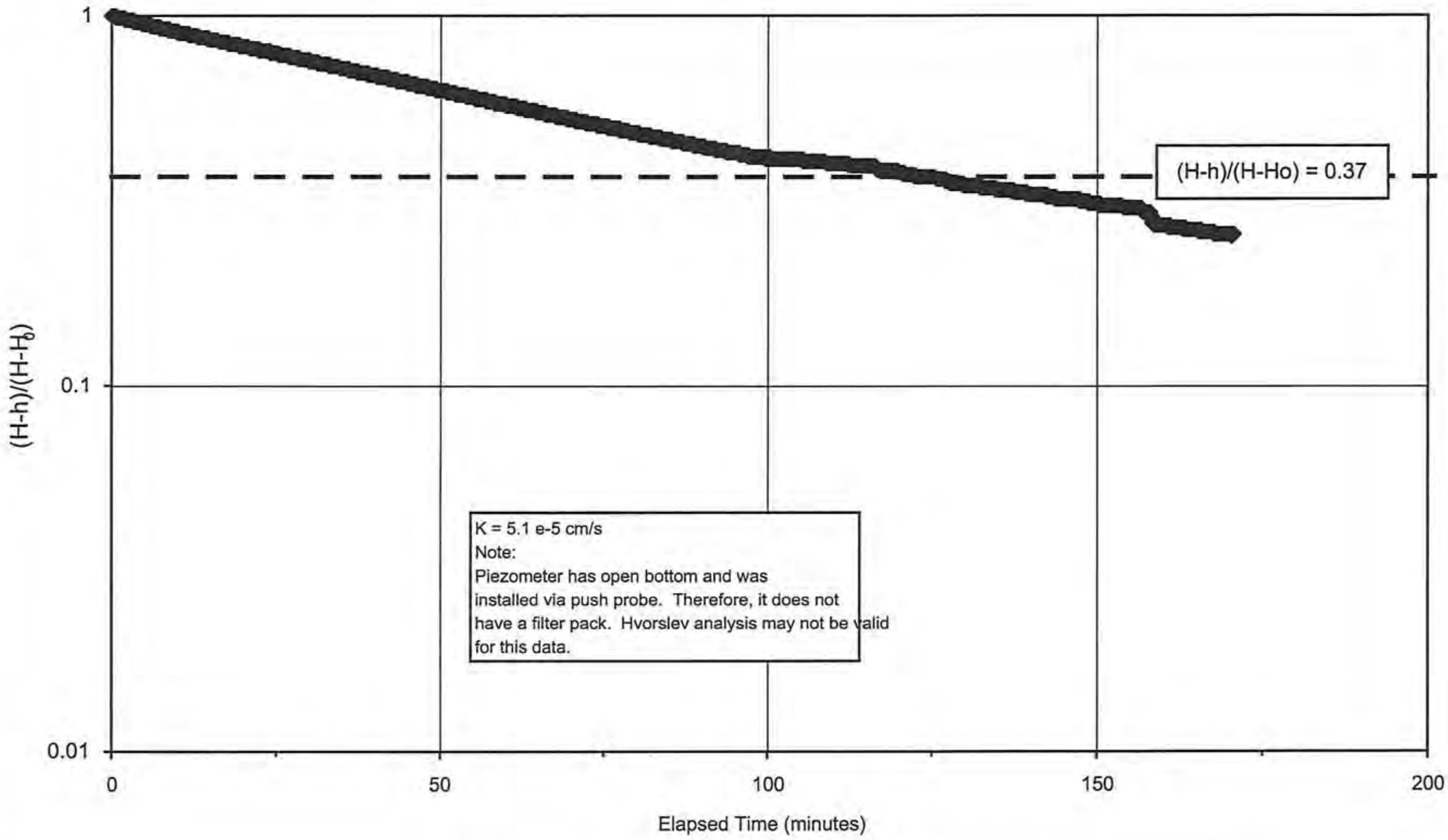
Golder Associates

TECK COMINCO
PEND OREILLE SLUG TESTING

TITLE

P04 Slug Test Hydrograph - Hvorslev Analysis

DRAWN	TW	DATE	Nov-05	JOB NO.	043-1344.402
CHECKED	DM	SCALE	na	DWG. NO.	na
REVIEWED	DM	FILE NAME	P04Slug.xls	FIGURE NO.	1



K = 5.1 e-5 cm/s
Note:
Piezometer has open bottom and was installed via push probe. Therefore, it does not have a filter pack. Hvorslev analysis may not be valid for this data.

Golder Associates	TITLE	**P05 Slug Test Hydrograph - Hvorslev Analysis**				
TECK COMINCO **PEND OREILLE SLUG TESTING**	DRAWN	TW	DATE	Nov-05	JOB NO.	043-1344.402
	CHECKED	DM	SCALE	na	DWG. NO.	na
	REVIEWED	DM	FILE NAME	P01Slug.xls	FIGURE NO.	1

APPENDIX E

VEGETATION AND OFF-SITE SOIL SAMPLE INVENTORY

Table E-1

Vegetation, Soils, and LFH Samples Collected for Potential Analyses

Site Identification	Unique Sample Number	Species Common Name	Species Latin Name	Sample Type	Selected For Analysis
PO-TDF1-T1	PO-TDF1-T1-Act-19V	black cottonwood	*Populus balsamifera*	Shrub	✓
	PO-TDF1-T1-GR-20V	Canada bluegrass	*Poa compressa*	Grass	✓
	PO-TDF1-T1-GR-21V	Rocky Mountain fescue	*Festuca saximontana*	Grass	
	PO-TDF1-T1-C-8S-ICPMS	n/a	n/a	Soil-composite	
	PO-TDF1-T1--C-8S-Hg	n/a	n/a	Soil-composite	
PO-TDF1-T2	PO-TDF1-T2-GR-22V	Canada bluegrass	*Poa compressa*	Grass	✓
	PO-TDF1-T2-Act-23V	black cottonwood	*Populus balsamifera*	Shrub	
	PO-TDF1-T2-C-9S-ICPMS	n/a	n/a	Soil-composite	
	PO-TDF1-T2-C-9S-Hg	n/a	n/a	Soil-composite	
PO-TDF1-T3	PO-TDF1-T3-Act-24V	black cottonwood	*Populus balsamifera*	Shrub	
	PO-TDF1-T3-Pw-25V	western white pine	*Pinus monticola*	Conifer	
	PO-TDF1-T3-GR-26V	Canada bluegrass	*Poa compressa*	Grass	✓
	PO-TDF1-T3-LI-30V	greater dog pelt	*Peltigera membranacea*	Lichen	
	PO-TDF1-T3-LFH4	n/a	n/a	LFH	
	PO-TDF1-T3-G-10Sa	n/a	n/a	Soil-grab	
	PO-TDF1-T3-G-10Sb	n/a	n/a	Soil-grab	
	PO-TDF1-T3-G-10Sc	n/a	n/a	Soil-grab	
	PO-TDF1-T3-G-10Sd	n/a	n/a	Soil-grab	
	PO-TDF1-T3-G-10Se	n/a	n/a	Soil-grab	
	PO-TDF1-T3-C-10S-Hg	n/a	n/a	Soil-composite	
PO-TDF1-T4	PO-TDF1-T4-Pl-27V	lodgepole pine	*Pinus contorta*	Conifer	✓
	PO-TDF1-T4-Pw-28V	western white pine	*Pinus monticola*	Conifer	
	PO-TDF1-T4-Act-29V	black cottonwood	*Populus balsamifera*	Shrub	✓
	PO-TDF1-T4-LFH5	n/a	n/a	LFH	
	PO-TDF1-T4-C-11S-ICPMS	n/a	n/a	Soil-composite	
	PO-TDF1-T4-C-11S-Hg	n/a	n/a	Soil-composite	

Table E-1

Vegetation, Soils, and LFH Samples Collected for Potential Analyses

Site Identification	Unique Sample Number	Species Common Name	Species Latin Name	Sample Type	Selected For Analysis
PO-TDF1-T5	PO-TDF1-T5-Act-31V	black cottonwood	*Populus balsamifera*	Shrub	
	PO-TDF1-T5-GR-32V	Rocky Mountain fescue	*Festuca saximontana*	Grass	
	PO-TDF1-T5-GR-33V	tall wheatgrass	*Thinopyrum ponticum*	Grass	
	PO-TDF1-T5-C-12S-ICPMS	n/a	n/a	Soil-composite	
	PO-TDF1-T5-C-Hg	n/a	n/a	Soil-composite	
PO-TDF1-T6	PO-TDF1-T6-GR-34V	tall wheatgrass	*Thinopyrum ponticum*	Grass	
	PO-TDF1-T6-GR-35V	Rocky Mountain fescue	*Festuca saximontana*	Grass	
	PO-TDF1-T6-C-13S-ICPMS	n/a	n/a	Soil-composite	
	PO-TDF1-T6-C-13S-Hg	n/a	n/a	Soil-composite	
PO-TDF1-T7	PO-TDF1-T7-PI-36V	lodgepole pine	*Pinus contorta*	Conifer	✓
	PO-TDF1-T7-Act-37V	black cottonwood	*Populus balsamifera*	Shrub	✓
	PO-TDF1-T7-GR-38V	Canada bluegrass	*Poa compressa*	Grass	✓
	PO-TDF1-T7-LI-39V	greater dog pelt	*Peltigera membranacea*	Grass	
	PO-TDF1-T7-LFH6	n/a	n/a	LFH	
	PO-TDF1-T7-C-14S-ICPMS	n/a	n/a	Soil-composite	
	PO-TDF1-T7-C-14S-Hg	n/a	n/a	Soil-composite	
PO-TDF1-W1a Wetland South Side of Road	PO-TDF1-W1a-TY-31V	common cattail	*Typha latifolia*	Herb	✓
	PO-TDF1-WIa-78V	Willow species	*Salix spp.*	Shrub	
	PO-TDF1-W1a-EQ-79V	common horsetail	*Equisetum arvense*	Herb	
	PO-TDF1-W1a-G-15Sa-ICPMS	n/a	n/a	Soil-grab	
	PO-TDF1-W1a-G-15Sb-ICPMS	n/a	n/a	Soil-grab	
	PO-TDF1-W1a-G-15Sc-ICPMS	n/a	n/a	Soil-grab	
	PO-TDF1-W1a-G-15Sd-ICPMS	n/a	n/a	Soil-grab	
	PO-TDF1-W1a-G-15Se-ICPMS	n/a	n/a	Soil-grab	
	PO-TDF1-W1a-C-15S-Hg	n/a	n/a	Soil-composite	✓

Table E-1

Vegetation, Soils, and LFH Samples Collected for Potential Analyses

Site Identification	Unique Sample Number	Species Common Name	Species Latin Name	Sample Type	Selected For Analysis
PO-TDF1-W1b Wetland North Side of Road	PO-TDF1-W1b-C-15Sf-ICPMS	n/a	n/a	Soil-composite	
	PO-TDF1-W1b-C-15Sf-Hg	n/a	n/a	Soil-composite	✓
	PO-TDF1-W1b-TY-80V	common cattail	*Typha latifolia*	Herb	✓
	PO-TDF1-W1b-EQ-81V	common horsetail	*Equisetum arvense*	Herb	
	PO-TDF1-W1b-WI-82V	willow species	*Salix spp.*	Shrub	
PO-TDF1-T9	PO-TDF1-T9-Act-43V	black cottonwood	*Populus balsamifera*	Shrub	
	PO-TDF1-T9-GR-44V	Rocky Mountain fescue	*Festuca saximontana*	Grass	
	PO-TDF1-T9-GR-45V	tall wheatgrass	*Thinopyrum ponticum*	Grass	
	PO-TDF1-T9-LI-46V	greater dog pelt	*Peltigera membranacea*	Lichen	
	PO-TDF1-T9-C-16S-ICPMS	n/a	n/a	Soil-composite	
	PO-TDF1-T9-C-16S-Hg	n/a	n/a	Soil-composite	
PO-TDF1-T10	PO-TDF1-T10-Pl-47V	lodgepole pine	*Pinus contorta*	Conifer	✓
	PO-TDF1-T10-Act-48V	black cottonwood	*Populus balsamifera*	Shrub	✓
	PO-TDF1-T10-GR-49V	Rocky Mountain fescue	*Festuca saximontana*	Grass	
	PO-TDF1-T10-LI-50V	greater dog pelt	*Peltigera membranacea*	Lichen	
	PO-TDF1-T10-LFH-7	n/a	n/a	LFH	
	PO-TDF1-T10-C-17S-ICPMS	n/a	n/a	Soil-composite	
	PO-TDF1-T10-C-17S-Hg	n/a	n/a	Soil-composite	
PO-TDF1-T11	PO-TDF1-T11-Fd-51V	Douglas-fir	*Pseudotsuga menziesii*	Conifer	
	PO-TDF1-T11-Pl-52V	lodgepole pine	*Pinus contorta*	Conifer	
	PO-TDF1-T11-GR-53V	tall wheatgrass	*Thinopyrum ponticum*	Grass	
	PO-TDF1-T11-LI-54V	greater dog pelt	*Peltigera membranacea*	Lichen	
	PO-TDF1-T11-LFH8	n/a	n/a	LFH	
	PO-TDF1-T11-C-18S-ICPMS	n/a	n/a	Soil-composite	
	PO-TDF1-T11-C-18S-Hg	n/a	n/a	Soil-composite	

Table E-1

Vegetation, Soils, and LFH Samples Collected for Potential Analyses

Site Identification	Unique Sample Number	Species Common Name	Species Latin Name	Sample Type	Selected For Analysis
PO-TDF1-T12	PO-TDF1-T12-Act-55V	black cottonwood	*Populus balsamifera*	Shrub	✓
	PO-TDF1-T12-Fd-56V	Douglas-fir	*Pseudotsuga menziesii*	Conifer	
	PO-TDF1-T12-Pl-57V	lodgepole pine	*Pinus contorta*	Conifer	✓
	PO-TDF1-T12-LI-58V	greater dog pelt	*Peltigera membranacea*	Lichen	
	PO-TDF1-T12-LFH9	n/a	n/a	LFH	
	PO-TDF1-T12-C-19S-ICPMS	n/a	n/a	Soil-composite	
	PO-TDF1-T12-C-19S-Hg	n/a	n/a	Soil-composite	
PO-TDF2-T13	PO-TDF2-T13-Fd-9V	Douglas-fir	*Pseudotsuga menziesii*	Conifer	
	PO-TDF2-T13-Pl-10V	lodgepole pine	*Pinus contorta*	Conifer	✓
	PO-TDF2-T13-Act-11V	black cottonwood	*Populus balsamifera*	Shrub	✓
	PO-TDF2-T13-GR-12V	Canada bluegrass	*Poa compressa*	Grass	✓
	PO-TDF2-T13-LI-13V	greater dog pelt	*Peltigera membranacea*	Lichen	
	PO-TDF2-T13-LFH-2	n/a	n/a	LFH	
	PO-TDF2-T13-C-5S-ICPMS	n/a	n/a	Soil - composite	
	PO-TDF2-T13-C-5S-Hg	n/a	n/a	Soil - composite	
PO-TDF2-T14	PO-TDF2-T14-Py-1V	ponderosa pine	*Pinus ponderosa*	Conifer	
	PO-TDF2-T14-Act-2V	black cottonwood	*Populus balsamifera*	Shrub	✓
	PO-TDF2-T14-GR-3V	Canada bluegrass	*Poa compressa*	Grass	✓
	PO-TDF2-T14-LI-4V	greater dog pelt	*Peltigera membranacea*	Lichen	
	PO-TDF2-T14-C-1S-ICPMS	n/a	n/a	Soil - composite	
	PO-TDF2-T14-C-1S-Hg	n/a	n/a	Soil - composite	
	PO-TDF2-T14-LFH-1	n/a	n/a	LFH	
PO-TFD2-T15	PO-TDF2-T15-C-4S-ICPMS	n/a	n/a	Soil - composite	
	PO-TDF2-T15-C-4S-Hg	n/a	n/a	Soil - composite	
PO-TDF2-T16	PO-TDF2-T16-GR-8V	Canada bluegrass	*Poa compressa*	Grass	✓
	PO-TDF2-T16-C-3S-ICPMS	n/a	n/a	Soil - composite	
	PO-TDF2-T16-C-3S-Hg	n/a	n/a	Soil - composite	

Table E-1

Vegetation, Soils, and LFH Samples Collected for Potential Analyses

Site Identification	Unique Sample Number	Species Common Name	Species Latin Name	Sample Type	Selected For Analysis
PO-TDF2-T17	PO-TDF2-T17-Act-5V	black cottonwood	*Populus balsamifera*	Shrub	✓
	PO-TDF2-T17-GR-6V	Canada bluegrass	*Poa compressa*	Grass	✓
	PO-TDF2-T17-Pl-7V	lodgepole pine	*Pinus contorta*	Conifer	✓
	PO-TDF2-T17-C-2S-ICPMS	n/a	n/a	Soil - composite	
	PO-TDF2-T17-C-2S-Hg	n/a	n/a	Soil - composite	
PO-OS-BO1Debris flow below TDF-2	PO-OS-BO1-Act--14V	black cottonwood	*Populus balsamifera*	Shrub	
	PO-OS-BO1-Fd-15V	Douglas-fir	*Pseudotsuga menziesii*	Conifer	
	PO-OS-BO1-C-6S-ICPMS	n/a	n/a	Soil - composite	
	PO-OS-BO1-C-6S-Hg	n/a	n/a	Soil - composite	✓
PO-OS-BO2 Debris flow below TDF-2	PO-OS-BO2-SH-16V	thimbleberry	*Rubus parviflorus*	Shrub	
	PO-OS-BO2--GR-17V	blue wildrye	*Elymus glaucas*	Grass	
	PO-OS-BO2-Bg-18V	grand fir	*Abies grandis*	Conifer	
	PO-OS-BO2-LFH3	n/a	n/a	LFH	
	PO-OS-BO2-C-7S-ICPMS	n/a	n/a	Soil - composite	
	PO-OS-BO2-C-7S-Hg	n/a	n/a	Soil - composite	✓
PO-OS-SA1 Headpipes below TDF-1	PO-OS-SA1-G-20Sa-ICPMS	n/a	n/a	Soil - grab	
	PO-OS-SA1-G-20Sb-ICPMS	n/a	n/a	Soil - grab	
	PO-OS-SA1-G-20Sc-ICPMS	n/a	n/a	Soil - grab	
	PO-OS-SA1-G-20Sd-ICPMS	n/a	n/a	Soil - grab	
	PO-OS-SA1-G-20Se-ICPMS	n/a	n/a	Soil - grab	
	PO-OS-SA1-C-20S-Hg	n/a	n/a	Soil-composite	✓
	PO-OS-SA1-SH-60V	thimbleberry	*Rubus parviflorus*	Shrub	
	PO-OS-SA1-Act-61V	black cottonwood	*Populus balsamifera*	Shrub	
	PO-OS-SA1-LFH10	n/a	n/a	LFH	
	PO-OS-SA1-Bg-78V	grand fir	*Abies grandis*	Conifer	
	PO-OS-SA1-C-20aS-ICPMS	n/a	n/a	Soil-composite	
	PO-OS-SA1-C-20aS-Hg	n/a	n/a	Soil-composite	

Table E-1

Vegetation, Soils, and LFH Samples Collected for Potential Analyses

Site Identification	Unique Sample Number	Species Common Name	Species Latin Name	Sample Type	Selected For Analysis
PO-OS-AP1a Nearest to TDF-1	PO-OS-AP1a-SH-62V	thimbleberry	*Rubus parviflorus*	Shrub	
	PO-OS-AP1a-Bg-63V	grand fir	*Abies grandis*	Conifer	
	PO-OS-AP1a-LI-64V	dog pelt	*Peltigera canina*	Lichen	
	PO-OS-AP1a-LFH11	n/a	n/a	LFH	
	PO-OS-AP1a-C-21S-ICPMS	n/a	n/a	Soil-composite	
	PO-OS-AP1a-C-21S-Hg	n/a	n/a	Soil-composite	✓
PO-OS-AP1b Between TDF-1 and TDF-2	PO-OS-AP1b-Bg-68V	grand fir	*Abies grandis*	Conifer	
	PO-OS-AP1b-SH-69V	thimbleberry	*Rubus parviflorus*	Shrub	
	PO-OS-AP1b-LI-70V	dog pelt	*Peltigera canina*	Lichen	
	PO-OS-AP1b-LFH13	n/a	n/a	LFH	
	PO-OS-AP1b-C-23S-ICPMS	n/a	n/a	Soil-composite	
	PO-OS-AP1b-C-23S-Hg	n/a	n/a	Soil-composite	✓
PO-OS-AP1c Nearest to TDF-2	PO-OS-AP1c-Fd-65V	Douglas-fir	*Pseudotsuga menziesii*	Conifer	
	PO-OS-AP1c-Bp-66V	paper birch	*Betula papyrifera*	Shrub	
	PO-OS-AP1c-SH-67V	tall Oregon-grape	*Mahonia aquilfolium*	Shrub	
	PO-OS-AP1c-LFH13	n/a	n/a	LFH	
	PO-OS-AP1c-C-22S-ICPMS	n/a	n/a	Soil-composite	
	PO-OS-AP1c-C-22S-Hg	n/a	n/a	Soil-composite	✓
PO-OS-AP2a	PO-OS-AP2a-SH-71V	thimbleberry	*Rubus parviflorus*	Shrub	
	PO-OS-AP2a-SH-72V	tall Oregon-grape	*Mahonia aquilfolium*	Shrub	
	PO-OS-AP2a-LI-73V	dog pelt	*Peltigera canina*	Lichen	
	PO-OS-AP2a-24S-ICPMS	n/a	n/a	Soil-composite	
	PO-OS-AP2a-24S-Hg	n/a	n/a	Soil-composite	✓

Table E-1

Vegetation, Soils, and LFH Samples Collected for Potential Analyses

Site Identification	Unique Sample Number	Species Common Name	Species Latin Name	Sample Type	Selected For Analysis
PO-OS-AP2b	PO-OS-AP2b-Pl-74V	lodgepole pine	*Pinus contorta*	Conifer	
	PO-OS-AP2b-SH-75V	thimbleberry	*Rubus parviflorus*	Shrub	
	PO-OS-AP2b-Act-76V	tall Oregon-grape	*Mahonia aquilfolium*	Shrub	
	PO-OS-AP2b-LI-77V	dog pelt	*Peltigera canina*	Lichen	
	PO-OS-AP2b-LFH14	n/a	n/a	LFH	
	PO-OS-AP2b-C-25S-ICPMS	n/a	n/a	Soil-composite	
	PO-OS-AP2b-C-25S-Hg	n/a	n/a	Soil-composite	✓
PO-C2	PO-C2-C-Bg-87V	grand fir	*Abies grandis*	Conifer	
	PO-C2-C-SH-88V	thimbleberry	*Rubus parviflorus*	Shrub	
	PO-C2-C-LI-89V	dog pelt	*Peltigera canina*	Lichen	
PO-UD-1	PO-UD-1-Bg-83V	grand fir	*Abies grandis*	Conifer	
	PO-UD-1-EQ-84V	common horsetail	*Equisetium arvense*	Herb	
	PO-UD-1-SH-85V	thimbleberry	*Rubus parviflorus*	Shrub	
	PO-UD-1-LI-86V	pelt species	*Peltigera spp.*	Lichen	

APPENDIX F

SITE WILDLIFE SURVEY

Table F-1

TDF-1 and TDF-2 Reconnaissance-Level Wildlife Survey

Species Code	Species	Zone	Easting	Northing	Distance	Bearing	Behavior*	Audio	Visual	Sex	Age	Number	Comments
AMRO	American Robin	11	474147	5415026	90	120	S	Yes		M	A	1	
AMRO	American Robin	11	474177	5415234	65	320	S	Yes		M	A	1	
AMRO	American Robin	11	474249	5415300	47	0	S	Yes	Yes	M	A	1	
AMRO	American Robin	11	474546	5415203	0	0	S	Yes		M	A	1	
AMRO	American Robin	11	474411	5414905	138	170	S	Yes		M	A	1	
BCCH	Black-capped Chickadee	11	474460	5415403	33	59	V		Yes	U	A/J	4	
BCCH	Black-capped Chickadee	11	474607	5415225			S	Yes		M	A	1	
BCCH	Black-capped Chickadee	11	474549	541405	10	220	S	Yes	Yes	M	A	1	
BHCO	Brown-headed Cowbird	11	474520	5415316	20	50	S	Yes	Yes	M	A	1	
BHCO	Brown-headed Cowbird	11	474607	5415225	50	50	S	Yes	Yes	M	A	1	
BHCO	Brown-headed Cowbird	11	474607	5415225	40	275	S	Yes	Yes	M	A	1	
BHCO	Brown-headed Cowbird	11	474607	5415225	40	120	S	Yes	Yes	M	A	1	
BLSW	Black Swift	11	474443	5415188	0	0	V		Yes	U	A	1	
CAVI	Cassin's Vireo	11	474282	5415196	88	180	S	Yes		M	A	1	
CAVI	Cassin's Vireo	11	474359	5415350	131	90	S	Yes		M	A	1	
CAVI	Cassin's Vireo	11	474443	5415188	63	230	S	Yes		U	A	1	
CBCH	Chestnut-bkd. Chickadee	11	474411	5414905	15	305	C	Yes	Yes	U	A	1	
CEWA	Cedar Waxwing	11	474460	5415403	75	50	C	Yes	Yes	U	A	1	
CEWA	Cedar Waxwing	11	474549	5415405	0	0	V		Yes	U	A	2	Fly over
CHSP	Chipping Sparrow	11	474296	5415233	0	0							Nest with 2 eggs
CHSP	Chipping Sparrow	11	474282	5415196	0	0						1	Nest with 1 egg
CHSP	Chipping Sparrow	11	474410	5414874	105	140	V		Yes			4	Family group
DEJU	Dark-eyed Junco	11	474472	5415202	0	0	V		Yes	F	A	Q	Nest with 5 eggs in spoil area
DEJU	Dark-eyed Junco	11	474443	5415188	10	340	S	Yes		M	A	1	
DEJU	Dark-eyed Junco	11	474410	5414874	105	150	S	Yes		M	A	1	
ELK	Elk	11	474549	541405	150	3	V		Yes			18	9 cows, 7 calves, 2 bulls
GCKI	Golden-crowned Kinglet	11	474317	5414865	30	340	S	Yes		M	A	1	
GHOW	Great Horned Owl	11	474431	5415088	97	150	V		Yes	U	J	1	
HAFL	Hammond's Flycatcher	11	474549	541405	60	10	S	Yes		M	A	1	
HAFL	Hammond's Flycatcher	11	474549	541405	90	70	S	Yes		M	A	1	
KILL	Killdeer	11	474282	5415196	65	265	C	Yes	Yes	U	A	1	
LABU	Lazuli Bunting	11	474296	5415233	10	28	S	Yes	Yes	M	A	1	
LABU	Lazuli Bunting	11	474410	5414874	92	130	S	Yes		M	A	1	
LABU	Lazuli Bunting	11	474410	5414874	113	170	S	Yes		M	A	1	
MACW	MacGillivray's Warbler	11	474147	5415026	24	170	S	Yes	Yes	M	A	1	
MACW	MacGillivray's Warbler	11	474340	5415357	109	20	S	Yes	Yes	M	A	1	
MACW	MacGillivray's Warbler	11	474520	5415316	15	200	S	Yes	Yes	M	A	1	
MACW	MacGillivray's Warbler	11	474607	5415225	40	180	S	Yes		M	A	1	
MACW	MacGillivray's Warbler	11	474422	5415132	62	200	S	Yes		M	A	1	
NOGO	Northern Goshawk	11	474607	5415225	196	260	V		Yes	U	J	1	
OCWA	Orange-crowned Warbler	11	474239	5415401	0	0	V		Yes	F	A	1	Nest nearby - female agitated
OCWA	Orange-crowned Warbler	11	474177	5415234	69	335	S	Yes		M	A	1	
OCWA	Orange-crowned Warbler	11	474460	5415403	50	160	S	Yes		M	A	1	
OCWA	Orange-crowned Warbler	11	474607	5415225	75	230	S	Yes		M	A	1	
OCWA	Orange-crowned Warbler	11	474607	5415225	70	140	S	Yes		M	A	1	
OCWA	Orange-crowned Warbler	11	474443	5415188	76	120	S	Yes		M	A	1	

*Behavior Codes: S=singing male, C=calling, V=visual, D=drumming

TDF-1 and TDF-2 Reconnaissance-Level Wildlife Survey

Species Code	Species	Zone	Easting	Northing	Distance	Bearing	Behavior*	Audio	Visual	Sex	Age	Number	Comments
OCWA	Orange-crowned Warbler	11	474413	5414972	6	240	S	Yes	Yes	M	A	1	
OCWA	Orange-crowned Warbler	11	474411	5414905	25	220	S	Yes	Yes	M	A	1	
OCWA	Orange-crowned Warbler	11	474549	5415405	15	355	S	Yes	Yes	M	A	1	
OSFL	Olive-sided Flycatcher	11	474520	5415316	150	330	S	Yes		M	A	1	
PIWO	Pileated Woodpecker	11	474607	5415225	75	65	C	Yes	Yes	U	A	1	
RBNU	Red-breasted Nuthatch	11	474431	5415088	25	290	S	Yes		U	A	1	
RESQ	Red Squirrel	11	474296	5415233	151	345	C	Yes				1	
RESQ	Red Squirrel	11	474460	5415403	43	125	C	Yes				1	
RESQ	Red Squirrel	11	474607	5415225	40	80	C	Yes		U	A	1	
RESQ	Red Squirrel	11	474443	5415188	60	190	C	Yes		U	A	1	
RESQ	Red Squirrel	11	474422	5415132	30	216	C	Yes		U	A	1	
RESQ	Red Squirrel	11	474431	5415088	100	130	C	Yes		U	A	1	
RESQ	Red Squirrel	11	474411	5414905	5	0	C	Yes	Yes	U	A	1	
REVI	Red-eyed Vireo	11	474296	5415233	64	130	S	Yes		M	A	1	
REVI	Red-eyed Vireo	11	474296	5415233	109	205	S	Yes		M	A	1	
REVI	Red-eyed Vireo	11	474520	5415316	10	60	S	Yes		M	A	1	
REVI	Red-eyed Vireo	11	474607	5415225	150	150	S	Yes		M	A	1	
REVI	Red-eyed Vireo	11	474431	5415088	104	220	S	Yes		M	A	1	
RNSA	Red-naped Sapsucker	11	474460	5415403	111	300	V		Yes	U	A	1	
RNSA	Red-naped Sapsucker	11	474422	5415132	50	200	D	Yes		U	U	1	
RNSA	Red-naped Sapsucker	11	474549	5415405	60	110	C	Yes		U	J		Nest with young
RUHU	Rufous Hummingbird	11	474607	5415225	20	320	V		Yes	M	A	1	
RUHU	Rufous Hummingbird	11	474443	5415188	10	340	V		Yes	M	A	1	
SOSP	Song Sparrow	11	474296	5415233	74	135	S	Yes		M	A	1	
SOSP	Song Sparrow	11	474199	5415061	0	0	V		Yes	F	A	1	With food
STJA	Steller's Jay	11	474282	5415196	208	240	C	Yes		U	A	1	
SWTH	Swainson's Thrush	11	474147	5415026	35	170	C	Yes		U	A	1	
SWTH	Swainson's Thrush	11	474147	5415026	100	175	S	Yes		M	A	1	
SWTH	Swainson's Thrush	11	474177	5415234	100	335	S	Yes		M	A	1	
SWTH	Swainson's Thrush	11	474460	5415403	100	125	S	Yes		M	A	1	
SWTH	Swainson's Thrush	11	474607	5415225	65	0	S	Yes		M	A	1	
SWTH	Swainson's Thrush	11	474443	5415188	76	220	S	Yes		M	A	1	
SWTH	Swainson's Thrush	11	474317	541865	35	330	S	Yes		M	A	1	
TOWA	Townsend's Warbler	11	474270	5414873	40	300	S	Yes		M	A	1	
TUVU	Turkey Vulture	11	474431	5415088	0	0	V		Yes	U	A	1	
VGSW	Violet-green Swallow	11	474443	5415188	0	0	V		Yes	U	U	6	
WAVI	Warbling Vireo	11	474549	5415405	30	150	S	Yes	Yes	U	A	1	
WAVI	Warbling Vireo	11	474549	5415405	90	80	S	Yes		U	A	1	
WEKI	Western Kingbird	11	474097	5414558	0	0	V		Yes	U	A	1	
WIWR	Winter Wren	11	474177	5415234	78	15	S	Yes		M	A	1	
YRWA	Yellow-rumped Warbler	11	474460	5415403	90	90	S	Yes		M	A	1	
YRWA	Yellow-rumped Warbler	11	474460	5415403	90	140	S	Yes		M	A	1	
YRWA	Yellow-rumped Warbler	11	474410	5414874	41	270	S	Yes		M	A	1	
YRWA	Yellow-rumped Warbler	11	474549	541405	40	0	S	Yes		M	A	1	
RALU	Columbia Spotted Frog	11	474291	5415142	n/a	n/a	V		Yes	U	A	1	Observed in ditch near wetland

*Behavior Codes: S=singing male, C=calling, V=visual, D=drumming

APPENDIX G

TDF-1 STABILITY ANALYSIS

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APPENDIX G

TECK COMINCO
TDF-1 TAILINGS STABILITY ANALYSIS

Submitted to:

Teck Cominco American Incorporated
Spokane Washington

Submitted by:

Golder Associates Inc.
Redmond, WA 98052-3333

October 2, 2006

043-1344.507

100206mlb1 Appendix G

EXECUTIVE SUMMARY

Analyses were completed to assess the stability of the tailings in TDF-1 with respect to dispersion by geotechnical mechanisms such as slope stability and seismic triggers, and by hydrologic forces such as flooding, debris flows and surface erosion. These analyses, described in greater detail in Appendix G, were used to determine the instability of the embankment face at its current slope, and to determine stabilization measures.

The stability of the tailings embankment and impoundment were evaluated with respect to sliding under both static and seismic conditions. After establishing appropriate design criteria, the preliminary reconfigurations of the dam and impoundment necessary to achieve those criteria were defined.

The outer face of the existing embankment is insufficiently stable against sliding under static conditions and local failure is likely to occur during seismic loading. In addition, the outer face is not stable against long term erosion. Therefore we recommend that the outer face of the embankment be flattened to a 2.5H:1V slope beginning at the top of the existing rock buttress. The material removed to allow flattening of the slope will be placed at the top of the slope, extending the new 2.5H:1V slope and forming a berm on top of the tailings surface.

With the modified 2.5H:1V slope on the outer face of the embankment, the tailings embankment is stable with adequate factors of safety for static conditions as well as seismic loadings. Measured piezometric levels were used in the analyses.

Various hydrologic events were considered to determine the capacity of existing drainage features. The events considered ranged from the 2-year, 24-hour event to a local PMP, 6-hour event, which is the most extreme event considered at the site. The diversion channel was designed to convey 38 cfs. This is sufficient capacity for the 10-yr, 25-yr, 100-yr and 500-yr, 24-hr storm estimates from HEC-HMS. However it will not pass the peak flow from PMP events.

Because the diversion ditch is small in some places, it is reasonable to assume that the diversion ditch may fail during a storm event and water would have to be stored behind the TDF-1 dam or released along another pathway (e.g., dam overtopping or spillway).

The potential for debris flows threatening the containment of the tailings was evaluated and found to be inconsequential. There is a high risk for long term erosion potential of the outer embankment slope; therefore, it must be addressed through a combination of armor rock, establishing vegetation and maintenance. By blending local limestone rock from the waste rock supply into fine grained surface materials that will support vegetation, the surface can be made stable against long term erosion. The details and results of these analyses are described in greater detail in Appendix G.

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1.0 INTRODUCTION

This appendix describes the work done to assess the stability of the tailings in TDF-1 with respect to dispersion by geotechnical mechanisms such as slope stability and seismic triggers, and by hydrologic forces such as flooding, debris flows and surface erosion. The probabilities of various failure modes are evaluated, along with factors-of-safety and the consequences, to arrive at qualitative assessments of risk. Based on these risks, design criteria for the final remedial design configuration were established. This was followed by development of preliminary designs for modifications necessary to achieve the design criteria.

The primary modes of release that were evaluated include:

- Slope stability;
    - Static Conditions, including variable piezometric levels;
    - Seismic Loading;
- Flooding and dispersion due to overtopping;
- Surface Erosion of slopes due to direct precipitation; and
- Debris Flows, both external and internal.

The modes of release, or failure modes, are related in several ways. For that reason our approach to evaluating the stability of each mode was integrated to consider all the failure modes and their solutions.

The stability of the tailings embankment was previously assessed by Golder Associates in our report number 962-1618, entitled "Field Investigation and Remedial Design for Tailings Pond No. 1, Pend Oreille Mine" in 1996 and by Dames & Moore, 1988 and 1997. The Golder Report concluded that the stability of the existing tailings embankment was unacceptable and in order to ensure adequate static and seismic stability the slope of the tailings embankment should be flattened to 2.5H to 1.0V. Drainage measures, including a drainage diversion ditch, were also recommended.

The existing outer face of the tailings embankment is also unstable with respect to long term erosion. The fine sand face is easily erodable and has little vegetation support it.

Based on the previous analyses we conducted stability analyses for two main cases, assuming that that outer dam face was flattened to 2.5H:1V and to 3H:1V.

2.0 REVIEW OF HYDROLOGIC RISK AND METHODS

2.1 Summary of Previous Studies

Dames & Moore provided a design report on the Tailings Pond No. 1 (TDF-1) in 1997. It included hydrologic analyses used to determine stability and size the diversion ditch around TDF-1. Peak runoff was calculated for the 2-year through 100-year events using the rational method. The report assumes a contributing area of 402 acres, of which about 80% is the hillside above the tailings pond and 20% is the tailings pond itself. The peak runoff from the 25-year storm event (38 cfs) was used as the design flow for the drainage ditch around the perimeter of TDF-1 (Dames & Moore, 1997).

2.2 Extreme Value Precipitation Estimates

2.2.1 NOAA Atlas

The NOAA Atlas 2, which is used for Washington State, contains precipitation isopluvials for 6-hour and 24-hour duration storms (National Weather Service, 1973). The maps are available for storm events ranging from the 2-year event (50% probability of occurring in any given year) and the 100-year event (1% probability of occurring in any given year).

The values from these maps are then used to calculate shorter, longer and intermediate duration storms for the same event probability. For our purposes, short term events are more critical. Equations and procedures for calculating the shorter durations are provided in NOAA Atlas 2. The 2-year and 100-year, 1-hour duration events are calculated using region-specific equations. Region 1, determined from Figure 18 of NOAA Atlas 2, is used for this site. The intermediate events for the 1-hour duration are obtained by plotting the 2-year and 100-year events on a nomograph and reading the values from the line drawn connecting the 2-year and 100-year events. The 30-min, 15-min, 10-min, and 5-min duration storms are calculated using ratios provided in NOAA Atlas 2 and apply to the entire state of Washington. The Table 2-1 summarizes the values obtained from NOAA Atlas 2.

TABLE 2-1

Precipitation Values Obtained from NOAA Atlas 2 for TDF-2

Event	24-hr[a]	6-hr[a]	1-hr[b, c]	30-min[d]	15-min[d]	10-min[d]	5-min[d]
2-yr	1.6	0.825	0.34	0.27	0.20	0.15	0.04
5-yr	2	1.1	0.55	0.43	0.31	0.25	0.07
10-yr	2.2	1.2	0.68	0.54	0.39	0.31	0.09
25-yr	2.6	1.45	0.79	0.62	0.45	0.36	0.10
50-yr	2.8	1.55	0.92	0.73	0.52	0.41	0.12
100-yr	3	1.75	1.04	0.82	0.60	0.47	0.14

Notes:

a. From NOAA Atlas 2 Precipitation Maps
b. 2-yr and 100-yr values calculated using equations in NOAA Atlas 2 for Washington
c. 5-yr, 10-yr, 25-yr, and 5-yr values are interpolated between 2-yr and 100-yr using nomograph from NOAA Atlas 2
d. Calculated using ratios in NOAA Atlas 2

2.2.2 WDOE Dam Safety Hydrology Recommendations

The Washington State Department of Ecology provides technical guidance in the development of extreme value precipitation to use in the design of dams. The values are calculated based on the mean annual precipitation at the site (30 inches, as reported in the EIS), the 2-year precipitation values for the 6-hour and 24-hour durations (obtained from NOAA Atlas 2 figures), and regional factors. Detailed equations can be found in Technical Note 3: Design Storm Construction of the Dam Safety Guidelines (Ecology, 1993). Worksheets are provided by WDOE and were used in these calculations. One worksheet each is provided for a long duration storm (24-hour), an intermediate duration storm (6-hour), and a short duration storm (2-hour). There is no procedure to calculate durations less than 2 hours. Table 2-2 summarizes the calculated values using the WDOE method. Design Steps correspond to storm events ranging from the 500-year event to the Probable Maximum Precipitation (PMP).

TABLE 2-2

Precipitation Values Obtained from WDOE Dam Safety Guidelines

Design Step	24-hr	6-hr	2-hr
2-yr	1.62	0.83	0.47
10-yr	2.39	1.20	0.67
25-yr	2.81	1.40	0.79
100-yr	3.51	1.73	1.01
Step 1	4.43	2.16	1.33
Step 2	4.85	2.36	1.49
Step 3	5.63	2.73	1.80
Step 4	6.49	3.13	2.16
Step 5	7.43	3.58	2.60
Step 6	8.48	4.07	3.13
Step 7	9.63	4.62	3.75
Step 8	10.90	5.22	4.50

2.2.3 Hydrometeorological Reports

Hydrometeorological Report No. 57, published in 1994, outlines procedures for determining the General Storm and Local Storm PMPs for various storm durations. The General PMP is calculated for areas greater than 10 mi^2 and less than 10,000 mi^2. The local PMP is calculated for areas greater than 1 mi^2 and less than 500 mi^2. The drainage basin for TDF-1 is approximately 0.32 mi^2. Therefore no areal correction was provided for basins smaller than 10 mi^2 or 1 mi^2.

The 24-hour duration General PMP is obtained from PMP maps included in the Hydrometeorological Report. Other durations are calculated using region specific ratios provided in Table 15.1 of the Hydrometeorological Report. The 1-hour, Local PMP is obtained from Figure 15.36 and ratios to calculate other durations are obtained from Figure 15.38 of the Hydrometeorological Report. Tables 2-3 and 2-4 summarize the PMP storms for various durations.

TABLE 2-3

General Storm PMP Values Obtained from Hydrometeorological Report No. 57

Event	72-hr	48-hr	24-hr	6-hr	1-hr
General PMP, 10 mi^2 (in)	14.6	13.2	9.4	4.9	1.5

TABLE 2-4

Local Storm PMP Values Obtained from Hydrometeorological Report No. 57

Event	6-hr	5-hr	4-hr	3-hr	2-hr	1-hr	45-min	30-min	15-min
Local PMP, 1 mi^2 (in)	7.6	7.6	7.5	7.4	7.3	6.6	5.9	4.9	3.3

2.3 Inflow Hydrographs

2.3.1 Precipitation Depth Duration Selected for Analysis

To determine the peak flows and the volume of water that could cause overtopping of TDF-1, the following precipitation values were used to develop a HEC-HMS model for the site:

- NOAA Atlas 2 – 10-yr, 24-hr storm (2.2 in);
- NOAA Atlas 2 – 25-yr, 24-hr storm (2.6 in);
- NOAA Atlas 2 – 100-yr, 24-hr storm (3.0 in);
- WDOE Design Step 1 (4.43 in);
- Calculated General PMP, 24-hr storm (9.4 in); and
- Calculated Local PMP, 6-hr storm (7.6 in).

The design of the diversion ditch was based on Dames & Moore's evaluation of the 25-yr, 24-hr storm, which is the standard in Washington. The 25-yr, 24-hr storm was included in this analysis for comparison purposes.

The 24 hour duration storms were included to compare the capacity of the diversion ditch and the storage available behind TDF-1 to the volume and peak flows produced during a long duration storm event. The 6-hour duration, Local PMP was included to compare capacity with the flow and volumes from a short and intense storm.

As part of the Dam Safety Guidelines, a worksheet is available to determine the design step (equivalent to the recurrence interval for a design storm) for a dam based on downstream hazards, potential loss of life, and environmental damage. This worksheet was used to determine what the design step would be for TDF-1 if it impounded water. The result was WDOE Design Step 1, equivalent to the 500-year event. Therefore, WDOE Design Step 1 is included in the hydrology analysis.

Figures 2-1 and 2-2 compare the values used in the calculations (NOAA or PMP) with other estimates for the same recurrence interval and duration (WDOE). Figure 2-1 shows that the NOAA estimates and WDOE estimates are similar for the 6-hour events. However, the WDOE 2-hour estimates are lower and 24-hour estimates are higher than the NOAA estimates. Figure 2-2 shows the General and Local PMP estimates and the WDOE Design Step 8 estimates, which usually corresponds to a PMP event. The Local PMP estimates are higher than either the WDOE or General PMP estimates for the same duration. The WDOE estimates are higher than the General PMP estimates.

2.3.2 Development of the Inflow Hydrographs

The contributing basin characteristics include:

- Area = 0.32 mi^2 (211 acres);
- Weighted curve number = 57 (includes forested area, golf course, and TDF-2 and Soil Group B);
- Initial loss = 1.52 in; and
- SCS lag time = 49.2 min.

The difference in area between this report and the Dames & Moore Report (402 acres) is assumed to be TDF-3. Any runoff from areas upstream of TDF-3 is diverted around the impoundment and discharged to Frog Creek, which flows to the Pend Oreille River independent of TDF-1. Precipitation which falls directly on TDF-3 is contained within TDF-3, which is a lined facility for containment of dangerous waste. This difference in area also contributes to the difference in computed peak flows for the 25-yr, 24-hr storm event.

The 10-yr, 24-hr storm; 25-yr, 24-hr storm; 100-yr, 24-hr storm; and the Local PMP were modeled as *frequency storms*. A *frequency storm*, in HEC-HMS, allows the user to produce a synthetic storm from statistical precipitation data for a specified duration. Precipitation depth values are entered for all durations from the peak intensity to the total storm length. The General PMP and the WDOE Design Step 1 were modeled using SCS Type IA temporal precipitation distributions because short duration (less than 1 hour) values could not be reliably extrapolated. The Eastern Washington Stormwater Management Manual supports the use of SCS Type IA storms for Eastern Washington because Type IA is similar to regional storms and recent analysis supports the use of this storm throughout Eastern Washington.

Figure 2-1
Comparison of WDOE and NOAA Estimates of Precipitation Depth

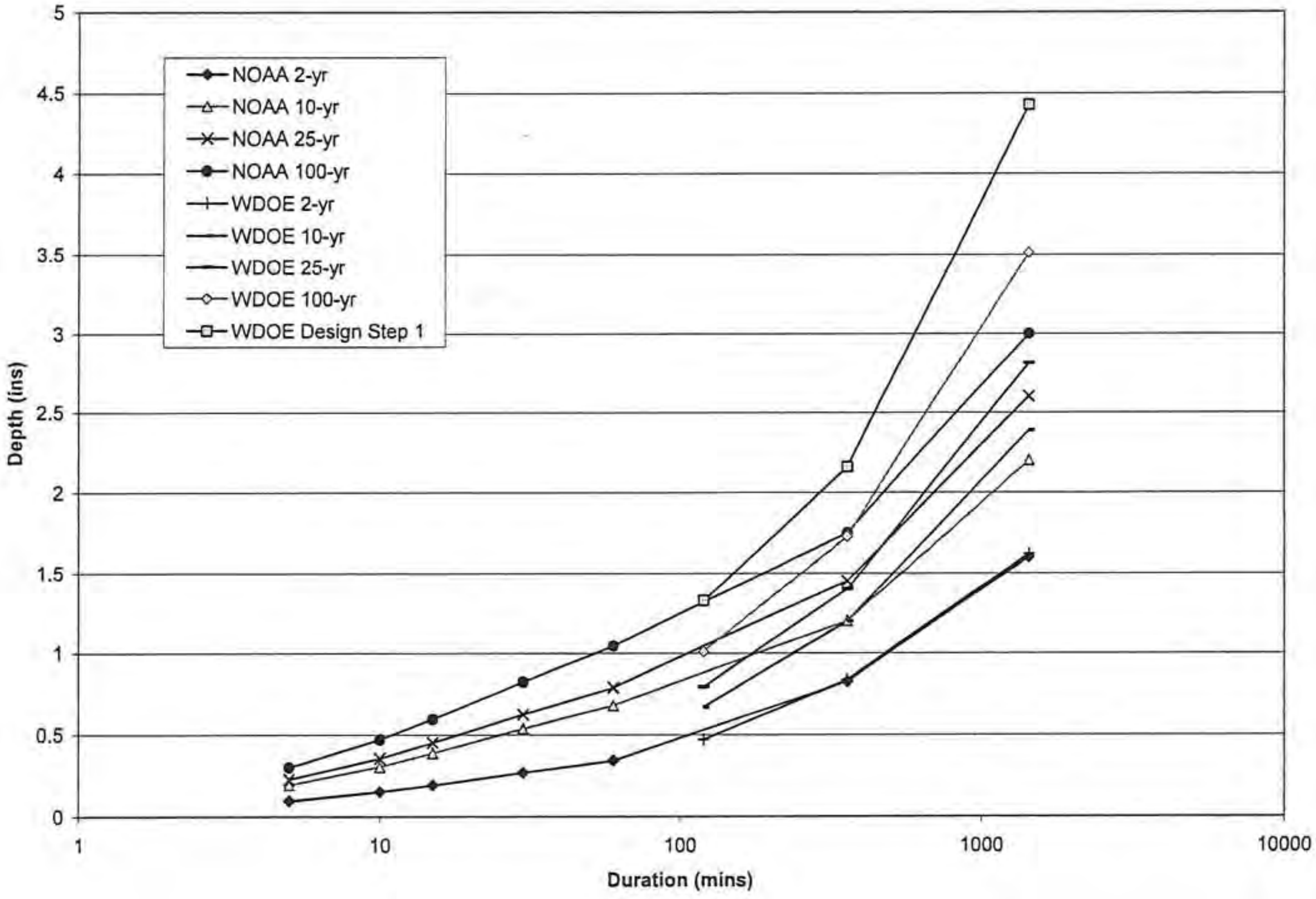


Figure 2-2
Comparison of General PMP, Local PMP, and WDOE Estimates of Precipitation Depth

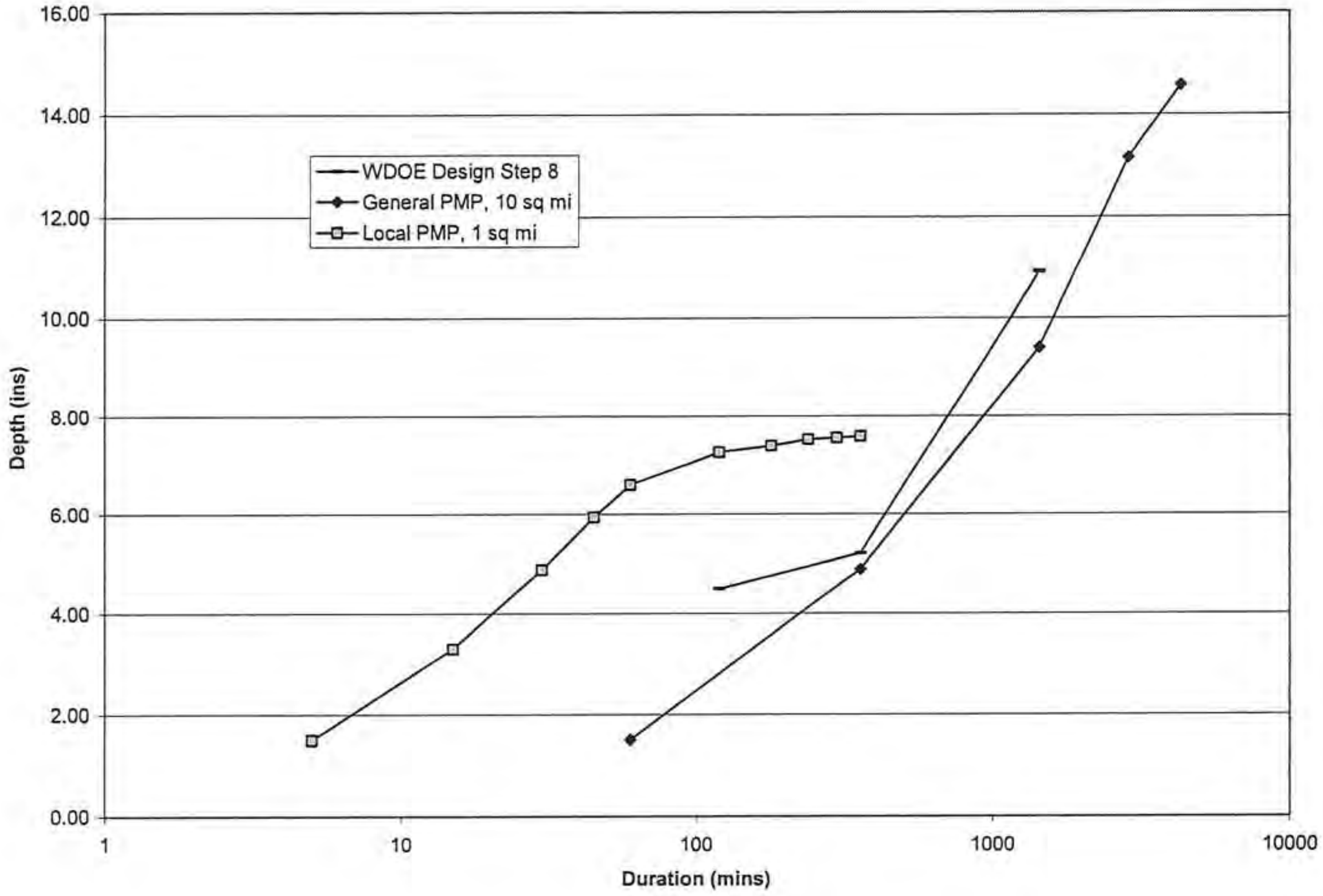


Table 2-5 shows the peak flows, time to peak and total volume calculated for each of the precipitation events. The General PMP has the highest total storm volume, but the Local PMP has the highest peak flow.

TABLE 2-5

HEC-HMS Model Results

Storm Event	Peak Q (cfs)	Time to Peak	Total Volume (ac-ft)
10-yr, 24-hr Storm	5.41	01Jan2006, 12:51	2.49
25-yr, 24-hr Storm	8.57	01Jan2006, 13:30	4.10
100-yr, 24-hr Storm	16.29	01Jan2006, 13:20	6.19
WDOE Design Step 1	14.34	01Jan2006, 09:18	16.81
General PMP, 24-hr	120	01Jan2006, 08:48	74.64
Local PMP, 6-hr	460	01Jan2006, 03:59	50.83

2.4 Routing of Hydrographs to Evaluate System Performance and Stability

The existing diversion channel was designed to convey 38 cfs. This is sufficient capacity for the 10-yr, 25-yr, 100-yr and 500-yr, 24-hr storm estimates from HEC-HMS. However it will not pass the peak flow from either PMP. During a 24-hour event, this is approximately 75 ac-ft of water conveyed, assuming it flows at full capacity throughout the period. During a 6-hour event, this corresponds to about 19 ac-ft. Therefore the diversion ditch would be able to transport the full volume of the 24-hour event, but not of the 6-hour event.

Because the diversion ditch is small in some places, it is reasonable to assume that the diversion ditch would fail during a storm event and water would have to be stored behind the TDF-1 dam or released along another pathway (e.g., dam overtopping or spillway).

The Dames & Moore design of TDF-1 diversion ditches included sloping the tailings back at about 0.5% to promote drainage to the diversion ditches. Assuming that this was implemented at a 0.5% slope, and that there is no other way for water to leave the tailings surface, there is approximately, 10 ac. Ft. of available storage on the tailing impoundment surface. Assuming the WDOE Design Step 1 is used for design, the volume available behind TDF-1 is not adequate to store the full volume from the design event and water would have to be released. Spillways or improvements to the drainage ditches to prevent plugging (increased size or the use of trash racks) need to be considered.

One proposed design for TDF-1 includes building a berm along the front crest of TDF-1. However, the sides of TDF-1 would remain open, allowing any excess water to be released to Pend Orielle River. The potential for armoring of the areas where excess water would be released should be evaluated.

Table 3-1 is a summary of the 53 historical earthquakes within about 150 km (93 mi) of the site. Table 1 lists the earthquakes by magnitude range, estimated epicentral distance from the site, and estimated focal depth.

Table 3-1
Historical Earthquakes (1568-2006) within Approximately 150 km (93 mi) of the Teck Cominco Mine Site[1]

Magnitude Range	Number of Earthquakes	Range in Epicentral Distance from the Site (km)[2]	Range in Focal Depth (km)
1.00-1.99	6	71[3]	7[3]
2.00-2.99	21	63-135	0-20
3.00-3.99	24	71-144	0-18
4.00-4.99	2	71-133	4-5
Total	53	--	--

Notes: [1] Based on U.S. Geological Survey (2006a) earthquake catalog. Includes all magnitude types.
[2] Approximate horizontal (radial) distance from the approximate center of the Teck Cominco Mine site.
[3] All six earthquakes in this magnitude range had the same epicentral location (i.e., latitude/longitude) and same hypocentral depth.

The largest historical earthquake to have occurred in eastern Washington (and possibly all of Washington) was the December 1872 Washington State earthquake (Bakun et al, 2002). It had an estimated moment magnitude (M_W) ranging between 6.5 and 7.0, and was located near the city of Chelan, at the south end of Lake Chelan (Bakun et al, 2002), more than 235 km (145 mi) southwest of the site. This location is in the eastern foothills of the Cascade Range. Isoseismal mapping of Modified Mercalli Intensity (MMI) generated by the earthquake (U.S. Geological Survey, 2006c) indicates that the site area was on the boundary between MMI 5 and MMI 6 earthquake shaking. Correlations of MMI and PGA (University of Washington, 2001b) suggest that this level of shaking (i.e., MMI 5 to 6) represents a PGA range of about 0.04-0.18 g.

Based on the Quaternary fault and fold mapping of the United States by the U.S. Geological Survey (2006b), and active fault investigations in the northwestern Rocky Mountains by Geomatrix (1989), there appear to be no active (i.e., late Quaternary) faults in the region of the site. Geomatrix (1989) further states that in most cases it can be demonstrated that the mapped faults have been inactive since the maximum advance of the Fraser glaciation about 15,000 years ago. The apparent nearest potentially active fault may be the Cabinet Mountain fault (so named in this study) that is located about 120 km (74 mi) east of the site near the western boundary of Montana (U.S. Geological Survey, 2006b).

3.2.3 Development and Evaluation of Deterministic and Probabilistic Peak Ground Accelerations

3.2.3.1 Identification and Characterization of Potential Seismogenic Sources within Region of the Site

Based on the Quaternary fault and fold mapping of the United States (U.S. Geological Survey, 2006b), only one potentially active fault is mapped within about 150 km (93 mi) of the site. This is

3.0 REVIEW OF SEISMIC RISK AND METHODS

3.1 Summary of Previous Studies

Seismic risk studies are available for the project site and neighboring sites in Canada. The studies were completed by Dames & Moore, National Bureau of Standards, National Science Foundation, Golder Associates Ltd., and other researchers in Canada. Dames & Moore summarized the results of these studies in their October 1997 design report. The previous work concluded that a horizontal seismic acceleration of 0.05g to 0.06g was adequate for design at the site. This is considered a low seismic risk.

3.2 Site Specific Evaluation of Potential Earthquake Ground Motions

3.2.1 General

The evaluation of earthquake ground motions for the Teck Cominco Mine site, located in the northeast corner of Washington State, was based on a deterministic seismic hazard assessment (DSHA) and an evaluation of the results for the site of probabilistic seismic hazard assessment (PSHA) mapping of the United States by the U.S. Geological Survey (2002). The output ground motions values from both the DSHA and the PSHA mapping are horizontal peak ground accelerations (PGA) for outcropping rock. For the DSHA, the PGAs are median values, and for the PSHA, they are mean values. The PGA values recommended for use is site seismic stability analyses are derived from the use and evaluation of the results of both the DSHA and the U.S. Geological Survey (2002) PSHA mapping.

3.2.2 Tectonic/Seismic Setting

The Teck Cominco Mine site is located in the northern Rocky Mountains geologic/tectonic province as defined by Alt and Hyndman (1995), Madole et al (1987), and Hunt (1974). The northern Rock Mountains, in the region of the site, are characterized by broad, rounded hills with elevations generally less than 5,000 feet above mean sea level (amsl), which are underlain by Paleozoic metamorphic rocks that have been intruded by Cretaceous igneous rocks (Stoffel et al, 1991; Hunt, 1974). The bedrock is locally overlain by Quaternary glacial and non-glacial surficial deposits (Stoffel et al, 1991).

The region of the site, in the northern Rocky Mountains, is characterized by a low rate of historical seismicity, and a lack of correlation between the reported seismicity and mapped geologic structure (Geomatrix, 1989). Based on the catalog of historical earthquakes (U.S. Geological Survey, 2006a), only 53 earthquakes have been recorded within 150 km (93 mi) of the site for the period searched from 1568-2006. The closest of the recorded earthquakes to the site was located about 63 km (39 mi) north-northwest. This earthquake occurred September 4, 1999, and it had a reported duration-magnitude (M_D) of 2.7, and an estimated focal depth of about 5 km (3 mi) (U.S. Geological Survey, 2006a). The largest earthquakes within 150 km (93 mi) of the site included a local magnitude (M_L) 4.0 event that occurred on August 6, 1985 about 71 km (44 mi) northeast of the site, and an M_D event that occurred on November 11, 2001 about 133 km (82 mi) south of the site (U.S. Geological Survey, 2006a). The estimated focal depths of these earthquakes were, 5 km (3 mi) and 4 km (2½ mi), respectively (U.S. Geological Survey, 2006a). The November 11, 2001 earthquake was associated with the Spokane earthquake sequence that began in June of 2001, and included more than 70 earthquakes less than magnitude 4.0 (University of Washington, 2001a; U.S. Geological Survey, 2001).

an unnamed fault as mapped by the U.S. Geological Survey (2006b), but we have termed it the Cabinet Mountain fault for this study. It is located about 120 km (74 mi) east of the site. Three additional potentially active faults mapped by Lidke (2002, 2003a, 2003b) are located from 215 km (133 mi) to 258 km (159 mi) from the site. For this study, we have also identified a maximum background earthquake (MBE) to represent historical seismicity that cannot as yet be assigned to mapped faults.

The geometric and geologic characteristics of the potential seismogenic sources are summarized in Table 3-2. The significant sources are described in more detail below.

Table 3-2
Estimated Geometric/Geologic Characteristics of Potential Seismogenic Sources within Region of the Teck Cominco Mine Site

Seismogenic Source[1] (fault type/age)	Distance[2] (km)	Total Length[3] (km)	Segment Length[4] (km)	Rupture Width[5] (km)	Displ. (m)	Slip Rate[6] (mm/yr)	MCE[7] (M_W)
Maximum Background Earthquake (MBE) (?/Q?)	10 13	-- --	-- --	-- --	-- --	-- --	5.0 5.5
Cabinet Mtn. Fault (R?/Q?)	120	~50	50	15	--	< 0.2	7.0
Pinto Fault (N/Q)	215	10	10	15	--	< 0.2	6.4
Central Ferry Fault (SS/Q)	247	10	10	15	1.0-1.5	< 0.2	6.6
Frenchman Hills Fault (R/Q)	258	194	51	15	--	< 0.2	7.0

Notes: [1] Fault sources identified from the available literature, data, and maps (e.g., U.S. Geological Survey, 2006b; Lidke, 2002, 2003a, 2003b; Rogers et al, 1991). R = reverse-slip fault; SS = strike-slip fault; N = normal-slip fault; Q = Quaternary.

[2] The distance is the closest, approximate source-to-site distance as scaled from available maps. For the MBE, the distance based on an evaluation of hypocentral depths of historical earthquakes within 150 km of the site, on nucleation depths in California (Coppersmith, 1991), and on depths of maximum background earthquakes in the Basin-and-Range (de Polo, 1994).

[3] The total length of the fault zone as taken from the literature, or scaled from available fault maps.

[4] The length of the individual segment(s) of the fault zones as taken from the literature, or estimated.

[5] The rupture width is the estimated seismogenic width downdip along the fault plane.

[6] Slip rate taken from the available literature (e.g., Lidke, 2002, 2003a, 2003b), or estimated.

[7] MCE = maximum credible earthquake. The MCE is the preferred estimated value selected from the results of an evaluation using the earthquake magnitude/fault rupture relationships of Wells and Coppersmith (1994), Anderson et al (1996), and Slemmons (1982). The MCE for the MBE estimated based on an evaluation of the historical seismicity within 150 km (93 mi) of the site (U.S. Geological Survey, 2006a), and guidelines by DOE (1993). M_W = moment magnitude.

The closest potential seismogenic source to the site is the MBE. This source was identified to represent the historical earthquakes occurring within the region of the site that cannot be associated with mapped, or known active faults. The MBE is often also termed the "random earthquake" source. The development of the closest distance to the MBE source, and its maximum credible earthquake (MCE), were based on an evaluation of the historical seismicity (e.g., magnitude and focal depth), combined with a review of past estimates of MBEs for Washington (e.g., DOE, 1993; Geomatrix, 1989), and a review of earthquake nucleation depths versus earthquake magnitude compiled for southern California (Coppersmith, 1991).

The historical seismicity (U.S. Geological Survey, 2006a) indicates the largest earthquake that has occurred within 150 km (93 mi) of the site was magnitude 4.0. A common practice to assign an MCE to background earthquakes is to increase the largest recorded background earthquake by 1 to 1.5 magnitudes. Thus, we assigned M_W 5.0 and M_W 5.5 as the MCEs for the MBE (Table 2). This is consistent with the guidelines by the DOE (1993) of magnitude 5.25 to 6.25 for the assignment of MCEs for MBEs (i.e., "random" earthquakes) in Washington State. The closest distance to these MBE MCE earthquakes (i.e., 10 and 13 km, Table 2) was based on an evaluation of the magnitude versus focal depth envelope described by the earthquakes within 150 km (93 mi) of the site. From the plot of these events, an envelope of the earthquakes would project to about 10 km (6 mi) depth for magnitude 5.0, and 13 km (8 mi) depth for magnitude 5.5. These values were then compared and evaluated with respect to the earthquake magnitude versus nucleation depth data of Coppersmith (1991).

The closest mapped, potentially active fault (U.S. Geological Survey, 2006b), the Cabinet Mountain fault, is assumed to be a reverse-slip fault that strikes north-south along the western front of the Cabinet Mountains in western Montana; approximately 120 km (74 mi) from the site. The Cabinet Mountain fault has a total length estimated to be about 50 km (31 mi). We estimated the seismogenic depth of the fault to be about 15 km (9 mi). Using these fault geometric and geologic characteristics, and the earthquake magnitude/fault rupture relationships of Anderson et al (1996) and Wells and Coppersmith (1994), we estimate an MCE for the Cabinet Mountain fault to be M_W 7.0 (Table 2).

3.2.3.2 Deterministic Seismic Hazard Assessment

Using the MCEs developed for each potential seismogenic source and the closest source-to-site distances (Table 2), along with the attenuation relationships of Sadigh et al (1997), Abrahamson and Silva (1997), Boore et al (1997) and Spudich et al (1999), we calculate the median PGAs for each potential source (Table 3). Table 3 also lists the median plus 1 sigma (84th percentile) PGAs as more conservative PGA values.

We have used four attenuation relationships in an attempt to reduce bias in the results if only one relationship was used. The Spudich et al (1999) relationship was developed exclusively for normal-slip faults, and we apply it for only one source (i.e., the Pinto fault). The remaining three relationships are applied to all sources. The median, or median + 1 sigma PGAs are averaged (arithmetic mean) to arrive at a final PGA value that represents the individual seismogenic source (Table 3-3).

Table 3-3
Results of Deterministic MCE Evaluation of Median Peak Ground Acceleration for the Teck Cominco Mine Site from Potential Seismogenic Sources within the Region

Potential Seismogenic Source[1] (fault type)	**MCE[2] (M_W)**	**Distance[3] (km)**	**Median PGA[4] (g)**				
			Sadigh et al (1997)	**Abrahamson and Silva (1997)**	**Boore et al (1997)**	**Spudich et al (1999)**	**Mean[5]**
Maximum Background Earthquake (?)	5.0 5.5	10 13	0.11 (0.22) 0.12 (0.23)	0.09 (0.17) 0.10 (0.20)	0.09 (0.16) 0.10 (0.18)	--	0.10 (0.18) 0.11 (0.20)
Cabinet Mtn. Fault (R?)	7.0	120	0.02 (0.03)	0.04 (0.06)	0.05 (0.09)	--	0.04 (0.06)
Pinto Fault (N)	6.4	215	<0.01 (0.01)	0.01 (0.02)	0.02 (0.03)	<0.01 (0.01)	0.01 (0.02)
Central Ferry Fault (SS)	6.6	247	<0.01 (0.01)	0.01 (0.02)	0.02 (0.03)	--	0.01 (0.02)
Frenchman Hills Fault (R)	7.0	258	<0.01 (0.01)	0.02 (0.03)	0.02 (0.03)	--	0.02 (0.02)

Notes: [1] The potential seismogenic sources taken from Table 2. N = normal-slip fault; R = reverse-slip fault; SS = strike-slip fault.

[2] MCE = maximum credible earthquake. M_W = moment magnitude.

[3] The closest source-to-site distance based on scaling from available maps. For the MBE, the distance based on an evaluation of hypocentral depths of historical earthquakes within 150 km of the site, on nucleation depths in California (Coppersmith, 1991), and on depths of maximum background earthquakes in the Basin-and-Range (de Polo, 1994).

[4] The median peak horizontal ground acceleration (PGA) calculated using four current attenuation relationships that were developed primarily from California and basin-and-range earthquake strong motion records. Values in parentheses ( ) are the median + 1 sigma PGAs.

[5] Arithmetic mean of the median PGA values.

From Table 3, we observe that the MBE dominates the other potential seismogenic sources in terms of median PGA, and median + 1 sigma PGA. If the MBE MCE is taken as M_W 5.5 at a distance of 13 km (8 mi), the median site PGA is 0.11 g, and median + 1 sigma PGA is 0.20 g. The closest mapped seismogenic source (Cabinet Mountain fault) results in a median site PGA of only 0.04 g, and median + 1 sigma PGA of only 0.06 g (Table 3).

3.2.3.3 Evaluation of Probabilistic Seismic Hazard Assessment (PSHA) Mapping

The U.S. Geological Survey (2002) has completed PSHA mapping for the United States, including the region of the site. The outputs from the PSHA mapping are PGAs and spectral accelerations. The values we use in this study are mean PGAs for firm rock.

The U.S. Geological Survey (2002), through interactive deaggregation on their web site, provides mean PGAs for the 108-, 224-, 475-, 975-, 2,475-, and 4,975-year return periods. These return periods equate to the probabilities:

- 108-year return period = 50 percent probability of exceedance in 75 years
- 224-year return period = 20 percent probability of exceedance in 50 years
- 475-year return period = 10 percent probability of exceedance in 50 years
- 975-year return period = 5 percent probability of exceedance in 50 years
- 2,475-year return period = 2 percent probability of exceedance in 50 years
- 4,975-year return period = 1 percent probability of exceedance in 50 years

The 475-year return period was the basis for the 1997 Uniform Building Code. The 2,475-year return period risk level forms the basis of the 2003 International Building Code adopted by the State of Washington, and is the risk level used for the design of municipal and hazardous waste landfills. The PSHA PGA results for the site, from the U.S. Geological Survey (2002) PSHA mapping, are listed in Table 3-4.

Table 3-4
Results of U.S. Geological Survey (2002) PSHA Mapping for the Teck Cominco Mine Site

PSHA Data Source	PGA (g)					
	108-Year Return Period	224-Year Return Period	475-Year Return Period	975-Year Return Period	2,475-Year Return Period	4,975-Year Return Period
U.S. Geological Survey (2002)	0.027	0.040	0.060	0.083	0.133	0.186

3.3 Discussion, Conclusions and Recommendations

The Teck Cominco site is located in a region of low tectonic and seismic activity. This is evident in the low number (i.e., 53) of historical earthquakes that have occurred within about 150 km (93 mi) of the site (with the closest earthquake being 63 km [39 mi] distant), and the lack of mapped active faults in the northwestern Rocky Mountains. The low rate of tectonic activity is also reflected in the relatively low PGA values that result from the U.S. Geological Survey (2002) PSHA mapping in the region (Table 4).

The results of a DSHA for the site, using MCEs on the mapped (i.e., faults) and inferred (i.e., the MBE) potential seismogenic sources, also results, for the most part, in relatively low PGA values (Table 3). The largest PGAs from the DSHA derive from the MBE. The inclusion of the MBE in the DSHA is a conservative application because there are no mapped/known active faults in the northwestern Rocky Mountains (the region of the site), and the closest historical earthquake was about 63 km (39 mi) away to the north.

Based on the DSHA results (Table 3) and the evaluation of the PSHA mapping results from the U.S. Geological Survey (2002), we recommend that the 2,475-year return period PGA be used for site seismic stability analyses. This PGA value is 0.13 g, and is consistent with the median PGA values from the DSHA for the MBE. This acceleration is also consistent with previous work by Golder and others.

4.0 TAILING EMBANKMENT SLOPE STABILITY

4.1 General

Analyses of the stability of the tailings embankment were completed previously by Golder Associates (1996) and D & M (1988 and 1997). We used the material properties provided in these reports in our current stability analyses. The properties are discussed as follows.

4.2 Evaluation of Material Properties

In their July 1988 report, D&M presents shear strength and unit weight parameters for the soil and rock units encountered in and around the tailings embankment. The parameters for the soils were developed from data collected in four borings and a suite of laboratory tests, which included direct shear and triaxial shear testing. The rock parameters were reported to be estimated from typical values in the literature. Table 4-1 summarizes the material parameters used by D&M.

TABLE 4-1

Material Properties Used By D&M

Material	Friction Angle	Cohesion (psf)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)
Tailings	36	0	101 – 104	119 – 123
Glacial Sand and Gravel	36	0	135	-
Mine Waste Rock	38	0	115	125
Slate Bedrock	25	2000	165	--

In their December, 1996 report, Golder Associates presents shear strength parameters for the soil and rock units encountered in and around the tailings embankment. The parameters were developed from Cone Penetration Tests and boreholes (SPT blow count values and laboratory index testing). Table 4-2 summarizes the material propertied used in the Golder report.

TABLE 4-2

Material Properties Used in Golder 1996

Material	Friction Angle	Cohesion (psf)
Tailings	30 – 34	0
Foundation Soils	38	0
Rockfill Berm	38	0
Foundation Bedrock	25	2000

The strength parameters reported by D&M and Golder are similar except for the effective friction angle provided for the tailings. This is due to Golder Associates basing the strength on the results of Cone Penetration Testing. For the current report, the strength properties were also reviewed based on literature values and our engineering judgment. For these analyses, we used the parameters presented in Table 4-3.

TABLE 4-3

Material Properties Used in Further Analyses Herein

Material	Friction Angle	Cohesion (psf)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)
Tailings	30	0	104	123
Foundation Soils	38	0	135	-
Rockfill Berm	38	0	115	125
Bedrock	25	2000	165	

For this analysis, shear strength parameters were selected for the tailings that are on the conservative side of the range reported by Golder Associates (1996). It is our opinion that the lower values are more representative of the tailings away from the face of the embankment. For final design, the strength properties will be reassessed.

4.3 Review and Evaluation of Piezometric Levels

During operations, piezometric levels were high in the tailings due to a freewater pond maintained at the rear of the impoundment. More recently, water levels in the tailings were lowered by construction of a surface water collection ditch around the perimeter of the tailings and the cessation of tailings deposition. The collection ditch diverts surface water away before it can infiltrate into the subsurface. A decant structure maintains the pond at minimum feasible levels.

Groundwater levels used in the stability analysis are based on data collected in piezometers. Three of the piezometers have transducers installed, which allows for near continuous monitoring of the groundwater elevation. For these analyses, the piezometric surface through the tailings was developed based on the groundwater elevations in the piezometers, the collection ditch along the perimeter of the tailings and seepage areas on the downstream side of the embankment.

4.4 Estimated Factors of Safety Against Sliding

4.4.1 General

4.4.1.1 Critical Sections for Analysis

Stability of the embankment has two main components. The first component is the global and the surficial stability of the embankment. These are considered for static and seismic design cases. The second component is long term erosion stability of the embankment.

The consequences of global instability (failure) are of greater consequences than instability of the face. Face or surficial stability issues include raveling and erosion. These issues generally involve relatively small quantities of soil and are sometimes considered as maintenance problems. Global stability issues are generally more serious because they can involve relatively large quantities of soil.

Long-term erosion considerations are discussed in Section 4.5.2. The current embankment configuration has a face that is steeper than 1.5H:1V and generally, artificial slopes over 3H:1V are subject to high levels of erosion and it is difficult to establish and maintain a vegetative cover.

For the purposes of the stability analyses for this section of the appendix, and based on the results of previous studies, we assumed that the face will be regraded and therefore have analyzed the stability for both a 2.5H:1V and 3H:1V slope inclinations. Our analyses focused on the global stability of the embankment. Two sections (A-A' and B-B' – See Main Report Figure 4-4 "Geologic Cross-Section Transects") through the embankment were analyzed using the soil strength parameters discussed in the previous section. The main difference between the sections is that soil, instead of bedrock, sand and gravel is present beneath the tailings in Section A-A'.

The piezometric levels for the sections were defined by seeps downslope of the toe of the embankment, piezometers within the embankment and the diversion ditch at the perimeter of the tailings. Water level data measured in PP-D, P03, G1-S were used in Section A-A', and indicated a general piezometric surface at Elevation 2223 feet. Water level data measured in PP-C and P01 were used in Section B-B', and indicated a general piezometric surface at Elevation 2214 feet.

4.4.1.2 Methods of Analysis

The commercially available slope stability software package Slide, Version 5.025, was utilized for all of our stability analyses. The program allows the user to calculate the factor of safety against sliding using many different methods and along different shaped slip surfaces. For the purposes of this report, all calculations used Spencer's Method and circular slip surfaces.

4.4.1.3 Minimum Criteria

In their October, 1997 design report, Dames & Moore indicate that the Mine Safety and Health Administration (MSHA) guidelines require minimum factors of safety for the static and seismic stability of impounding structures. The minimum factors of safety are 1.5 for static and 1.2 for seismic loading conditions.

The Washington State Department of Ecology Dam Safety Office (DSO) published a document entitled "Dam Safety Guidelines". In Part IV of the Guidelines, a minimum factor of safety equal to 1.5 for long term static design conditions is recommended (for steady seepage maximum storage pool conditions). The U.S. Army Corps of Engineers (USACE) similarly requires a minimum factor of static equal to 1.5 for long term static conditions of an earth dam in their Publication Number EM 1110-2-1902 "Engineering and Design – Slope Stability". Based on the guidelines in DSO and USACO documents, we have used a factor of safety equal to 1.5 for the static condition as our benchmark for stability. Neither publication recommends a specific minimum factor of safety for a specific seismic load.

Both the DSO guidelines and USACE Regulation No. 1110-2-1806 recommend evaluation of the potential for seismic induced liquefaction and estimates of embankment deformation. The DSO guidelines and COE regulations set the seismic acceleration for the design based on the Maximum Credible Earthquake (MCE), Maximum Design Earthquake (MDE), and the Operating Design Earthquake (ODE).

Golder evaluated the potential for liquefaction using data collected from their Cone Penetration Tests (Golder 1988). The results of the liquefaction analysis are discussed in Section 4.4.3.3.

The target factor of safety for seismic loading using a pseudo static method of analysis is typically 1.0, given the conservative nature of the analysis. The 1.2 target reported above by Dame & Moore appears high for a non-impounding low hazard waste impoundment and, as noted by Dames & Moore, a target of 1.0 is more typical. Golder will review the relevant dam safety guidelines prior to final design. However, for the current report we consider that a reasonable target factor of safety for a pseudo-static seismic factor of safety is 1.0.

4.4.2 Existing Stability of the Embankment Face

In its current configuration, the face is steeper than 1.5H:1V. The factors of safety for this configuration are less than 1.0 for the static case for surficial stability and less than 1.5 for a crest to toe type global failure. The long term stability of the embankment does not meet the stability criteria.

4.4.3 Global Stability

4.4.3.1 Static Stability

The static stability of the two selected sections was assessed. The minimum static factor of safety against global stability for Section A-A' at 3H:1V was calculated as **1.70** and at 2.5H:1V was calculated at **1.57**. The minimum static factor of safety for Section B-B' at 3H:1V was calculated as **1.81** and at 2.5H:1V was calculated at **1.54**. This indicates that based on static analyses a 2.5H:1V slope angle is considered acceptable.

Although we consider that the piezometric levels used in the above analysis are acceptable to be assumed for long term purposes, a sensitivity analysis was performed with respect to the piezometric level. The piezometric level defined in the static analysis was used as the base level, the ground surface was used as the maximum. The results of the sensitivity analysis are shown in Figures 4-1 through 4-8. For Section A-A' regraded to 3H:1V, the sensitivity analysis indicates that the water level could increase on the order of 8 feet (in PP-D) before causing the factor of safety to drop to 1.5. For Section B-B' regraded to 3H:1V, the sensitivity analysis indicates that the water level could increase on the order of 15 feet (in PP-C) before reaching a factor of safety of 1.5.

For Section A-A' regraded to 2.5H:1V, the sensitivity analysis indicates that the water level could increase on the order of 4 feet (in PP-D) before reaching a factor of safety of 1.5. For Section B-B' regraded to 2.5H:1V, the sensitivity analysis indicates that the water level could increase on the order of 10 feet (in PP-C) before reaching a factor of safety of 1.5.

Figure 4-1

Section A Stability – Sensitivity to Increasing Groundwater Levels, Slope 2.5H:1V

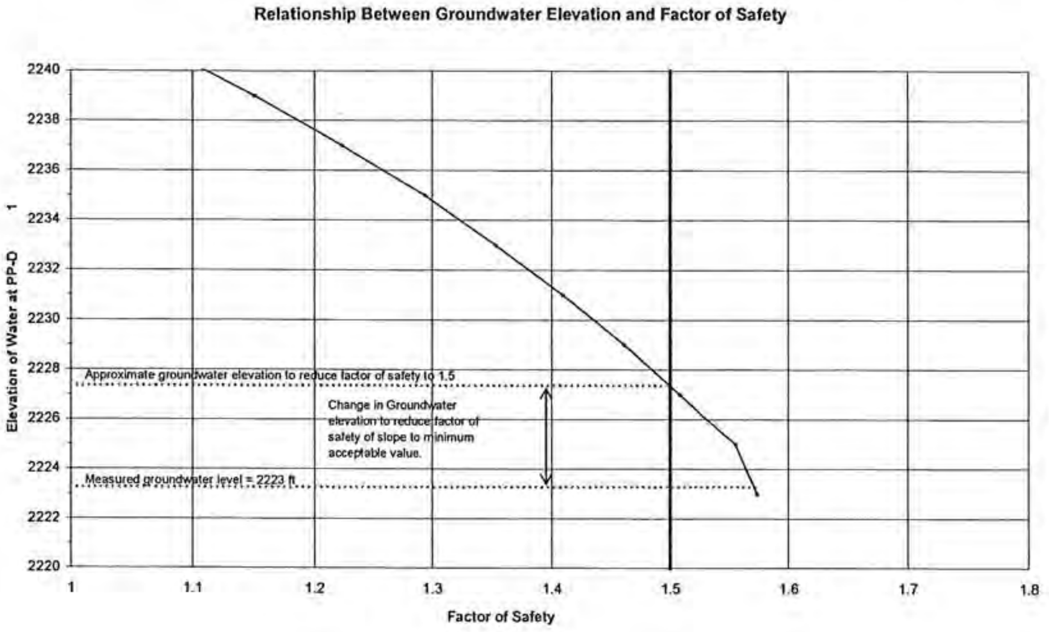


Figure 4-2

Section A Stability – Sensitivity to Increasing Groundwater Levels, Slope 3H:1V

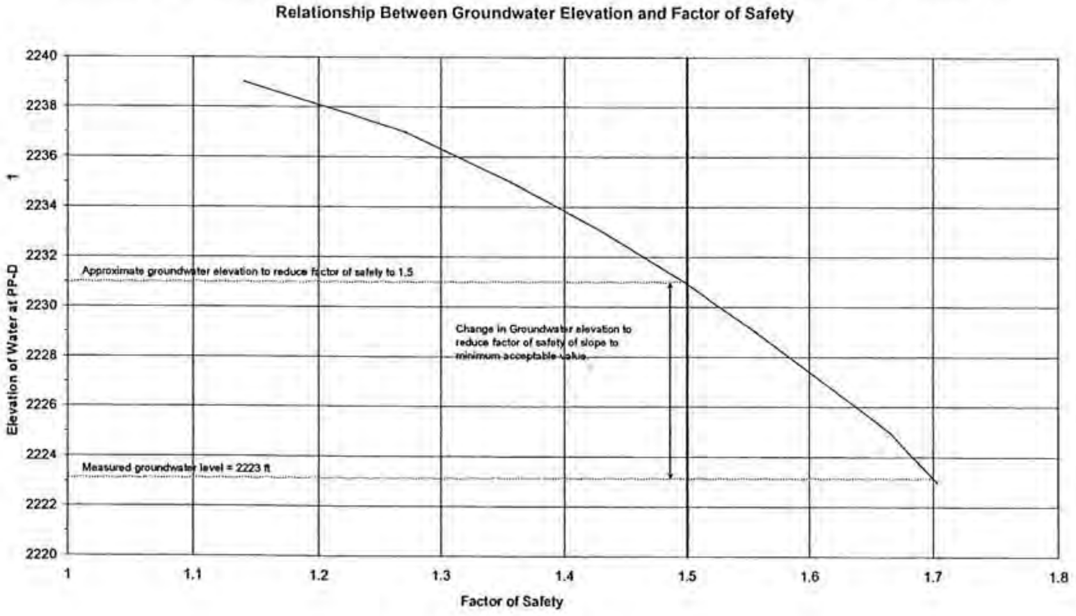


Figure 4-3

Section B Stability – Sensitivity to Increasing Groundwater Levels, Slope 2.5H:1V

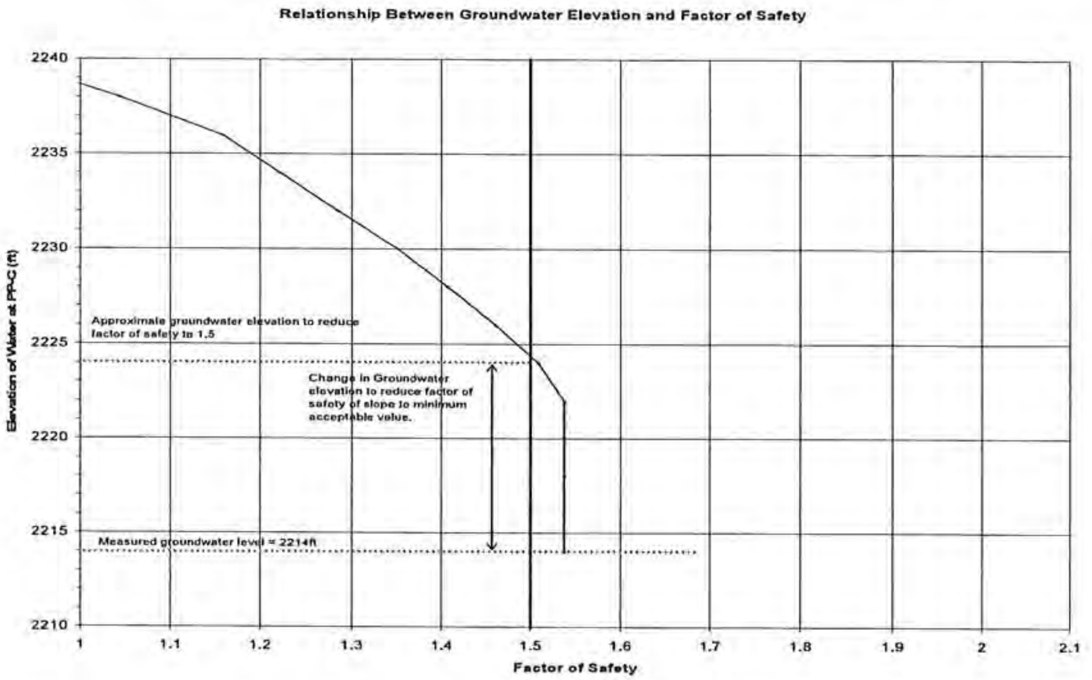
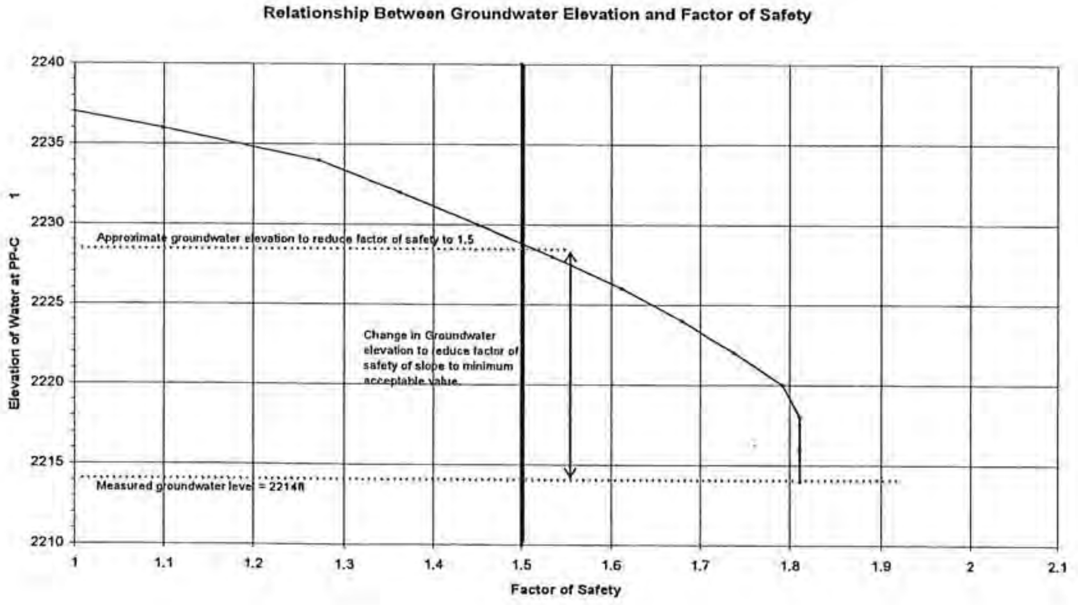


Figure 4-4

Section B Stability – Sensitivity to Increasing Groundwater Levels, Slope 3H:1V



4.4.3.2 Seismic Stability

Sections A-A' and B-B' were also analyzed for stability under seismic loading. Typically, pseudo-static analyses consider 50 percent of the peak ground acceleration. Golder's previous analyses assumed that the seismic acceleration would be a pseudo-static acceleration amplified two times as a result of propagation through the tailings. Based on this we used a pseudo-static acceleration equal to the peak ground accelerations (PGA). This assumption will be reassessed prior to final design; but it is likely that the use of a pseudo-static acceleration equal to the PGA is conservative. The same soil strength parameters and measured piezometric levels were used.

As discussed in Section 3.0, for the project site latitude of N48.8830 and longitude W117.3540, the peak ground acceleration (PGA) for the 475 year event is 0.06g and for the 2,475 year event is 0.13g.

Table 4-4 presents the resulting factors of safety which were calculated.

TABLE 4-4

Summary of Factors of Safety for Various Peak Ground Accelerations

2.5H:1V	Peak Ground Acceleration		3H:1V	Peak Ground Acceleration	
	0.06g'	0.13g'		0.06g'	0.13g'
Section A-A;	1.33	1.10	Section A-A'	1.40	1.15
Section B-B'	1.31	1.10	Section B-B'	1.50	1.25

Permanent deformation of the embankment is unlikely for either section based on the calculated factors of safety. The above results indicate that a 2.5H:1V slope angle is considered acceptable for the range of PGA utilized and assuming that liquefaction of the tailings does not impact the global stability analysis, as discussed below.

For informational purposes a sensitivity analysis with respect to horizontal seismic acceleration was also performed. The results of the sensitivity analyses are shown on the attached graphs. The pseudo-static accelerations required to produce factors of safety of 1.2 and 1.0 are provided in Table 4-5.

TABLE 4-5

Summary of Peak Ground Accelerations that Produce the Specified Factors of Safety

2.5H:1V	Req'd Factors of Saftey		3H:1V	Req'd Factors of Saftey	
	1.2	1.0		1.2	1.0
Section A-A;	0.10g'	0.17g'	Section A-A'	0.11g'	0.19g'
Section B-B'	0.95g'	0.18g'	Section B-B'	0.15g'	0.23g'

Figure 4-5
Section A Stability – Sensitivity to Peak Ground Acceleration, Slope 2.5H:1V

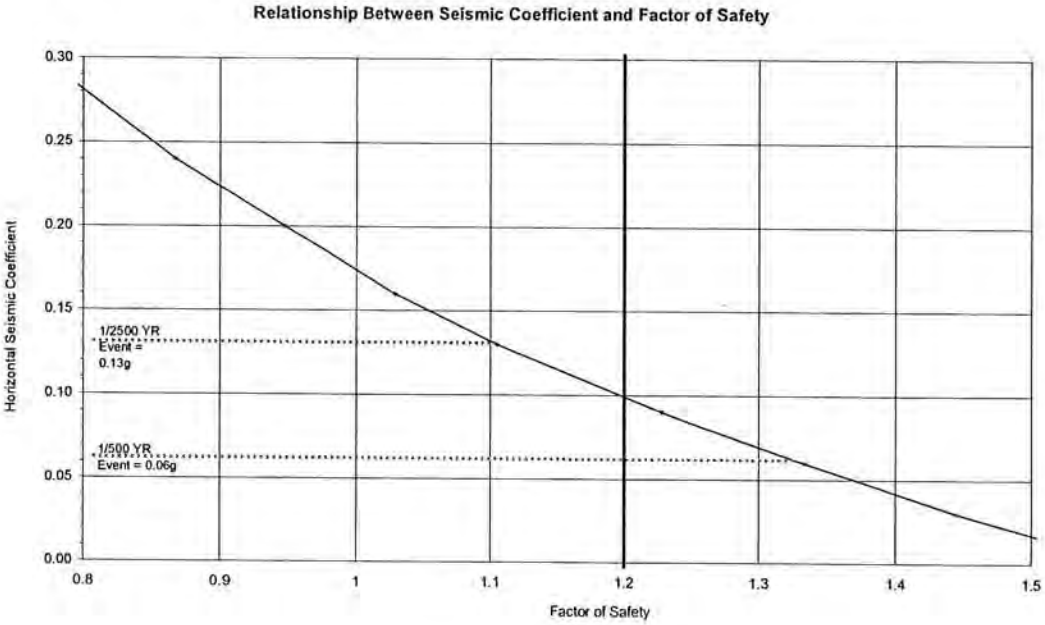


Figure 4-6
Section A Stability – Sensitivity to Peak Ground Acceleration, Slope 3H:1V

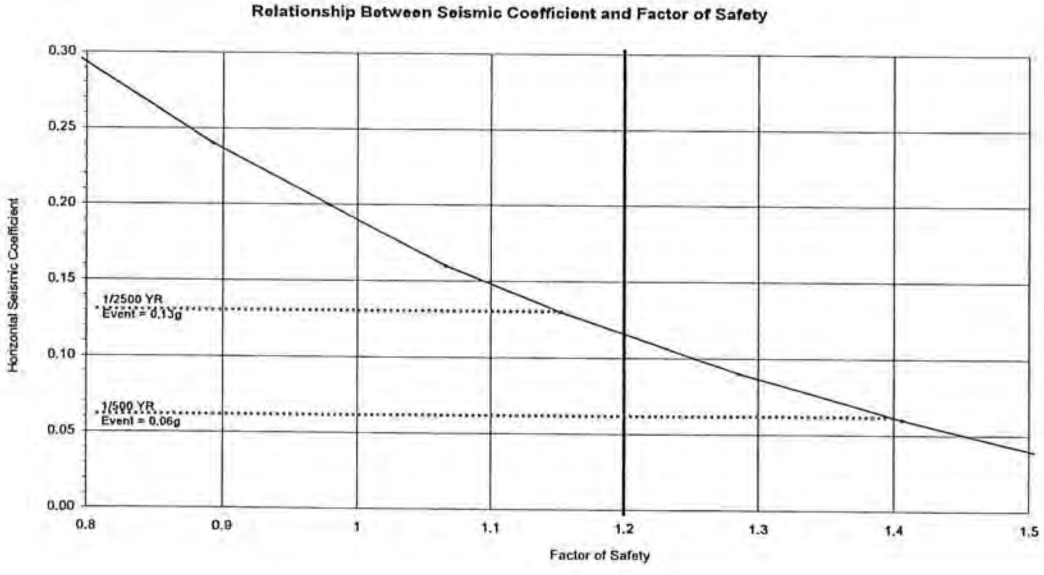


Figure 4-7
Section B Stability – Sensitivity to Peak Ground Acceleration, Slope 2.5H:1V

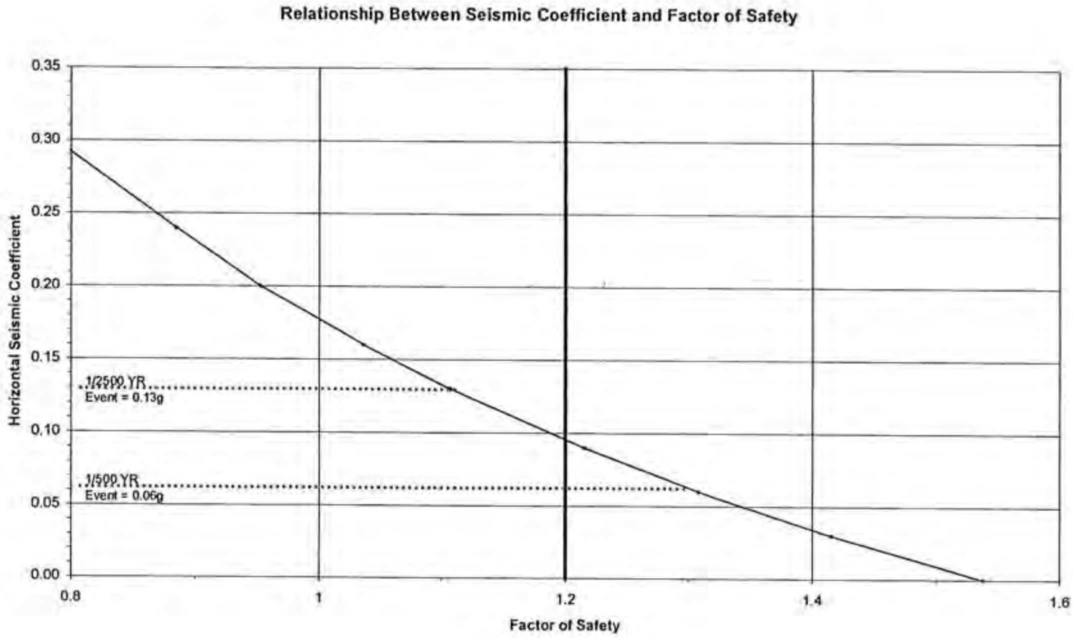
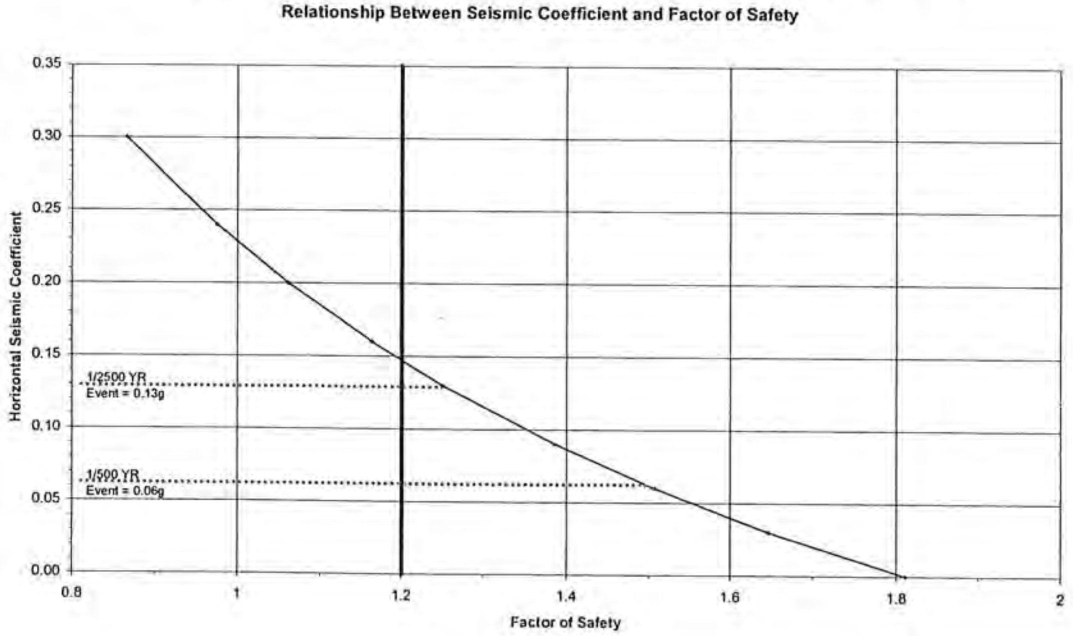


Figure 4-8
Section B Stability – Sensitivity to Peak Ground Acceleration, Slope 3H:1V



4.4.3.3 Liquefaction

Golder (1996) previously analyzed the liquefaction potential in using the Seed simplified procedure for a Magnitude 6.0 design seismic event. The results of the analysis indicated that the tailings near the crest of the embankment had a sufficiently high in-situ cyclic resistance that liquefaction was unlikely to occur, while saturated tailings away from the embankment crest were likely to liquefy. Although the tailings in the interior may liquefy during the design event, it was considered that the tailings near the embankment crest would have sufficient strength to retain the liquefied tailings. This conclusion is also consistent with Dames & Moore's liquefaction assessments.

For the purposes of this report it was therefore assumed that the liquefied tailings did not impact the global stability of the embankment. This assumption will be checked at the final design stage using the finalized seismic assessment and a liquefaction assessment of the tailings, potentially using a ground response analysis to assess acceleration response through the tailings mass.

4.4.4 Stability of a 2H:IV Outer Slope

The factors of safety for this configuration are less than 1.5 for a crest to toe type global failure. The long term stability would not meet the stability criteria.

4.4.5 Proposed Stabilization Measures

4.4.5.1 Proposed Measures

The stability of the existing embankment face is below generally accepted minimum factors of safety for both static and seismic conditions. Based on this preliminary assessment and in accordance with previous stability assessments, we recommend that the slope of the embankment be regraded to a maximum of 2.5H:1V. Once the slope is flattened the global stability of the embankment meets the factor of safety criteria.

4.5 Evaluation of Other Risks to Embankment Stability

4.5.1 Debris Flows

4.5.1.1 Originating from External Sources

The risk to the tailings containment from an external debris flows is considered to be low. The natural topography surrounding the mine is less steep than much of the mountainous area typical for this part of the state. Typical natural slopes upstream from the mine range from 5-10%. Most of the surrounding topography is covered with heavy vegetation including conifers, deciduous trees, grasses, and shrubs.

Additionally, the geology of the surrounding area consists of shallow bedrock composed of slate, beneath a veneer of glacial sediments and colluvium materials. This type of geology is not generally susceptible to debris flow or landslide movements. Therefore, the risk for an external debris flow impacting the tailings embankment is low.

4.5.1.2 Originating on the Embankment Face

The steep outer face of the tailings embankment, and slopes downstream, may be susceptible to debris flow in terms of geometry. However, the tailings face materials will be well drained, well compacted, and relatively strong; these are characteristics that render materials generally resistant to conditions that would produce source materials for a debris flow. Additionally, the potential risk of erosion to the face of the embankment is addressed in later sections. Long-term slope stabilization methods will be employed. Therefore, the embankment as a source of debris flow is also low risk.

4.5.2 Long Term Erosion

4.5.2.1 Tailings Surface Erosion Risk

The tailings surface is very nearly flat and partially covered with sparse, hardy vegetation consisting of grasses and mosses. A few young conifers and deciduous trees are scattered across the tailings surface. Due to the flat nature of the tailings surface, and the sparse vegetation, there is no significant erosion risk to the tailings surface.

4.5.2.2 Embankment Face Erosion Risk

The face of the tailings embankment is considered to be a high risk for long term erosion. Currently, the face is as steep as 1.3H:1V in places, composed of fine sand with partially embedded timber cribs. However, the timber cribs do not provide assured long-term stability due to the continuing deterioration of the timber, and the displacement of the cribs. Even with the timber cribs in place the steep sandy slope of the embankment is susceptible to surface erosion. The embankment face has also experienced localized failure previously. There are some deciduous trees growing on the surface of the embankment, which may provide some face stability. However, overall, the face is inherently unstable and requires modification and stabilization.

The proposed method of stabilization for the embankment face considers flattening of the face in conjunction with additional stabilization methods and materials.

4.5.2.3 Erosion Stabilization Measures Proposed

The steepness of the embankment face not only poses a high risk for overall stability of the embankment, but also poses a high risk for long term erosion. Therefore, the most direct way of addressing stabilization involves flattening the embankment face. Generally, most final slopes for mine reclamation should be between a 2H:1V slope and a 3H:1V slope (WSDNR, 1997). The flatter the slope, the more stable it will be and easier to reclaim. Additionally, downslope movement of sand and gravels, similar to the materials of the embankment face, usually does not occur on reclaimed slopes of 2H:1V to 3H:1V (WSDNR, 1997).

Slope steepness and lack of vegetative cover are among the most important factors increasing the amount of erosion and reducing the stability of a reclaimed site (WRCC, 1996). Therefore, three practices should be implemented to reduce the risk of erosion to the face of the embankment. These are: (1) reducing the slope of the embankment face to 2.5H:1V, (2) providing an armor cover, and (3) re-establishing vegetation on the embankment face. These practices are discussed in greater detail below.

Reducing Embankment Face Slope

As previously noted, the steepness of the embankment face poses a high risk to stability and surface erosion. Therefore, the face should be flattened to reduce the slope and provide stabilization. Currently, the embankment face ranges from 35-45 feet in height (vertical distance) over a horizontal distance of 45-55 feet (1.3H:1V slope). Flattening the slope back to a 2.5H:1V face will disturb approximately 100 feet horizontally on the embankment side and 100 feet on the tailings surface for placement of the cut slope. It should be noted that approximately 200-300 feet from the toe of the embankment, there is a well-established vegetated area that contains potentially valuable habitat for wildlife, as well as having inherent erosion protection properties. Disturbance to this area should be avoided during installation of any erosion stabilization measures.

Laying back the face of the tailings embankment to a 2.5H:1V slope will provide a significant reduction in long-term erosion risk. However, additional slope stabilization measures and materials should be implemented for short-term erosion prevention. Some of these short-term measures will provide long-term erosion control benefits. These stabilization methods include armoring and re-vegetation.

Armored Cover

An applicable and effective final cover design includes the amendment of rock into the topsoil surface on the face of the embankment (NRC, 1990). The rock provides resistance to erosion due to high intensity rainfall events, while also providing a stable medium for vegetation establishment. Revegetation improves the long-term stability of slopes and strengthens resistance to erosion. There is a large supply of fragmented, angular material on site (from waste rock), ranging from 2-inches to 6-inches in diameter, that could be used for armor.

The flattening of the embankment face results in a longer slope length, which is a factor related to increases soil loss and erosion. Also, the grading of the face and amendment of armor rock will result in a bare soil surface, which is more susceptible to erosion. Therefore, protection of the bare surface is required until such time vegetation is fully established.

Protection of the Bare Surface and Re-vegetation

There are several methods of surface protection that would be applicable for this site. Seeding and either mulching or the placement of erosion control blankets are methods that should be considered. Seeding involves the application of grass, forb, and woody plant seed mixes to the slope areas, either by broadcasting seed by hand, or by hydroseeding. Seeding is an effective way of establishing slope stabilizing vegetation quickly. Using a proper seed mix and soils amended with paper waste (widely available in Washington State) or other amendment materials, a lasting vegetative cover can be quickly established (Norman and Raforth, 1998).

Mulching involves the spreading of straw over exposed soil surfaces. Mulch not only protects the soil from erosion, but can also protect any applied seed from being washed away. Mulch can be applied separately, or as a part of a hydroseed blend mix. Alternatively, an erosion control blanket may be considered. These blankets consist of jute mat, straw mat, excelsior, and coconut fiber material, usually layered with a fine netting. If used, netting should be biodegradable or photodegradable. These nets generally degrade over a season. There is evidence that photodegradable netting has problems in northern regions, such as Maine. However, netting also poses risk to wildlife. Birds, reptiles, and small mammals can easily be caught and entangled in the netting. There are products available that do not contain netting if wildlife issues exist.

A combination of seeding with either mulching or erosion control blanket installation would provide the maximum protection for bare areas resulting from re-grading.

If needed, additional structural erosion control methods may also be installed on the slope. For this tailings embankment, a biotechnical stabilization, such as wattling or brush matting, could be used.

Wattling consists of laying straw or fibrous "wattles" which are long, cylindrical rolls of straw or fibrous plant material, which are staked along the contour of a slope. Brush matting consists of planting live woody plant material into the slope faces along excavated trenches along slope contours.

For the tailings embankment, brush matting is the least desirable of the two biotechnical stabilization methods, due to the increased installation time and the potential to trigger soil movements during installation.

Wattles may be staked into the surface with standard wood stakes, or "live" stakes, consisting of sections of woody plants cut into lengths from hardy species which root easily and eventually grow into mature woody shrubs. Additionally, the wattles help break up the slope length, and help trap sediments and seed for re-vegetation. Applicable species of "live" stakes for this project site are red alder, willow, black cottonwood, and snowberry. These species are native to this site, and would establish easily.

If structural wattles and stakes are used, combined with the protection of the bare slopes and the reduced slope of the tailings embankment face, the short-term and long-term erosion risk is very low.

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APPENDIX H

HUMAN LEAD BLOOD CONCENTRATION MODEL RUNS (EPA IEUBK MODEL)

```
                 LEAD MODEL FOR WINDOWS Version 1.0

==================================================================================
Model Version: 1.0 Build 263
User Name: Douglas Morell
Date: September 29, 2006
Site Name: Pend Oreille Mine TDF-1 and TDF-2
Operable Unit:
Run Mode: Child Visitor to TDF-1
==================================================================================

The time step used in this model run: 1 - Every 4 Hours (6 times a day).

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

  Age          Time           Ventilation        Lung Absorption       Outdoor Air
             Outdoors            Rate                  (%)                Pb Conc
              (hours)         (mA3/day)                                (ug Pb/mA3)
-------------------------------------------------------------------------------------

  .5-1        1.000            2.000               32.000               0.100
  1-2         2.000            3.000               32.000               0.100
  2-3         3.000            5.000               32.000               0.100
  3-4         4.000            5.000               32.000               0.100
  4-5         4.000            5.000               32.000               0.100
  5-6         4.000            7.000               32.000               0.100
  6-7         4.000            7.000               32.000               0.100

****** Diet ******

  Age       Diet Intake (ug/day)
----------------------------------

  .5-1        5.530
  1-2         5.780
  2-3         6.490
  3-4         6.240
  4-5         6.010
  5-6         6.340
  6-7         7.000

****** Drinking Water ******

  Water Consumption:
  Age        Water (L/day)
----------------------------------

  .5-1        0.200
  1-2         0.500
  2-3         0.520
  3-4         0.530
  4-5         0.550
  5-6         0.580
  6-7         0.590
Drinking Water Concentration: 4.000 ug Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 150.000 ug/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000
Use alternate indoor dust Pb sources? No

  Age              Soil (ug Pb/g)            House Dust (ug Pb/g)
-------------------------------------------------------------------
```

```
 .5.-1              200.000                  150.000
 1-2                200.000                  150.000
 2-3                200.000                  150.000
 3-4                200.000                  150.000
 4-5                200.000                  150.000
 5-6                200.000                  150.000
 6-7                200.000                  150.000

****** Alternate Intake ******

 Age        Alternate (ug Pb/day)
--------------------------------------
 .5-1           17.300
 1-2            17.300
 2-3            17.300
 3-4            17.300
 4-5            17.300
 5-6            17.300
 6-7            17.300

****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 2.500 ug Pb/dL

*****************************************
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
*****************************************

 Year          Air                 Diet           Alternate       Water
             (ug/day)            (ug/day)          (ug/day)      (ug/day)
-----------------------------------------------------------------------------
  .5-1        0.021               2.430             4.560         0.351
  1-2         0.034               2.548             4.577         0.882
  2-3         0.062               2.904             4.645         0.931
  3-4         0.067               2.836             4.718         0.964
  4-5         0.067               2.790             4.819         1.021
  5-6         0.093               2.971             4.864         1.087
  6-7         0.093               3.296             4.887         1.111

  Year       Soil+Dust            Total             Blood
             (ug/day)            (ug/day)          (ug/dL)
--------------------------------------------------------------
 .5-1        3.865               11.227              6.0
 1-2         6.161               14.202              6.0
 2-3         6.253               14.795              5.5
 3-4         6.351               14.936              5.2
 4-5         4.806               13.504              4.6
 5-6         4.365               13.380              4.2
 6-7         4.142               13.529              3.8
```

```
                 LEAD MODEL FOR WINDOWS Version 1.0

==================================================================================
Model Version: 1.0 Build 263
User Name: Douglas Morell
Date: September 29, 2006
Site Name: Pend Oreille Mine TDF-1 and TDF-2
Operable Unit:
Run Mode: Child Visitor to TDF-2
==================================================================================

The time step used in this model run: 1 - Every 4 Hours (6 times a day).

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

  Age          Time          Ventilation       Lung Absorption        Outdoor Air
             Outdoors            Rate                (%)                Pb Conc
             (hours)          (mA3/day)                              (ug Pb/mA3)
-----------------------------------------------------------------------------------------

  .5-1        1.000            2.000              32.000               0.100
  1-2         2.000            3.000              32.000               0.100
  2-3         3.000            5.000              32.000               0.100
  3-4         4.000            5.000              32.000               0.100
  4-5         4.000            5.000              32.000               0.100
  5-6         4.000            7.000              32.000               0.100
  6-7         4.000            7.000              32.000               0.100

****** Diet ******

  Age       Diet Intake (ug/day)
-----------------------------------

  .5-1         5.530
  1-2          5.780
  2-3          6.490
  3-4          6.240
  4-5          6.010
  5-6          6.340
  6-7          7.000

****** Drinking Water ******

  Water Consumption:
  Age        Water (L/day)
-----------------------------------

  .5-1          0.200
  1-2           0.500
  2-3           0.520
  3-4           0.530
  4-5           0.550
  5-6           0.580
  6-7           0.590
Drinking Water Concentration: 4.000 ug Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 150.000 ug/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000
Use alternate indoor dust Pb sources? No

  Age             Soil (ug Pb/g)          House Dust (ug Pb/g)
--------------------------------------------------------------------
```

```
 .5.-1              200.000                 150.000
 1-2                200.000                 150.000
 2-3                200.000                 150.000
 3-4                200.000                 150.000
 4-5                200.000                 150.000
 5-6                200.000                 150.000
 6-7                200.000                 150.000

****** Alternate Intake ******

 Age        Alternate (ug Pb/day)
------------------------------------
  .5-1     27.300
 1-2       27.300
 2-3       27.300
 3-4       27.300
 4-5       27.300
 5-6       27.300
 6-7       27.300
           27.000

****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 2.500 ug Pb/dL

****************************************
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
****************************************

 Year          Air                 Diet          Alternate        Water
             (ug/day)            (ug/day)         (ug/day)       (ug/day)
-----------------------------------------------------------------------------
  .5-1        0.021               2.365            7.005          0.342
   1-2        0.034               2.496            7.072          0.864
   2-3        0.062               2.852            7.197          0.914
   3-4        0.067               2.791            7.327          0.948
   4-5        0.067               2.751            7.497          1.007
   5-6        0.093               2.933            7.577          1.073
   6-7        0.093               3.258            7.539          1.098

  Year       Soil+Dust            Total           Blood
             (ug/day)            (ug/day)         (ug/dL)
-------------------------------------------------------------
 .5-1        3.762              13.496            7.2
 1-2         6.033              16.498            7.0
 2-3         6.140              17.165            6.4
 3-4         6.250              17.382            6.1
 4-5         4.737              16.058            5.5
 5-6         4.309              15.985            5.0
 6-7         4.094              16.083            4.6
```

```
                LEAD MODEL FOR WINDOWS Version 1.0

==================================================================================
Model Version: 1.0 Build 263
User Name: Douglas Morell
Date: September 29, 2006
Site Name: Pend Oreille Mine TDF-1 and TDF-2
Operable Unit:
Run Mode: Child Visitor to Site Sediments
==================================================================================

The time step used in this model run: 1 - Every 4 Hours (6 times a day).

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

  Age          Time          Ventilation        Lung Absorption       Outdoor Air
             Outdoors           Rate                 (%)                 Pb Conc
             (hours)         (mA3/day)                                 (ug Pb/mA3)
-------------------------------------------------------------------------------------
  .5-1       1.000            2.000              32.000               0.100
  1-2        2.000            3.000              32.000               0.100
  2-3        3.000            5.000              32.000               0.100
  3-4        4.000            5.000              32.000               0.100
  4-5        4.000            5.000              32.000               0.100
  5-6        4.000            7.000              32.000               0.100
  6-7        4.000            7.000              32.000               0.100

****** Diet ******

  Age       Diet Intake (ug/day)
----------------------------------
  .5-1        5.530
  1-2         5.780
  2-3         6.490
  3-4         6.240
  4-5         6.010
  5-6         6.340
  6-7         7.000

****** Drinking Water ******

  Water Consumption:
  Age       Water (L/day)
----------------------------------
  .5-1        0.200
  1-2         0.500
  2-3         0.520
  3-4         0.530
  4-5         0.550
  5-6         0.580
  6-7         0.590
Drinking Water Concentration: 4.000 ug Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 150.000 ug/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000
Use alternate indoor dust Pb sources? No

  Age             Soil (ug Pb/g)          House Dust (ug Pb/g)
--------------------------------------------------------------
```

```
 .5.-1                200.000                   150.000
 1-2                  200.000                   150.000
 2-3                  200.000                   150.000
 3-4                  200.000                   150.000
 4-5                  200.000                   150.000
 5-6                  200.000                   150.000
 6-7                  200.000                   150.000

****** Alternate Intake ******

 Age          Alternate (ug Pb/day)

-------------------------------------
 .5-1        16.250
 1-2         16.250
 2-3         16.250
 3-4         16.250
 4-5         16.250
 5-6         16.250
 6-7         16.250

****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 2.500 ug Pb/dL

****************************************
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
****************************************

 Year          Air                  Diet          Alternate       Water
             (ug/day)             (ug/day)         (ug/day)      (ug/day)
------------------------------------------------------------------------------
   .5-1       0.021                 2.437           4.296          0.352
    1-2       0.034                 2.554           4.308          0.884
    2-3       0.062                 2.910           4.372          0.933
    3-4       0.067                 2.841           4.439          0.965
    4-5       0.067                 2.795           4.534          1.023
    5-6       0.093                 2.975           4.575          1.089
    6-7       0.093                 3.300           4.596          1.113

   Year       Soil+Dust             Total           Blood

             (ug/day)             (ug/day)         (ug/dL)
-------------------------------------------------------------------
 .5-1          3.876               10.982           5.9
 1-2           6.174               13.955           5.9
 2-3           6.265               14.542           5.4
 3-4           6.362               14.674           5.1
 4-5           4.813               13.231           4.5
 5-6           4.371               13.103           4.1
 6-7           4.147               13.249           3.8
```

```
                LEAD MODEL FOR WINDOWS Version 1.0

================================================================================
Model Version: 1.0 Build 263
User Name: Douglas Morell
Date: September 29, 2006
Site Name: Pend Oreille Mine TDF-1 and TDF-2
Operable Unit:
Run Mode: Residential on TDF-1 w/Child Visitor to TDF-2
================================================================================

The time step used in this model run: 1 - Every 4 Hours (6 times a day).

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

 Age          Time          Ventilation        Lung Absorption      Outdoor Air
             Outdoors          Rate                 (%)               Pb Conc
             (hours)        (mA3/day)                               (ug Pb/mA3)
-------------------------------------------------------------------------------------

  .5-1       1.000           2.000              32.000              0.100
  1-2        2.000           3.000              32.000              0.100
  2-3        3.000           5.000              32.000              0.100
  3-4        4.000           5.000              32.000              0.100
  4-5        4.000           5.000              32.000              0.100
  5-6        4.000           7.000              32.000              0.100
  6-7        4.000           7.000              32.000              0.100

****** Diet ******

  Age       Diet Intake (ug/day)
----------------------------------

  .5-1        5.530
  1-2         5.780
  2-3         6.490
  3-4         6.240
  4-5         6.010
  5-6         6.340
  6-7         7.000

****** Drinking Water ******

  Water Consumption:
  Age       Water (L/day)
----------------------------------

  .5-1        0.200
  1-2         0.500
  2-3         0.520
  3-4         0.530
  4-5         0.550
  5-6         0.580
  6-7         0.590
Drinking Water Concentration: 4.000 ug Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 45100 ug/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000
Use alternate indoor dust Pb sources? No

  Age             Soil (ug Pb/g)          House Dust (ug Pb/g)
------------------------------------------------------------------
```

```
  .5.-1              630.000                  451.000
  1-2                630.000                  451.000
  2-3                630.000                  451.000
  3-4                630.000                  451.000
  4-5                630.000                  451.000
  5-6                630.000                  451.000
  6-7                630.000                  451.000

****** Alternate Intake ******

 Age        Alternate (ug Pb/day)
--------------------------------------
  .5-1           27.300
  1-2            27.300
  2-3            27.300
  3-4            27.300
  4-5            27.300
  5-6            27.300
  6-7            27.300

****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 2.500 ug Pb/dL

*****************************************
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
*****************************************

 Year          Air                  Diet         Alternate        Water
             (ug/day)             (ug/day)        (ug/day)      (ug/day)
------------------------------------------------------------------------------
  .5-1        0.021                2.193          6.496           0.317
  1-2         0.034                2.275          6.447           0.787
  2-3         0.062                2.628          6.632           0.842
  3-4         0.067                2.596          6.814           0.882
  4-5         0.067                2.619          7.138           0.959
  5-6         0.093                2.817          7.279           1.031
  6-7         0.093                3.144          7.357           1.060

  Year       Soil+Dust             Total          Blood

             (ug/day)             (ug/day)       (ug/dL)
-------------------------------------------------------------------
 .5-1        10.751               19.778           10.4
 1-2         16.946               26.489           10.9
 2-3         17.433               27.598           10.1
 3-4         17.912               28.271            9.7
 4-5         13.899               24.682            8.5
 5-6         12.756               23.976            7.5
 6-7         12.175               23.829            6.8
```

```
                LEAD MODEL FOR WINDOWS Version 1.0

==================================================================================
Model Version: 1.0 Build 263
User Name: Douglas Morell
Date: September 29, 2006
Site Name: Pend Oreille Mine TDF-1 and TDF-2
Operable Unit:
Run Mode: Residential on TDF-2 w/Child Visitor to TDF-1
==================================================================================

The time step used in this model run: 1 - Every 4 Hours (6 times a day).

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

  Age          Time           Ventilation        Lung Absorption       Outdoor Air
             Outdoors            Rate                 (%)                Pb Conc
             (hours)          (mA3/day)                               (ug Pb/mA3)
------------------------------------------------------------------------------------

  .5-1        1.000            2.000              32.000             0.100
  1-2         2.000            3.000              32.000             0.100
  2-3         3.000            5.000              32.000             0.100
  3-4         4.000            5.000              32.000             0.100
  4-5         4.000            5.000              32.000             0.100
  5-6         4.000            7.000              32.000             0.100
  6-7         4.000            7.000              32.000             0.100

****** Diet ******

  Age       Diet Intake (ug/day)
----------------------------------

  .5-1        5.530
  1-2         5.780
  2-3         6.490
  3-4         6.240
  4-5         6.010
  5-6         6.340
  6-7         7.000

****** Drinking Water ******

  Water Consumption:
  Age       Water (L/day)
----------------------------------

  .5-1        0.200
  1-2         0.500
  2-3         0.520
  3-4         0.530
  4-5         0.550
  5-6         0.580
  6-7         0.590
Drinking Water Concentration: 4.000 ug Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 706.500 ug/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000
Use alternate indoor dust Pb sources? No

  Age            Soil (ug Pb/g)          House Dust (ug Pb/g)
-----------------------------------------------------------------
```

```
  .5.-1             995.000              706.500
  1-2               995.000              706.500
  2-3               995.000              706.500
  3-4               995.000              706.500
  4-5               995.000              706.500
  5-6               995.000              706.500
  6-7               995.000              706.500

****** Alternate Intake ******

 Age        Alternate (ug Pb/day)
-------------------------------------
  .5-1     17.300
  1-2      17.300
  2-3      17.300
  3-4      17.300
  4-5      17.300
  5-6      17.300
  6-7      17.300

****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 2.500 ug Pb/dL

*****************************************
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
*****************************************

 Year          Air                 Diet            Alternate         Water
             (ug/day)            (ug/day)           (ug/day)        (ug/day)
------------------------------------------------------------------------------
   .5-1        0.021               2.116              3.972           0.306
    1-2        0.034               2.158              3.876           0.747
    2-3        0.062               2.507              4.009           0.803
    3-4        0.067               2.488              4.139           0.845
    4-5        0.067               2.551              4.406           0.934
    5-6        0.093               2.760              4.519           1.010
    6-7        0.093               3.089              4.581           1.041

   Year       Soil+Dust             Total             Blood
             (ug/day)             (ug/day)           (ug/dL)
------------------------------------------------------------------
  .5-1       16.319               22.734              11.9
  1-2        25.293               32.108              13.1
  2-3        26.163               33.544              12.2
  3-4        27.012               34.551              11.8
  4-5        21.300               29.257              10.1
  5-6        19.660               28.041               8.8
  6-7        18.822               27.626               7.9
```

```
                LEAD MODEL FOR WINDOWS Version 1.0

==================================================================================
Model Version: 1.0 Build 263
User Name: Douglas Morell
Date: September 29, 2006
Site Name: Pend Oreille Mine TDF-1 and TDF-2
Operable Unit:
Run Mode: Residential on Site Sediments with Child Visitor to TDF-2
==================================================================================

The time step used in this model run: 1 - Every 4 Hours (6 times a day).

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

  Age          Time           Ventilation        Lung Absorption        Outdoor Air
             Outdoors            Rate                 (%)                 Pb Conc
             (hours)          (mA3/day)                                 (ug Pb/mA3)
-------------------------------------------------------------------------------------

  .5-1       1.000            2.000              32.000               0.100
  1-2        2.000            3.000              32.000               0.100
  2-3        3.000            5.000              32.000               0.100
  3-4        4.000            5.000              32.000               0.100
  4-5        4.000            5.000              32.000               0.100
  5-6        4.000            7.000              32.000               0.100
  6-7        4.000            7.000              32.000               0.100

****** Diet ******

  Age      Diet Intake (ug/day)
----------------------------------

  .5-1      5.530
  1-2       5.780
  2-3       6.490
  3-4       6.240
  4-5       6.010
  5-6       6.340
  6-7       7.000

****** Drinking Water ******

  Water Consumption:
  Age       Water (L/day)
----------------------------------

  .5-1       0.200
  1-2        0.500
  2-3        0.520
  3-4        0.530
  4-5        0.550
  5-6        0.580
  6-7        0.590
Drinking Water Concentration: 4.000 ug Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 425.100 ug/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000
Use alternate indoor dust Pb sources? No

  Age            Soil (ug Pb/g)          House Dust (ug Pb/g)
-----------------------------------------------------------------
```

```
 .5.-1            593.000            425.100
 1-2              593.000            425.100
 2-3              593.000            425.100
 3-4              593.000            425.100
 4-5              593.000            425.100
 5-6              593.000            425.100
 6-7              593.000            425.100

****** Alternate Intake ******

 Age        Alternate (ug Pb/day)
-------------------------------------
 .5-1      27.300
 1-2       27.300
 2-3       27.300
 3-4       27.300
 4-5       27.300
 5-6       27.300
 6-7       27.300

****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 2.500 ug Pb/dL

****************************************
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
****************************************

 Year          Air                 Diet            Alternate        Water
            (ug/day)            (ug/day)           (ug/day)       (ug/day)
------------------------------------------------------------------------------
  .5-1        0.021               2.207              6.536          0.319
   1-2        0.034               2.292              6.495          0.793
   2-3        0.062               2.645              6.676          0.848
   3-4        0.067               2.611              6.855          0.887
   4-5        0.067               2.630              7.167          0.963
   5-6        0.093               2.827              7.304          1.034
   6-7        0.093               3.153              7.378          1.063

  Year       Soil+Dust            Total             Blood

             (ug/day)            (ug/day)          (ug/dL)
-----------------------------------------------------------------
 .5-1        10.188              19.271             10.1
 1-2         16.080              25.694             10.6
 2-3         16.529              26.761              9.8
 3-4         16.971              27.391              9.4
 4-5         13.144              23.971              8.2
 5-6         12.055              23.313              7.3
 6-7         11 .502             23.190              6.6
```

APPENDIX I

APPLICABLE, RELEVANT OR APPROPRIATE REQUIREMENTS

Appendix I

Pertinent Federal and State Laws and Regulations

Safe Drinking Water Act of 1974, 42 USC 300, et seq. National Primary Drinking Water Standards, 40 CFR 141	Establishes maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs) that are drinking water criteria designed to protect human health from the potential adverse effects of contaminants in drinking water.	Ground water at the Site is not a current drinking water source, but it is considered a potential future source of drinking water. MCLs and MCLGs should be considered in establishing cleanup levels that are protective of ground-water, points of compliance, and institutional controls.
National Secondary Drinking Water Standards, 40 CFR 143	Establishes secondary drinking water standards for use in establishing cleanup levels.	Federal secondary standards are not enforceable standards and are not typically applicable or relevant and appropriate requirements; however, the State of Washington Model Toxics Control Act requires that these standards be considered in establishing cleanup levels protective of ground-water.
Clean Water Act of 1977, 33 USC 1251, as amended Water Quality Standards, 40 CFR 131	Establishes the requirements and procedures for states to develop and adopt water quality standards based on federal water quality criteria that are at least as stringent as the federal standards. Provides USEPA authority to review and approve state standards.	Applicable to the Site. Although Washington State has received USEPA approval and has adopted more stringent State standards under WAC 173-201A, the Federal regulation should be considered in establishing Site cleanup levels.
Resource Conservation and Recovery Act, 42 USC 6901, et seq. Criteria for Classification of Solid Waste Disposal Facilities and Practices, 40 CFR 257	Criteria specified under this standard are used to determine which solid waste disposal facilities and practices pose a reasonable possibility of adverse risk to human health and the environment.	Mining and ore beneficiation waste are exempted by the Bevel Amendment. Most of the provisions of this chapter have been delegated to the state. (See State Hazardous Waste Management Act.).

Clean Air Act of 1977, as amended 42 USC 7401, et seq. National Ambient Air Quality Standards, 40 CFR 50	Requirements of these regulations are applicable to airborne releases of criteria pollutants specified under the statute. Specific release limits for particulates are set at 50 µg/m 3 annually or 150 µg/m 3 per 24-hour period.	Applicable to airborne releases of criteria pollutants that might be generated during response or cleanup actions.
Ambient Air Quality Monitoring, 40 CFR 58 areas.	This regulation presents the criteria and requirements for ambient air quality monitoring and reporting for local air pollution control agencies and operators of new sources of air pollutants.	Applicable only to response and cleanup actions that meet the regulatory definition of a new source. Also, these requirements may be considered relevant and appropriate to response and cleanup actions that have the potential to emit air contaminants, even if they are not a new source.
Standards of Performance for New Stationary Sources, 40 CFR 60	These requirements provide standards for new stationary or modifications of existing sources.	Applicable if assessment or response actions include stationary sources.
National Emission Standard for Hazardous Air Pollutants (NESHAP), 40 CFR 61	40 CFR 61 provides general requirements for regulated facilities that generate air emissions containing hazardous substances. .	These requirements are applicable to response and cleanup actions that release air emissions containing hazardous substances.
Hazardous Materials Transportation Act, 49 USC 1801, et seq. Hazardous Materials Regulation, 49 CFR 171 Hazardous Materials Tables, Hazardous Materials Communications Requirements, and Emergency Response Information Requirements, 49 CFR 172	These requirements state that no person may offer to accept hazardous material for transportation in commerce unless the material is properly classed, described, packaged, marked, labeled, and in condition for shipment. Tables are used to identify requirements for labeling, packaging, and transportation based on categories of waste types. Small quantities of radioactive wastes are not subject to the requirements of the standard if activity levels are below limits established in paragraph 173.421, 173.422, or 173.424. Specific performance requirements are established for packages used for shipping and transport of hazardous materials.	These requirements are applicable to hazardous material generated during response and cleanup actions, which is sent offsite for disposal. These requirements are applicable if hazardous materials are generated during response and cleanup actions that are transported offsite. In the event of a discharge of hazardous waste during transportation from the treatment facility to the disposal facility, this section is applicable.

Hazardous Waste Clean Up/Model Toxics Control Act, Ch. 70.105D RCW Model Toxics Control Act, WAC 173-340-700	Establishes a process and requirements for cleanup of contaminated sites in the state. MTCA regulations have been authorized for use in implementing corrective action in the state. Specifies that all cleanup actions be protective of human health; comply with all applicable state and federal regulations; and provide for compliance monitoring. Identifies the methods used to develop cleanup standards and their use in selection of a cleanup action. Specifies cleanup goals, which implement the strictest federal or state cleanup criteria. In addition to meeting requirements of other regulations, MTCA uses three basic methods for establishing cleanup levels. These methods may be used to identify cleanup standards for ground-water, surface water, soils, and protection of air quality.	Requirements of MTCA are applicable to the Site. Remedial actions at the Site are being conducted pursuant to MTCA under an Agreed Order.
Hazardous Waste Management Act, 70.105 RCW Dangerous Waste Regulations, WAC 173-303	Establishes the design, operation, and monitoring requirements for managing dangerous waste.	The active operations for TDF-1 and TDF-2 at the Site pre-date the regulation; therefore the regulation is not applicable. Tailings would not classify as a dangerous waste, if the material is excavated or removed during response or cleanup or actions of either TDF-1 or TDF-2.
Solid Waste Management, Recovery and Recycling Act, Ch. 70.95 RCW Minimum Functional Standards for Solid Waste Handling, WAC 173-304	These standards establish requirements to be met for the management of solid waste. Solid waste controlled by this Act includes garbage, industrial waste, construction waste, and ashes. Requirements for containerized storage, collection, transportation, treatment, and disposal of solid waste are included. These standards set ground-water MCLs at the same levels as the state drinking water standards.	The active operations at the Site pre-date the regulation; therefore the regulation is not applicable. These regulations are applicable when solid waste is generated during assessment or response actions.

Water Pollution Control/Water Resource Act of 1971, Ch. 90.48 RCW/Ch.90.54 RCW Surface Water Quality Standards, WAC 173-201A	These standards set water quality standards at levels protective of aquatic life.	Surface water quality criteria established under this chapter are applicable in assessing risk and response actions.
Protection of Upper Aquifer Zones, WAC 173-154	This regulation directs Ecology to provide for protection of upper aquifers and upper aquifer zones to avoid depletions, excessive water level declines, or reductions in water quality.	This regulation is not applicable because it establishes the policy and program for Ecology. However, the regulation is relevant and appropriate because protection of the aquifer from adverse impacts caused by solid waste is a primary goal.
State Waste Discharge Program, WAC 173-216	The regulation establishes requirements for industrial and commercial operations that discharge to the ground-water, surface waters, or municipal sewerage systems. Specific discharges prohibited under the program are identified. The intent of the regulation is to maintain the highest possible standards, and the law requires the use of all known available and reasonable methods to prevent and control the discharge of wastes into the waters of the state.	Requirements of this program are applicable to assessment or response actions that include discharges to the ground or to surface waters.
Department of Health Standards for Public Water Supplies, WAC 246-290	The rule established under WAC 246-290 defines the regulatory requirements necessary to protect consumers using public drinking water supplies. The rules are intended to conform with the federal SDWA, as amended. WAC 246-290-310 establishes MCLs that define the water quality requirements for public water supplies. WAC 246-290-310 establishes both primary and secondary MCLs and identifies that enforcement of the primary standards is the Department of Health's first priority.	The requirements of WAC 246-290-310 are relevant and appropriate. Although the ground-water at the Site is not a source of drinking water, groundwater at the Site has sufficient yield and quality to be considered a potential future resource.
State Environmental Policy Act, Chapter 43.21C RCW SEPA Rules, WAC 197-11	These requirements establish compliance with the State Environmental Policy Act.	These requirements are applicable for response or cleanup actions at the Site.

Water Quality Standards for Ground Waters of the State of Washington; WAC 173-200	Establishes ground-water quality standards to provide for protection of the environment and human health, as well as an antidegradation policy to protect existing and future beneficial uses of ground-water.	WAC 173-200 standards do not apply to cleanup actions undertaken pursuant to the Model Toxics Control Act (MTCA). Instead, MTCA establishes ground-water cleanup standards at such sites.
Ambient Air Quality Standards for Particulate Matter, WAC 173-470	These requirements set maximum acceptable levels for particulate matter in the ambient air and the 24-hour ambient air concentration standard for particles less than 10 µm in diameter (PM10). The section defines standards for particle fallout in industrial, commercial, and residential areas. Alternate levels are set for areas where natural dust levels are high.	These requirements are applicable to response and cleanup actions that might emit particulate matter to the air.
Washington Clean Air Act, Ch. 70.94 RCW and Ch. 43.21A RCW General Regulations for Air Pollution, WAC 173-400	The regulation requires that all sources of air contaminants meet emission standards for visible, particulate, fugitive, odors, and hazardous air emissions. This section requires that all emission units use reasonably available control technology, which may be determined for some source categories to be more stringent than the emission limitations listed in this chapter. The regulation requires that source testing and monitoring be performed. A new source would include any process or source that may increase emissions or ambient air concentration of any contaminant for which federal or state ambient or emission standards have been established.	Requirements of this standard are applicable to response and cleanup actions that could result in the emission of hazardous substance air pollutants.
Controls for New Sources of Air Pollution, WAC 173-460	This standard requires that new sources of air emissions provide emission estimates for toxic air contaminants listed in the regulation. The standard requires that emissions be quantified and used in risk modeling to evaluate ambient impacts and to establish acceptable source impact levels. The standard establishes three major requirements for new sources of air pollutants: use of best available control technology; quantification of toxic emissions; and demonstration that human health is protected.	The standard is applicable to response and cleanup actions where contaminants identified as toxic air pollutants are present and air emissions might be generated.

Water Well Construction, Ch. 18.104 RCW Minimum Standards for Construction and Maintenance of Water Wells, WAC 173-160	These requirements establish minimum standards for design, construction, capping, and sealing of all wells. The requirements set additional requirements, including disinfection of equipment, decommissioning of wells, and quality of drilling water.	These requirements are applicable because response and cleanup actions could include construction of wells for ground-water monitoring of ground-water.
Rules and Regulations Governing the Licensing of Well Contractors and Operators, WAC 173-162	This regulation establishes training standards for well contractors and operators.	This regulation is relevant and appropriate because response and cleanup actions could involve ground-water well installation or construction of geotechnical borings.

CFR = Code of Federal Regulations
Ecology = Washington Department of Ecology
MCL = maximum contaminant level
MCLG = maximum contaminant level goal
MTCA = Model Toxics Control Act
RCW = Revised Code of Washington
SEPA = State Environmental Policy Act
SDWA = Safe Drinking Water Act
WAC = Washington Administrative Code.

APPENDIX J

CLEANUP ALTERNATIVE COST ESTIMATES

TABLE J-1

ESTIMATED COST FOR ALTERNATIVE 2 Institutional Controls, Sediment Capture, and Monitoring

Item	Quantity	Units	Unit Cost	Cost	Notes
CAPITAL COSTS					
Sedimentation Pond	1	ea	$67,245	$67,245	
Upgrade existing access road	1,200	lf	$20.00	$24,000	
Construct new TDF-1 access road	157	lf	$40.00	$6,280	
Refurbish existing TDF-1 drainage ditch	4,209	lf	$15.00	$63,135	
Construction Subtotal				**$160,660**	
ENGINEERING COSTS					
Engineering Design Report and Bid Package				$10,000	
Pre-Design Survey & Investigation				$5,000	
Engineering Permit, Wetland and F&W Issues				$5,000	
Construction Surveillance				$5,000	
As-Built Report				$2,500	
Legal and Deed Restrictions				$10,000	
Engineering Subtotal				**$37,500**	
Contingency			25%	**$40,000**	
TOTAL ESTIMATED CAPITAL COSTS				**$238,160**	
INSPECTION AND MAINTENANCE					
Inspection				$26,779	Net Present Value
Maintenance				$371,937	Net Present Value
Subtotal				**$399,000**	Rounded
Contingency			25%	**$100,000**	
TOTAL I&M COST				**$499,000**	

TABLE J-2

ESTIMATED COST FOR ALTERNATIVE 3 TDF-1 Slope Improvement (2.5H:1V) and Accelerate Re-Vegetation

Item	Quantity	Units	Unit Cost	Cost	Notes
CAPITAL COSTS					
Mob/Demob	1	lump sum	$15,000	$15,000	
Sedimentation Pond	1	ea	$67,245	$67,245	
Silt fence	1,876	lf	$3.50	$6,566	
Temporary Facilities	2	month	$2,200	$4,400	
Upgrade existing access road	1,200	lf	$20.00	$24,000	
Construct new TDF1 access road	157	lf	$40.00	$6,280	
Excavate Tailings	60,342	cy	$5.00	$301,710	
Spread and Compact Tailings	60,342	cy	$2.00	$120,684	
Place soil cap on TDF-1 face	4,429	cy	$22.38	$99,097	
Apply compost and fertilizer by tilling(a)	16.6	acre	$6,002	$99,470	
Apply compost or other nutrients to the surface(b)	8.0	acre	$2,647	$21,304	
Refurbish existing drainage ditch	4,209	lf	$15.00	$63,135	
Replace drainage pipes	200	lf	$33.00	$6,600	
Construct new drainage ditch	2,395	lf	$30.00	$71,850	
Seeding(c)	16.6	acre	$2,000	$33,147	
Construction Subtotal				**$940,489**	

TABLE J-2

ESTIMATED COST FOR ALTERNATIVE 3 TDF-1 Slope Improvement (2.5H:1V) and Accelerate Re-Vegetation

Item	Quantity	Units	Unit Cost	Cost	Notes
ENGINEERING COSTS					
Engineering Design Report and Bid Package				$35,000	
Pre-Design Survey & Investigation				$25,000	
Engineering Permit, Wetland and F&W Issues				$5,000	
Construction Surveillance	1	month	$30,000	$30,000	
As-Built Report				$5,000	
Legal and Deed Restrictions				$10,000	
Engineering Subtotal				**$110,000**	
Contingency			25%	**$235,000**	
TOTAL ESTIMATED CAPITAL COSTS				**$1,285,489**	
INSPECTION AND MAINTENANCE					
Inspection				$26,779	Net Present Value
Maintenance				$11,860	Net Present Value
Subtotal				**$39,000**	Rounded
Contingency			25%	**$10,000**	
TOTAL I&M COST				**$49,000**	

Notes:

(a) Apply to non-vegetated portion of TDF-1, all of TDF-2, and dam faces for both ponds.

(b) Apply to vegetated portion of TDF-1 peripheral to wetlands.

(c) All areas except wetlands and peripheral vegetated area.

TABLE J-3

ESTIMATED COST FOR ALTERNATIVE 4 TDF-1 Slope Improvement (2.5H:1V), TDF-2 Partial Soil Cap and Re-Vegetation

Item	Quantity	Units	Unit Cost	Cost	Notes
CAPITAL COSTS					
Mob/Demob	1	lump sum	$25,000	$25,000	
Sedimentation Pond	1	ea	$67,245	$67,245	
Silt fence	3,953	lf	$3.50	$13,836	
Temporary Facilities	3	month	$2,200	$6,600	
Upgrade existing access road	1,200	lf	$20	$24,000	
Construct new TDF-1 access road	157	lf	$40	$6,280	
Excavate Tailings	60,342	cy	$5.00	$301,710	
Spread and Compact Tailings	60,342	cy	$2.00	$120,684	
Place soil cap on TDF-1 face	4,429	cy	$22.38	$99,097	
Clear borrow area	1.3	acre	$7,600	$9,745	
TDF-2 cover	3,326	cy	$9.50	$31,596	
Capping soil	3,326	cy	$13.75	$45,731	
Apply compost and fertilizer by tilling(a)	16.6	acre	$6,002	$99,470	
Apply compost or other nutrients to the surface(b)	8.0	acre	$2,647	$21,304	
Refurbish existing TDF-1 drainage ditch	4,209	lf	$15.00	$63,135	
Replace drainage pipes	200	lf	$33.00	$6,600	
Construct new TDF-2 drainage ditch	2,395	lf	$30.00	$71,850	
Seeding(c)	16.6	acre	$2,000	$33,147	
Construction Subtotal				**$1,047,030**	

TABLE J-3

ESTIMATED COST FOR ALTERNATIVE 4 TDF-1 Slope Improvement (2.5H:1V), TDF-2 Partial Soil Cap and Re-Vegetation

Item	Quantity	Units	Unit Cost	Cost	Notes
ENGINEERING COSTS					
Engineering Design Report and Bid Package			$35,000	$35,000	
Pre-Design Survey & Investigation			$25,000	$25,000	
Engineering Permit, Wetland and F&W Issues			$10,000	$10,000	
Construction Surveillance	2	month	$30,000	$60,000	
As-Built Report			$10,000	$10,000	
Legal and Deed Restrictions			$10,000	$10,000	
Engineering Subtotal				**$150,000**	Rounded
Contingency			25%	**$299,000**	
TOTAL ESTIMATED CAPITAL COSTS				**$1,496,000**	
INSPECTION AND MAINTENANCE					
Inspection				$31,540	Net Present Value
Maintenance				$18,491	Net Present Value
Subtotal				**$50,000**	Rounded
Contingency			25%	**$13,000**	
TOTAL I&M COST				**$63,000**	

Notes:
(a) Apply to non-vegetated portion of TDF-1, all of TDF-2, and dam faces for both ponds.

TABLE J-4

ESTIMATED COST FOR ALTERNATIVE 5 TDF-1 Slope Improvement (2.5H:1V), TDF-1 Wetland Removal, TDF-2 Partial Soil Cap, and Re-Vegetation

Item	Quantity	Units	Unit Cost	Cost	Notes
CAPITAL COSTS					
Mob/Demob	1	lump sum	$25,000	$25,000	
Sedimentation Pond	1	ea	$67,245	$67,245	
Silt fence	3,953	lf	$3.50	$13,836	
Temporary Facilities	4	month	$2,200	$8,800	
Upgrade existing access road	1,200	lf	$20	$24,000	
Construct new TDF-1 access road	157	lf	$40	$6,280	
Excavate Tailings	60,342	cy	$5.00	$301,710	
Spread and Compact Tailings	60,342	cy	$2.00	$120,684	
Place soil cap on TDF-1 face	4,429	cy	$22.38	$99,097	
Clear borrow area	1.3	acre	$7,600	$9,745	
Clear wetlands replacement area	1.7	acre	$7,600	$12,859	
TDF-2 cover	3,326	cy	$9.50	$31,596	
Capping Soil	3,326	cy	$13.75	$45,731	
Apply compost and fertilizer by tilling(a)	27.1	acre	$6,002	$162,680	
Wetlands planting	1.7	acre	$12,000	$20,304	
Refurbish existing TDF-1 drainage ditch	4,209	lf	$15.00	$63,135	
Replace drainage pipes	200	lf	$33.00	$6,600	
Construct new TDF-2 drainage ditch	2,395	lf	$30.00	$71,850	
Seeding(a)	28.4	acre	$2,000	$56,774	
Construction Subtotal				**$1,147,927**	

TABLE J-4

ESTIMATED COST FOR ALTERNATIVE 5 TDF-1 Slope Improvement (2.5H:1V), TDF-1 Wetland Removal, TDF-2 Partial Soil Cap, and Re-Vegetation

Item	Quantity	Units	Unit Cost	Cost	Notes
ENGINEERING COSTS					
Engineering Design Report and Bid Package			$35,000	$35,000	
Pre-Design Survey & Investigation			$25,000	$25,000	
Wetlands Functions and Values Delineation			$5,000	$5,000	
Biological Assessment			$10,000	$10,000	
Permitting			$25,000	$25,000	
Construction Surveillance	3	month	$30,000	$90,000	
As-Built Report			$10,000	$10,000	
Legal and Deed Restrictions			$10,000	$10,000	
Engineering Subtotal				**$210,000**	Rounded
Contingency			25%	**$339,000**	
TOTAL ESTIMATED CAPITAL COSTS				**$1,697,000**	
INSPECTION AND MAINTENANCE					
Inspection				$31,540	Net Present Value
Maintenance				$23,720	Net Present Value
Subtotal				**$55,000**	Rounded
Contingency			25%	**$14,000**	
TOTAL I&M COST				**$69,000**	

Notes:
(a) Apply to all TDF areas and borrow area.

TABLE J-5

ESTIMATED COST FOR ALTERNATIVE 6 TDF-1 Slope Improvement (2.5H:1V), TDF-1 and TDF-2 Soil Cap, and Re-Vegetation

Item	Quantity	Units	Unit Cost	Cost	Notes
CAPITAL COSTS					
Mob/Demob	1	lump sum	$25,000	$25,000	
Sedimentation Pond	1	ea	$67,245	$67,245	
Silt fence	3,953	lf	$3.50	$13,836	
Temporary Facilities	4	month	$2,200	$8,800	
Upgrade existing access road	1,200	lf	$20	$24,000	
Construct new TDF-1 access road	157	lf	$40	$6,280	
Excavate Tailings	60,342	cy	$5.00	$301,710	
Spread and Compact Tailings	60,342	cy	$2.00	$120,684	
Place soil cap on TDF-1 face	4,429	cy	$22.38	$99,097	
Clear borrow area	2.6	acre	$7,600	$19,490	
Clear wetlands replacement area	1.7	acre	$7,600	$12,859	
TDF-1 cover	10,049	cy	$11.00	$110,543	
TDF-2 cover	6,352	cy	$9.50	$60,344	
Capping Soil	16,401	cy	$13.75	$225,519	
Apply compost and fertilizer by tilling(a)	28.4	acre	$6,002	$170,375	
Wetlands planting	1.7	acre	$12,000	$20,304	
Refurbish existing TDF-1 drainage ditch	4,209	lf	$15.00	$63,135	
Replace drainage pipes	200	lf	$33.00	$6,600	
Construct new TDF-2 drainage ditch	2,395	lf	$30.00	$71,850	
Seeding(a)	28.4	acre	$2,000	$56,774	
Construction Subtotal				**$1,484,447**	

ESTIMATED COST FOR ALTERNATIVE 6 TDF-1 Slope Improvement (2.5H:1V), TDF-1 and TDF-2 Soil Cap, and Re-Vegetation

Item	Quantity	Units	Unit Cost	Cost	Notes
ENGINEERING COSTS					
Engineering Design Report and Bid Package			$35,000	$35,000	
Pre-Design Survey & Investigation			$25,000	$25,000	
Wetlands Functions and Values Delineation			$5,000	$5,000	
Biological Assessment			$10,000	$10,000	
Permitting			$25,000	$25,000	
Construction Surveillance	3	month	$30,000	$90,000	
As-Built Report			$10,000	$10,000	
Legal and Deed Restrictions			$10,000	$10,000	
Engineering Subtotal				**$210,000**	Rounded
Contingency			25%	**$424,000**	
TOTAL ESTIMATED CAPITAL COSTS				**$2,118,000**	
INSPECTION AND MAINTENANCE					
Inspection				$31,540	Net Present Value
Maintenance				$23,720	Net Present Value
Subtotal				**$55,000**	Rounded
Contingency			25%	**$14,000**	
TOTAL I&M COST				**$69,000**	

Notes:
(a) Apply to all TDF areas and borrow area.

ATTACHMENT B

PEND OREILLE MINE TDF-1 AND TDF-2 HYDROGEOLOGY DATA REVIEW MEMORANDUM, URS CORPORATION, MAY 8, 2008

URS

MEMORANDUM

TO: Ms. Kris McCaig
Senior Environmental Coordinator
Teck Cominco American Incorporated

FROM: David Enos

DATE: May 8, 2008

FILE: 36298248

SUBJECT: Pend Oreille Mine TDF-1 and TDF-2 Hydrogeology Data Review

Introduction and Objectives

URS Corporation (URS) was asked by Teck Cominco American Incorporated (TCAI) to review existing hydrogeological data developed for the area of the Pend Oreille Mine (POM) site near tailings disposal facilities (TDF) #1 and #2. Data reviewed includes the Draft Remedial Investigation/Feasibility Study (RI/FS) Report for the POM TDF-1 and TDF-2 prepared by Golder dated October 17, 2006; Stability Assessment Report, Pend Oreille Tailings Pond No. 1, prepared by Dames and Moore dated July 15, 1988; soil boring and monitoring well logs for various explorations completed at and near TDF-1 and TDF-2; and miscellaneous internal files and reports containing hydrogeologic data pertaining to the site. Figures 1 and 2 present the site vicinity and overall location of tailings facilities at the Pend Oreille Mine site.

The objective of the review was to develop an independent conceptual site hydrogeologic model of near surface groundwater flow conditions in the area of TDF-1 and TDF-2, identify data gaps, if any, and to develop potential monitoring well locations to fill data gaps if warranted. The purpose of the review is to evaluate whether the current groundwater monitoring network is sufficient to characterize potential groundwater chemical impacts of TDF-1 and TDF-2 at the point of compliance as part of the RI/FS conducted for the site.

Conceptual Site Hydrogeologic Model

Near surface groundwater beneath the site appears to be present in unconfined conditions across most of the site. The near surface aquifer appears to be comprised of three different aquifer subunits. These subunits include a thin perched or semi-perched aquifer in the northern portion of the site; the main regional aquifer underlying TDF-2, portions of TDF-1, and extending south to TDF-3; and an aquifer subunit present within saturated zones of TDF-1. The following summarizes our understanding of each of these three aquifer subunit.

Perched Aquifer Subunit. This aquifer is characterized by MW-203. Groundwater elevation at MW-203 is approximately 2,290 feet above mean sea level (MSL) (August 2005), with a saturated thickness of about 3 feet based on the bedrock elevation of 2,287 MSL, which perches the aquifer subunit. This aquifer subunit is comprised of tailings material at the MW-203 location, although it is possible that portions of this aquifer are comprised of glaciofluvial deposits north and northeast of MW-203. Groundwater flow direction is unknown although flow might be toward the regional aquifer southwest or northwest of MW-203. Recharge of this aquifer is likely from upland areas and local precipitation. Figure 3 presents approximate bedrock elevations at exploration locations at the site. Figure 4 presents approximate groundwater elevations.

Regional Aquifer. This aquifer is represented by MW-201; the monitoring wells located north of TDF-3 including MW-2 and MW-7; and possibly the seep located downgradient of TDF-1. Wetlands on TDF-1 might be a transitional area where this aquifer partially recharges the aquifer subunit within TDF-1 and perches on fine-grained tailings material. One historic soil boring completed within TDF-1 during late 1987 might have encountered this unit beneath TDF-1 (Boring 4 in Dames and Moore, 1988). Groundwater elevations vary from about 2,253 feet MSL (August 2005) at MW-201 to approximately 2,263 and 2,267 feet MSL in monitoring wells MW-7 and MW-2 respectively (July 2005). This aquifer is comprised of glaciofluvial sands and gravels with a saturated thickness ranging from about 10 feet near MW-201 to greater than 15.7 feet and 27 feet near MW-2 and MW-7, respectively. The bedrock elevation beneath this aquifer is about 2,200 feet MSL across much of the study area, decreasing to the west and northwest and increasing to the northeast. The northern extent of the aquifer appears bounded by bedrock between MW-201 and MW-202. The bedrock encountered beneath the north portion of TDF-2 appears to have a relatively steep contour between MW-201 and MW-202 becoming less steep between MW-202 and MW-203. Recharge of this aquifer is likely from upland areas including the TDF-1 aquifer subunit, TDF-2 and the perched aquifer subunit, the TDF-3 area, and local precipitation. Discharge of this aquifer is likely through seeps/creeks along the Pend Oreille River canyon and subsurface flow to the Pend Oreille River pool.

TDF-1 Aquifer Subunit. This aquifer subunit is limited to saturated tailings contained within TDF-1. Piezometers PO-1 to PO-5 characterizes groundwater in this subunit. Wetlands located on the southeastern and upgradient side of TDF-1 are likely a transitional area between the regional aquifer and this subunit. Groundwater elevations in this aquifer range from about 2,225 feet MSL near the center of TDF-1 to about 2,250 feet MSL (approximately the ground surface) along the southeastern (upgradient) edge of TDF-1, based on the presence of wetland in this location. Saturated thickness as observed in piezometers varies from 8 feet to 39 feet. Bedrock bounds the lower portion of most of this aquifer subunit although the northwest portion of TDF-1 might be underlain with glaciofluvial sands and gravels. Recharge of this aquifer subunit likely occurs through precipitation on the surface of TDF-1 and inflow from the regional aquifer along the southeastern upgradient edge of TDF-1. Discharge of this aquifer likely occurs through decant and drainage structures constructed within TDF-1, seepage to underlying sands and gravels, and drainage along the tailings dam.

Data Gaps

Perched Aquifer Subunit. Extent and flow direction of this aquifer subunit are unknown. However, it is probable that groundwater from this unit discharges to the regional aquifer northwest or southwest of MW-203. Because this perched aquifer subunit has a relatively thin saturated interval which likely drains to the regional aquifer, no additional investigation is warranted in our opinion.

Regional Aquifer. Within the immediate area near TDF-1 and TDF-2, three wells have been completed into this aquifer. Two of these wells, MW-2 and MW-7, are located upgradient from TDF-1 and TDF-2, but downgradient from TDF-3. MW-201 is located within the TDF-2 area, upgradient from TDF-1. Additional wells have been installed into this aquifer upgradient of the site near TDF-3 but are not considered for this study. The absence of groundwater monitoring wells downgradient from TDF-1 is a data gap.

TDF-1 Aquifer Subunit. Groundwater occurrence, flow direction and gradient, and discharge are relatively well characterized. The hydrogeology relating to the wetland area near the southeast portion of TDF-1 and the interaction of this subunit with the regional aquifer is not well understood.

Recommendations

Perched Aquifer Subunit. URS does not recommend additional characterization of this aquifer subunit given the purpose of identifying potential groundwater chemical impacts at the point of compliance.

Regional Aquifer. URS recommends that three monitoring wells be installed downgradient from TDF-1 as shown on Figure 4. One of these wells, MW-301, should be installed south of the 54000N grid line along the access road west of TDF-1. The second well, MW-302, should be completed between the central portion of TDF-1 and the Pend Oreille River. The third well, MW-303, should be completed immediately north of Stream 2 along the access road. All wells should be completed in unconsolidated soils overlying bedrock. The following provides justification of these wells.

MW-301. This well will provide hydrogeologic control to the southwest, will provide data regarding groundwater chemistry downgradient from the southern portion of the TDF-1, and is likely to represent chemical releases from portions of TDF-1 underlain by bedrock.

MW-302. This well is sited to evaluate groundwater conditions along a flat area downgradient from the central portion of TDF-1. The subsurface conditions in this area are unknown and bedrock might be present at a shallow depth. This well will not be completed if soil borings do not encounter saturated soils above bedrock in this area.

MW-303. This well is sited to capture groundwater discharges from portions of TDF-1 underlain by glaciofluvial deposits. These glaciofluvial deposits likely represent larger groundwater discharges including more potential contaminant mass. In addition, this well will likely represent the combined TDF-1 and TDF-2 affects upstream of the point of compliance.

Each of the new wells should be developed and surveyed as described in the *Draft Work Plan, Groundwater Monitoring Well Installation, Pend Oreille Mine TDF-1*, dated February 20, 2008. Further, URS recommends using monitoring wells MW-2 and MW-7, located downgradient from TDF-3, as upgradient monitoring wells for evaluating TDF-1 and TDF-2 groundwater conditions. Groundwater from monitoring wells MW-2, MW-7, MW-201, MW-

301, MW-302, and MW-303 should be measured and sampled for total metals and other constituents as described in the February 20, 2008 *Draft Work Plan* to evaluate groundwater conditions in the vicinity of TDF-1 and TDF-2.

TDF-1 Aquifer Subunit. URS does not recommend additional characterization of this aquifer subunit. Understanding the interaction of the regional aquifer to the wetlands on TDF-1 is likely not necessary to evaluate groundwater chemical impacts at the point of compliance.

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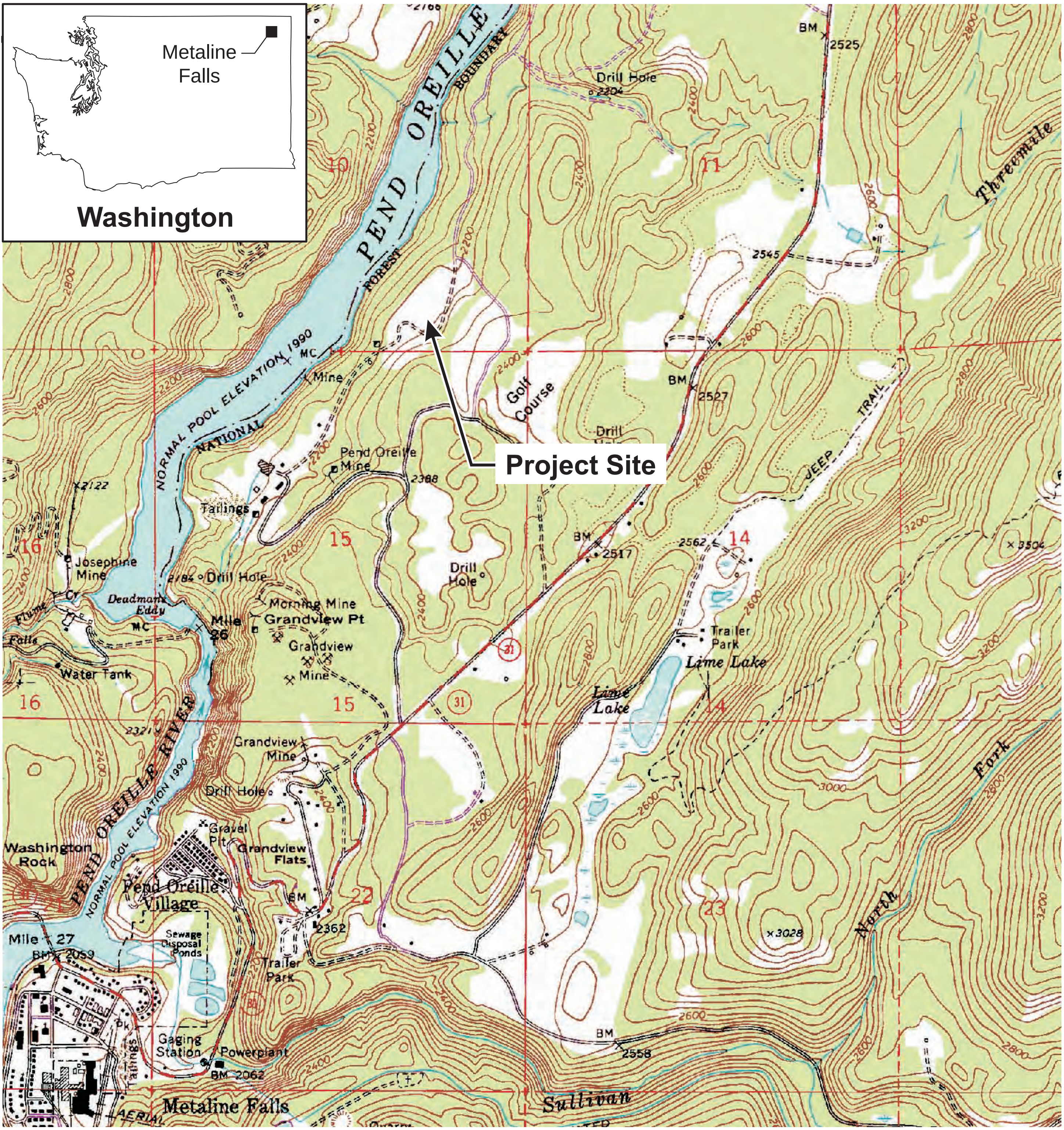


SOURCE: 7.5-minute USGS topographic quadrangles, Metaline Falls and Boundary Dam, Washington, 1986

Job No. 36298284

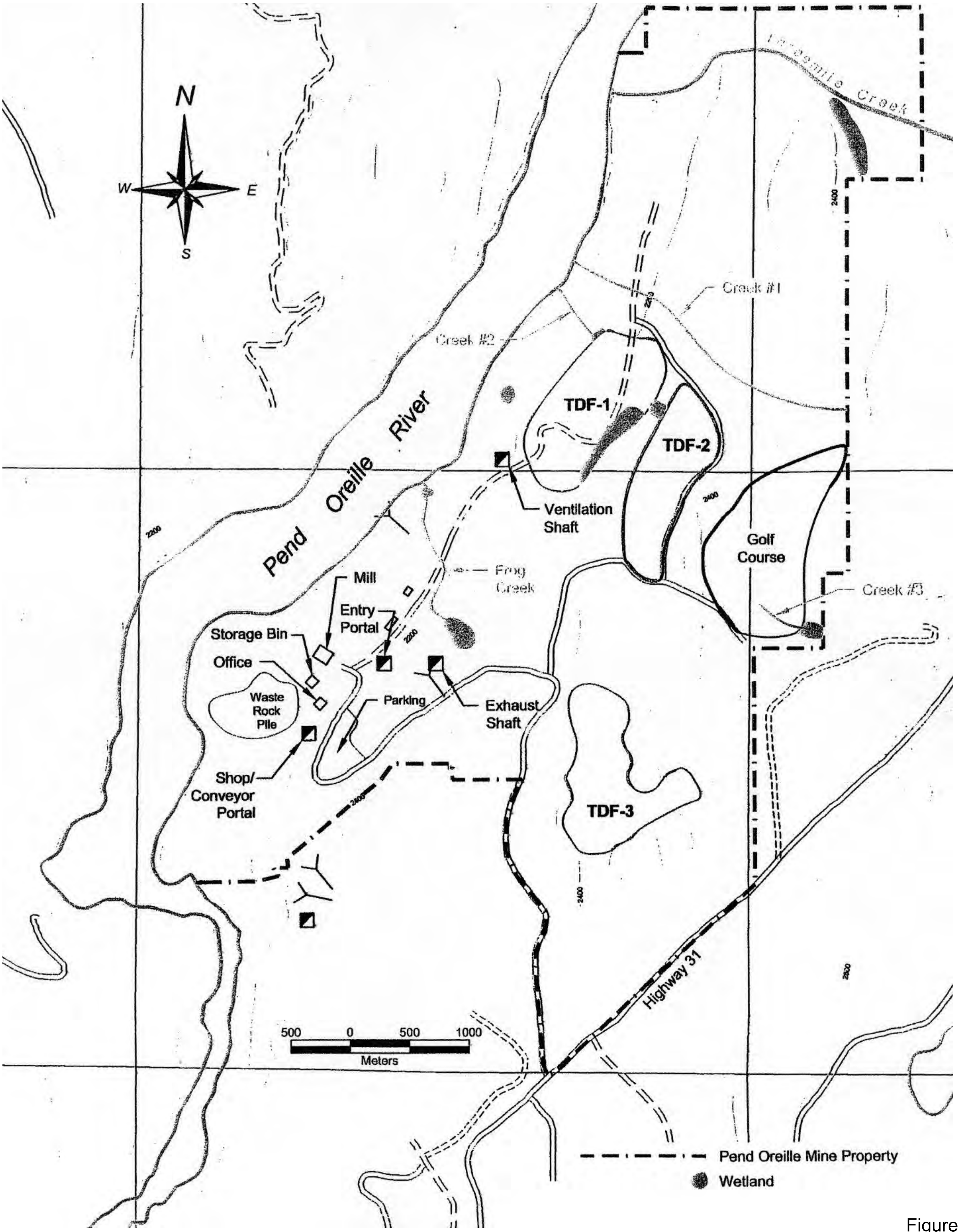
Figure 1

Site Location Map

URS

Teck Cominco American Incorporated
Pend Oreille Mine

Pend Oreille Mine.cdr



SOURCE: ENSR International, 1999

Figure 2
Site Plan

URS

Teck Cominco American, Inc.
Pend Oreille Mine RI/FS

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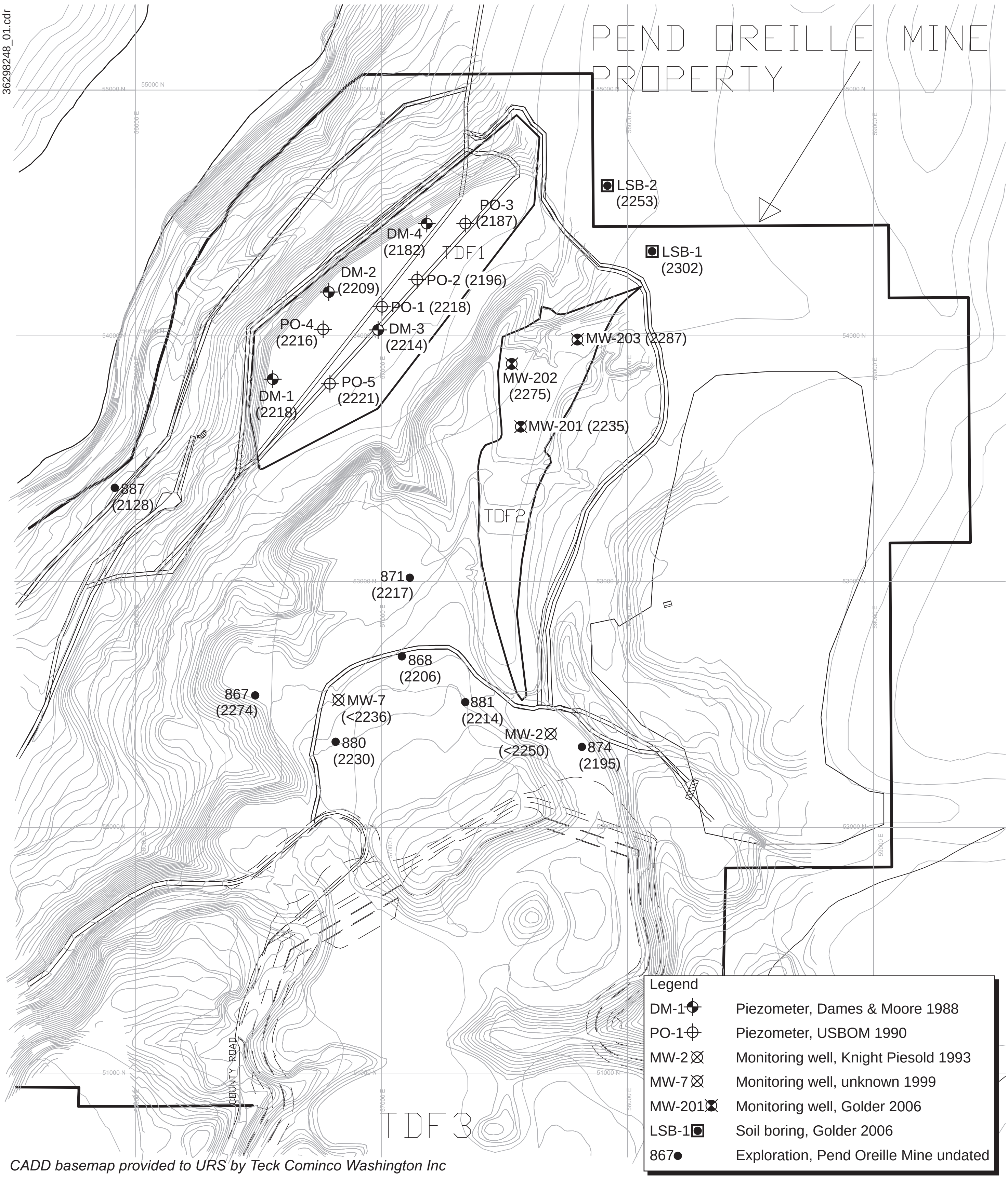

CADD basemap provided to URS by Teck Cominco Washington Inc

All locations
are approximate.

0 500 1,000

Approximate Scale in Feet

Elevations in Feet MSL

Job No. 36298248

Figure 3

Approximate Bedrock Elevations

URS

Teck Cominco Washington Inc
Pend Oreille Mine
Washington

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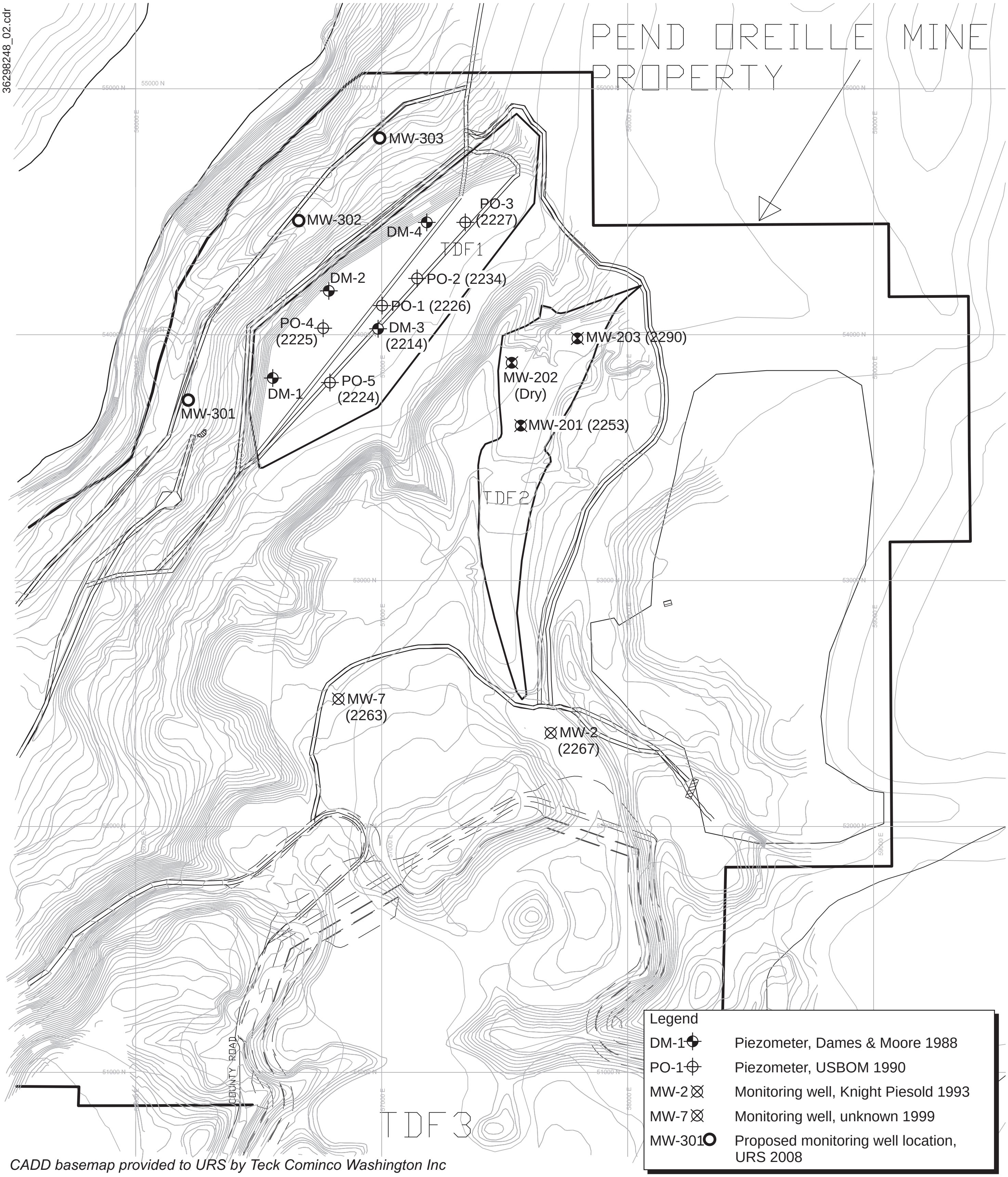

CADD basemap provided to URS by Teck Cominco Washington Inc

All locations
are approximate.

Job No. 36298248

0 500 1,000

Approximate Scale in Feet

Elevations in Feet MSL

Figure 4

Groundwater Elevations and Proposed Monitoring Well Locations

URS

Teck Cominco Washington Inc
Pend Oreille Mine
Washington

ATTACHMENT C

REPORT, SUPPLEMENTAL MONITORING WELL INSTALLATION AND GROUNDWATER MONITORING, PEND OREILLE MINE TDF-1 AND TDF-2, URS CORPORATION, FEBRUARY 24, 2009

URS

REPORT
SUPPLEMENTAL MONITORING WELL INSTALLATION AND GROUNDWATER MONITORING PEND OREILLE MINE TDF-1 AND TDF-2
METALINE FALLS, WASHINGTON

PREPARED FOR:
TECK AMERICAN INCORPORATED

URS JOB NO. 36298248
February 24, 2009

URS

February 24, 2009

Ms. Kris McCaig, Senior Environmental Coordinator
Teck American Incorporated
501 N. Riverpoint Boulevard, Suite 300
Spokane, Washington 99202

Re: Report
Supplemental Monitoring Well Installation
and Groundwater Monitoring
Pend Oreille Mine TDF-1 and TDF-2
Metaline Falls, Washington
URS Job No.: 36298248

Dear Ms. McCaig,

URS Corporation (URS) is pleased to present this report summarizing our supplemental monitoring well installation and groundwater monitoring study at the Teck American Incorporated (TAI) Pend Oreille Mine Tailings Disposal Facility (TDF) #1 and #2. The site is located along the Pend Oreille River, north of Metaline Falls, Washington. This report is based on our February 7, 2008 proposal and our subsequent Work Plan dated May 22, 2008 and revised by letter dated July 31, 2008. URS has prepared this report to document the installation of three groundwater monitoring wells and the results of two groundwater sampling events at the site.

We trust this report provides you with the information you require. Should you have questions regarding the information presented in this report or need further assistance, please contact us.

Sincerely,
URS Corporation

R. David Enos, LG, LHG
Vice President, Branch Office Manager

State of Washington
Hydrogeologist
402
Licensed Geologist
R David Enos

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APPENDICES

1.0 INTRODUCTION AND BACKGROUND

Teck American Incorporated (TAI) is conducting a remedial investigation/feasibility study (RI/FS) to select remedial alternatives for closure of the historic Pend Oreille Mine tailings disposal facilities (TDF) #1 and #2. The site is located along the Pend Oreille River, north of Metaline Falls, Washington as shown on Vicinity Map, Figure 1. The RI/FS is being conducted under Agreed Order No. 2585 between TAI and the Washington State Department of Ecology (Ecology). The draft "Remedial Investigation/Feasibility Study Report for the Pend Oreille Mine Tailing Disposal Facilities TDF-1 and TDF-2, Metaline Falls, Washington" was prepared for TAI by Golder Associates (Golder) and submitted to Ecology on October 17, 2006. As part of the RI/FS, groundwater, seep water, soil, tailings, and vegetation material in the vicinity of TDF-1 and TDF-2 were sampled and analyzed. Based on review of the draft RI/FS report, Ecology provided comments to TAI that additional assessment activities were necessary in the area of TDF-1 and TDF-2 to complete characterization of the potential groundwater threat to human health and the environment. These comments were provided in a letter to TAI dated January 16, 2008 and during several subsequent meetings between TAI, URS, and Ecology.

To address Ecology's concerns, URS reviewed the exiting hydrogeologic data and developed an independent site conceptual model of near surface groundwater flow conditions. The findings of this study were presented in a memorandum dated May 8, 2008 entitled "Pend Oreille Mine TDF-1 and TDF-2 Hydrogeology Data Review". In summary, the site conceptual model described that near surface groundwater beneath the site generally occurs within three aquifer subunits including: (1) a perched aquifer subunit present beneath the northern portion of TDF-2, (2) an aquifer subunit comprised of saturated tailings within TDF-1, and (3) a regional aquifer subunit comprised of granular material underlying portions of TDF-1 and TDF-2. This study also evaluated the existing groundwater monitoring network relative to the site conceptual model and identified potential actionable data gaps including:

1. The interaction between the wetland area near the southeast portion of TDF-1 and the regional aquifer is not well characterized;
2. Groundwater monitoring wells are not present within the regional aquifer subunit downgradient of TDF-1.

In addition to data gaps identified during the data review, Ecology provided a third actionable data gap including:

3. Upgradient groundwater conditions are not defined in the RI/FS.

To address these data gaps, URS conducted this supplemental monitoring well installation and groundwater monitoring study as described in the following sections of this report.

2.0 ENVIRONMENTAL SETTING

2.1 GEOLOGIC SETTING

The site is located within the Pend Oreille River valley in an area consisting of Cambrian- through Silurian/Devonian-aged sedimentary carbonate and slate bedrock that has been folded and faulted to create a prominent mountainous topography. Recent glaciations in the Quaternary Period further shaped the land into dissected highlands and glacial valleys. A more detailed discussion of site geologic setting, including bedrock occurrence and formation descriptions, is provided in the October 17, 2006 draft report "Remedial Investigation/Feasibility Study Report for the Pend Oreille Mine Tailing Disposal Facilities TDF-1 and TDF-2, Metaline Falls, Washington" prepared by Golder for TAI.

2.2 SOILS

Soils in the general area of study consist of glacial drift that has been locally reworked by fluvial processes or by man. Soil types observed during the installation of monitoring wells generally consisted of silt, silty sands, and silty gravels. Soil thickness was observed to range from approximately 4 feet at the location of MW-303 to greater than 15 feet at the locations of monitoring wells MW-301 and MW-302.

2.3 HYDROGEOLOGIC SETTING

The October 17, 2006 draft report "Remedial Investigation/Feasibility Study Report for the Pend Oreille Mine Tailing Disposal Facilities TDF-1 and TDF-2, Metaline Falls, Washington," prepared by Golder for TAI, describes the general nature of groundwater and surface water flow and hydrogeologic conditions at the site. The May 8, 2008 memorandum "Pend Oreille Mine TDF-1 and TDF-2 Hydrogeology Data Review" prepared by URS provides a specific hydrogeologic site conceptual model for near surface groundwater occurrence in the area of TDF-1 and TDF-2.

3.0 SCOPE OF SERVICES

The purpose of the project was to further evaluate groundwater conditions in the area of historic tailing disposal facilities TDF-1 and TDF-2. This included installing three groundwater monitoring wells downgradient from TDF-1 (MW-301, MW-302, and MW-303); collecting groundwater samples from the three new wells, two existing on-site wells located at TDF-2 (MW-201 and MW-203), and two existing wells upgradient of TDF-1 and TDF-2 (MW-2 and MW-7) in August 2008 and December 2008; measuring depth-to-water in these wells; and collecting a seep water sample from a seep complex located southeast portion of TDF-1 between TDF-1 and TDF-2.

This work was accomplished in general accordance with the Ecology approved RI/FS Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) prepared by Golder dated May 24, 2005; URS proposal dated February 7, 2008; and the URS Work Plan dated May 22, 2008, which was revised by a letter dated July 31, 2008. In accordance with the proposal and work plan, site investigation activities included the following tasks:

- Prepared a health and safety plan in accordance with WAC 296-62 and CFR 1910.120.
- Contacted the one-call public utility notification organization.
- Contracted Environmental West Exploration, a licensed drilling firm, to drill and install three groundwater monitoring wells. These wells were designated MW-301, MW-302, and MW-303. URS collected soil samples at intervals of approximately five feet during drilling using decontaminated split-spoon sampling devices. Soil conditions were described using the Unified Soil Classification System (USCS) by a URS geologist.
- Installed a two-inch-diameter polyvinyl chloride (PVC) monitoring well into each soil boring. Wells were constructed as resource protection wells consistent with Washington Administrative Code (WAC) 173-160. Start cards were submitted to Ecology prior to the start of field activities.
- Placed the soil cuttings from drilling and decontamination liquids into labeled drums that were placed on TDF-1 See Investigation Derived Waste (IDW) Section for discussion.
- Coordinated with a licensed surveying firm to survey the elevation and location of top of casing for each new well.

- Developed each new well by purging at least five well volumes from each well.
- Collected groundwater samples from each of the new wells in August and December 2008. Each well was purged using low-flow sampling techniques using a peristaltic and/or a decontaminated submersible pump for shallow wells (MW-301, MW-302, and MW-303).
- Collected groundwater samples from existing monitoring wells MW-201 and MW-203 in August and December 2008 and from MW-2 and MW-7 in December 2008 using a decontaminated submersible pump.
- Teck Washington Incorporated (TWI), the owner of the Pend Oreille Mine, collected August 2008 groundwater monitoring data from existing monitoring wells MW-2 and MW-7. These monitoring wells are located upgradient from TDF-1 and TDF-2 and are routinely sampled under a State Industrial Waste Discharge permit managed by TWI for Pend Oreille Mine tailings discharged to TDF-3.
- Groundwater samples were placed in laboratory-prepared and -preserved sample containers and submitted to TestAmerica Laboratories of Spokane, Washington for laboratory analysis for total Ag, As, Ba, Ca, Cd, Cr, Cu, Fe, Hg, Mn, Zn, Pb, and Se by Environmental Protection Agency (EPA) 200 Series Methods; alkalinity by Standard Method 2320B; and chloride and sulfate by EPA Method 300. Groundwater samples collected during the December 2008 event were analyzed for total As, Cr, Fe, Mn, Mg, and Pb by EPA 200 Series Methods; alkalinity by Standard Method 2320B; and chloride and sulfate by EPA Method 300. Samples were submitted under chain-of-custody. Note that samples collected from monitoring wells MW-2 and MW-7 in August 2008 by TWI personnel were submitted to SVL Labs of Kellogg, Idaho for a slightly different suite of analytes.
- Measured the depth to groundwater in each well before purging using a decontaminated water level indicator.

4.0 FIELD ACTIVITIES

Field activities for the Pend Oreille Mine TDF-1 and TDF-2 supplemental monitoring well installation and groundwater sampling study were conducted during August 2008 and December 2008. Monitoring well installation occurred on August 4, 2008. The initial groundwater monitoring event occurred on August 7, 2008 (monitoring wells MW-301, MW-302, MW-303, and the seep). TWI conducted groundwater monitoring on August 4, 2008 (monitoring wells MW-2 and MW-7). On August 15, 2008, URS completed August 2008 groundwater monitoring by collecting groundwater samples from MW-201 and MW-203 (the August sampling event was troubled with a malfunctioning pump controller and was conducted on multiple days). The second groundwater monitoring event occurred on December 10, 2008.

URS observed monitoring well installation; collected soil and groundwater samples from monitoring wells MW-201, 203, 301, 302, 303, and the seep; and arranged for laboratory analyses. TWI personnel collected groundwater samples and arranged for laboratory analyses for monitoring wells MW-2 and MW-7 during the August 2008 sampling event; URS coordinated sampling of these wells during the December 2008 event.

URS subcontracted Environmental West Exploration of Spokane, Washington to install and develop the three groundwater-monitoring wells in accordance with Ecology standards for construction of wells (WAC 173-160). Field sheets, logbooks and photographs were used by URS to document the investigation activities. At the time of well installation, Ecology personnel were also on-site to observe well installation and provided insight into local and regional hydrogeologic conditions, as encountered.

4.1 GROUNDWATER MONITORING WELL INSTALLATION

Three new above-grade groundwater-monitoring wells labeled MW-301, MW-302, and MW-303 were installed on August 4, 2008. URS documented Environmental West's fieldwork for compliance with project specifications. Soil samples were collected for field screening prior to the installation of each well. Soil cuttings, decontamination rinse water and purge water resulting from well development were placed in several 55 gallon drums. The drums were placed at TDF-1 pending disposal.

Soil samples were collected approximately every 5 feet during drilling using decontaminated split-spoon sampling devices. Soil conditions were described using the Unified Soil Classification System (USCS) by a URS geologist. Each soil sample was screened for potential contamination using visual methods. Boring logs for each well installation are included in Appendix A.

Monitoring wells MW-301 and MW-303 were installed downgradient of TDF-1 near the property boundary, along an access road. MW-302 was installed downslope (west) of the northwestern portion of TDF-1 near an area of seeps. The locations of the new and existing monitoring wells are shown in Groundwater Elevations and Monitoring Well Locations, August 2008, and Groundwater Elevations and Monitoring Well Locations, December 2008, Figures 2 and 3, respectively.

Soils encountered during drilling of monitoring well MW-301 included silty fine to medium gravel to about seven feet bgs and silty fine to medium sand to 15 feet bgs, the total depth of the boring. Soil encountered during drilling MW-302 included silt to about seven feet bgs and silty fine to medium gravel with sand to 15 feet, the total depth of the boring. Soil encountered during drilling of MW-303 included fine to coarse gravel to five feet bgs underlain by dry slate bedrock. The total depth of MW-303 was 13 feet bgs.

The wells were installed in accordance with Ecology Standards for construction of wells (WAC 173-160) and the SAP. Each well screen was two-inch diameter, Schedule 40 PVC with 0.010-inch screen slots. Groundwater was encountered at approximately five feet below ground surface (bgs) during drilling of MW-301 and the screen was placed from 4½ to 15 feet bgs. At MW-302, groundwater was encountered at approximately nine feet bgs and the screen was placed from eight to 15 feet bgs. At MW-303, groundwater was encountered at approximately four feet bgs and the screen was placed from four to 13 feet bgs. The wells were developed following the procedures outlined in the SAP. Well logs are presented in Appendix A. Well elevations and locations for the monitoring wells were acquired by a surveyor under contract with TWI.

4.2 GROUNDWATER MONITORING

The existing monitoring wells (MW-201 and MW-203) and the new monitoring wells (MW-301, MW-302, and MW-303) were sampled by URS between August 7 and 10, 2008, and December 10, 2008. Existing monitoring well MW-202 did not contain groundwater and was not sampled. Groundwater samples were collected by TWI personnel from existing upgradient wells MW-2 and MW-7 on August 4, 2008; URS collected groundwater samples from these wells on December 10, 2008. Low-flow, minimal draw down sampling methods were utilized for groundwater sampling. Before purging, depth-to-water measurements were obtained at all wells. Well purging was conducted at a flow rate between 0.1 and 0.5 L/min. During purging, specific conductance, temperature, pH, dissolved oxygen, and turbidity measurements were recorded at regular intervals using a Horiba U22 Water Quality Meter. Samples were obtained once the water quality parameters stabilized where successive water quality measurements had a difference of less than 10%. Samples were packaged and transported under Chain-of-Custody procedures to the laboratory. Decontamination, record keeping, and purge water disposal was performed in general accordance with the QAPP.

During the August 2008 monitoring event, a water sample was collected from a temporary seep sampling point installed between TDF-1 and TDF-2. The sampling point is identified as ‘Seep.’ This location was not sampled during the December 2008 monitoring because the presence of ice and snow created access and safety issues.

Depth to groundwater measurements were collected from the monitoring wells during each groundwater sampling event. These measurements were used to calculate the groundwater elevations in each well. Note that groundwater was not detected in monitoring well MW-202. The results are presented in Groundwater Elevations, TDF-1 and TDF-2, Table 1.

In August 2008, groundwater elevations ranged from 2,116.80 feet above mean sea level (MSL) in monitoring well MW-301 to 2,374.92 feet MSL in monitoring well MW-7. Groundwater flow direction of the unconfined regional aquifer in the area between TDF-1 and TDF-2 was estimated to flow to the north-northwest under a gradient of 0.008 ft/ft. Groundwater flow direction downslope (northwest) of TDF-1 is estimated to flow generally northwest toward the river.

Between the August 2008 and December 2008 events, groundwater elevations decreased in monitoring wells MW-302, MW-201, MW-203, MW-2, and MW-7. Decreases ranged from 0.08 feet in MW-201 to 1.06 feet in MW-7. Groundwater elevation increased 0.96 feet in monitoring wells MW-301 and 0.37 feet in MW-303. Groundwater gradient was estimated to flow to the northwest under a gradient of 0.008 ft/ft.

Groundwater flow direction in the perched aquifer subunit located near the MW-203 location could not be established. Based on absence of groundwater at the MW-202 location, groundwater flow is likely to the northwest and the river. Groundwater elevation and flow direction maps generated using groundwater elevation data collected during the August and December 2008 events are presented as Figures 2 and 3, respectively.

5.0 ANALYTICAL RESULTS

URS subcontracted with TestAmerica of Spokane, Washington to analyze groundwater samples for this project. Groundwater samples collected from MW-2 and MW-7 during the August 2008 event were collected by TWI personnel and were analyzed by SVL Analytical of Kellogg, Idaho.

The groundwater analytical results are summarized below and presented in Summary of Groundwater Analytical Results, TDF-1 and TDF-2, Table 2. Laboratory data are included in Appendix B.

5.1 AUGUST 2008

Total arsenic was detected in the groundwater sample collected from MW-203 at a concentration of 0.00899 milligrams/liter (mg/l), exceeding the Model Toxics Control Act (MTCA) Method A groundwater cleanup level. Total manganese was detected in the groundwater sample collected from MW-302 at a concentration of 3.51 mg/l, exceeding the MTCA Method B groundwater cleanup level. Total chromium was detected at a concentration exceeding the Method A groundwater cleanup level for hexavalent chromium in upgradient well MW-7 during the August 2008 sampling event; it is unlikely that hexavalent chromium is present in groundwater at this location considering the geochemical conditions of groundwater at the site. All remaining analytes in the groundwater samples from the monitoring wells and seep were either not detected or were detected at concentrations less than the MTCA Method A or Method B groundwater cleanup level, if established.

5.2 DECEMBER 2008

Total manganese was detected in the groundwater sample collected from MW-302 at a concentration of 2.85 mg/l, exceeding the MTCA Method B groundwater cleanup level. All other analytes were either not detected or were detected at concentrations less than applicable MTCA Method A or Method B groundwater cleanup levels.

6.0 INVESTIGATION DERIVED WASTE

Soil cuttings, decontamination rinse water and purge water resulting from the development of the three new wells were placed into appropriately labeled UN-approved 55-gallon drums. The drums were transported to TDF-1 for temporary storage pending disposal. The drums were to be emptied on to the surface of TDF-1 during the December 2008 monitoring event, but adverse conditions did not allow for this to be completed. TWI personnel have subsequently disposed of the material as planned and have recycled the drums.

7.0 SUMMARY AND CONCLUSIONS

To supplement the site draft RI/FS, URS conducted monitoring well installation and groundwater monitoring at the TAI Pend Oreille Mine TDF-1 and TDF-2 site. As part of this study, three additional monitoring wells were installed to supplement the three existing monitoring wells completed in 2005 at the site. Groundwater from these new and existing wells, water from one seep present between TDF-1 and TDF-2, and groundwater from two existing upgradient wells were sampled and analyzed for contaminants of concern.

Findings of this Supplemental Monitoring Well Installation and Groundwater Monitoring Report generally support earlier discussions of groundwater occurrence and hydrogeologic conditions including:

- Groundwater was not present in monitoring well MW-202 in August 2008 and December 2008 during this supplemental study.
- Results of analysis indicated that arsenic was present in well MW-203 during the August 2008 sampling event at concentrations exceeding the MTCA Method A groundwater cleanup level; the arsenic concentration in this well was less than the MTCA Method A groundwater cleanup level during the December 2008 sampling event. Monitoring well MW-203 is located in the TDF-2 area.
- Results indicate that manganese was present at a concentration exceeding the MTCA Method B groundwater cleanup level at well MW-302, located immediately downgradient of the northwestern portion of TDF-1, during the August 2008 and December 2008 sampling event.
- Total chromium was detected in groundwater at a concentration exceeding the Method A groundwater cleanup level for hexavalent chromium at upgradient well MW-7 during the August 2008 sampling event; it is unlikely that significant hexavalent chromium is present in groundwater at this location considering the geochemical conditions of groundwater at the site. Chromium was not detected at MW-7 during the December 2008 sampling event.
- Monitoring wells MW-301 and MW-303, located downgradient of TDF-1 and TDF-2 near the property boundary, did not contain contaminants of concern at concentrations exceeding MTCA groundwater cleanup levels during the August 2008 and December 2008 sampling events.

- The permeable sand and gravel unconfined aquifer unit discussed in the draft RI/FS report, and referred to as the regional aquifer subunit in the hydrogeologic data review memorandum appears to be continuous between TDF-2 (MW-201) and monitoring wells MW-2 and MW-7. Groundwater flow direction of this aquifer appears to be to the northwest to north-northwest under a gradient of about 0.01 ft/ft in the southeastern portion of the site. Groundwater gradient appears to be to the northwest in the northwestern portion of the site, significantly increasing in gradient west of TDF-1 as groundwater approaches the Pend Oreille River. Groundwater discharge of this aquifer appears to occur at several locations including a zone of seeps located near the southeast edge of TDF-1 between TDF-1 and TDF-2; at a zone of seeps downgradient of the northwest portion of TDF-1 near the MW-302 location; Creek 1 and Creek 2 north and west of TDF-1; and likely through groundwater and seep discharge near the eastern bank of the Pend Oreille River.
- Monitoring wells MW-301, 302, and 303 appear to be placed hydraulically downgradient from TDF-1 and TDF-2 source areas.

8.0 LIMITATIONS

The findings and conclusions documented in this report have been prepared for specific application to this project and have been developed in a manner consistent with the level of care and skill normally exercised by members of the environmental science profession currently practicing under similar conditions in the area, and in general accordance with the terms and conditions set forth in our Agreement, and with the URS proposal dated February 7, 2008. No other warranty, express or implied, is made.

The findings presented in this report are based on conditions observed at specific site locations and sampling intervals at the time of the assessment. Because conditions between the boreholes and sampling intervals may vary over distance and time, the potential always remains for the presence of unknown, unidentified, unforeseen, or changed surface and subsurface contamination. Conclusions in this report are based on comparison of chemical analytical results to current regulatory standards.

This report is for the exclusive use of the TAI and their representatives. No third party shall have the right to rely on our opinions rendered in connection with the services or in this document without our written consent and the third party's agreement to be bound to the same conditions and limitations as TAI.

URS appreciates the opportunity to provide these services. Please contact the undersigned regarding any questions related to the information provided in this letter report.

9.0 REFERENCES

Golder Associates Inc., “Draft Remedial Investigation/Feasibility Study Report for the Pend Oreille Mine Tailing Disposal Facilities TDF-1 and TDF-2.” 17 October 2006.

Golder Associates Inc., “Appendix A: Sampling and Analysis Plan for the Pend Oreille Mine Tailing Disposal Facilities TDF-1 and TDF-2 Remedial Investigation/Feasibility Study.” 24 May 2005.

Golder Associates Inc., “Appendix B: Quality Assurance Project Plan for Remedial Investigation/Feasibility Study at the Pend Oreille Mine Tailings Disposal Facilities TDF-1 and TDF-2.” 24 May 2005.

URS. Memorandum, “Pend Oreille Mine TDF-1 and TDF-2 Hydrogeology Date Review” prepared for Teck Cominco American Incorporated, 8 May 2008.

FIGURES

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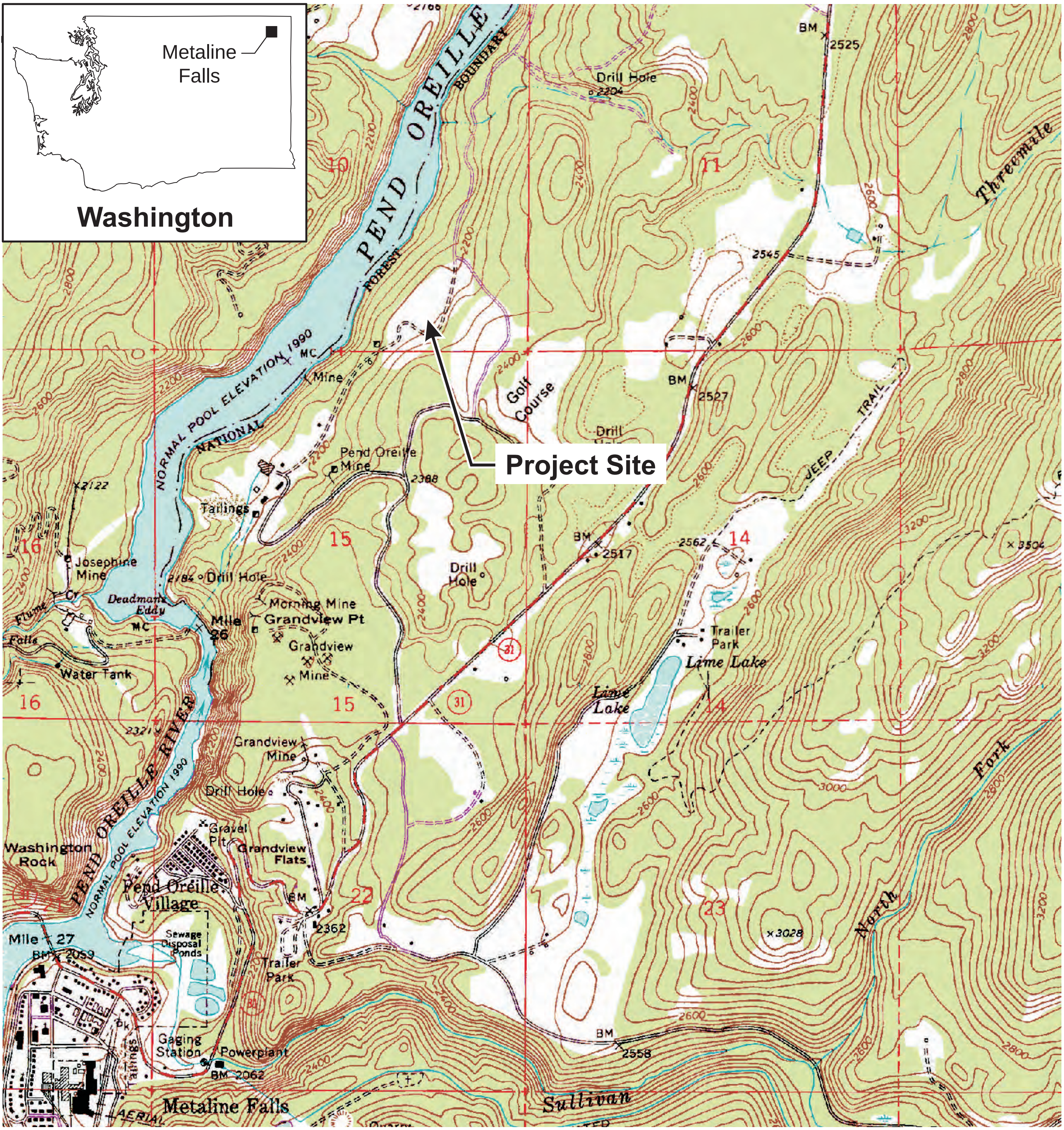


SOURCE: 7.5-minute USGS topographic quadrangles, Metaline Falls and Boundary Dam, Washington, 1986

N

0 0.5 1

Scale in Miles

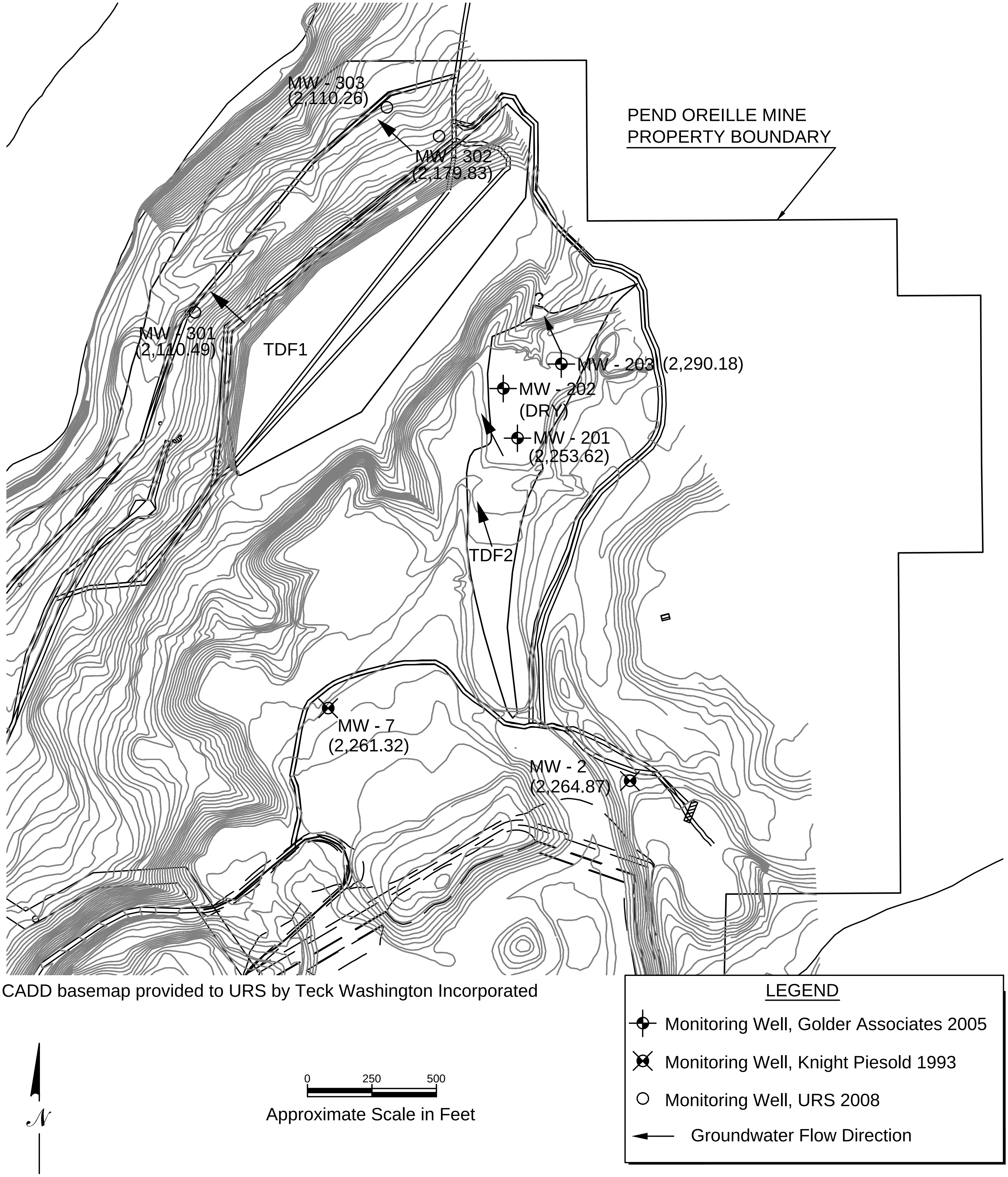
Job No. 36298248

Figure 1

Site Location Map

URS

Teck American Incorporated
Pend Oreille Mine



CADD basemap provided to URS by Teck Washington Incorporated

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Figure 2

Groundwater Elevations and Monitoring Well Locations - August 2008

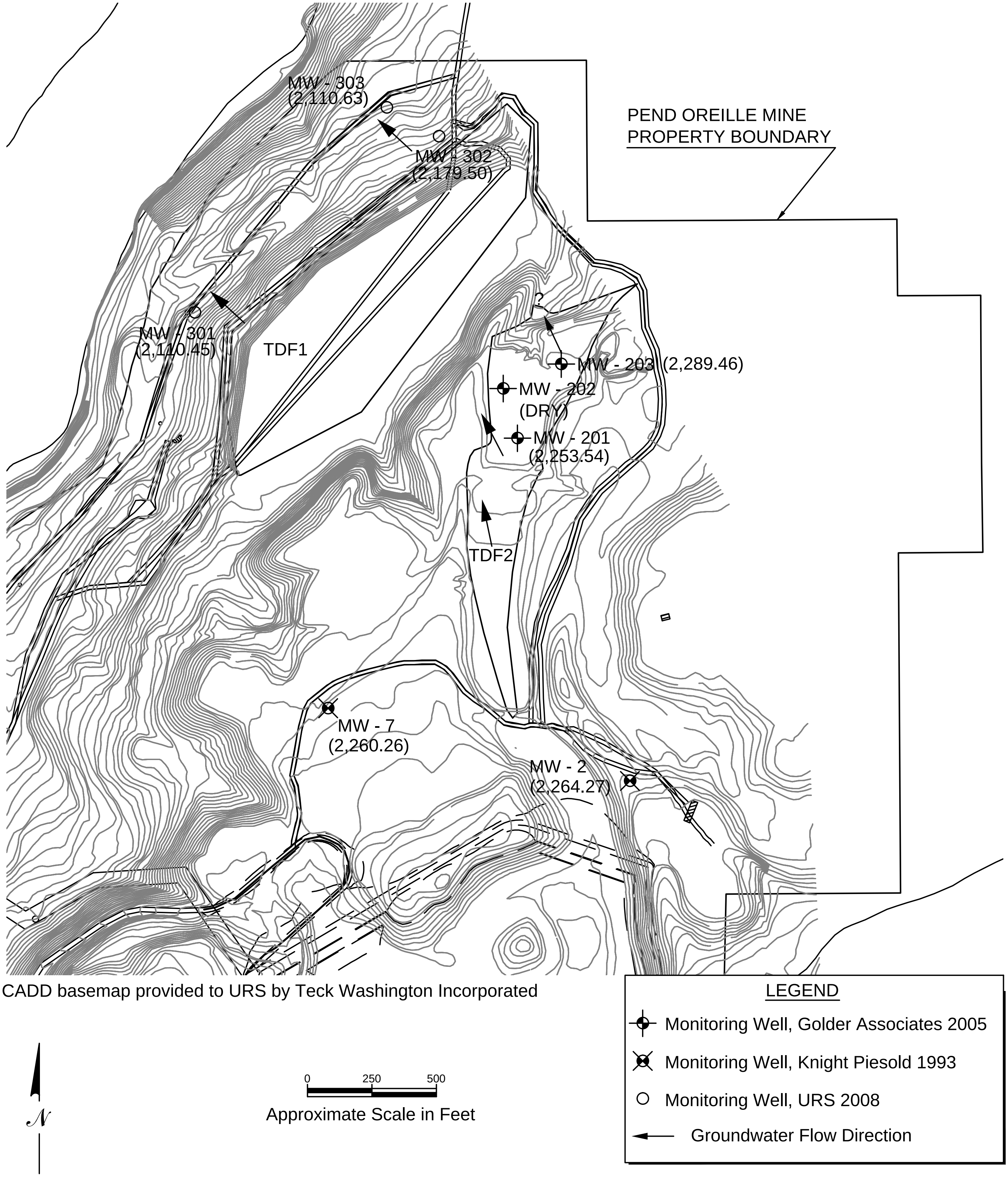
TDF-1 and TDF-2 RI/FS

Job No. 36298248

All locations are approximate

Teck American Incorporated
Pend Oreille Mine
Washington

URS



CADD basemap provided to URS by Teck Washington Incorporated

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Figure 3

Groundwater Elevations and Monitoring Well Locations - December 2008

TDF-1 and TDF-2 RI/FS

Job No. 36298248

All locations are approximate

Teck American Incorporated
Pend Oreille Mine
Washington

URS

TABLES

Table 1
Groundwater Elevations
TDF-1 and TDF-2

Monitoring Well Information		Depth to Water		Groundwater Elevation	
Monitoring Well ID	Casing Elevation	August 2008	December 2008	August 2008	December 2008
MW-201	2,335.07	81.45	81.53	2,253.62	2,253.54
MW-202	2,332.50	dry	dry	-	-
MW-203	2,332.68	42.50	43.22	2,290.18	2,289.46
MW-301	2,116.80	7.31	6.35	2,109.49	2,110.45
MW-302	2,189.30	9.47	9.80	2,179.83	2,179.50
MW-303	2,116.99	6.73	6.36	2,110.26	2,110.63
MW-2	2,348.87	84.00	84.60	2,264.87	2,264.27
MW-7	2,374.92	113.60	114.66	2,261.32	2,260.26

Notes:
Survey data provided by CLC Associates, Inc.

TABLE 2
Summary of Groundwater Analytical Results
August 2008 and December 2008
Pend Oreille Mine TDF-1 and TDF-2 RI/FS

Sample ID:	MTCA GW Screening Levels		**MW-201**	**MW-201**	**MW-203**	**MW-203**	**MW-301**	**MW-301**	**MW-302**		**MW-302**		**MW-303**	**MW-303**	**Seep**	**MW-2***	**MW-2**	**MW-7***	**MW-7**
Sample Date:			8/15/2008	12/10/2008	8/15/2008	12/10/2008	8/7/2008	12/10/2008	8/7/2008		12/10/2008		8/7/2008	12/10/2008	8/7/2008	8/7/2008	12/10/2008	8/7/2008	12/10/2008
Field QC:	**Method A**	**Method B**								DUP		DUP							
Metals (mg/L)																			
Arsenic	0.005	0.000058	0.00100 U	0.00100 U	**0.00899**	0.00100 U	0.00100 U	0.00100 U	0.00100 U	0.00100 U	0.00100 U	0.00100 U	0.00100 U	0.00100 U	0.00100 U	-	0.00139	-	0.00117
Barium	NE	3.2	0.0502	-	0.177	-	0.0593	-	0.114	0.115	-	-	0.0576	-	0.397	-	-	-	-
Cadmium	0.005	0.008	0.00200 U	-	0.00200 U	-	0.00200 U	-	0.00243	0.00247	-	-	0.00200 U	-	0.00283	<0.0020	-	<0.0020	-
Calcium	NE	NE	73.5	-	188	-	286	-	155	157	-	-	176	-	99.5	71.7	-	70.7	-
Chromium	0.05	24 (Cr^{+3}) / 0.048 (Cr^{+6})	0.00800 U	0.00800 U	0.0326	0.00800 U	0.00800 U	0.00800 U	0.00800 U	0.00800 U	0.00800 U	0.00800 U	0.00800 U	0.00800 U	0.0453	<0.0060	0.00866	1.52	0.00800 U
Copper	NE	0.59	0.00800 U	-	0.0426	-	0.00800 U	-	0.00800 U	0.0176	-	-	0.00800 U	-	0.0741	<0.00100	-	<0.00100	-
Iron	NE	NE	0.0200	0.406	20.0	0.0868	0.179 J	0.183	0.0332 J	0.0221 J	0.706	0.730	1.32 J	1.53	53.5 J	<0.060	1.76	6.52	0.114
Lead	0.015	NE	0.00100 U	0.00100 U	0.0138	0.00100 U	0.00119	0.00100 U	0.00155	0.00100 U	0.00100 U	0.00100 U	0.00146	0.00100 U	0.00178	<0.0075	0.00100 U	<0.0075	0.00100 U
Magnesium	NE	NE	21.2	21.6	64.2	51.5	64.4	59.6	45.5	45.8	51.6	50.6	52.3	57.7	37.0	22.1	25.7	23.6	23.2
Manganese	NE	2.2	0.0100 U	0.0174	0.876	0.159	0.0100 U	0.0162	**3.51**	**3.53**	**2.85**	**2.80**	0.273	0.0808	1.11	<0.0040	0.0989	0.0995	0.0221
Mercury	0.002	0.0048	0.000200 U	-	0.000200 U	-	0.000200 U	-	0.000200 U	0.000200 U	-	-	0.000200 U	-	0.000200 U	<0.00020	-	<0.00020	-
Selenium	NE	0.08	0.00114	-	0.000808	-	0.00318	-	0.00100 U	0.00100 U	-	-	0.0151	-	0.00132	-	-	-	0.00132
Silver	NE	0.08	0.0100 U	-	0.0100 U	-	0.0100 U	-	0.0100 U	0.0100 U	-	-	0.0100 U	-	0.0100 U	<0.0050	-	<0.0050	-
Zinc	NE	4.8	0.0100 U	0.0100 U	0.142	0.0107	0.0319	0.0342	0.0620	0.0638	0.119	0.114	0.0522	0.0259	0.300	<0.0100	0.0135	<0.0100	<0.01
Anions (mg/L)																			
Chloride	NE	NE	10.4	8.35	0.720	0.620	3.21	3.62	7.10	5.00	4.25	4.34	7.00	5.38	8.00	0.854	5.89	5.60	1.51
Sulfate	NE	NE	22.4	27.4	356	594	833 J	960	348 J	349 J	764	778	477 J	790	88.5 J	73.2	54.3	36.5	74.0
Conventionals (mg/L)																			
Total Alkalinity	NE	NE	240	243	270	265	270	265	293	285	285	283	245	250	310	310	245	310	210
Field Parameters:																			
Temperature			9.00	9.00	9.40	9.40	12.34	7.07	11.44	-	8.35	-	11.47	7.51	12.45	11.77	8.86	10.30	9.42
pH			7.44	7.35	7.05	7.27	6.87	6.93	6.55	-	7.08	-	6.78	7.14	6.88	7.62	7.48	7.64	7.51
Turbidity (NTU)			31.9	79	180	32	49.9	16	43.8	-	70	-	47.1	110	306	-	45	-	31
Dissolved Oxygen (mg/l)			6.80	6.10	7.56	3.30	5.99	6.60	3.44	-	3.00	-	3.33	4.80	4.66	-	5.30	-	5.90
Conductivity (umhos/cm)			0.90	0.534	1.14	1.16	1.79	1.51	99.90	-	1.16	-	42.20	1.17	1.89	540	0.599	530	0.534

Notes:

Chemical analysis by TestAmerica, Spokane, Washington.

* Chemical analysis by SVL Analytical, Kellogg, Idaho. Samples collected by TAI.

Bolded values indicate the MTCA Method A or B groundwater screening levels were exceeded.

mg/L = milligrams per liter

U = Not detected above reporting limit

J = Estimated value

DUP = Field duplicate

GW = Groundwater

Field parameters measured using a Horriba 22. Temperature in degrees Celcius. pH='power of hydrogen'. Turbidity = Nephelometric Turbidity Units (NTUs). Dissolved Oygen =mg/l

NE = Not established

Model Toxics Control Act (MTCA) Cleanup Regulation, WAC 173-340. MTCA Method A and B values are from Ecology website CLARC tables downloaded August 2008 (https://fortress.wa.gov/ecy/clarc/reporting/CLARCReporting.aspx).

APPENDIX A

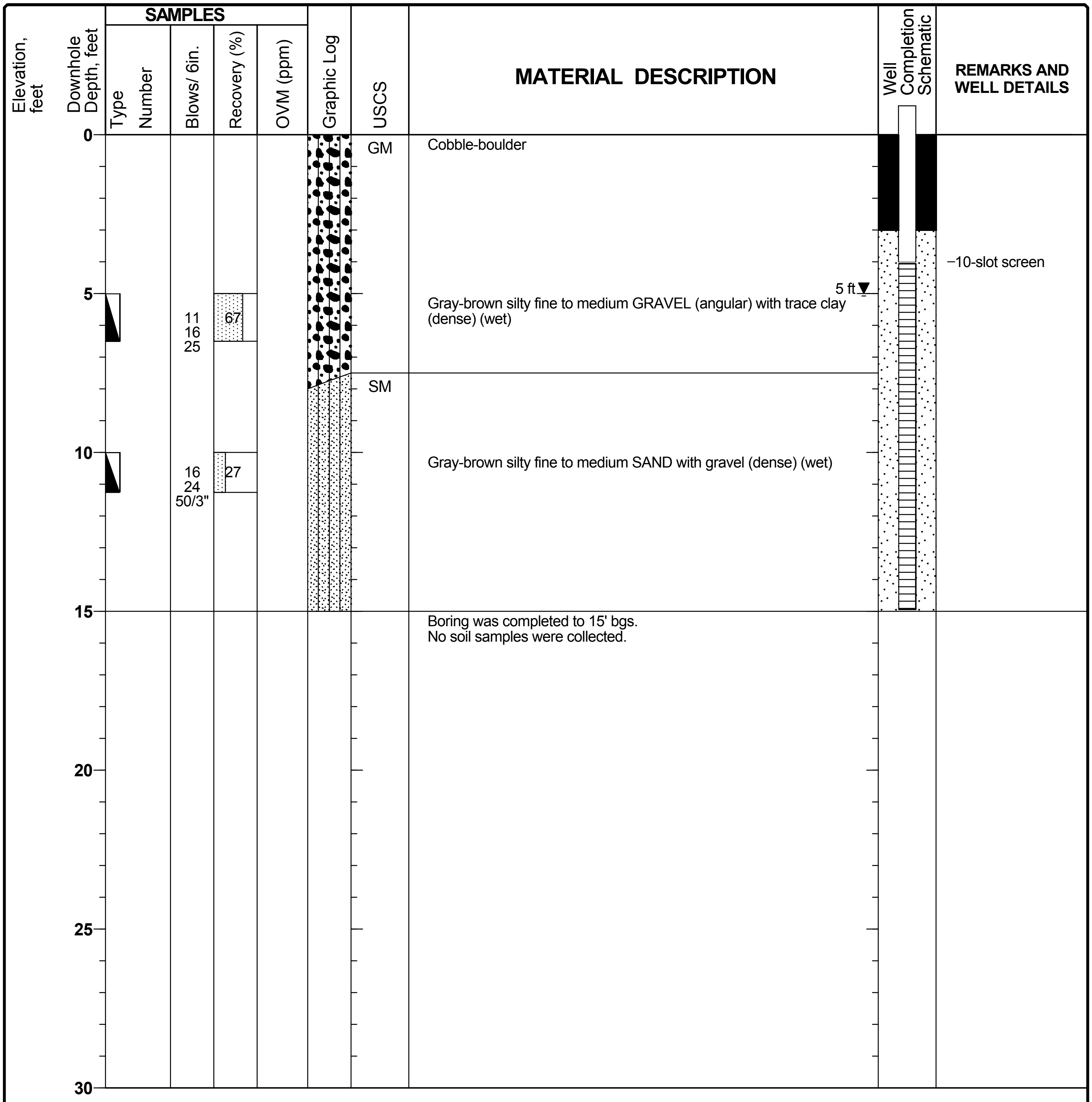
BORING LOGS

Project: Pend Oreille Mine
Project Location: Metaline Falls, WA
Project Number: 36298248

Log of Boring 301

Sheet 1 of 1

Date(s) Drilled	**8/4/08**	Logged By	**GDP**	Checked By	**GDP**
Drilling Method	**ODEX**	Drilling Contractor	**EWE**	Total Depth of Borehole	**15 feet bgs**
Drill Rig Type	**T-300**	Drill Bit Size/Type	**4" O.D.**	Ground Surface Elevation	
Groundwater Level	**5 feet bgs**	Sampling Method	**SPT**	Hammer Data	**140 lb, 30" drop**
Borehole Backfill		Location	**Pend Oreille Mine, TD F-1**		



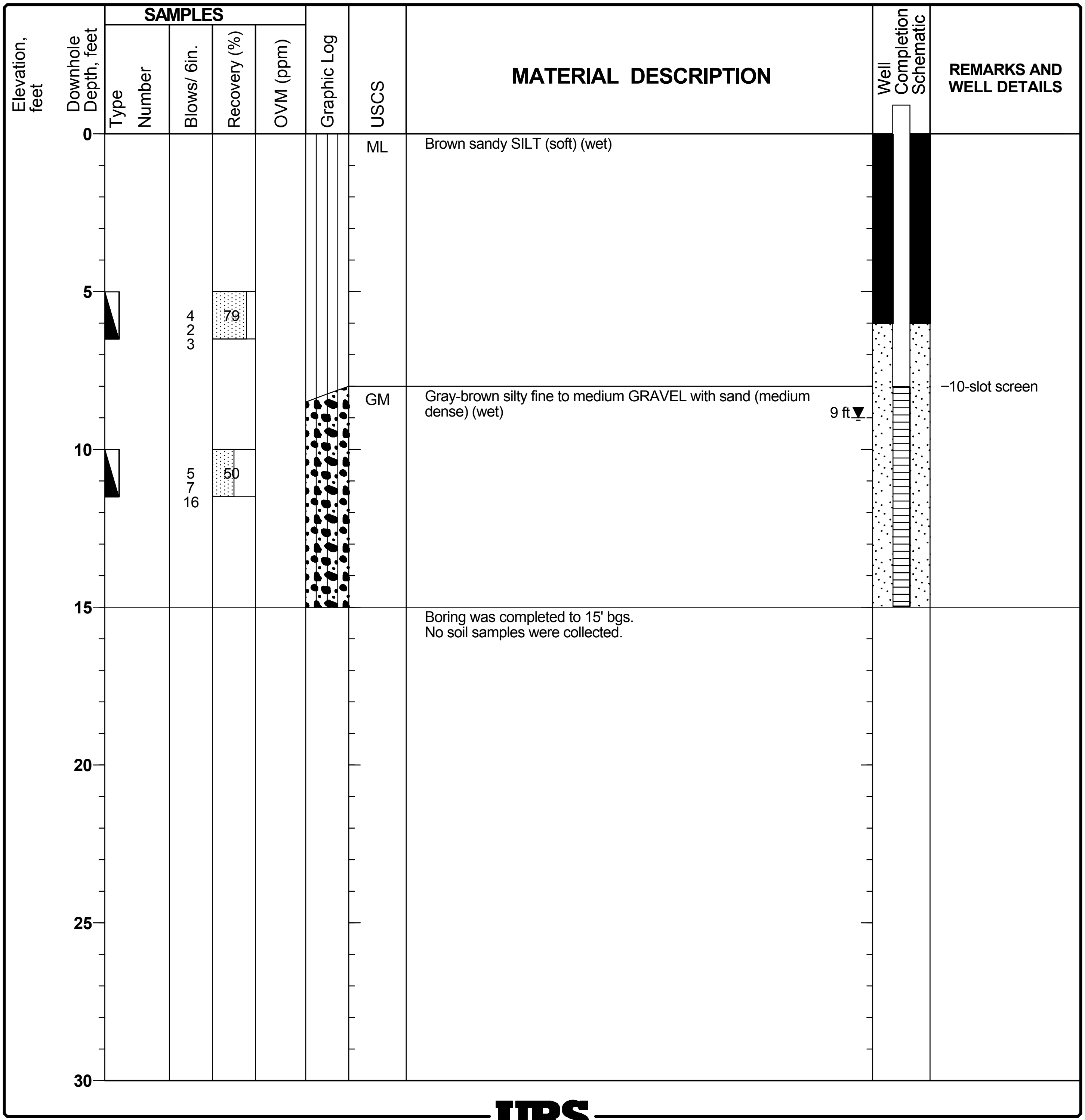
Downhole Depth, feet	Blows/ 6in.	Recovery (%)	USCS	MATERIAL DESCRIPTION	REMARKS AND WELL DETAILS
0			GM	Cobble-boulder	
4					–10-slot screen
5	11 16 25	67		Gray-brown silty fine to medium GRAVEL (angular) with trace clay (dense) (wet)	
7.5			SM		
10	16 24 50/3"	27		Gray-brown silty fine to medium SAND with gravel (dense) (wet)	
15				Boring was completed to 15' bgs. No soil samples were collected.	

Project: Pend Oreille Mine
Project Location: Metaline Falls, WA
Project Number: 36298248

Log of Boring 302

Sheet 1 of 1

Date(s) Drilled	**8/4/08**	Logged By	**GDP**	Checked By	**GDP**
Drilling Method	**ODEX**	Drilling Contractor	**EWE**	Total Depth of Borehole	**15 feet bgs**
Drill Rig Type	**T-300**	Drill Bit Size/Type	**4" O.D.**	Ground Surface Elevation	
Groundwater Level	**9 feet bgs**	Sampling Method	**SPT**	Hammer Data	**140 lb, 30" drop**
Borehole Backfill		Location	**Pend Oreille Mine, TD F-1**		



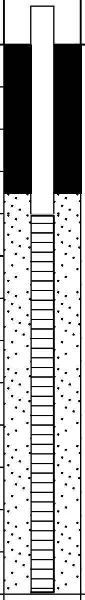
Downhole Depth, feet	Blows/ 6in.	Recovery (%)	USCS	MATERIAL DESCRIPTION	REMARKS AND WELL DETAILS
0			ML	Brown sandy SILT (soft) (wet)	
5	4 2 3	79			
8			GM	Gray-brown silty fine to medium GRAVEL with sand (medium dense) (wet)	10-slot screen
10	5 7 16	50			
15				Boring was completed to 15' bgs. No soil samples were collected.	

Project: Pend Oreille Mine
Project Location: Metaline Falls, WA
Project Number: 36298248

Log of Boring 303

Sheet 1 of 1

Date(s) Drilled	**8/4/08**	Logged By	**GDP**	Checked By	**GDP**
Drilling Method	**ODEX**	Drilling Contractor	**EWE**	Total Depth of Borehole	**13 feet bgs**
Drill Rig Type	**T-300**	Drill Bit Size/Type	**4" O.D.**	Ground Surface Elevation	
Groundwater Level	**4 feet bgs**	Sampling Method	**SPT**	Hammer Data	**140 lb, 30" drop**
Borehole Backfill		Location	**Pend Oreille Mine, TD F-1**		



Elevation, feet	Downhole Depth, feet	SAMPLES					Graphic Log	USCS	MATERIAL DESCRIPTION	Well Completion Schematic	REMARKS AND WELL DETAILS
		Type	Number	Blows/ 6in.	Recovery (%)	OVM (ppm)					
	0							GM	Gray-black fine to coarse GRAVEL (very angular) (very dense) (wet)		
									Weathered rock	4 ft ▼	–10-slot screen
	5	◣		16 50/2"	20				Competent rock		
	10								No sample Dry rock, slate		
									Boring was completed to 13' bgs. No soil samples were collected.		
	15										
	20										
	25										
	30										

APPENDIX B

LABORATORY DATA

SPOKANE, WA 11922 E. 1ST AVENUE
SPOKANE VALLEY, WA 99206
ph: (509) 924.9200 fax: (509) 924.9290

August 27, 2008

Gary Panther
URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

RE: TDF-1

Enclosed are the results of analyses for samples received by the laboratory on 08/08/08 08:25. The following list is a summary of the Work Orders contained in this report, generated on 08/27/08 08:55.

If you have any questions concerning this report, please feel free to contact me.

Work Order	Project	ProjectNumber
SRH0060	TDF-1	36298248

TestAmerica Spokane

Randee Decker

Randee Decker, Project Manager

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
08/27/08 08:55

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MW-302	SRH0060-01	Water	08/07/08 12:00	08/08/08 08:25
MW-303	SRH0060-02	Water	08/07/08 13:00	08/08/08 08:25
MW-301	SRH0060-03	Water	08/07/08 14:00	08/08/08 08:25
Seep	SRH0060-04	Water	08/07/08 15:00	08/08/08 08:25
Dup	SRH0060-05	Water	08/07/08 00:00	08/08/08 08:25

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
08/27/08 08:55

Total Metals by EPA 200 Series Methods

TestAmerica Spokane

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SRH0060-01 (MW-302)		**Water**			**Sampled: 08/07/08 12:00**					
Barium	EPA 200.7	**0.114**	-----	0.00800	mg/l	1x	8080060	08/12/08 07:56	08/12/08 11:26	
Cadmium	"	**0.00243**	-----	0.00200	"	"	"	"	"	
Calcium	"	**155**	-----	0.600	"	"	"	"	"	
Chromium	"	ND	-----	0.00800	"	"	"	"	"	
Copper	"	ND	-----	0.00800	"	"	"	"	"	
Iron	"	**0.0332**	-----	0.0200	"	"	"	"	08/14/08 09:46	
Magnesium	"	**45.5**	-----	0.0100	"	"	"	"	08/12/08 11:26	
Manganese	"	**3.51**	-----	0.0100	"	"	"	"	"	
Mercury	EPA 245.1	ND	-----	0.000200	"	"	8080078	08/13/08 11:21	08/13/08 14:53	
Silver	EPA 200.7	ND	-----	0.0100	"	"	8080060	08/12/08 07:56	08/12/08 13:36	L
Zinc	"	**0.0620**	-----	0.0100	"	"	"	"	08/12/08 11:26	
SRH0060-02 (MW-303)		**Water**			**Sampled: 08/07/08 13:00**					
Barium	EPA 200.7	**0.0576**	-----	0.00800	mg/l	1x	8080060	08/12/08 07:56	08/12/08 11:47	
Cadmium	"	ND	-----	0.00200	"	"	"	"	"	
Calcium	"	**176**	-----	0.600	"	"	"	"	"	
Chromium	"	ND	-----	0.00800	"	"	"	"	"	
Copper	"	ND	-----	0.00800	"	"	"	"	"	
Iron	"	**1.32**	-----	0.0200	"	"	"	"	08/14/08 09:53	
Magnesium	"	**52.3**	-----	0.0100	"	"	"	"	08/12/08 11:47	
Manganese	"	**0.273**	-----	0.0100	"	"	"	"	"	
Mercury	EPA 245.1	ND	-----	0.000200	"	"	8080078	08/13/08 11:21	08/13/08 14:55	
Silver	EPA 200.7	ND	-----	0.0100	"	"	8080060	08/12/08 07:56	08/12/08 13:39	L
Zinc	"	**0.0522**	-----	0.0100	"	"	"	"	08/12/08 11:47	
SRH0060-03 (MW-301)		**Water**			**Sampled: 08/07/08 14:00**					
Barium	EPA 200.7	**0.0593**	-----	0.00800	mg/l	1x	8080060	08/12/08 07:56	08/12/08 11:54	
Cadmium	"	ND	-----	0.00200	"	"	"	"	"	
Calcium	"	**286**	-----	0.600	"	"	"	"	"	
Chromium	"	ND	-----	0.00800	"	"	"	"	"	
Copper	"	ND	-----	0.00800	"	"	"	"	"	
Iron	"	**0.179**	-----	0.0200	"	"	"	"	08/14/08 09:59	
Magnesium	"	**64.4**	-----	0.0100	"	"	"	"	08/12/08 11:54	
Manganese	"	ND	-----	0.0100	"	"	"	"	"	
Mercury	EPA 245.1	ND	-----	0.000200	"	"	8080078	08/13/08 11:21	08/13/08 14:58	
Silver	EPA 200.7	ND	-----	0.0100	"	"	8080060	08/12/08 07:56	08/12/08 13:41	L
Zinc	"	**0.0319**	-----	0.0100	"	"	"	"	08/12/08 11:54	

TestAmerica Spokane

Randee Decker, Project Manager

Total Metals by EPA 200 Series Methods

TestAmerica Spokane

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SRH0060-04 (Seep)		**Water**			**Sampled: 08/07/08 15:00**					
Barium	EPA 200.7	**0.397**	-----	0.00800	mg/l	1x	8080060	08/12/08 07:56	08/12/08 12:01	
Cadmium	"	**0.00283**	-----	0.00200	"	"	"	"	"	
Calcium	"	**99.5**	-----	0.600	"	"	"	"	"	
Chromium	"	**0.0453**	-----	0.00800	"	"	"	"	"	
Copper	"	**0.0741**	-----	0.00800	"	"	"	"	"	
Iron	"	**53.5**	-----	0.0200	"	"	"	"	08/14/08 10:06	
Magnesium	"	**37.0**	-----	0.0100	"	"	"	"	08/12/08 12:01	
Manganese	"	**1.11**	-----	0.0100	"	"	"	"	"	
Mercury	EPA 245.1	ND	-----	0.000200	"	"	8080078	08/13/08 11:21	08/13/08 15:00	
Silver	EPA 200.7	ND	-----	0.0100	"	"	8080060	08/12/08 07:56	08/12/08 13:44	**L**
Zinc	"	**0.300**	-----	0.0100	"	"	"	"	08/12/08 12:01	
SRH0060-05 (Dup)		**Water**			**Sampled: 08/07/08 00:00**					
Barium	EPA 200.7	**0.115**	-----	0.00800	mg/l	1x	8080060	08/12/08 07:56	08/12/08 12:06	
Cadmium	"	**0.00247**	-----	0.00200	"	"	"	"	"	
Calcium	"	**157**	-----	0.600	"	"	"	"	"	
Chromium	"	ND	-----	0.00800	"	"	"	"	"	
Copper	"	**0.0176**	-----	0.00800	"	"	"	"	"	
Iron	"	**0.0221**	-----	0.0200	"	"	"	"	08/14/08 10:11	
Magnesium	"	**45.8**	-----	0.0100	"	"	"	"	08/12/08 12:06	
Manganese	"	**3.53**	-----	0.0100	"	"	"	"	"	
Mercury	EPA 245.1	ND	-----	0.000200	"	"	8080078	08/13/08 11:21	08/13/08 15:02	
Silver	EPA 200.7	ND	-----	0.0100	"	"	8080060	08/12/08 07:56	08/12/08 13:47	**L**
Zinc	"	**0.0638**	-----	0.0100	"	"	"	"	08/12/08 12:06	

TestAmerica Spokane

Randee Decker

Randee Decker, Project Manager

Conventional Chemistry Parameters by APHA/EPA Methods

TestAmerica Spokane

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SRH0060-01 (MW-302)	**Water**				**Sampled: 08/07/08 12:00**					
Total Alkalinity	SM 2320B	**293**	-----	4.00	mg/l	1x	8080076	08/13/08 10:23	08/14/08 11:44	
SRH0060-02 (MW-303)	**Water**				**Sampled: 08/07/08 13:00**					
Total Alkalinity	SM 2320B	**245**	-----	4.00	mg/l	1x	8080076	08/13/08 10:23	08/14/08 11:44	
SRH0060-03 (MW-301)	**Water**				**Sampled: 08/07/08 14:00**					
Total Alkalinity	SM 2320B	**270**	-----	4.00	mg/l	1x	8080076	08/13/08 10:23	08/14/08 11:44	
SRH0060-04 (Seep)	**Water**				**Sampled: 08/07/08 15:00**					
Total Alkalinity	SM 2320B	**310**	-----	4.00	mg/l	1x	8080076	08/13/08 10:23	08/14/08 11:44	
SRH0060-05 (Dup)	**Water**				**Sampled: 08/07/08 00:00**					
Total Alkalinity	SM 2320B	**285**	-----	4.00	mg/l	1x	8080076	08/13/08 10:23	08/14/08 11:44	

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
08/27/08 08:55

Anions by EPA Method 300.0

TestAmerica Spokane

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SRH0060-01 (MW-302)			**Water**			**Sampled: 08/07/08 12:00**				
Chloride	EPA 300.0	**7.10**	-----	5.00	mg/l	10x	8080071	08/12/08 09:30	08/12/08 11:18	
Sulfate	"	**348**	-----	20.0	"	40x	"	"	08/12/08 13:56	
SRH0060-02 (MW-303)			**Water**			**Sampled: 08/07/08 13:00**				
Chloride	EPA 300.0	**7.00**	-----	5.00	mg/l	10x	8080071	08/12/08 09:30	08/12/08 12:11	
Sulfate	"	**477**	-----	20.0	"	40x	"	"	08/12/08 14:22	
SRH0060-03 (MW-301)			**Water**			**Sampled: 08/07/08 14:00**				
Chloride	EPA 300.0	**3.21**	-----	0.500	mg/l	1x	8080071	08/12/08 09:30	08/12/08 14:35	
Sulfate	"	**833**	-----	25.0	"	50x	"	"	08/12/08 14:48	
SRH0060-04 (Seep)			**Water**			**Sampled: 08/07/08 15:00**				
Chloride	EPA 300.0	**8.00**	-----	5.00	mg/l	10x	8080071	08/12/08 09:30	08/12/08 12:37	
Sulfate	"	**88.5**	-----	5.00	"	"	"	"	"	
SRH0060-05 (Dup)			**Water**			**Sampled: 08/07/08 00:00**				
Chloride	EPA 300.0	**5.00**	-----	5.00	mg/l	10x	8080071	08/12/08 09:30	08/12/08 12:50	
Sulfate	"	**349**	-----	20.0	"	40x	"	"	08/12/08 15:01	

TestAmerica Spokane

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Randee Decker, Project Manager

URS Corp.	Project Name: **TDF-1**	
920 N. Argonne Road Suite 300	Project Number: 36298248	Report Created:
Spokane, WA 99212	Project Manager: Gary Panther	08/27/08 08:55

Total Metals by EPA 200 Series Methods

TestAmerica Seattle

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SRH0060-01 (MW-302)	**Water**			**Sampled: 08/07/08 12:00**						
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	8H14056	08/14/08 16:42	08/18/08 15:08	
Lead	"	**0.00155**	-----	0.00100	"	"	"	"	"	
Selenium	"	ND	-----	0.00100	"	"	"	"	"	
SRH0060-02 (MW-303)	**Water**			**Sampled: 08/07/08 13:00**						
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	8H14056	08/14/08 16:42	08/18/08 15:14	
Lead	"	**0.00146**	-----	0.00100	"	"	"	"	"	
Selenium	"	**0.0151**	-----	0.00100	"	"	"	"	"	
SRH0060-03 (MW-301)	**Water**			**Sampled: 08/07/08 14:00**						
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	8H14056	08/14/08 16:42	08/18/08 15:20	
Lead	"	**0.00119**	-----	0.00100	"	"	"	"	"	
Selenium	"	**0.00318**	-----	0.00100	"	"	"	"	"	
SRH0060-04 (Seep)	**Water**			**Sampled: 08/07/08 15:00**						
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	8H14056	08/14/08 16:42	08/18/08 15:26	
Lead	"	**0.00178**	-----	0.00100	"	"	"	"	"	
Selenium	"	**0.00132**	-----	0.00100	"	"	"	"	"	
SRH0060-05 (Dup)	**Water**			**Sampled: 08/07/08 00:00**						
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	8H14056	08/14/08 16:42	08/18/08 15:32	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
Selenium	"	ND	-----	0.00100	"	"	"	"	"	

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
08/27/08 08:55

Total Metals by EPA 200 Series Methods - Laboratory Quality Control Results

TestAmerica Spokane

QC Batch: 8080060 **Water Preparation Method: Metals**

Blank (8080060-BLK1) **Extracted: 08/12/08 07:56**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Iron	EPA 200.7	ND	---	0.0200	mg/l	1x	--	--	--	--	--	--	08/14/08 09:31	
Calcium	"	ND	---	0.600	"	"	--	--	--	--	--	--	08/12/08 10:53	
Cadmium	"	ND	---	0.00200	"	"	--	--	--	--	--	--	"	
Magnesium	"	ND	---	0.0100	"	"	--	--	--	--	--	--	"	
Silver	"	ND	---	0.0100	"	"	--	--	--	--	--	--	08/12/08 13:30	
Barium	"	ND	---	0.00800	"	"	--	--	--	--	--	--	08/12/08 10:53	
Chromium	"	ND	---	0.00800	"	"	--	--	--	--	--	--	"	
Copper	"	ND	---	0.00800	"	"	--	--	--	--	--	--	"	
Manganese	"	ND	---	0.0100	"	"	--	--	--	--	--	--	"	
Zinc	"	ND	---	0.0100	"	"	--	--	--	--	--	--	"	

LCS (8080060-BS1) **Extracted: 08/12/08 07:56**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Magnesium	EPA 200.7	10.2	---	0.0100	mg/l	1x	--	10.0	102%	(85-115)	--	--	08/12/08 10:38	
Iron	"	1.01	---	0.0200	"	"	--	1.00	101%	"	--	--	08/14/08 09:26	
Calcium	"	10.3	---	0.600	"	"	--	10.0	103%	"	--	--	08/12/08 10:38	
Silver	"	1.17	---	0.0100	"	"	--	1.00	117%	"	--	--	08/12/08 13:27	L
Cadmium	"	1.01	---	0.00200	"	"	--	"	101%	"	--	--	08/12/08 10:38	
Copper	"	0.969	---	0.00800	"	"	--	"	96.9%	"	--	--	"	
Zinc	"	1.05	---	0.0100	"	"	--	"	105%	"	--	--	"	
Chromium	"	1.02	---	0.00800	"	"	--	"	102%	"	--	--	"	
Barium	"	1.02	---	0.00800	"	"	--	"	102%	"	--	--	"	
Manganese	"	1.05	---	0.0100	"	"	--	"	105%	"	--	--	"	

Duplicate (8080060-DUP1) **QC Source: SRH0060-01** **Extracted: 08/12/08 07:56**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Magnesium	EPA 200.7	45.9	---	0.0100	mg/l	1x	45.5	--	--	--	0.807%	(20)	08/12/08 12:33	
Iron	"	0.0441	---	0.0200	"	"	0.0332	--	--	--	28.3%	"	08/14/08 10:39	R2
Copper	"	ND	---	0.00800	"	"	ND	--	--	--	10.1%	"	08/12/08 12:33	
Chromium	"	ND	---	0.00800	"	"	ND	--	--	--	NR	"	"	
Zinc	"	0.0610	---	0.0100	"	"	0.0620	--	--	--	1.65%	"	"	
Cadmium	"	0.00259	---	0.00200	"	"	0.00243	--	--	--	6.42%	"	"	
Calcium	"	156	---	0.600	"	"	155	--	--	--	1.04%	"	"	
Silver	"	ND	---	0.0100	"	"	ND	--	--	--	NR	"	08/12/08 13:53	
Barium	"	0.115	---	0.00800	"	"	0.114	--	--	--	1.23%	"	08/12/08 12:33	
Manganese	"	3.53	---	0.0100	"	"	3.51	--	--	--	0.654%	"	"	

TestAmerica Spokane

Randee Decker

Randee Decker, Project Manager

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
08/27/08 08:55

Total Metals by EPA 200 Series Methods - Laboratory Quality Control Results

TestAmerica Spokane

QC Batch: 8080060 **Water Preparation Method: Metals**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Matrix Spike (8080060-MS1)				**QC Source: SRH0060-01**				**Extracted: 08/12/08 07:56**						
Chromium	EPA 200.7	1.03	---	0.00800	mg/l	1x	ND	1.00	103%	(75-125)	--	--	08/12/08 12:40	
Silver	"	1.11	---	0.0100	"	"	ND	"	111%	"	--	--	08/12/08 14:05	
Barium	"	1.15	---	0.00800	"	"	0.114	"	104%	(70-130)	--	--	08/12/08 12:40	
Magnesium	"	56.4	---	0.0100	"	"	45.5	10.0	109%	(75-125)	--	--	"	
Calcium	"	168	---	0.600	"	"	155	"	129%	"	--	--	"	M7
Cadmium	"	1.02	---	0.00200	"	"	0.00243	1.00	102%	(70-130)	--	--	"	
Iron	"	0.773	---	0.0200	"	"	0.0332	"	74.0%	(75-125)	--	--	08/14/08 10:55	M8
Zinc	"	1.08	---	0.0100	"	"	0.0620	"	102%	(70-130)	--	--	08/12/08 12:40	
Manganese	"	4.59	---	0.0100	"	"	3.51	"	108%	(75-125)	--	--	"	
Copper	"	0.994	---	0.00800	"	"	0.00658	"	98.8%	(70-130)	--	--	"	
Matrix Spike Dup (8080060-MSD1)				**QC Source: SRH0060-01**				**Extracted: 08/12/08 07:56**						
Magnesium	EPA 200.7	56.1	---	0.0100	mg/l	1x	45.5	10.0	106%	(75-125)	0.602%	(20)	08/12/08 12:45	
Iron	"	1.06	---	0.0200	"	"	0.0332	1.00	103%	"	31.3%	"	08/14/08 10:50	R
Copper	"	0.989	---	0.00800	"	"	0.00658	"	98.2%	(70-130)	0.582%	"	08/12/08 12:45	
Cadmium	"	1.02	---	0.00200	"	"	0.00243	"	101%	"	0.775%	"	"	
Calcium	"	166	---	0.600	"	"	155	10.0	115%	(75-125)	0.856%	"	"	
Barium	"	1.14	---	0.00800	"	"	0.114	1.00	103%	(70-130)	0.975%	"	"	
Silver	"	1.13	---	0.0100	"	"	ND	"	113%	(75-125)	1.42%	"	08/12/08 14:08	
Chromium	"	1.02	---	0.00800	"	"	ND	"	102%	"	0.417%	"	08/12/08 12:45	
Manganese	"	4.55	---	0.0100	"	"	3.51	"	104%	"	0.879%	"	"	
Zinc	"	1.06	---	0.0100	"	"	0.0620	"	99.9%	(70-130)	1.81%	"	"	

TestAmerica Spokane

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Randee Decker

Randee Decker, Project Manager

Total Metals by EPA 200 Series Methods - Laboratory Quality Control Results

TestAmerica Spokane

QC Batch: 8080078 **Water Preparation Method: Metals**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (8080078-BLK1)								**Extracted: 08/13/08 11:21**						
Mercury	EPA 245.1	ND	---	0.000200	mg/l	1x	--	--	--	--	--	--	08/13/08 14:21	
LCS (8080078-BS1)								**Extracted: 08/13/08 11:21**						
Mercury	EPA 245.1	0.000927	---	0.000200	mg/l	1x	--	0.00100	92.7%	(85-115)	--	--	08/13/08 14:19	
Duplicate (8080078-DUP1)				**QC Source: SRH0058-18**				**Extracted: 08/13/08 11:21**						
Mercury	EPA 245.1	ND	---	0.00200	mg/l	1x	ND	--	--	--	NR	(17.1)	08/13/08 15:16	
Matrix Spike (8080078-MS1)				**QC Source: SRH0058-18**				**Extracted: 08/13/08 11:21**						
Mercury	EPA 245.1	0.0102	---	0.00200	mg/l	1x	ND	0.0100	102%	(70-130)	--	--	08/13/08 15:18	
Matrix Spike Dup (8080078-MSD1)				**QC Source: SRH0058-18**				**Extracted: 08/13/08 11:21**						
Mercury	EPA 245.1	0.00956	---	0.00200	mg/l	1x	ND	0.0100	95.6%	(70-130)	6.48%	(18.2)	08/13/08 15:20	

TestAmerica Spokane

Randee Decker, Project Manager

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
08/27/08 08:55

Conventional Chemistry Parameters by APHA/EPA Methods - Laboratory Quality Control Results

TestAmerica Spokane

QC Batch: 8080076 **Water Preparation Method: Wet Chem**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (8080076-BLK1)										**Extracted: 08/13/08 10:23**				
Total Alkalinity	SM 2320B	ND	---	4.00	mg/l	1x	--	--	--	--	--	--	08/14/08 11:44	
LCS (8080076-BS1)										**Extracted: 08/13/08 10:23**				
Total Alkalinity	SM 2320B	495	---	4.00	mg/l	1x	--	500	99.0%	(90-110)	--	--	08/14/08 11:44	
Duplicate (8080076-DUP1)					**QC Source: SRH0060-01**					**Extracted: 08/13/08 10:23**				
Total Alkalinity	SM 2320B	290	---	4.00	mg/l	1x	293	--	--	--	1.03%	(10)	08/14/08 11:44	

TestAmerica Spokane

Randee Decker, Project Manager

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
08/27/08 08:55

Anions by EPA Method 300.0 - Laboratory Quality Control Results

TestAmerica Spokane

QC Batch: 8080071 **Water Preparation Method: Wet Chem**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (8080071-BLK1)								**Extracted:**	**08/12/08 09:30**					
Sulfate	EPA 300.0	ND	---	0.500	mg/l	1x	--	--	--	--	--	--	08/12/08 09:51	
Chloride	"	ND	---	0.500	"	"	--	--	--	--	--	--	"	
LCS (8080071-BS1)								**Extracted:**	**08/12/08 09:30**					
Chloride	EPA 300.0	4.86	---	0.500	mg/l	1x	--	5.00	97.2%	(90-110)	--	--	08/12/08 10:17	
Sulfate	"	4.92	---	0.500	"	"	--	"	98.4%	"	--	--	"	MNR
Duplicate (8080071-DUP1)				**QC Source:**	**SRH0060-01**			**Extracted:**	**08/12/08 09:30**					
Chloride	EPA 300.0	6.00	---	5.00	mg/l	10x	7.10	--	--	--	16.8%	(20)	08/12/08 11:32	
Sulfate	"	310	---	20.0	"	40x	348	--	--	--	11.8%	(10.6)	08/12/08 14:09	R2
Matrix Spike (8080071-MS1)				**QC Source:**	**SRH0060-01**			**Extracted:**	**08/12/08 09:30**					
Chloride	EPA 300.0	7.90	---	5.00	mg/l	10x	7.10	5.00	16.0%	(80-120)	--	--	08/12/08 11:45	M8
Matrix Spike Dup (8080071-MSD1)				**QC Source:**	**SRH0060-01**			**Extracted:**	**08/12/08 09:30**					
Chloride	EPA 300.0	7.80	---	5.00	mg/l	10x	7.10	5.00	14.0%	(80-120)	1.27%	(14.3)	08/12/08 11:58	M8

TestAmerica Spokane

Randee Decker, Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
08/27/08 08:55

Total Metals by EPA 200 Series Methods - Laboratory Quality Control Results

TestAmerica Seattle

QC Batch: 8H14056 **Water Preparation Method: EPA 200 Series**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (8H14056-BLK1)													**Extracted: 08/14/08 16:42**	
Lead	EPA 200.8	ND	---	0.00100	mg/l	1x	--	--	--	--	--	--	08/19/08 08:06	
Selenium	"	ND	---	0.00100	"	"	--	--	--	--	--	--	08/18/08 14:26	
Arsenic	"	ND	---	0.00100	"	"	--	--	--	--	--	--	"	
LCS (8H14056-BS1)													**Extracted: 08/14/08 16:42**	
Selenium	EPA 200.8	0.0818	---	0.00100	mg/l	1x	--	0.0800	102%	(85-115)	--	--	08/18/08 14:32	
Lead	"	0.0785	---	0.00100	"	"	--	"	98.2%	"	--	--	"	
Arsenic	"	0.0791	---	0.00100	"	"	--	"	98.9%	"	--	--	"	
Duplicate (8H14056-DUP1)							**QC Source: SRH0060-01**						**Extracted: 08/14/08 16:42**	
Lead	EPA 200.8	0.00155	---	0.00100	mg/l	1x	0.00155	--	--	--	0.00%	(20)	08/18/08 14:44	
Arsenic	"	ND	---	0.00100	"	"	ND	--	--	--	13.3%	"	"	
Selenium	"	ND	---	0.00100	"	"	ND	--	--	--	10.8%	"	"	
Matrix Spike (8H14056-MS1)							**QC Source: SRH0060-01**						**Extracted: 08/14/08 16:42**	
Arsenic	EPA 200.8	0.0802	---	0.00100	mg/l	1x	0.000720	0.0800	99.3%	(75-125)	--	--	08/18/08 14:38	
Lead	"	0.0788	---	0.00100	"	"	0.00155	"	96.6%	"	--	--	"	
Selenium	"	0.0818	---	0.00100	"	"	0.000880	"	101%	"	--	--	"	

TestAmerica Spokane

Randee Decker, Project Manager

Notes and Definitions

Report Specific Notes:

L - Laboratory Control Sample and/or Laboratory Control Sample Duplicate recovery was above the acceptance limits. Analyte not detected, data not impacted.

M7 - The MS and/or MSD were above the acceptance limits. See Blank Spike (LCS).

M8 - The MS and/or MSD were below the acceptance limits. See Blank Spike (LCS).

MNR - No results were reported for the MS/MSD. The sample used for the MS/MSD required dilution due to the sample matrix. Because of this, the spike compounds were diluted below the detection limit.

R - The RPD exceeded the method control limit due to sample matrix effects. The individual analyte QA/QC recoveries, however, were within acceptance limits.

R2 - The RPD exceeded the acceptance limit.

Laboratory Reporting Conventions:

DET - Analyte DETECTED at or above the Reporting Limit. Qualitative Analyses only.

ND - Analyte NOT DETECTED at or above the reporting limit (MDL or MRL, as appropriate).

NR/NA - Not Reported / Not Available

dry - Sample results reported on a Dry Weight Basis. Results and Reporting Limits have been corrected for Percent Dry Weight.

wet - Sample results and reporting limits reported on a Wet Weight Basis (as received). Results with neither 'wet' nor 'dry' are reported on a Wet Weight Basis.

RPD - RELATIVE PERCENT DIFFERENCE (RPDs calculated using Results, not Percent Recoveries).

MRL - METHOD REPORTING LIMIT. Reporting Level at, or above, the lowest level standard of the Calibration Table.

MDL* - METHOD DETECTION LIMIT. Reporting Level at, or above, the statistically derived limit based on 40CFR, Part 136, Appendix B. *MDLs are listed on the report only if the data has been evaluated below the MRL. Results between the MDL and MRL are reported as Estimated Results.

Dil - Dilutions are calculated based on deviations from the standard dilution performed for an analysis, and may not represent the dilution found on the analytical raw data.

Reporting Limits - Reporting limits (MDLs and MRLs) are adjusted based on variations in sample preparation amounts, analytical dilutions and percent solids, where applicable.

Electronic Signature - Electronic Signature added in accordance with TestAmerica's *Electronic Reporting and Electronic Signatures Policy.* Application of electronic signature indicates that the report has been reviewed and approved for release by the laboratory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Randee Decker, Project Manager

TestAmerica
ANALYTICAL TESTING CORPORATION

11720 North Creek Pkwy N Suite 400, Bothell, WA 98011-8244 425-420-9200 FAX 420-9210 ☐
11922 E. First Ave, Spokane, WA 99206-5302 509-924-9200 FAX 924-9290 ☐
9405 SW Nimbus Ave, Beaverton, OR 97008-7145 503-906-9200 FAX 906-9210 ☐
2000 W International Airport Rd Ste A10, Anchorage, AK 99502-1119 907-563-9200 FAX 563-9210 ☐

CHAIN OF CUSTODY REPORT

Work Order #: SRH006

CLIENT: URS
REPORT TO: GARY D. PANTNER
ADDRESS:
PHONE:
FAX:
INVOICE TO: URS Corp
P.O. NUMBER:
PROJECT NAME: TDF-1
PROJECT NUMBER: 36298248
SAMPLED BY: GDP

TURNAROUND REQUEST
in Business Days *
Organic & Inorganic Analyses
☒ STD. ☐ 7 ☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐ <1
Petroleum Hydrocarbon Analyses
☒ STD. ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐ <1
☐ OTHER Specify:
* Turnaround Requests less than standard may incur Rush Charges.

PRESERVATIVE

REQUESTED ANALYSES

	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	AS BA CA	Cd Cr CU	Fe Hg MG	MN ZN	Pb SE Ag	Alkalinity	Chloride	Sulfate						MATRIX (W, S, O)	# OF CONT.	LOCATION / COMMENTS	TA WO ID
1	MW-302	8-7-08 12:00														W	4	-01	WA
2	MW-303	↓ 1:00														↓	3	-02	
3	MW-301	2:00															3	-03	↓
4	SEEP	15:00															3	-04	
5	DUP																3	-05	
6																			
7																			
8																			
9																			
10																			

RELEASED BY:
PRINT NAME: Gary D. Pantner
FIRM: URS Corp
DATE: 8-8-08
TIME: 8:25
RECEIVED BY:
PRINT NAME: Chris Williams
FIRM: TA-S
DATE: 8/8/08
TIME: 8:25

RELEASED BY:
PRINT NAME:
FIRM:
DATE:
TIME:
RECEIVED BY:
PRINT NAME:
FIRM:
DATE:
TIME:

ADDITIONAL REMARKS:
TEMP: .8°C
PAGE 1 OF 1

TAL-1000 0907

* Hold dissolved Metals

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

SPOKANE, WA 11922 E. 1ST AVENUE
SPOKANE VALLEY, WA 99206
ph: (509) 924.9200 fax: (509) 924.9290

August 28, 2008

Gary Panther
URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

RE: TDF-1

Enclosed are the results of analyses for samples received by the laboratory on 08/15/08 14:45.
The following list is a summary of the Work Orders contained in this report, generated on 08/28/08 16:22.

If you have any questions concerning this report, please feel free to contact me.

Work Order	Project	ProjectNumber
SRH0103	TDF-1	36298248

TestAmerica Spokane

Randee Decker, Project Manager

URS Corp.	Project Name:	**TDF-1**	
920 N. Argonne Road Suite 300	Project Number:	36298248	Report Created:
Spokane, WA 99212	Project Manager:	Gary Panther	08/28/08 16:22

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MW-203	SRH0103-01	Water	08/15/08 10:00	08/15/08 14:45
MW-201	SRH0103-02	Water	08/15/08 11:00	08/15/08 14:45

TestAmerica Spokane

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Randee Decker, Project Manager

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
08/28/08 16:22

Total Metals by EPA 200 Series Methods

TestAmerica Spokane

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SRH0103-01 (MW-203)		**Water**			**Sampled: 08/15/08 10:00**					
Barium	EPA 200.7	**0.177**	-----	0.00800	mg/l	1x	8080179	08/25/08 07:31	08/26/08 13:30	
Cadmium	"	ND	-----	0.00200	"	"	"	"	"	
Calcium	"	**188**	-----	0.600	"	"	"	"	"	
Chromium	"	**0.0326**	-----	0.00800	"	"	"	"	"	
Copper	"	**0.0426**	-----	0.00800	"	"	"	"	"	
Iron	"	**20.0**	-----	0.0200	"	"	"	"	"	
Magnesium	"	**64.2**	-----	0.0100	"	"	"	"	"	
Manganese	"	**0.876**	-----	0.0100	"	"	"	"	"	
Mercury	EPA 245.1	ND	-----	0.000200	"	"	8080180	08/25/08 07:34	08/26/08 11:10	
Silver	EPA 200.7	ND	-----	0.0100	"	"	8080179	08/25/08 07:31	08/28/08 07:58	
Zinc	"	**0.142**	-----	0.0100	"	"	"	"	08/26/08 13:30	
SRH0103-02 (MW-201)		**Water**			**Sampled: 08/15/08 11:00**					
Barium	EPA 200.7	**0.0502**	-----	0.00800	mg/l	1x	8080179	08/25/08 07:31	08/26/08 13:35	
Cadmium	"	ND	-----	0.00200	"	"	"	"	"	
Calcium	"	**73.5**	-----	0.600	"	"	"	"	"	
Chromium	"	ND	-----	0.00800	"	"	"	"	"	
Copper	"	ND	-----	0.00800	"	"	"	"	"	
Iron	"	**0.0200**	-----	0.0200	"	"	"	"	"	
Magnesium	"	**21.2**	-----	0.0100	"	"	"	"	"	
Manganese	"	ND	-----	0.0100	"	"	"	"	"	
Mercury	EPA 245.1	ND	-----	0.000200	"	"	8080180	08/25/08 07:34	08/26/08 11:17	
Silver	EPA 200.7	ND	-----	0.0100	"	"	8080179	08/25/08 07:31	08/28/08 08:01	
Zinc	"	ND	-----	0.0100	"	"	"	"	08/26/08 13:35	

Conventional Chemistry Parameters by APHA/EPA Methods

TestAmerica Spokane

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SRH0103-01 (MW-203)		**Water**			**Sampled: 08/15/08 10:00**					
Total Alkalinity	SM 2320B	**270**	-----	4.00	mg/l	1x	8080181	08/25/08 09:08	08/25/08 15:48	
SRH0103-02 (MW-201)		**Water**			**Sampled: 08/15/08 11:00**					
Total Alkalinity	SM 2320B	**240**	-----	4.00	mg/l	1x	8080181	08/25/08 09:08	08/25/08 15:48	

Randee Decker, Project Manager

Anions by EPA Method 300.0

TestAmerica Spokane

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SRH0103-01 (MW-203)		**Water**			**Sampled: 08/15/08 10:00**					
Chloride	EPA 300.0	**0.720**	-----	0.500	mg/l	1x	8080140	08/19/08 09:30	08/19/08 14:52	
Sulfate	"	**356**	-----	10.0	"	20x	"	"	08/19/08 14:04	
SRH0103-02 (MW-201)		**Water**			**Sampled: 08/15/08 11:00**					
Chloride	EPA 300.0	**10.4**	-----	2.50	mg/l	5x	8080140	08/19/08 09:30	08/19/08 15:05	
Sulfate	"	**22.4**	-----	2.50	"	"	"	"	"	

Total Metals per EPA 200 Series Methods

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SRH0103-01 (MW-203)		**Water**			**Sampled: 08/15/08 10:00**					
Arsenic	EPA 200.8	**0.00899**	-----	0.00100	mg/l	1x	8080816	08/26/08 10:21	08/26/08 17:27	
Lead	"	**0.0138**	-----	0.00100	"	"	"	"	"	
Selenium	"	**0.000808**	-----	0.000500	"	"	"	"	"	
SRH0103-02 (MW-201)		**Water**			**Sampled: 08/15/08 11:00**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	8080816	08/26/08 10:21	08/26/08 17:42	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
Selenium	"	**0.00114**	-----	0.000500	"	"	"	"	"	

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
08/28/08 16:22

Total Metals by EPA 200 Series Methods - Laboratory Quality Control Results

TestAmerica Spokane

QC Batch: 8080179 **Water Preparation Method: Metals**

Blank (8080179-BLK1) **Extracted: 08/25/08 07:31**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Chromium	EPA 200.7	ND	---	0.00800	mg/l	1x	--	--	--	--	--	--	08/26/08 12:20	
Iron	"	ND	---	0.0200	"	"	--	--	--	--	--	--	"	
Copper	"	ND	---	0.00800	"	"	--	--	--	--	--	--	"	
Magnesium	"	ND	---	0.0100	"	"	--	--	--	--	--	--	"	
Zinc	"	ND	---	0.0100	"	"	--	--	--	--	--	--	"	
Manganese	"	ND	---	0.0100	"	"	--	--	--	--	--	--	"	
Cadmium	"	ND	---	0.00200	"	"	--	--	--	--	--	--	"	
Calcium	"	ND	---	0.600	"	"	--	--	--	--	--	--	"	
Barium	"	ND	---	0.00800	"	"	--	--	--	--	--	--	"	
Silver	"	ND	---	0.0100	"	"	--	--	--	--	--	--	08/28/08 07:49	

LCS (8080179-BS1) **Extracted: 08/25/08 07:31**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Magnesium	EPA 200.7	10.3	---	0.0100	mg/l	1x	--	10.0	103%	(85-115)	--	--	08/26/08 12:15	
Silver	"	1.05	---	0.0100	"	"	--	1.00	105%	"	--	--	08/28/08 07:46	
Iron	"	1.05	---	0.0200	"	"	--	"	105%	"	--	--	08/26/08 12:15	
Chromium	"	1.03	---	0.00800	"	"	--	"	103%	"	--	--	"	
Copper	"	0.953	---	0.00800	"	"	--	"	95.3%	"	--	--	"	
Cadmium	"	1.04	---	0.00200	"	"	--	"	104%	"	--	--	"	
Barium	"	1.06	---	0.00800	"	"	--	"	106%	"	--	--	"	
Manganese	"	1.05	---	0.0100	"	"	--	"	105%	"	--	--	"	
Calcium	"	10.4	---	0.600	"	"	--	10.0	104%	"	--	--	"	
Zinc	"	1.11	---	0.0100	"	"	--	1.00	111%	"	--	--	"	

Duplicate (8080179-DUP1) **QC Source: SRH0086-02** **Extracted: 08/25/08 07:31**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Manganese	EPA 200.7	ND	---	0.0100	mg/l	1x	ND	--	--	--	NR	(20)	08/26/08 14:32	
Iron	"	ND	---	0.0200	"	"	ND	--	--	--	2.98%	"	"	
Silver	"	ND	---	0.0100	"	"	ND	--	--	--		"	08/28/08 08:04	
Copper	"	ND	---	0.00800	"	"	ND	--	--	--	74.7%	"	08/26/08 14:32	R4
Magnesium	"	8.79	---	0.0100	"	"	8.87	--	--	--	0.840%	"	"	
Chromium	"	ND	---	0.00800	"	"	ND	--	--	--	36.5%	"	"	R4
Zinc	"	ND	---	0.0100	"	"	ND	--	--	--	NR	"	"	
Cadmium	"	ND	---	0.00200	"	"	ND	--	--	--		"	"	
Calcium	"	33.5	---	0.600	"	"	33.8	--	--	--	0.771%	"	"	
Barium	"	0.0471	---	0.00800	"	"	0.0464	--	--	--	1.49%	"	"	

TestAmerica Spokane

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Randee Decker, Project Manager

Total Metals by EPA 200 Series Methods - Laboratory Quality Control Results

TestAmerica Spokane

QC Batch: 8080179 **Water Preparation Method: Metals**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Matrix Spike (8080179-MS1)				**QC Source: SRH0086-02**				**Extracted: 08/25/08 07:31**						
Barium	EPA 200.7	1.09	---	0.00800	mg/l	1x	0.0464	1.00	105%	(70-130)	--	--	08/26/08 14:37	
Silver	"	1.04	---	0.0100	"	"	ND	"	104%	(75-125)	--	--	08/28/08 08:07	
Cadmium	"	1.03	---	0.00200	"	"	ND	"	103%	(70-130)	--	--	08/26/08 14:37	
Calcium	"	44.5	---	0.600	"	"	33.8	10.0	107%	(75-125)	--	--	"	
Iron	"	1.04	---	0.0200	"	"	0.0136	1.00	103%	"	--	--	"	
Magnesium	"	19.4	---	0.0100	"	"	8.87	10.0	106%	"	--	--	"	
Chromium	"	1.02	---	0.00800	"	"	0.000726	1.00	102%	"	--	--	"	
Zinc	"	1.08	---	0.0100	"	"	0.00580	"	108%	(70-130)	--	--	"	
Copper	"	0.959	---	0.00800	"	"	0.00357	"	95.5%	"	--	--	"	
Manganese	"	1.07	---	0.0100	"	"	ND	"	107%	(75-125)	--	--	"	
Matrix Spike Dup (8080179-MSD1)				**QC Source: SRH0086-02**				**Extracted: 08/25/08 07:31**						
Cadmium	EPA 200.7	1.03	---	0.00200	mg/l	1x	ND	1.00	103%	(70-130)	0.669%	(20)	08/26/08 14:42	
Zinc	"	1.09	---	0.0100	"	"	0.00580	"	108%	"	0.295%	"	"	
Silver	"	1.07	---	0.0100	"	"	ND	"	107%	(75-125)	3.40%	"	08/28/08 08:10	
Barium	"	1.08	---	0.00800	"	"	0.0464	"	103%	(70-130)	1.10%	"	08/26/08 14:42	
Magnesium	"	19.2	---	0.0100	"	"	8.87	10.0	103%	(75-125)	1.19%	"	"	
Calcium	"	43.9	---	0.600	"	"	33.8	"	101%	"	1.36%	"	"	
Copper	"	0.942	---	0.00800	"	"	0.00357	1.00	93.8%	(70-130)	1.79%	"	"	
Iron	"	1.05	---	0.0200	"	"	0.0136	"	103%	(75-125)	0.861%	"	"	
Chromium	"	1.01	---	0.00800	"	"	0.000726	"	101%	"	1.22%	"	"	
Manganese	"	1.06	---	0.0100	"	"	ND	"	106%	"	0.924%	"	"	

Randee Decker, Project Manager

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
08/28/08 16:22

Total Metals by EPA 200 Series Methods - Laboratory Quality Control Results

TestAmerica Spokane

QC Batch: 8080180 **Water Preparation Method: Metals**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (8080180-BLK1)								**Extracted: 08/25/08 07:34**						
Mercury	EPA 245.1	ND	---	0.000200	mg/l	1x	--	--	--	--	--	--	08/26/08 10:52	
LCS (8080180-BS1)								**Extracted: 08/25/08 07:34**						
Mercury	EPA 245.1	0.000984	---	0.000200	mg/l	1x	--	0.00100	98.4%	(85-115)	--	--	08/26/08 10:50	
Duplicate (8080180-DUP1)				**QC Source: SRH0086-02**				**Extracted: 08/25/08 07:34**						
Mercury	EPA 245.1	ND	---	0.000200	mg/l	1x	ND	--	--	--	NR	(17.1)	08/26/08 11:19	
Matrix Spike (8080180-MS1)				**QC Source: SRH0086-02**				**Extracted: 08/25/08 07:34**						
Mercury	EPA 245.1	0.00107	---	0.000200	mg/l	1x	ND	0.00100	107%	(70-130)	--	--	08/26/08 11:22	
Matrix Spike Dup (8080180-MSD1)				**QC Source: SRH0086-02**				**Extracted: 08/25/08 07:34**						
Mercury	EPA 245.1	0.00107	---	0.000200	mg/l	1x	ND	0.00100	107%	(70-130)	0.00%	(18.2)	08/26/08 11:24	

TestAmerica Spokane

Randee Decker, Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
08/28/08 16:22

Conventional Chemistry Parameters by APHA/EPA Methods - Laboratory Quality Control Results

TestAmerica Spokane

QC Batch: 8080181 **Water Preparation Method: Wet Chem**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (8080181-BLK1)								**Extracted: 08/25/08 09:08**						
Total Alkalinity	SM 2320B	ND	---	4.00	mg/l	1x	--	--	--	--	--	--	08/25/08 15:48	
LCS (8080181-BS1)								**Extracted: 08/25/08 09:08**						
Total Alkalinity	SM 2320B	495	---	4.00	mg/l	1x	--	500	99.0%	(90-110)	--	--	08/25/08 15:48	
Duplicate (8080181-DUP1)					**QC Source: SRG0106-08**			**Extracted: 08/25/08 09:08**						
Total Alkalinity	SM 2320B	50.0	---	4.00	mg/l	1x	47.5	--	--	--	5.13%	(10)	08/25/08 15:48	

TestAmerica Spokane

Randee Decker

Randee Decker, Project Manager

URS Corp.	Project Name:	**TDF-1**	
920 N. Argonne Road Suite 300	Project Number:	36298248	Report Created:
Spokane, WA 99212	Project Manager:	Gary Panther	08/28/08 16:22

Anions by EPA Method 300.0 - Laboratory Quality Control Results

TestAmerica Spokane

QC Batch: 8080140 **Water Preparation Method: Wet Chem**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (8080140-BLK1)									**Extracted: 08/19/08 09:30**					
Chloride	EPA 300.0	ND	---	0.500	mg/l	1x	--	--	--	--	--	--	08/19/08 10:10	
Sulfate	"	ND	---	0.500	"	"	--	--	--	--	--	--	"	
LCS (8080140-BS1)									**Extracted: 08/19/08 09:30**					
Chloride	EPA 300.0	4.68	---	0.500	mg/l	1x	--	5.00	93.6%	(90-110)	--	--	08/19/08 10:36	
Sulfate	"	5.26	---	0.500	"	"	--	"	105%	"	--	--	"	
Duplicate (8080140-DUP1)				**QC Source: SRH0106-01**					**Extracted: 08/19/08 09:30**					
Sulfate	EPA 300.0	9.02	---	0.500	mg/l	1x	9.31	--	--	--	3.16%	(10.6)	08/19/08 11:27	
Chloride	"	4.65	---	0.500	"	"	4.62	--	--	--	0.647%	(20)	08/20/08 11:11	
Matrix Spike (8080140-MS1)				**QC Source: SRH0106-01**					**Extracted: 08/19/08 09:30**					
Sulfate	EPA 300.0	15.3	---	0.500	mg/l	1x	9.31	5.00	121%	(80-120)	--	--	08/19/08 11:40	M7
Chloride	"	8.94	---	0.500	"	"	4.62	"	86.4%	"	--	--	08/20/08 11:24	
Matrix Spike Dup (8080140-MSD1)				**QC Source: SRH0106-01**					**Extracted: 08/19/08 09:30**					
Sulfate	EPA 300.0	15.4	---	0.500	mg/l	1x	9.31	5.00	122%	(80-120)	0.325%	(10)	08/19/08 11:53	M7
Chloride	"	8.96	---	0.500	"	"	4.62	"	86.8%	"	0.223%	(14.3)	08/20/08 11:37	

Total Metals per EPA 200 Series Methods - Laboratory Quality Control Results

TestAmerica Portland

QC Batch: 8080816 **Water Preparation Method: EPA 200/3005**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (8080816-BLK1)									**Extracted: 08/26/08 10:21**					
Arsenic	EPA 200.8	ND	---	0.00100	mg/l	1x	--	--	--	--	--	--	08/26/08 16:40	
Lead	"	ND	---	0.00100	"	"	--	--	--	--	--	--	"	
Selenium	"	ND	---	0.000500	"	"	--	--	--	--	--	--	"	
LCS (8080816-BS1)									**Extracted: 08/26/08 10:21**					
Arsenic	EPA 200.8	0.0973	---	0.00100	mg/l	1x	--	0.100	97.3%	(85-115)	--	--	08/26/08 16:45	
Lead	"	0.102	---	0.00100	"	"	--	"	102%	"	--	--	"	
Selenium	"	0.0952	---	0.000500	"	"	--	"	95.2%	"	--	--	"	
Duplicate (8080816-DUP1)							**QC Source: PRH0577-01**		**Extracted: 08/26/08 10:21**					
Arsenic	EPA 200.8	0.00183	---	0.00100	mg/l	1x	0.00175	--	--	--	4.30%	(20)	08/26/08 16:55	
Lead	"	0.0994	---	0.00100	"	"	0.0988	--	--	--	0.616%	"	"	
Selenium	"	0.00284	---	0.000500	"	"	0.00252	--	--	--	11.7%	"	"	
Matrix Spike (8080816-MS1)							**QC Source: PRH0577-01**		**Extracted: 08/26/08 10:21**					
Arsenic	EPA 200.8	0.108	---	0.00100	mg/l	1x	0.00175	0.100	106%	(70-130)	--	--	08/26/08 17:06	
Lead	"	0.194	---	0.00100	"	"	0.0988	"	94.8%	(75-125)	--	--	"	
Selenium	"	0.109	---	0.000500	"	"	0.00252	"	106%	(70-130)	--	--	"	
Matrix Spike (8080816-MS2)							**QC Source: PRH0797-03**		**Extracted: 08/26/08 10:21**					
Arsenic	EPA 200.8	2.89	---	0.0100	mg/l	10x	2.62	0.100	274%	(70-130)	--	--	08/26/08 22:04	MHA
Lead	"	0.120	---	0.00100	"	1x	0.00975	"	110%	(75-125)	--	--	08/26/08 18:14	
Selenium	"	0.143	---	0.000500	"	"	0.00721	"	136%	(70-130)	--	--	"	M7

Notes and Definitions

Report Specific Notes:

M7	-	The MS and/or MSD were above the acceptance limits. See Blank Spike (LCS).
MHA	-	Due to high levels of analyte in the sample, the MS/MSD calculation does not provide useful spike recovery information. See Blank Spike (LCS).
R4	-	Due to the low levels of analyte in the sample, the duplicate RPD calculation does not provide useful information.

Laboratory Reporting Conventions:

DET	-	Analyte DETECTED at or above the Reporting Limit. Qualitative Analyses only.
ND	-	Analyte NOT DETECTED at or above the reporting limit (MDL or MRL, as appropriate).
NR/NA	-	Not Reported / Not Available
dry	-	Sample results reported on a Dry Weight Basis. Results and Reporting Limits have been corrected for Percent Dry Weight.
wet	-	Sample results and reporting limits reported on a Wet Weight Basis (as received). Results with neither 'wet' nor 'dry' are reported on a Wet Weight Basis.
RPD	-	RELATIVE PERCENT DIFFERENCE (RPDs calculated using Results, not Percent Recoveries).
MRL	-	METHOD REPORTING LIMIT. Reporting Level at, or above, the lowest level standard of the Calibration Table.
MDL*	-	METHOD DETECTION LIMIT. Reporting Level at, or above, the statistically derived limit based on 40CFR, Part 136, Appendix B. *MDLs are listed on the report only if the data has been evaluated below the MRL. Results between the MDL and MRL are reported as Estimated Results.
Dil	-	Dilutions are calculated based on deviations from the standard dilution performed for an analysis, and may not represent the dilution found on the analytical raw data.
Reporting Limits	-	Reporting limits (MDLs and MRLs) are adjusted based on variations in sample preparation amounts, analytical dilutions and percent solids, where applicable.
Electronic Signature	-	Electronic Signature added in accordance with TestAmerica's *Electronic Reporting and Electronic Signatures Policy.* Application of electronic signature indicates that the report has been reviewed and approved for release by the laboratory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

TestAmerica
ANALYTICAL TESTING CORPORATION

11720 North Creek Pkwy N Suite 400, Bothell, WA 98011-8244 425-420-9200 FAX 420-9210 ☐
11922 E. First Ave, Spokane, WA 99206-5302 509-924-9200 FAX 924-9290 ☐
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2000 W International Airport Rd Ste A10, Anchorage, AK 99502-1119 907-563-9200 FAX 563-9210 ☐

CHAIN OF CUSTODY REPORT

Work Order #: SRH0103

CLIENT: URS
REPORT TO: GARY PANTHER
ADDRESS:
PHONE: 954-5090 FAX:

INVOICE TO: URS CORP
P.O. NUMBER:

PROJECT NAME: TDF-1
PROJECT NUMBER: 36298248
SAMPLED BY: GDP

TURNAROUND REQUEST
in Business Days *

Organic & Inorganic Analyses
☒ 10 STD. ☐ 7 ☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐ <1

Petroleum Hydrocarbon Analyses
☐ 5 STD. ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐ <1

OTHER Specify:

** Turnaround Requests less than standard may incur Rush Charges.*

PRESERVATIVE / REQUESTED ANALYSES

	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	AS BA CA	Cd Cr Cu	Fe Hg Mg	Mn Zn	Pb Se Ag	ALK	Chloride	Sulfate						MATRIX (W, S, O)	# OF CONT.	LOCATION / COMMENTS	TA WO ID
1	MW-203	8.15.08 10:00														W	3		-01
2	MW-201	8.15.08 11:00														W	3		-02
3	Dup	8.15.08														W	3		-03
4																			
5																			
6																			
7																			
8																			
9																			
10																			

RELEASED BY: DATE: 8.15.08
PRINT NAME: GARY D. PANTHER FIRM: URS TIME: 2:45
RECEIVED BY: DATE: 8/15/08
PRINT NAME: Randee Decker FIRM: TestAmerica TIME: 1445

RELEASED BY: DATE:
PRINT NAME: FIRM: TIME:
RECEIVED BY: DATE:
PRINT NAME: FIRM: TIME:

ADDITIONAL REMARKS: HOLD DISSOLVED

TEMP: 29 PAGE 1 OF 1

TAL-1000 0907

Cominco - Pend Oreille Mine
PO Box 7
Metaline Falls, WA 99153

Work Order: **W804513**
Reported: 22-Aug-08 15:44

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Sampled By	Date Received
080805-MW2	W804513-01	Ground Water	05-Aug-08	GK/JB	07-Aug-08
080805-MW5	W804513-02	Ground Water	05-Aug-08	GK/JB	07-Aug-08
080805-MW7	W804513-03	Ground Water	05-Aug-08	GK/JB	07-Aug-08

Solid samples are analyzed on an as-received, wet-weight basis, unless otherwise requested.
Sample preparation is defined by the client as per their Data Quality Objectives.
The complete report includes pages for each sample, a full QC report, and a notes section.

Cominco - Pend Oreille Mine
PO Box 7
Metaline Falls, WA 99153

Work Order: **W804513**
Reported: 22-Aug-08 15:44

Client Sample ID: **080805-MW2**
SVL Sample ID: **W804513-01 (Ground Water)**

Sample Report Page 1 of 1

Sampled: 05-Aug-08
Received: 07-Aug-08
Sampled By: GK/JB

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total)										
EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.000064		W833077	JAA	13-Aug-08	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.7	Aluminum	< 0.080	mg/L	0.080	0.028		W833037	AS	19-Aug-08	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0010		W833037	AS	19-Aug-08	
EPA 200.7	**Calcium**	71.7	mg/L	0.040	0.016		W833037	AS	19-Aug-08	
EPA 200.7	Chromium	< 0.0060	mg/L	0.0060	0.0010		W833037	AS	19-Aug-08	
EPA 200.7	Iron	< 0.060	mg/L	0.060	0.020		W833037	AS	19-Aug-08	
EPA 200.7	Lead	< 0.0075	mg/L	0.0075	0.0039		W833037	AS	19-Aug-08	
EPA 200.7	**Magnesium**	22.1	mg/L	0.060	0.015		W833037	AS	19-Aug-08	
EPA 200.7	Manganese	< 0.0040	mg/L	0.0040	0.0013		W833037	AS	19-Aug-08	
EPA 200.7	**Potassium**	2.27	mg/L	0.50	0.07		W833037	AS	19-Aug-08	
EPA 200.7	**Silica (SiO2)**	20.7	mg/L	0.17	0.05		W833037	AS	19-Aug-08	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0008		W833037	AS	19-Aug-08	
EPA 200.7	**Sodium**	3.95	mg/L	0.50	0.04		W833037	AS	19-Aug-08	
EPA 200.7	Zinc	< 0.0100	mg/L	0.0100	0.0019		W833037	AS	19-Aug-08	
EPA 200.8	Copper	< 0.00100	mg/L	0.00100	0.00009	2.5	W833012	KWH	15-Aug-08	
Metals (Dissolved)										
EPA 200.7	Lead	< 0.0075	mg/L	0.0075	0.0039		W833155	DG	22-Aug-08	
EPA 200.7	Zinc	< 0.0100	mg/L	0.0100	0.0019		W833155	DG	22-Aug-08	
EPA 200.8	Copper	< 0.00120	mg/L	0.00120	0.00015	4	W833039	KWH	14-Aug-08	D1
Classical Chemistry Parameters										
EPA 120.1	**Specific conductance**	540	umhos/cm	1.0			W832254	JMS	08-Aug-08	
EPA 350.1	**Ammonia as N**	0.040	mg/L	0.030	0.005		W833202	SM	18-Aug-08	
EPA 353.2	**Nitrate/Nitrite as N**	0.277	mg/L	0.0500	0.0012		W833283	SM	19-Aug-08	
SM 2320B	**Total Alkalinity**	277	mg/L	1.0	0.3		W832244	DKS	08-Aug-08	
SM 2320B	**Bicarbonate**	277	mg/L	1.0	0.3		W832244	DKS	08-Aug-08	
SM 2320B	Carbonate	< 1.0	mg/L	1.0	0.3		W832244	DKS	08-Aug-08	
SM 2320B	Hydroxide	< 1.0	mg/L	1.0	0.3		W832244	DKS	08-Aug-08	
SM 2540 C	**Total Diss. Solids**	290	mg/L	10	4.3		W832260	JMS	11-Aug-08	
SM 2540 D	Total Susp. Solids	< 5.0	mg/L	5.0	4.2		W832256	JMS	11-Aug-08	
SM 4500-P-E	**Orthophosphate as P**	0.03	mg/L	0.01	0.006		W832229	DKG	07-Aug-08	H3
Anions by Ion Chromatography										
EPA 300.0	**Fluoride**	0.101	mg/L	0.100	0.025		W833253	AJE	15-Aug-08	
EPA 300.0	**Chloride**	0.854	mg/L	0.200	0.032		W833253	AJE	15-Aug-08	
EPA 300.0	**Sulfate as SO4**	73.2	mg/L	1.50	0.24	5	W833253	AJE	15-Aug-08	D2

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Nan Wilson
Laboratory Director

Cominco - Pend Oreille Mine
PO Box 7
Metaline Falls, WA 99153

Work Order: **W804513**
Reported: 22-Aug-08 15:44

Client Sample ID: **080805-MW5**
SVL Sample ID: **W804513-02 (Ground Water)**

Sample Report Page 1 of 1

Sampled: 05-Aug-08
Received: 07-Aug-08
Sampled By: GK/JB

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total)										
EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.000064		W833077	JAA	13-Aug-08	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.7	Aluminum	< 0.080	mg/L	0.080	0.028		W833037	AS	19-Aug-08	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0010		W833037	AS	19-Aug-08	
EPA 200.7	**Calcium**	183	mg/L	0.040	0.016		W833037	AS	19-Aug-08	
EPA 200.7	Chromium	< 0.0060	mg/L	0.0060	0.0010		W833037	AS	19-Aug-08	
EPA 200.7	Iron	< 0.060	mg/L	0.060	0.020		W833037	AS	19-Aug-08	
EPA 200.7	Lead	< 0.0075	mg/L	0.0075	0.0039		W833037	AS	19-Aug-08	
EPA 200.7	**Magnesium**	75.4	mg/L	0.060	0.015		W833037	AS	19-Aug-08	
EPA 200.7	Manganese	< 0.0040	mg/L	0.0040	0.0013		W833037	AS	19-Aug-08	
EPA 200.7	**Potassium**	4.07	mg/L	0.50	0.07		W833037	AS	19-Aug-08	
EPA 200.7	**Silica (SiO2)**	24.1	mg/L	0.17	0.05		W833037	AS	19-Aug-08	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0008		W833037	AS	19-Aug-08	
EPA 200.7	**Sodium**	7.70	mg/L	0.50	0.04		W833037	AS	19-Aug-08	
EPA 200.7	Zinc	< 0.0100	mg/L	0.0100	0.0019		W833037	AS	19-Aug-08	
EPA 200.8	Copper	< 0.00100	mg/L	0.00100	0.00009	2.5	W833012	KWH	15-Aug-08	
Metals (Dissolved)										
EPA 200.7	Lead	< 0.0075	mg/L	0.0075	0.0039		W833155	DG	22-Aug-08	
EPA 200.7	Zinc	< 0.0100	mg/L	0.0100	0.0019		W833155	DG	22-Aug-08	
EPA 200.8	Copper	< 0.00120	mg/L	0.00120	0.00015	4	W833039	KWH	14-Aug-08	D1
Classical Chemistry Parameters										
EPA 120.1	**Specific conductance**	1300	umhos/cm	1.0			W832254	JMS	08-Aug-08	
EPA 350.1	**Ammonia as N**	0.053	mg/L	0.030	0.005		W833202	SM	18-Aug-08	
EPA 353.2	**Nitrate/Nitrite as N**	0.234	mg/L	0.0500	0.0012		W833283	SM	19-Aug-08	
SM 2320B	**Total Alkalinity**	382	mg/L	1.0	0.3		W832244	DKS	08-Aug-08	
SM 2320B	**Bicarbonate**	382	mg/L	1.0	0.3		W832244	DKS	08-Aug-08	
SM 2320B	Carbonate	< 1.0	mg/L	1.0	0.3		W832244	DKS	08-Aug-08	
SM 2320B	Hydroxide	< 1.0	mg/L	1.0	0.3		W832244	DKS	08-Aug-08	
SM 2540 C	**Total Diss. Solids**	950	mg/L	10	4.3		W832260	JMS	11-Aug-08	
SM 2540 D	Total Susp. Solids	< 5.0	mg/L	5.0	4.2		W832256	JMS	11-Aug-08	
SM 4500-P-E	**Orthophosphate as P**	0.07	mg/L	0.01	0.006		W832229	DKG	07-Aug-08	H3
Anions by Ion Chromatography										
EPA 300.0	Fluoride	< 0.100	mg/L	0.100	0.025		W833253	AJE	15-Aug-08	
EPA 300.0	**Chloride**	3.47	mg/L	0.200	0.032		W833253	AJE	15-Aug-08	
EPA 300.0	**Sulfate as SO4**	1000	mg/L	30.0	4.70	100	W833253	AJE	15-Aug-08	D2

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Nan Wilson
Laboratory Director

Cominco - Pend Oreille Mine
PO Box 7
Metaline Falls, WA 99153

Work Order: **W804513**
Reported: 22-Aug-08 15:44

Client Sample ID: **080805-MW7**
SVL Sample ID: **W804513-03 (Ground Water)**

Sample Report Page 1 of 1

Sampled: 05-Aug-08
Received: 07-Aug-08
Sampled By: GK/JB

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total)										
EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.000064		W833077	JAA	13-Aug-08	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.7	Aluminum	< 0.080	mg/L	0.080	0.028		W833037	AS	19-Aug-08	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0010		W833037	AS	19-Aug-08	
EPA 200.7	**Calcium**	70.7	mg/L	0.040	0.016		W833037	AS	19-Aug-08	
EPA 200.7	**Chromium**	1.52	mg/L	0.0060	0.0010		W833037	AS	19-Aug-08	
EPA 200.7	**Iron**	6.52	mg/L	0.060	0.020		W833037	AS	19-Aug-08	
EPA 200.7	Lead	< 0.0075	mg/L	0.0075	0.0039		W833037	AS	19-Aug-08	
EPA 200.7	**Magnesium**	23.6	mg/L	0.060	0.015		W833037	AS	19-Aug-08	
EPA 200.7	**Manganese**	0.0995	mg/L	0.0040	0.0013		W833037	AS	19-Aug-08	
EPA 200.7	**Potassium**	2.71	mg/L	0.50	0.07		W833037	AS	19-Aug-08	
EPA 200.7	**Silica (SiO2)**	19.6	mg/L	0.17	0.05		W833037	AS	19-Aug-08	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0008		W833037	AS	19-Aug-08	
EPA 200.7	**Sodium**	3.51	mg/L	0.50	0.04		W833037	AS	19-Aug-08	
EPA 200.7	Zinc	< 0.0100	mg/L	0.0100	0.0019		W833037	AS	19-Aug-08	
EPA 200.8	Copper	< 0.00100	mg/L	0.00100	0.00009	2.5	W833012	KWH	15-Aug-08	
Metals (Dissolved)										
EPA 200.7	Lead	< 0.0075	mg/L	0.0075	0.0039		W833155	DG	22-Aug-08	
EPA 200.7	Zinc	< 0.0100	mg/L	0.0100	0.0019		W833155	DG	22-Aug-08	
EPA 200.8	Copper	< 0.00120	mg/L	0.00120	0.00015	4	W833039	KWH	14-Aug-08	D1
Classical Chemistry Parameters										
EPA 120.1	**Specific conductance**	530	umhos/cm	1.0			W832254	JMS	08-Aug-08	
EPA 350.1	**Ammonia as N**	0.031	mg/L	0.030	0.005		W833202	SM	18-Aug-08	
EPA 353.2	Nitrate/Nitrite as N	< 0.0500	mg/L	0.0500	0.0012		W833283	SM	19-Aug-08	
SM 2320B	**Total Alkalinity**	238	mg/L	1.0	0.3		W832244	DKS	08-Aug-08	
SM 2320B	**Bicarbonate**	238	mg/L	1.0	0.3		W832244	DKS	08-Aug-08	
SM 2320B	Carbonate	< 1.0	mg/L	1.0	0.3		W832244	DKS	08-Aug-08	
SM 2320B	Hydroxide	< 1.0	mg/L	1.0	0.3		W832244	DKS	08-Aug-08	
SM 2540 C	**Total Diss. Solids**	320	mg/L	10	4.3		W832260	JMS	11-Aug-08	
SM 2540 D	**Total Susp. Solids**	5.0	mg/L	5.0	4.2		W832256	JMS	11-Aug-08	
SM 4500-P-E	**Orthophosphate as P**	0.05	mg/L	0.01	0.006		W832229	DKG	07-Aug-08	H3
Anions by Ion Chromatography										
EPA 300.0	Fluoride	< 0.100	mg/L	0.100	0.025		W833253	AJE	15-Aug-08	
EPA 300.0	**Chloride**	5.60	mg/L	0.200	0.032		W833253	AJE	15-Aug-08	
EPA 300.0	**Sulfate as SO4**	36.5	mg/L	0.30	0.05		W833253	AJE	15-Aug-08	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Nan Wilson
Laboratory Director

Cominco - Pend Oreille Mine
PO Box 7
Metaline Falls, WA 99153

Work Order: **W804513**
Reported: 22-Aug-08 15:44

Quality Control - BLANK Data

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Metals (Total)								
EPA 245.1	Mercury	mg/L	<0.00020	0.000064	0.00020	W833077	13-Aug-08	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)								
EPA 200.7	Aluminum	mg/L	<0.080	0.028	0.080	W833037	19-Aug-08	
EPA 200.7	Cadmium	mg/L	<0.0020	0.0010	0.0020	W833037	19-Aug-08	
EPA 200.7	Calcium	mg/L	<0.040	0.016	0.040	W833037	19-Aug-08	
EPA 200.7	Chromium	mg/L	<0.0060	0.0010	0.0060	W833037	19-Aug-08	
EPA 200.7	Iron	mg/L	<0.060	0.020	0.060	W833037	19-Aug-08	
EPA 200.7	Lead	mg/L	<0.0075	0.0039	0.0075	W833037	19-Aug-08	
EPA 200.7	Magnesium	mg/L	<0.060	0.015	0.060	W833037	19-Aug-08	
EPA 200.7	Manganese	mg/L	<0.0040	0.0013	0.0040	W833037	19-Aug-08	
EPA 200.7	Potassium	mg/L	<0.50	0.07	0.50	W833037	19-Aug-08	
EPA 200.7	Silica (SiO2)	mg/L	<0.17	0.05	0.17	W833037	19-Aug-08	
EPA 200.7	Silver	mg/L	<0.0050	0.0008	0.0050	W833037	19-Aug-08	
EPA 200.7	Sodium	mg/L	<0.50	0.04	0.50	W833037	19-Aug-08	
EPA 200.7	Zinc	mg/L	<0.0100	0.0019	0.0100	W833037	19-Aug-08	
EPA 200.8	Copper	mg/L	<0.00100	0.00009	0.00100	W833012	15-Aug-08	
Metals (Dissolved)								
EPA 200.7	Lead	mg/L	<0.0075	0.0039	0.0075	W833155	22-Aug-08	
EPA 200.7	Zinc	mg/L	<0.0100	0.0019	0.0100	W833155	22-Aug-08	
EPA 200.8	Copper	mg/L	<0.00100	0.000037	0.00100	W833039	14-Aug-08	
Classical Chemistry Parameters								
EPA 120.1	Specific conductance	umhos/cm	<1.0		1.0	W832254	08-Aug-08	
EPA 350.1	Ammonia as N	mg/L	<0.030	0.005	0.030	W833202	18-Aug-08	
EPA 353.2	Nitrate/Nitrite as N	mg/L	<0.0500	0.0012	0.0500	W833283	19-Aug-08	
SM 2540 C	Total Diss. Solids	mg/L	<10	4.3	10	W832260	11-Aug-08	
SM 2540 D	Total Susp. Solids	mg/L	<5.0	4.2	5.0	W832256	11-Aug-08	
SM 4500-P-E	Orthophosphate as P	mg/L	<0.01	0.006	0.01	W832229	07-Aug-08	
Anions by Ion Chromatography								
EPA 300.0	Fluoride	mg/L	<0.100	0.025	0.100	W833253	15-Aug-08	
EPA 300.0	Chloride	mg/L	<0.200	0.032	0.200	W833253	15-Aug-08	
EPA 300.0	Sulfate as SO4	mg/L	<0.30	0.05	0.30	W833253	15-Aug-08	

Quality Control - LABORATORY CONTROL SAMPLE Data

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Total)									
EPA 245.1	Mercury	mg/L	0.00477	0.00500	95.4	85 - 115	W833077	13-Aug-08	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)									
EPA 200.7	Aluminum	mg/L	1.04	1.00	104	85 - 115	W833037	19-Aug-08	
EPA 200.7	Cadmium	mg/L	1.07	1.00	107	85 - 115	W833037	19-Aug-08	
EPA 200.7	Calcium	mg/L	20.7	20.0	103	85 - 115	W833037	19-Aug-08	
EPA 200.7	Chromium	mg/L	1.07	1.00	107	85 - 115	W833037	19-Aug-08	
EPA 200.7	Iron	mg/L	10.5	10.0	105	85 - 115	W833037	19-Aug-08	
EPA 200.7	Lead	mg/L	1.06	1.00	106	85 - 115	W833037	19-Aug-08	
EPA 200.7	Magnesium	mg/L	20.5	20.0	103	85 - 115	W833037	19-Aug-08	
EPA 200.7	Manganese	mg/L	1.05	1.00	105	85 - 115	W833037	19-Aug-08	
EPA 200.7	Potassium	mg/L	21.1	20.0	105	85 - 115	W833037	19-Aug-08	
EPA 200.7	Silica (SiO2)	mg/L	11.3	10.7	105	85 - 115	W833037	19-Aug-08	
EPA 200.7	Silver	mg/L	0.0549	0.0500	110	85 - 115	W833037	19-Aug-08	

Quality Control - LABORATORY CONTROL SAMPLE Data (Continued)

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136) (Continued)									
EPA 200.7	Sodium	mg/L	19.5	19.0	103	85 - 115	W833037	19-Aug-08	
EPA 200.7	Zinc	mg/L	1.07	1.00	107	85 - 115	W833037	19-Aug-08	
EPA 200.8	Copper	mg/L	0.0253	0.0250	101	85 - 115	W833012	15-Aug-08	
Metals (Dissolved)									
EPA 200.7	Lead	mg/L	1.03	1.00	103	85 - 115	W833155	22-Aug-08	
EPA 200.7	Zinc	mg/L	1.04	1.00	104	85 - 115	W833155	22-Aug-08	
EPA 200.8	Copper	mg/L	0.0253	0.0250	101	85 - 115	W833039	14-Aug-08	
Classical Chemistry Parameters									
EPA 120.1	Specific conductance	umhos/cm	484	484	100	95 - 108	W832254	08-Aug-08	
EPA 350.1	Ammonia as N	mg/L	0.787	0.750	105	90 - 110	W833202	18-Aug-08	
EPA 353.2	Nitrate/Nitrite as N	mg/L	1.84	2.00	92.1	90 - 110	W833283	19-Aug-08	
SM 2540 C	Total Diss. Solids	mg/L	1220	1280	95.5	87 - 113	W832260	11-Aug-08	
SM 2540 D	Total Susp. Solids	mg/L	28.0	32.8	85.4	76 - 119	W832256	11-Aug-08	
SM 4500-P-E	Orthophosphate as P	mg/L	4.02	3.97	101	89 - 112	W832229	07-Aug-08	
Anions by Ion Chromatography									
EPA 300.0	Fluoride	mg/L	2.55	2.50	102	90 - 110	W833253	15-Aug-08	
EPA 300.0	Chloride	mg/L	4.93	5.00	98.6	90 - 110	W833253	15-Aug-08	
EPA 300.0	Sulfate as SO4	mg/L	10.3	10.0	103	90 - 110	W833253	15-Aug-08	

Quality Control - DUPLICATE Data

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Metals (Total)									
EPA 245.1	Mercury	mg/L	0.00141	0.00164	15.1	11.3	W833077	13-Aug-08	R2
Metals (Total Recoverable--reportable as Total per 40 CFR 136)									
EPA 200.7	Aluminum	mg/L	<0.080	<0.080	UDL	20	W833037	19-Aug-08	
EPA 200.7	Cadmium	mg/L	<0.0020	<0.0020	UDL	20	W833037	19-Aug-08	
EPA 200.7	Calcium	mg/L	33.7	33.9	0.7	8.37	W833037	19-Aug-08	
EPA 200.7	Chromium	mg/L	<0.0060	<0.0060	UDL	20	W833037	19-Aug-08	
EPA 200.7	Iron	mg/L	<0.060	<0.060	UDL	20	W833037	19-Aug-08	
EPA 200.7	Lead	mg/L	<0.0075	<0.0075	UDL	20	W833037	19-Aug-08	
EPA 200.7	Magnesium	mg/L	16.8	16.9	0.7	11.3	W833037	19-Aug-08	
EPA 200.7	Manganese	mg/L	<0.0040	<0.0040	UDL	12.5	W833037	19-Aug-08	
EPA 200.7	Potassium	mg/L	2.16	2.19	1.4	9.55	W833037	19-Aug-08	
EPA 200.7	Silica (SiO2)	mg/L	11.9	12.0	0.7	20	W833037	19-Aug-08	
EPA 200.7	Silver	mg/L	<0.0050	<0.0050	UDL	20	W833037	19-Aug-08	
EPA 200.7	Sodium	mg/L	4.35	4.40	1.2	9.64	W833037	19-Aug-08	
EPA 200.7	Zinc	mg/L	<0.0100	<0.0100	<RL	10.6	W833037	19-Aug-08	
EPA 200.8	Copper	mg/L	<0.00100	<0.00100	UDL	20	W833012	15-Aug-08	
Metals (Dissolved)									
EPA 200.7	Lead	mg/L	<0.0075	<0.0075	UDL	20	W833155	22-Aug-08	
EPA 200.7	Zinc	mg/L	<0.0100	<0.0100	UDL	10.6	W833155	22-Aug-08	
EPA 200.8	Copper	mg/L	0.00106	<0.00100	<RL	20	W833039	21-Aug-08	D1
Classical Chemistry Parameters									
EPA 120.1	Specific conductance	umhos/cm	536	539	0.6	20	W832254	08-Aug-08	
EPA 350.1	Ammonia as N	mg/L	0.048	0.052	7.1	20	W833202	18-Aug-08	
EPA 353.2	Nitrate/Nitrite as N	mg/L	0.281	0.277	1.4	20	W833283	19-Aug-08	
SM 2320B	Total Alkalinity	mg/L	48.2	48.3	0.3	20	W832244	08-Aug-08	

Cominco - Pend Oreille Mine
PO Box 7
Metaline Falls, WA 99153

Work Order: **W804513**
Reported: 22-Aug-08 15:44

Quality Control - DUPLICATE Data (Continued)

Classical Chemistry Parameters (Continued)

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
SM 2320B	Total Alkalinity	mg/L	710	719	1.3	20	W832244	08-Aug-08	
SM 2320B	Bicarbonate	mg/L	48.2	48.3	0.3	20	W832244	08-Aug-08	
SM 2320B	Bicarbonate	mg/L	710	719	1.3	20	W832244	08-Aug-08	
SM 2320B	Carbonate	mg/L	<1.0	<1.0	UDL	20	W832244	08-Aug-08	
SM 2320B	Carbonate	mg/L	<1.0	<1.0	UDL	20	W832244	08-Aug-08	
SM 2320B	Hydroxide	mg/L	<1.0	<1.0	UDL	20	W832244	08-Aug-08	
SM 2320B	Hydroxide	mg/L	<1.0	<1.0	UDL	20	W832244	08-Aug-08	
SM 2540 C	Total Diss. Solids	mg/L	1080	1090	1.1	20	W832260	11-Aug-08	
SM 2540 D	Total Susp. Solids	mg/L	32.0	37.0	14.5	20	W832256	11-Aug-08	
SM 4500-P-E	Orthophosphate as P	mg/L	0.03	0.03	0.0	20	W832229	07-Aug-08	

Anions by Ion Chromatography

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
EPA 300.0	Fluoride	mg/L	<0.100	0.101	<RL	13	W833253	15-Aug-08	
EPA 300.0	Chloride	mg/L	0.940	0.854	9.6	3.59	W833253	15-Aug-08	R3
EPA 300.0	Sulfate as SO4	mg/L	73.2	73.2	0.0	2.17	W833253	15-Aug-08	D2

Quality Control - MATRIX SPIKE Data

Metals (Total)

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
EPA 245.1	Mercury	mg/L	0.00096	<0.00020	0.00100	96.0	70 - 130	W833077	13-Aug-08	
EPA 245.1	Mercury	mg/L	0.00357	0.00164	0.00200	96.5	70 - 130	W833077	13-Aug-08	

Metals (Total Recoverable--reportable as Total per 40 CFR 136)

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
EPA 200.7	Aluminum	mg/L	1.06	<0.080	1.00	106	70 - 130	W833037	19-Aug-08	
EPA 200.7	Cadmium	mg/L	1.05	<0.0020	1.00	105	70 - 130	W833037	19-Aug-08	
EPA 200.7	Calcium	mg/L	54.6	33.9	20.0	103	70 - 130	W833037	19-Aug-08	
EPA 200.7	Chromium	mg/L	1.05	<0.0060	1.00	105	70 - 130	W833037	19-Aug-08	
EPA 200.7	Iron	mg/L	10.5	<0.060	10.0	105	70 - 130	W833037	19-Aug-08	
EPA 200.7	Lead	mg/L	1.05	<0.0075	1.00	105	70 - 130	W833037	19-Aug-08	
EPA 200.7	Magnesium	mg/L	37.4	16.9	20.0	102	70 - 130	W833037	19-Aug-08	
EPA 200.7	Manganese	mg/L	1.05	<0.0040	1.00	105	70 - 130	W833037	19-Aug-08	
EPA 200.7	Potassium	mg/L	23.6	2.19	20.0	107	70 - 130	W833037	19-Aug-08	
EPA 200.7	Silica (SiO2)	mg/L	23.2	12.0	10.7	105	70 - 130	W833037	19-Aug-08	
EPA 200.7	Silver	mg/L	0.0547	<0.0050	0.0500	109	70 - 130	W833037	19-Aug-08	
EPA 200.7	Sodium	mg/L	24.2	4.40	19.0	104	70 - 130	W833037	19-Aug-08	
EPA 200.7	Zinc	mg/L	1.04	<0.0100	1.00	103	70 - 130	W833037	19-Aug-08	
EPA 200.8	Copper	mg/L	0.0245	<0.00100	0.0250	98.0	70 - 130	W833012	15-Aug-08	

Metals (Dissolved)

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
EPA 200.7	Lead	mg/L	1.00	<0.0079	1.00	100	70 - 130	W833155	22-Aug-08	
EPA 200.7	Lead	mg/L	1.00	<0.0079	1.00	100	70 - 130	W833155	22-Aug-08	
EPA 200.7	Zinc	mg/L	0.964	<0.0105	1.00	96.4	70 - 130	W833155	22-Aug-08	
EPA 200.7	Zinc	mg/L	1.12	0.115	1.00	100	70 - 130	W833155	22-Aug-08	
EPA 200.8	Copper	mg/L	0.0260	<0.00100	0.0250	101	70 - 130	W833039	21-Aug-08	

Classical Chemistry Parameters

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
EPA 350.1	Ammonia as N	mg/L	0.550	0.052	0.500	99.7	90 - 110	W833202	18-Aug-08	
EPA 350.1	Ammonia as N	mg/L	0.518	0.007	0.500	102	90 - 110	W833202	18-Aug-08	
EPA 353.2	Nitrate/Nitrite as N	mg/L	1.32	0.277	1.00	104	90 - 110	W833283	19-Aug-08	
EPA 353.2	Nitrate/Nitrite as N	mg/L	1.08	0.0604	1.00	102	90 - 110	W833283	19-Aug-08	
SM 4500-P-E	Orthophosphate as P	mg/L	0.52	0.03	0.500	98.0	87 - 113	W832229	07-Aug-08	

Cominco - Pend Oreille Mine
PO Box 7
Metaline Falls, WA 99153

Work Order: **W804513**
Reported: 22-Aug-08 15:44

Quality Control - MATRIX SPIKE Data (Continued)

Anions by Ion Chromatography

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
EPA 300.0	Fluoride	mg/L	2.18	0.101	2.00	104	90 - 110	W833253	15-Aug-08	
EPA 300.0	Chloride	mg/L	3.96	0.854	3.00	104	90 - 110	W833253	15-Aug-08	
EPA 300.0	Sulfate as SO4	mg/L	122	73.2	50.0	98.5	90 - 110	W833253	15-Aug-08	D2

Notes and Definitions

D1	Sample required dilution due to matrix.
D2	Sample required dilution due to high concentration of target analyte.
H3	Sample was received and analyzed past holding time.
R2	RPD/RSD exceeded the laboratory acceptance limit.
R3	There is no control limit for the RPD if the concentration in the sample is less than five times the reporting limit
LCS	Laboratory Control Sample (Blank Spike)
RPD	Relative Percent Difference
UDL	A result is less than the detection limit
R > 4S	% recovery not applicable, sample concentration more than four times greater than spike level
<RL	A result is less than the reporting limit
MRL	Method Reporting Limit
MDL	Method Detection Limit
N/A	Not Applicable

SPOKANE, WA 11922 E. 1ST AVENUE
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January 13, 2009

Gary Panther
URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

RE: TDF-1

Enclosed are the results of analyses for samples received by the laboratory on 12/11/08 08:15. The following list is a summary of the Work Orders contained in this report, generated on 01/13/09 14:07.

If you have any questions concerning this report, please feel free to contact me.

Work Order	Project	ProjectNumber
SRL0070	TDF-1	36298248

TestAmerica Spokane

Randee Decker

Randee Decker, Project Manager

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
01/13/09 14:07

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MW-301	SRL0070-01	Water	12/10/08 11:00	12/11/08 08:15
MW-303	SRL0070-02	Water	12/10/08 12:00	12/11/08 08:15
MW-302	SRL0070-03	Water	12/10/08 13:00	12/11/08 08:15
MW-203	SRL0070-04	Water	12/10/08 14:00	12/11/08 08:15
MW-201	SRL0070-05	Water	12/10/08 14:30	12/11/08 08:15
MW-2	SRL0070-06	Water	12/10/08 15:00	12/11/08 08:15
MW-7	SRL0070-07	Water	12/10/08 16:00	12/11/08 08:15
DUP	SRL0070-08	Water	12/10/08 00:00	12/11/08 08:15

TestAmerica Spokane

Randee Decker

Randee Decker, Project Manager

Total Metals by EPA 200 Series Methods

TestAmerica Spokane

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SRL0070-01 (MW-301)		**Water**			**Sampled: 12/10/08 11:00**					
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	8120103	12/12/08 12:43	12/16/08 10:51	
Iron	"	**0.183**	-----	0.0200	"	"	"	"	12/16/08 15:30	
Magnesium	"	**59.6**	-----	0.0100	"	"	"	"	12/16/08 10:51	
Manganese	"	**0.0162**	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.0342**	-----	0.0100	"	"	"	"	"	
SRL0070-02 (MW-303)		**Water**			**Sampled: 12/10/08 12:00**					
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	8120103	12/12/08 12:43	12/16/08 10:58	
Iron	"	**1.53**	-----	0.0200	"	"	"	"	12/16/08 15:37	
Magnesium	"	**57.7**	-----	0.0100	"	"	"	"	12/16/08 10:58	
Manganese	"	**0.0808**	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.0259**	-----	0.0100	"	"	"	"	"	
SRL0070-03 (MW-302)		**Water**			**Sampled: 12/10/08 13:00**					
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	8120103	12/12/08 12:43	12/16/08 11:05	
Iron	"	**0.706**	-----	0.0200	"	"	"	"	12/16/08 15:44	
Magnesium	"	**51.6**	-----	0.0100	"	"	"	"	12/16/08 11:05	
Manganese	"	**2.85**	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.119**	-----	0.0100	"	"	"	"	"	
SRL0070-04 (MW-203)		**Water**			**Sampled: 12/10/08 14:00**					
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	8120103	12/12/08 12:43	12/16/08 11:11	
Iron	"	**0.0868**	-----	0.0200	"	"	"	"	12/16/08 15:50	
Magnesium	"	**51.5**	-----	0.0100	"	"	"	"	12/16/08 11:11	
Manganese	"	**0.159**	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.0107**	-----	0.0100	"	"	"	"	"	
SRL0070-05 (MW-201)		**Water**			**Sampled: 12/10/08 14:30**					
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	8120103	12/12/08 12:43	12/16/08 11:18	
Iron	"	**0.406**	-----	0.0200	"	"	"	"	12/16/08 15:57	
Magnesium	"	**21.6**	-----	0.0100	"	"	"	"	12/16/08 11:18	
Manganese	"	**0.0174**	-----	0.0100	"	"	"	"	"	
Zinc	"	ND	-----	0.0100	"	"	"	"	"	

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
01/13/09 14:07

Total Metals by EPA 200 Series Methods

TestAmerica Spokane

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SRL0070-06 (MW-2)		**Water**			**Sampled: 12/10/08 15:00**					
Chromium	EPA 200.7	**0.00866**	-----	0.00800	mg/l	1x	8120103	12/12/08 12:43	12/16/08 11:39	
Iron	"	**1.76**	-----	0.0200	"	"	"	"	12/16/08 16:03	
Magnesium	"	**25.7**	-----	0.0100	"	"	"	"	12/16/08 11:39	
Manganese	"	**0.0989**	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.0135**	-----	0.0100	"	"	"	"	"	
SRL0070-07 (MW-7)		**Water**			**Sampled: 12/10/08 16:00**					
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	8120103	12/12/08 12:43	12/16/08 11:45	
Iron	"	**0.114**	-----	0.0200	"	"	"	"	12/16/08 16:10	
Magnesium	"	**23.2**	-----	0.0100	"	"	"	"	12/16/08 11:45	
Manganese	"	**0.0221**	-----	0.0100	"	"	"	"	"	
Zinc	"	ND	-----	0.0100	"	"	"	"	"	
SRL0070-08 (DUP)		**Water**			**Sampled: 12/10/08 00:00**					
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	8120103	12/12/08 12:43	12/16/08 11:52	
Iron	"	**0.730**	-----	0.0200	"	"	"	"	12/16/08 16:16	
Magnesium	"	**50.6**	-----	0.0100	"	"	"	"	12/16/08 11:52	
Manganese	"	**2.80**	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.114**	-----	0.0100	"	"	"	"	"	

Randee Decker, Project Manager

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
01/13/09 14:07

Conventional Chemistry Parameters by APHA/EPA Methods

TestAmerica Spokane

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SRL0070-01 (MW-301)		**Water**			**Sampled: 12/10/08 11:00**					
Total Alkalinity	SM 2320B	**265**	-----	4.00	mg/l	1x	8120092	12/11/08 13:28	12/11/08 13:28	
SRL0070-02 (MW-303)		**Water**			**Sampled: 12/10/08 12:00**					
Total Alkalinity	SM 2320B	**250**	-----	4.00	mg/l	1x	8120092	12/11/08 13:28	12/11/08 13:28	
SRL0070-03 (MW-302)		**Water**			**Sampled: 12/10/08 13:00**					
Total Alkalinity	SM 2320B	**285**	-----	4.00	mg/l	1x	8120092	12/11/08 13:28	12/11/08 13:28	
SRL0070-04 (MW-203)		**Water**			**Sampled: 12/10/08 14:00**					
Total Alkalinity	SM 2320B	**265**	-----	4.00	mg/l	1x	8120092	12/11/08 13:28	12/11/08 13:28	
SRL0070-05 (MW-201)		**Water**			**Sampled: 12/10/08 14:30**					
Total Alkalinity	SM 2320B	**243**	-----	4.00	mg/l	1x	8120092	12/11/08 13:28	12/11/08 13:28	
SRL0070-06 (MW-2)		**Water**			**Sampled: 12/10/08 15:00**					
Total Alkalinity	SM 2320B	**245**	-----	4.00	mg/l	1x	8120092	12/11/08 13:28	12/11/08 13:28	
SRL0070-07 (MW-7)		**Water**			**Sampled: 12/10/08 16:00**					
Total Alkalinity	SM 2320B	**210**	-----	4.00	mg/l	1x	8120092	12/11/08 13:28	12/11/08 13:28	
SRL0070-08 (DUP)		**Water**			**Sampled: 12/10/08 00:00**					
Total Alkalinity	SM 2320B	**283**	-----	4.00	mg/l	1x	8120092	12/11/08 13:28	12/11/08 13:28	

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
01/13/09 14:07

Anions by EPA Method 300.0

TestAmerica Spokane

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SRL0070-01 (MW-301)		**Water**			**Sampled: 12/10/08 11:00**					
Chloride	EPA 300.0	**3.62**	-----	0.500	mg/l	1x	8120111	12/15/08 10:27	12/15/08 14:16	
Sulfate	"	**960**	-----	25.0	"	50x	"	"	12/15/08 14:29	
SRL0070-02 (MW-303)		**Water**			**Sampled: 12/10/08 12:00**					
Chloride	EPA 300.0	**5.38**	-----	0.500	mg/l	1x	8120111	12/15/08 10:27	12/15/08 14:42	
Sulfate	"	**790**	-----	25.0	"	50x	"	"	12/15/08 14:55	
SRL0070-03 (MW-302)		**Water**			**Sampled: 12/10/08 13:00**					
Chloride	EPA 300.0	**4.25**	-----	0.500	mg/l	1x	8120111	12/15/08 10:27	12/15/08 15:08	
Sulfate	"	**764**	-----	25.0	"	50x	"	"	12/15/08 15:21	
SRL0070-04 (MW-203)		**Water**			**Sampled: 12/10/08 14:00**					
Chloride	EPA 300.0	**0.620**	-----	0.500	mg/l	1x	8120111	12/15/08 10:27	12/15/08 15:35	
Sulfate	"	**594**	-----	25.0	"	50x	"	"	12/15/08 15:48	
SRL0070-05 (MW-201)		**Water**			**Sampled: 12/10/08 14:30**					
Chloride	EPA 300.0	**8.35**	-----	2.50	mg/l	5x	8120111	12/15/08 10:27	12/15/08 16:53	
Sulfate	"	**27.4**	-----	2.50	"	"	"	"	"	
SRL0070-06 (MW-2)		**Water**			**Sampled: 12/10/08 15:00**					
Chloride	EPA 300.0	**5.89**	-----	0.500	mg/l	1x	8120111	12/15/08 10:27	12/15/08 16:01	
Sulfate	"	**54.3**	-----	2.50	"	5x	"	"	12/16/08 18:47	
SRL0070-07 (MW-7)		**Water**			**Sampled: 12/10/08 16:00**					
Chloride	EPA 300.0	**1.51**	-----	0.500	mg/l	1x	8120111	12/15/08 10:27	12/15/08 16:14	
Sulfate	"	**74.0**	-----	2.50	"	5x	"	"	12/16/08 19:01	
SRL0070-08 (DUP)		**Water**			**Sampled: 12/10/08 00:00**					
Chloride	EPA 300.0	**4.34**	-----	0.500	mg/l	1x	8120111	12/15/08 10:27	12/15/08 17:46	
Sulfate	"	**778**	-----	25.0	"	50x	"	"	12/15/08 17:59	

TestAmerica Spokane

Randee Decker, Project Manager

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
01/13/09 14:07

Total Metals by EPA 200 Series Methods

TestAmerica Seattle

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SRL0070-01 (MW-301)		**Water**			**Sampled: 12/10/08 11:00**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	8L15051	12/15/08 14:58	12/17/08 01:36	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
SRL0070-02 (MW-303)		**Water**			**Sampled: 12/10/08 12:00**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	8L15051	12/15/08 14:58	12/17/08 01:42	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
SRL0070-03 (MW-302)		**Water**			**Sampled: 12/10/08 13:00**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	8L15051	12/15/08 14:58	12/17/08 01:48	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
SRL0070-04 (MW-203)		**Water**			**Sampled: 12/10/08 14:00**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	8L15051	12/15/08 14:58	12/17/08 01:55	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
SRL0070-05 (MW-201)		**Water**			**Sampled: 12/10/08 14:30**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	8L15051	12/15/08 14:58	12/17/08 02:21	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
SRL0070-06 (MW-2)		**Water**			**Sampled: 12/10/08 15:00**					
Arsenic	EPA 200.8	**0.00139**	-----	0.00100	mg/l	1x	8L15051	12/15/08 14:58	12/17/08 02:27	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
SRL0070-07 (MW-7)		**Water**			**Sampled: 12/10/08 16:00**					
Arsenic	EPA 200.8	**0.00117**	-----	0.00100	mg/l	1x	8L15051	12/15/08 14:58	12/17/08 02:34	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
SRL0070-08 (DUP)		**Water**			**Sampled: 12/10/08 00:00**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	8L15051	12/15/08 14:58	12/17/08 02:40	
Lead	"	ND	-----	0.00100	"	"	"	"	"	

TestAmerica Spokane

Randee Decker, Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Total Metals by EPA 200 Series Methods - Laboratory Quality Control Results

TestAmerica Spokane

QC Batch: 8120103 **Water Preparation Method: Metals**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (8120103-BLK1)								**Extracted: 12/12/08 12:43**						
Magnesium	EPA 200.7	ND	---	0.0100	mg/l	1x	--	--	--	--	--	--	12/16/08 09:23	
Chromium	"	ND	---	0.00800	"	"	--	--	--	--	--	--	"	
Zinc	"	ND	---	0.0100	"	"	--	--	--	--	--	--	"	
Iron	"	ND	---	0.0200	"	"	--	--	--	--	--	--	12/16/08 15:09	
Manganese	"	ND	---	0.0100	"	"	--	--	--	--	--	--	12/16/08 09:23	
LCS (8120103-BS1)								**Extracted: 12/12/08 12:43**						
Zinc	EPA 200.7	1.08	---	0.0100	mg/l	1x	--	1.00	108%	(85-115)	--	--	12/16/08 09:18	
Manganese	"	1.05	---	0.0100	"	"	--	"	105%	"	--	--	"	
Magnesium	"	10.1	---	0.0100	"	"	--	10.0	101%	"	--	--	"	
Iron	"	1.06	---	0.0200	"	"	--	1.00	106%	"	--	--	12/16/08 15:04	
Chromium	"	1.02	---	0.00800	"	"	--	"	102%	"	--	--	12/16/08 09:18	
Duplicate (8120103-DUP1)				**QC Source: SRL0091-01**				**Extracted: 12/12/08 12:43**						
Magnesium	EPA 200.7	21.5	---	0.0100	mg/l	1x	21.4	--	--	--	0.0664%	(20)	12/16/08 10:04	
Iron	"	1.33	---	0.0200	"	"	1.31	--	--	--	1.19%	"	12/16/08 16:28	
Manganese	"	0.0479	---	0.0100	"	"	0.0486	--	--	--	1.48%	"	12/16/08 10:04	
Zinc	"	0.0272	---	0.0100	"	"	0.0289	--	--	--	6.01%	"	"	
Chromium	"	ND	---	0.00800	"	"	ND	--	--	--	9.95%	"	"	
Matrix Spike (8120103-MS1)				**QC Source: SRL0091-01**				**Extracted: 12/12/08 12:43**						
Magnesium	EPA 200.7	31.2	---	0.0100	mg/l	1x	21.4	10.0	97.1%	(75-125)	--	--	12/16/08 10:23	
Chromium	"	1.03	---	0.00800	"	"	0.00534	1.00	102%	"	--	--	"	
Iron	"	2.35	---	0.0200	"	"	1.31	"	104%	"	--	--	12/16/08 16:47	
Zinc	"	1.13	---	0.0100	"	"	0.0289	"	110%	(70-130)	--	--	12/16/08 10:23	
Manganese	"	1.07	---	0.0100	"	"	0.0486	"	102%	(75-125)	--	--	"	
Matrix Spike Dup (8120103-MSD1)				**QC Source: SRL0091-01**				**Extracted: 12/12/08 12:43**						
Iron	EPA 200.7	2.32	---	0.0200	mg/l	1x	1.31	1.00	100%	(75-125)	1.55%	(20)	12/16/08 16:53	
Magnesium	"	31.0	---	0.0100	"	"	21.4	10.0	95.8%	"	0.411%	"	12/16/08 10:30	
Chromium	"	1.03	---	0.00800	"	"	0.00534	1.00	102%	"	0.159%	"	"	
Zinc	"	1.12	---	0.0100	"	"	0.0289	"	109%	(70-130)	0.692%	"	"	
Manganese	"	1.07	---	0.0100	"	"	0.0486	"	102%	(75-125)	0.133%	"	"	

Randee Decker, Project Manager

Conventional Chemistry Parameters by APHA/EPA Methods - Laboratory Quality Control Results

TestAmerica Spokane

QC Batch: 8120092 **Water Preparation Method: Wet Chem**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (8120092-BLK1)													**Extracted: 12/11/08 13:28**	
Total Alkalinity	SM 2320B	ND	---	4.00	mg/l	1x	--	--	--	--	--	--	12/11/08 13:28	
LCS (8120092-BS1)													**Extracted: 12/11/08 13:28**	
Total Alkalinity	SM 2320B	495	---	4.00	mg/l	1x	--	500	99.0%	(90-110)	--	--	12/11/08 13:28	
Duplicate (8120092-DUP1)					**QC Source: SRL0070-01**								**Extracted: 12/11/08 13:28**	
Total Alkalinity	SM 2320B	265	---	4.00	mg/l	1x	265	--	--	--	0.00%	(10)	12/11/08 13:28	

Randee Decker, Project Manager

Anions by EPA Method 300.0 - Laboratory Quality Control Results

TestAmerica Spokane

QC Batch: 8120111 **Water Preparation Method: Wet Chem**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (8120111-BLK1)								**Extracted: 12/15/08 10:27**						
Chloride	EPA 300.0	ND	---	0.500	mg/l	1x	--	--	--	--	--	--	12/15/08 13:15	
Sulfate	"	ND	---	0.500	"	"	--	--	--	--	--	--	"	
LCS (8120111-BS1)								**Extracted: 12/15/08 10:27**						
Chloride	EPA 300.0	5.44	---	0.500	mg/l	1x	--	5.00	109%	(90-110)	--	--	12/15/08 12:39	
Sulfate	"	5.24	---	0.500	"	"	--	"	105%	"	--	--	"	
Duplicate (8120111-DUP1)					**QC Source: SRL0070-05**			**Extracted: 12/15/08 10:27**						
Chloride	EPA 300.0	8.40	---	2.50	mg/l	5x	8.35	--	--	--	0.597%	(18.8)	12/15/08 17:06	
Sulfate	"	26.8	---	2.50	"	"	27.4	--	--	--	2.58%	(15.7)	"	
Matrix Spike (8120111-MS1)					**QC Source: SRL0070-05**			**Extracted: 12/15/08 10:27**						
Sulfate	EPA 300.0	34.8	---	2.50	mg/l	5x	27.4	5.00	148%	(80-120)	--	--	12/15/08 17:19	M7
Chloride	"	14.0	---	2.50	"	"	8.35	"	113%	"	--	--	"	
Matrix Spike Dup (8120111-MSD1)					**QC Source: SRL0070-05**			**Extracted: 12/15/08 10:27**						
Sulfate	EPA 300.0	31.0	---	2.50	mg/l	5x	27.4	5.00	70.0%	(80-120)	11.9%	(10)	12/15/08 17:33	M8
Chloride	"	12.3	---	2.50	"	"	8.35	"	79.0%	"	12.9%	"	"	M8

TestAmerica Spokane

Randee Decker, Project Manager

Total Metals by EPA 200 Series Methods - Laboratory Quality Control Results

TestAmerica Seattle

QC Batch: 8L15051 **Water Preparation Method: EPA 200 Series**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (8L15051-BLK1)										**Extracted: 12/15/08 14:58**				
Lead	EPA 200.8	ND	---	0.00100	mg/l	1x	--	--	--	--	--	--	12/16/08 23:52	
Arsenic	"	ND	---	0.00100	"	"	--	--	--	--	--	--	"	
LCS (8L15051-BS1)										**Extracted: 12/15/08 14:58**				
Lead	EPA 200.8	0.0704	---	0.00100	mg/l	1x	--	0.0800	88.0%	(85-115)	--	--	12/16/08 23:59	
Arsenic	"	0.0745	---	0.00100	"	"	--	"	93.1%	"	--	--	"	
Matrix Spike (8L15051-MS1)					**QC Source: BRL0145-01RE1**					**Extracted: 12/15/08 14:58**				
Lead	EPA 200.8	0.0698	---	0.00100	mg/l	1x	ND	0.0800	87.3%	(75-125)	--	--	12/17/08 00:05	
Arsenic	"	0.0738	---	0.00100	"	"	ND	"	92.2%	"	--	--	"	
Matrix Spike (8L15051-MS2)					**QC Source: BRL0152-01**					**Extracted: 12/15/08 14:58**				
Lead	EPA 200.8	0.0686	---	0.00100	mg/l	1x	ND	0.0800	85.7%	(75-125)	--	--	12/17/08 00:12	
Arsenic	"	0.0755	---	0.00100	"	"	0.00108	"	93.0%	"	--	--	"	

Randee Decker, Project Manager

Notes and Definitions

Report Specific Notes:

M7 - The MS and/or MSD were above the acceptance limits. See Blank Spike (LCS).
M8 - The MS and/or MSD were below the acceptance limits. See Blank Spike (LCS).

Laboratory Reporting Conventions:

DET - Analyte DETECTED at or above the Reporting Limit. Qualitative Analyses only.

ND - Analyte NOT DETECTED at or above the reporting limit (MDL or MRL, as appropriate).

NR/NA - Not Reported / Not Available

dry - Sample results reported on a Dry Weight Basis. Results and Reporting Limits have been corrected for Percent Dry Weight.

wet - Sample results and reporting limits reported on a Wet Weight Basis (as received). Results with neither 'wet' nor 'dry' are reported on a Wet Weight Basis.

RPD - RELATIVE PERCENT DIFFERENCE (RPDs calculated using Results, not Percent Recoveries).

MRL - METHOD REPORTING LIMIT. Reporting Level at, or above, the lowest level standard of the Calibration Table.

MDL* - METHOD DETECTION LIMIT. Reporting Level at, or above, the statistically derived limit based on 40CFR, Part 136, Appendix B. *MDLs are listed on the report only if the data has been evaluated below the MRL. Results between the MDL and MRL are reported as Estimated Results.

Dil - Dilutions are calculated based on deviations from the standard dilution performed for an analysis, and may not represent the dilution found on the analytical raw data.

Reporting Limits - Reporting limits (MDLs and MRLs) are adjusted based on variations in sample preparation amounts, analytical dilutions and percent solids, where applicable.

Electronic Signature - Electronic Signature added in accordance with TestAmerica's *Electronic Reporting and Electronic Signatures Policy.* Application of electronic signature indicates that the report has been reviewed and approved for release by the laboratory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

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11922 E. First Ave, Spokane, WA 99206-5302 509-924-9200 FAX 924-9290 ☐
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2000 W International Airport Rd Ste A10, Anchorage, AK 99502-1119 907-563-9200 FAX 563-9210 ☐

CHAIN OF CUSTODY REPORT

Work Order #: SRL0070

CLIENT: URS Corp

REPORT TO: GARY D. PANTHER
ADDRESS:

PHONE: 509-954-5090 FAX:

INVOICE TO: URS Corp. Spokane

P.O. NUMBER:

PROJECT NAME: POM-TDF-1

PROJECT NUMBER: 36298248

SAMPLED BY: GDP

TURNAROUND REQUEST
in Business Days *

Organic & Inorganic Analyses
☒ 10 STD. ☐ 7 ☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐ <1

Petroleum Hydrocarbon Analyses
☒ 5 STD. ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐ <1

☐ OTHER Specify:

* Turnaround Requests less than standard may incur Rush Charges.

PRESERVATIVE

REQUESTED ANALYSES

	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME		AS FE CR	Pb Mg ZN	SULFATE	Chloride	Alkalinity									MATRIX (W, S, O)	# OF CONT.	LOCATION/ COMMENTS	TA WO ID
1	MW-301	12-10-08	11:00	X	X	X	X	X									W	3		-01
2	MW-303		12:00	X	X	X	X	X												-02
3	MW-302		13:00	X	X	X	X	X												-03
4	MW-203		14:00	X	X	X	X	X												-04
5	MW-201		14:30	X	X	X	X	X												-05
6	MW-2		15:00	X	X	X	X	X												-06
7	MW-7		16:00	X	X	X	X	X												-07
8	DUP	↓	—	X	X	X	X	X												-08
9																				
10																				

RELEASED BY: Gary D Panther
PRINT NAME: GARY D. PANTHER FIRM: URS Corp DATE: 12-11-08 TIME: 8:15

RECEIVED BY:
PRINT NAME: Chris Williams FIRM: TA-Spokane DATE: 12/11/08 TIME: 8:15

RELEASED BY:
PRINT NAME: FIRM: DATE: TIME:

RECEIVED BY:
PRINT NAME: FIRM: DATE: TIME:

ADDITIONAL REMARKS:
Hold Field Filtered Samples

TEMP: 4.5°C

PAGE 1 OF 1

TAL-1000(0408)

REPORT
GROUNDWATER MONITORING
PEND OREILLE MINE TDF-1 AND TDF-2
METALINE FALLS, WASHINGTON

Prepared For:
TECK WASHINGTON INCORPORATED
URS JOB NO. 36298248

920 North Argonne Road, Suite 300
Spokane, Washington 99212
509.928.4413

January 28, 2010

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APPENDICES

1.0 INTRODUCTION AND BACKGROUND

Teck Washington Incorporated (Teck) is conducting a remedial investigation/feasibility study (RI/FS) to select remedial alternatives for closure of the historic Pend Oreille Mine tailings disposal facilities (TDF) #1 and #2. The site is located along the Pend Oreille River, north of Metaline Falls, Washington as shown on Vicinity Map, Figure 1. The RI/FS is being conducted under Agreed Order No. 2585 between Teck and the Washington State Department of Ecology (Ecology). The draft "Remedial Investigation/Feasibility Study Report for the Pend Oreille Mine Tailing Disposal Facilities TDF-1 and TDF-2, Metaline Falls, Washington" was prepared for Teck by Golder Associates (Golder) and submitted to Ecology on October 17, 2006. As part of the RI/FS, groundwater, monitoring wells MW-201, MW-202 and MW-203 were installed and groundwater samples were collected from these wells, existing piezometers and seep water. Additional samples were collected from soil, tailings, and vegetation material in the vicinity of TDF-1 and TDF-2 were sampled and analyzed. Based on review of the draft RI/FS report, Ecology provided comments to Teck that additional assessment activities were necessary in the area of TDF-1 and TDF-2 to complete characterization of the potential groundwater threat to human health and the environment. These comments were provided in a letter to Teck dated January 16, 2008 and during several subsequent meetings between Teck, URS, and Ecology.

To address Ecology's concerns, URS reviewed the exiting hydrogeologic data and developed an independent site conceptual model of near surface groundwater flow conditions. The findings of this study were presented in a memorandum dated May 8, 2008 entitled "Pend Oreille Mine TDF-1 and TDF-2 Hydrogeology Data Review". In summary, the site conceptual model described that near surface groundwater beneath the site generally occurs within three aquifer subunits including: (1) a perched aquifer subunit present beneath the northern portion of TDF-2, (2) an aquifer subunit comprised of saturated tailings within TDF-1, and (3) a regional aquifer subunit comprised of granular material underlying portions of TDF-1 and TDF-2. This study also evaluated the existing groundwater monitoring network relative to the site conceptual model and identified potential actionable data gaps. Based on these findings, URS installed three additional groundwater monitoring wells (MW-301, MW-302 and MW-303) downgradient of TDF-1 and conducted groundwater monitoring and sampling in August and December 2008 of select wells within the area of interest. Results of these activities are presented in the report "Supplemental Monitoring Well Installation and Groundwater Monitoring, Pend Oreille Mine TDF-1 and TDF-2" dated February 24, 2009.

This report documents groundwater monitoring and sampling data collected during events conducted in May and October 2009 and supplements the remedial investigation/feasibility study (RIFS) currently in the process of being finalized.

2.0 ENVIRONMENTAL SETTING

2.1 GEOLOGIC SETTING

The site is located within the Pend Oreille River valley in an area consisting of Cambrian- through Silurian/Devonian-aged sedimentary carbonate and slate bedrock that has been folded and faulted to create a prominent mountainous topography. Recent glaciations in the Quaternary Period further shaped the land into dissected highlands and glacial valleys. A more detailed discussion of site geologic setting, including bedrock occurrence and formation descriptions, is provided in the October 17, 2006 draft report "Remedial Investigation/Feasibility Study Report for the Pend Oreille Mine Tailing Disposal Facilities TDF-1 and TDF-2, Metaline Falls, Washington" prepared by Golder for Teck.

2.2 SOILS

Soils in the general area of study consist of glacial drift that has been locally reworked by fluvial processes or by man. Soil types observed during the installation of monitoring wells generally consisted of silt, silty sands, and silty gravels. Soil thickness was observed to range from approximately 4 feet at the location of MW-303 to greater than 15 feet at the locations of monitoring wells MW-301 and MW-302.

2.3 HYDROGEOLOGIC SETTING

The October 17, 2006 draft report "Remedial Investigation/Feasibility Study Report for the Pend Oreille Mine Tailing Disposal Facilities TDF-1 and TDF-2, Metaline Falls, Washington," prepared by Golder for Teck, describes the general nature of groundwater and surface water flow and hydrogeologic conditions at the site. The May 8, 2008 memorandum "Pend Oreille Mine TDF-1 and TDF-2 Hydrogeology Data Review" prepared by URS provides a specific hydrogeologic site conceptual model for near surface groundwater occurrence in the area of TDF-1 and TDF-2. The February 24, 2009 report "Supplemental Monitoring Well Installation and Groundwater Monitoring, Pend Oreille Mine TDF-1 and TDF-2" presents additional information regarding the hydrogeological setting of the site.

3.0 SCOPE OF SERVICES

The purpose of the project was to continue to evaluate groundwater conditions in the area of historic tailing disposal facilities TDF-1 and TDF-2. Activities included collecting groundwater samples from the three new wells located downgradient from TDF-1 (MW-301, MW-302 and MW-303), two existing on-site wells located at TDF-2 (MW-201 and MW-203), and two existing wells upgradient of TDF-1 and TDF-2 (MW-2 and MW-7) in May 2009 and October 2009; measuring depth-to-water in these wells; recording groundwater parameters and analyzing samples for contaminants of concern. In May 2009 a seep water sample from a seep complex located southeast portion of TDF-1 between TDF-1 and TDF-2 was also collected.

This work was accomplished in general accordance with the Ecology approved RI/FS Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) prepared by Golder dated May 24, 2005; the URS Work Plan dated May 22, 2008, which was revised by a letter dated July 31, 2008 and Work Orders 0930 and 0995 dated January 20, 2009 and June 3, 2009, respectively. In accordance with the proposal and work plan, groundwater monitoring activities included the following tasks:

- Collected groundwater samples from each of the selected wells on May 12, 2009 and October 28, 2009. Each well was purged using low-flow sampling techniques using a peristaltic and/or a decontaminated submersible pump for shallow wells (MW-301, MW-302, and MW-303). Sample collection from monitoring wells MW-2 and MW-7 were not required by Ecology during the October 2009 event as Teck had recently sampled these wells, however, depth to water measurements were recorded. These monitoring wells are located upgradient from TDF-1 and TDF-2 and are routinely sampled by Teck. This analytical data is also included as part of this report.
- Groundwater samples were placed in laboratory-prepared and -preserved sample containers and submitted to TestAmerica Laboratories of Spokane, Washington for laboratory analysis for total As, Cr, Mn, Zn, and Pb by Environmental Protection Agency (EPA) 200 Series Methods; and sulfate by EPA Method 300. During the May 2009 event, one sample (Seep) was also analyzed for dissolved metals by the same analytical methods. Samples were submitted under chain-of-custody. Note that samples collected from monitoring wells MW-2 and MW-7 in September 2009 by Teck personnel were submitted to SVL Labs of Kellogg, Idaho for a similar suite of analytes.

- Measured the depth to groundwater in each well before purging using a decontaminated water level indicator.

4.0 FIELD ACTIVITIES

4.1 GROUNDWATER MONITORING

Monitoring wells MW-201 and MW-203, both located on TDF-2 and monitoring wells MW-301, MW-302, and MW-303, located downgradient from TDF-1 were sampled by URS on May 12, 2009 and October 28, 2009. Monitoring well MW-202 did not contain groundwater and was not sampled during either event. Groundwater samples were collected by Teck personnel from upgradient wells MW-2 and MW-7 on October 7, 2009; URS collected groundwater samples from these wells on May 12, 2009. For samples collected by URS, low-flow, minimal draw down sampling methods were utilized. Before purging, depth-to-water measurements were obtained at all wells. Well purging was conducted at a flow rate between 0.1 and 0.5 L/min. During purging, specific conductance, temperature, pH, dissolved oxygen, and turbidity measurements were recorded at regular intervals using a Horiba U22 Water Quality Meter. Samples were obtained once the water quality parameters stabilized where successive water quality measurements had a difference of less than 10%. Samples were packaged and transported under Chain-of-Custody procedures to the laboratory. Decontamination, record keeping, and purge water disposal was performed in general accordance with the QAPP.

During the May 2009 monitoring event, a water sample was collected from a temporary seep sampling point installed between TDF-1 and TDF-2. The sampling point is identified as ‘Seep.’ This location was not sampled during the October 2009 monitoring event because it is not required for regulatory compliance.

Depth to groundwater measurements were collected from the monitoring wells during each groundwater sampling event. These measurements were used to calculate the groundwater elevations in each well. Note that groundwater was not detected in monitoring well MW-202. The results are presented in Table 1, Groundwater Elevations, TDF-1 and TDF-2.

In May 2009, groundwater elevations ranged from 2,110.40 feet above mean sea level (MSL) in monitoring well MW-301 to 2,291.15 feet MSL in monitoring well MW-203. Groundwater flow direction of the unconfined regional aquifer in the area between TDF-1 and TDF-2 was estimated to flow to the north-northwest under a gradient of 0.008 ft/ft. Groundwater flow direction downslope (northwest) of TDF-1 is estimated to flow generally northwest toward the river. Groundwater elevations are graphically depicted on Groundwater Elevations and Monitoring Well Locations-May 2009, Figure 2.

In October 2009, groundwater elevations ranged from 2,110.86 feet above mean sea level (MSL) in monitoring well MW-301 to 2,289.36 feet MSL in monitoring well MW-203. Groundwater flow direction of the unconfined regional aquifer in the area between TDF-1 and TDF-2 was estimated to flow to the north-northwest under a gradient of 0.008 ft/ft. Groundwater flow direction downslope (northwest) of TDF-1 is estimated to flow generally northwest toward the river. Groundwater elevations are graphically depicted on Groundwater Elevations and Monitoring Well Locations-October 2009, Figure 3.

Between the December 2008 and May 2009 events, groundwater elevations decreased in monitoring wells MW-301, MW-2 and MW-7. Decreases ranged from 0.05 feet in MW-301 to 0.75 feet in MW-2. Groundwater elevation increases ranged from 0.40 feet in monitoring wells MW-302 to 1.69 feet in MW-203. The groundwater elevation in MW-201 was the same in May 2009 as in December 2008.

Between the May 2009 and October 2009 events, groundwater elevations decreased in all monitoring wells except MW-301. Decreases ranged from 0.07 feet in MW-201 to 1.79 feet in MW-203. Groundwater elevation increased 0.46 feet in monitoring wells MW-301.

Groundwater elevation and flow direction maps generated using groundwater elevation data collected during the May and October 2009 events are presented as Figures 2 and 3, respectively.

5.0 ANALYTICAL RESULTS

URS subcontracted with TestAmerica of Spokane, Washington to analyze groundwater samples for this project. Groundwater samples collected from MW-2 and MW-7 during the October 2009 event were collected by Teck personnel and were analyzed by SVL Analytical of Kellogg, Idaho.

The groundwater analytical results are summarized below and presented in Summary of Groundwater Analytical Results, TDF-1 and TDF-2, Table 2. Laboratory data are included in Appendix B.

5.1 MAY 2009

Total arsenic and total lead were detected in the groundwater sample collected from the 'Seep' at concentrations of 0.00977 and 0.0244 milligrams/liter (mg/l), respectively. These concentrations exceed the Model Toxics Control Act (MTCA) Method A groundwater cleanup levels for each metal. Dissolved arsenic and dissolved lead was not detected in the 'Seep' sample. The detection of total lead is attributed to the high turbidity associated with the sample collected from the Seep. Total manganese was detected at a concentration of 3.28 mg/l in the sample collected from monitoring well MW-302, exceeding the MTCA Method B cleanup level. All remaining analytes were either not detected or were detected at concentrations less than the MTCA Method A or Method B groundwater cleanup level, if established.

5.2 OCTOBER 2009

Total and dissolved manganese was detected in the groundwater sample collected from MW-302 at concentrations of 4.40 mg/l and 2.50 mg/l, respectively. Both concentrations exceed the MTCA Method B groundwater cleanup level. All remaining analytes were either not detected or were detected at concentrations less than applicable MTCA Method A or Method B groundwater cleanup levels .

6.0 SUMMARY AND CONCLUSIONS

To supplement the site draft RI/FS, URS conducted groundwater monitoring at the Teck Pend Oreille Mine TDF-1 and TDF-2 site. Groundwater from new and existing wells, water from one seep present between TDF-1 and TDF-2, and groundwater from two existing upgradient wells were sampled and analyzed for contaminants of concern.

Findings of this report generally support earlier discussions of groundwater occurrence and hydrogeologic conditions including:

- Groundwater was not present in monitoring well MW-202 in May or October 2009 events.
- Results indicate that manganese was present at a concentration exceeding the MTCA Method B groundwater cleanup level at well MW-302, located immediately downgradient of the northwestern portion of TDF-1, during the May and October 2009 sampling events.

- Monitoring wells MW-301 and MW-303, located downgradient of TDF-1, TDF-2 and monitoring well MW-302 did not contain contaminants of concern (including manganese) at concentrations exceeding MTCA groundwater cleanup levels during the May and October 2009 sampling events.

7.0 LIMITATIONS

The findings and conclusions documented in this report have been prepared for specific application to this project and have been developed in a manner consistent with the level of care and skill normally exercised by members of the environmental science profession currently practicing under similar conditions in the area, and in general accordance with the terms and conditions set forth in our Agreement, and with the URS proposal dated February 7, 2008. No other warranty, express or implied, is made.

The findings presented in this report are based on conditions observed at specific site locations and sampling intervals at the time of the assessment. Because conditions between the boreholes and sampling intervals may vary over distance and time, the potential always remains for the presence of unknown, unidentified, unforeseen, or changed surface and subsurface contamination. Conclusions in this report are based on comparison of chemical analytical results to current regulatory standards.

This report is for the exclusive use of the Teck and their representatives. No third party shall have the right to rely on our opinions rendered in connection with the services or in this document without our written consent and the third party's agreement to be bound to the same conditions and limitations as Teck.

URS appreciates the opportunity to provide these services. Please contact the undersigned regarding any questions related to the information provided in this letter report.

8.0 REFERENCES

Golder Associates Inc., “Draft Remedial Investigation/Feasibility Study Report for the Pend Oreille Mine Tailing Disposal Facilities TDF-1 and TDF-2.” 17 October 2006.

Golder Associates Inc., “Appendix A: Sampling and Analysis Plan for the Pend Oreille Mine Tailing Disposal Facilities TDF-1 and TDF-2 Remedial Investigation/Feasibility Study.” 24 May 2005.

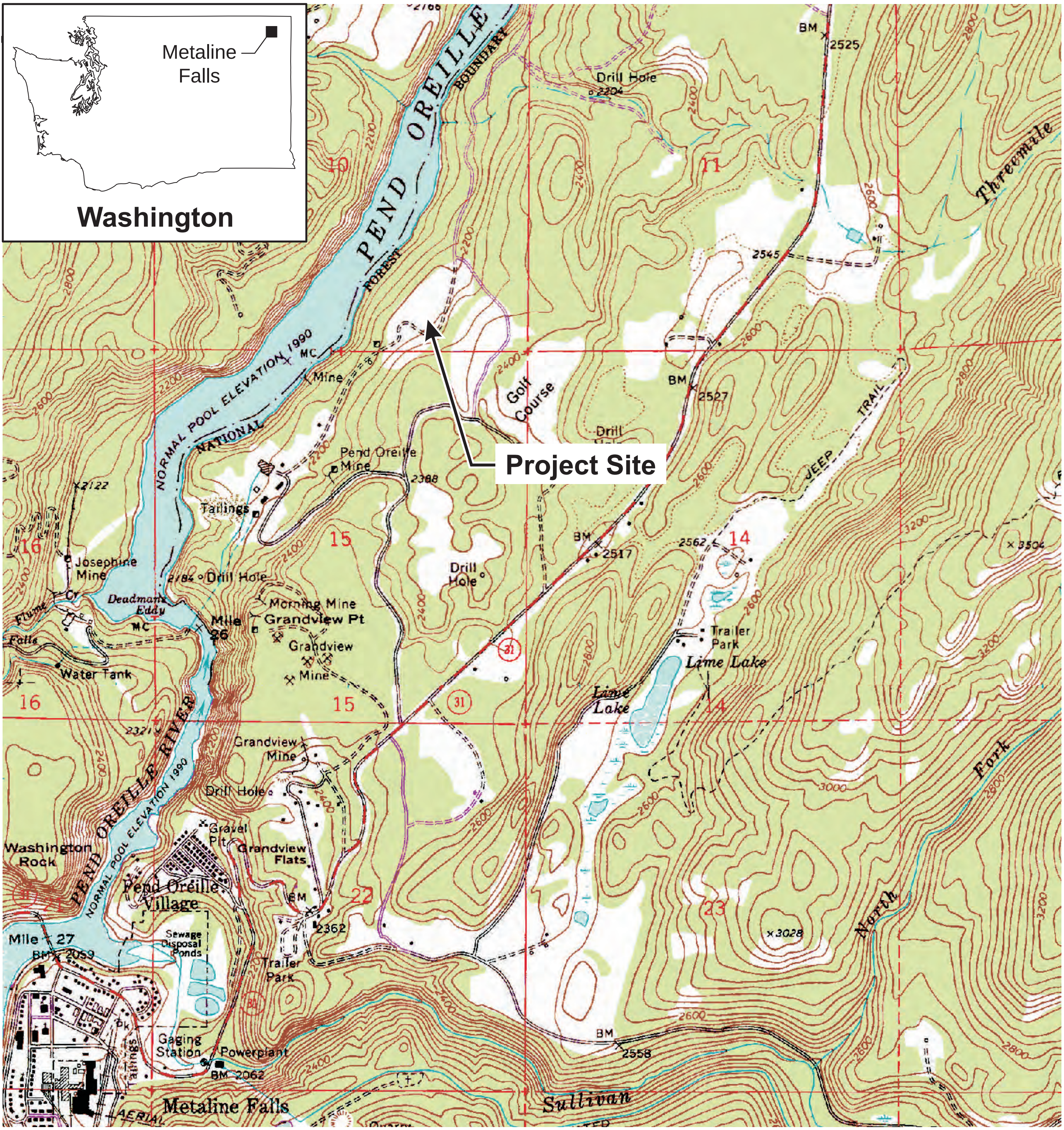
Golder Associates Inc., “Appendix B: Quality Assurance Project Plan for Remedial Investigation/Feasibility Study at the Pend Oreille Mine Tailings Disposal Facilities TDF-1 and TDF-2.” 24 May 2005.

URS. Memorandum, “Pend Oreille Mine TDF-1 and TDF-2 Hydrogeology Date Review” prepared for Teck Cominco American Incorporated, 8 May 2008.

URS. Report. “Supplemental Monitoring Well Installation and Groundwater Monitoring, Pend Oreille Mine TDF-1 and TDF-2, Metaline Falls, Washington” prepared for Teck American Incorporated, February 24, 2009

FIGURES

36298248 01.cdr



SOURCE: 7.5-minute USGS topographic quadrangles, Metaline Falls and Boundary Dam, Washington, 1986

N

0 0.5 1

Scale in Miles

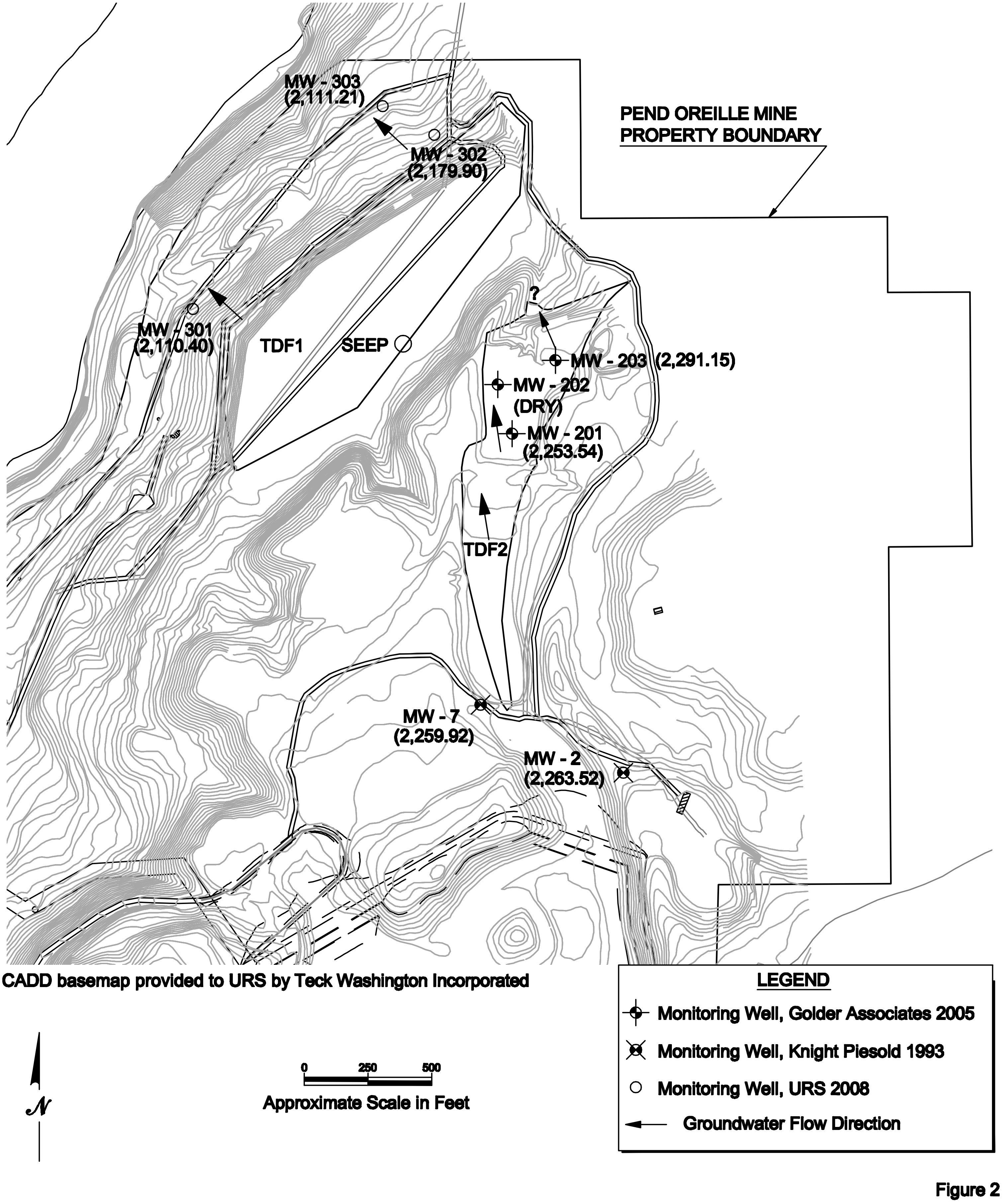
Job No. 36298248

Figure 1

Site Location Map

URS

Teck American Incorporated
Pend Oreille Mine



CADD basemap provided to URS by Teck Washington Incorporated

Figure 2

Groundwater Elevations and Monitoring Well Locations - May 2009

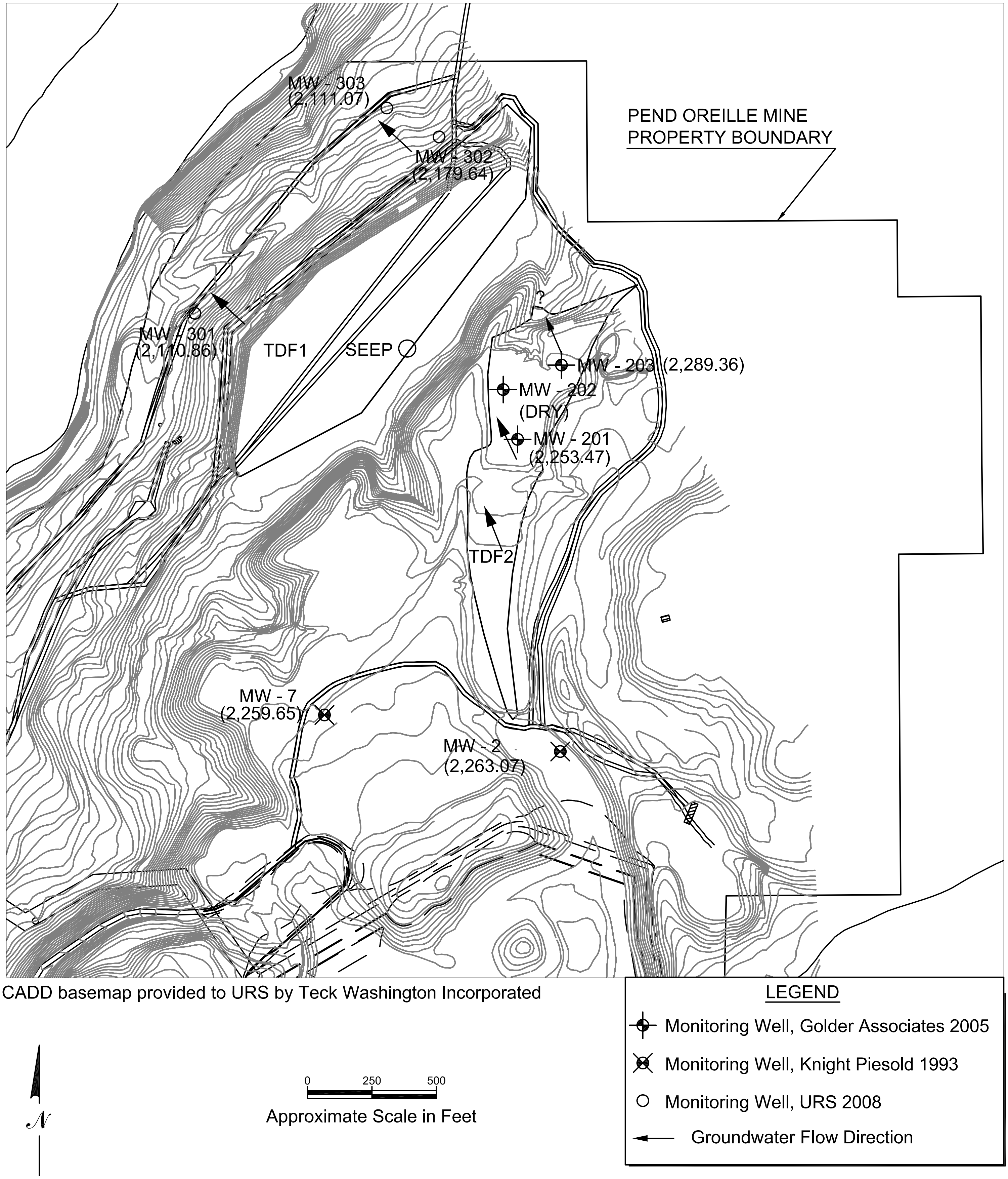
TDF-1 and TDF-2 RI/FS

Job No. 36298248

All locations are approximate

Teck American Incorporated
Pend Oreille Mine
Washington

URS



CADD basemap provided to URS by Teck Washington Incorporated

Figure 3

Groundwater Elevations and Monitoring Well Locations - October 2009

TDF-1 and TDF-2 RI/FS

Job No. 36298248

All locations are approximate

Teck American Incorporated
Pend Oreille Mine
Washington

TABLES

TABLE 1
GROUNDWATER ELEVATIONS and FIELD PARAMETERS
POM TDF-1 and TDF-2

Monitoring Well ID and Casing Elevation*	Date	Depth to Water*	Groundwater Elevation	Change in Elevation	Temperature Celsius	pH	Turbidity (NTU)	Dissolved Oxygen	Conductivity (*u* mhos/cm)
MW-201 2,335.07	Aug-08	81.45	2,253.62	-	9.00	7.44	31.9	6.80	0.900
	Dec-08	81.53	2,253.54	-0.08	9.00	7.35	79.0	6.10	0.534
	May-09	81.53	2,253.54	0.00	10.51	7.37	15.3	6.23	0.324
	Oct-09	81.60	2,253.47	-0.07	3.30	7.16	103	10.98	0.900
MW-202 2,332.50	Aug-08	dry	-	-	-	-	-	-	-
	Dec-08	dry	-	-	-	-	-	-	-
	May-09	dry	-	-	-	-	-	-	-
	Oct-09	dry	-	-	-	-	-	-	-
MW-203 2,332.68	Aug-08	42.50	2,290.18	-	9.40	7.05	180	7.56	1.140
	Dec-08	43.22	2,289.46	-0.72	9.40	7.27	32.0	3.30	1.160
	May-09	41.53	2,291.15	1.69	11.31	7.01	15.2	0.00	0.580
	Oct-09	43.32	2,289.36	-1.79	7.40	6.78	56	1.57	1.200
MW-301 2,116.80	Aug-08	7.31	2,109.49	-	12.34	6.87	49.9	5.99	1.79
	Dec-08	6.35	2,110.45	0.96	7.07	6.93	16.0	6.60	1.51
	May-09	6.40	2,110.40	-0.05	6.97	6.94	3.0	4.39	1.69
	Oct-09	5.94	2,110.86	0.46	4.20	6.41	3.0	3.95	1.52
MW-302 2,189.30	Aug-08	9.47	2,179.83	-	11.44	6.55	43.8	3.44	99.9
	Dec-08	9.80	2,179.50	-0.33	8.35	7.08	70.0	3.00	1.16
	May-09	9.40	2,179.90	0.40	7.06	6.99	23.9	0.00	1.39
	Oct-09	9.66	2,179.64	-0.26	3.03	6.69	43.6	0.00	1.31
MW-303 2,116.99	Aug-08	6.73	2,110.26	-	11.47	6.78	47.1	3.33	42.2
	Dec-08	6.36	2,110.63	0.37	7.51	7.14	110	4.80	1.17
	May-09	5.78	2,111.21	0.58	5.77	7.09	6.9	0.00	1.49
	Oct-09	5.92	2,111.07	-0.14	2.60	6.69	31.1	0.25	1.25
MW-2 2,348.87	Aug-08	84.00	2,264.87	-	11.77	7.62	-	-	540
	Dec-08	84.60	2,264.27	-0.60	8.86	7.48	45	5.30	0.599
	May-09	85.35	2,263.52	-0.75	10.52	7.35	12.4	6.17	0.378
	Oct-09	85.80	2,263.07	-0.45	-	-	-	-	-
MW-7 2,374.92	Aug-08	113.60	2,261.32	-	10.30	7.64	-	-	530
	Dec-08	114.66	2,260.26	-1.06	9.42	7.51	31.0	5.90	0.534
	May-09	115.00	2,259.92	-0.34	10.71	7.41	4.9	4.39	0.319
	Oct-09	115.27	2,259.65	-0.27	-	-	-	-	-

Notes:
- Not Measured
* As measured from top of casing.
Survey data provided by CLC Associates, Inc.
August 2008 data for MW-2 and MW-7 provided by TECK American, Inc.

TABLE 2
GROUNDWATER ANALYTICAL RESULTS
POM TDF-1 and TDF-2

Sample ID / Date Collected		Metals (mg/L)																			Anions (mg/L)		Conventionals (mg/L)
		Arsenic		Barium	Cadmium	Calcium	Chromium		Copper	Iron	Lead		Magnesium	Manganese		Mercury	Selenium	Silver	Zinc		Chloride	Sulfate	Total Alkalinity
		Total	Dissolved	Total	Total	Total	Total	Dissolved	Total	Total	Total	Dissolved	Total	Total	Dissolved	Total	Total	Total	Total	Dissolved			
MW-201	8/15/2008	0.00100 U	NA	0.0502	0.00200 U	73.5	0.00800 U	NA	0.00800 U	0.0200	0.00100 U	NA	21.2	0.0100 U	NA	0.000200 U	0.00114	0.0100 U	0.0100 U	NA	10.4	22.4	240
	12/10/2008	0.00100 U	NA	NA	NA	NA	0.00800 U	NA	NA	0.406	0.00100 U	NA	21.6	0.0174	NA	NA	NA	NA	0.0100 U	NA	8.35	27.4	243
	5/12/2009	0.00100 U	NA	NA	NA	NA	0.0102	NA	NA	NA	0.00100 U	NA	NA	0.0131	NA	NA	NA	NA	0.0100 U	NA	NA	30.6	NA
	10/28/2009	0.00207	0.00100 U	NA	NA	NA	0.0198	0.00800 U	NA	NA	0.00545	0.00100 U	NA	0.252	0.0126	NA	NA	NA	0.0614	0.0100 U	NA	27.8	NA
MW-203	8/15/2008	**0.00899**	NA	0.177	0.00200 U	188	0.0326	NA	0.0426	20.0	0.0138	NA	64.2	0.876	NA	0.000200 U	0.000808	0.0100 U	0.142	NA	0.720	356	270
	12/10/2008	0.00100 U	NA	NA	NA	NA	0.00800 U	NA	NA	0.0868	0.00100 U	NA	51.5	0.159	NA	NA	NA	NA	0.0107	NA	0.620	594	265
	5/12/2009	0.00100 U	NA	NA	NA	NA	0.00817	NA	NA	NA	0.00100 U	NA	NA	0.0871	NA	NA	NA	0.0100 U	0.0100 U	NA	NA	450	NA
	10/28/2009	0.00143	0.00100 U	NA	NA	NA	0.00800 U	0.00800 U	NA	NA	0.00100 U	0.00100 U	NA	0.188	0.174	NA	NA	NA	0.0153	0.0100 U	NA	514	NA
MW-301	8/7/2008	0.00100 U	NA	0.0593	0.00200 U	286	0.00800 U	NA	0.00800 U	0.179 J	0.00119	NA	64.4	0.0100 U	NA	0.000200 U	0.00318	0.0100 U	0.0319	NA	3.21	833 J	270
	12/10/2008	0.00100 U	NA	NA	NA	NA	0.00800 U	NA	NA	0.183	0.00100 U	NA	59.6	0.0162	NA	NA	NA	NA	0.0342	NA	3.62	960	265
	5/12/2009	0.00100 U	NA	NA	NA	NA	0.00800 U	NA	NA	NA	0.00100 U	NA	NA	0.0100 U	NA	NA	NA	NA	0.0160	NA	NA	684	NA
	10/28/2009	0.00100 U	0.00100 U	NA	NA	NA	0.00800 U	0.00800 U	NA	NA	0.00100 U	0.00100 U	NA	0.0100 U	0.0100 U	NA	NA	NA	0.0235	0.0160	NA	868	NA
MW-302	8/7/2008	0.00100 U	NA	0.114	0.00243	155	0.00800 U	NA	0.00800 U	0.0332 J	0.00155	NA	45.5	**3.51**	NA	0.000200 U	0.0100 U	0.0100 U	0.0620	NA	7.10	348 J	293
	8/7/2008 (DUP)	0.00100 U	NA	0.115	0.00247	157	0.00800 U	NA	0.0176	0.0221 J	0.00100 U	NA	45.8	**3.53**	NA	0.000200 U	0.0100 U	0.0100 U	0.0638	NA	5.00	349 J	285
	12/10/2008	0.00100 U	NA	NA	NA	NA	0.00800 U	NA	NA	0.706	0.00100 U	NA	51.6	**2.85**	NA	NA	NA	NA	0.119	NA	4.25	764	285
	12/10/2008 (DUP)	0.00100 U	NA	NA	NA	NA	0.00800 U	NA	NA	0.730	0.00100 U	NA	50.6	**2.80**	NA	NA	NA	NA	0.114	NA	4.34	778	283
	5/12/2009	0.00100 U	NA	NA	NA	NA	0.00800 U	NA	NA	NA	0.00133	NA	NA	**3.28**	NA	NA	NA	NA	0.0580	NA	NA	449	NA
	5/12/2009 (DUP)	0.00100 U	NA	NA	NA	NA	0.00800 U	NA	NA	NA	0.00100 U	NA	NA	**3.36**	NA	NA	NA	NA	0.0624	NA	NA	426	NA
	10/28/2009	0.00100 U	0.00100 U	NA	NA	NA	0.00800 U	0.00800 U	NA	NA	0.00100 U	0.00100 U	NA	**4.40**	**2.50**	NA	NA	NA	0.0681	0.0297	NA	488	NA
MW-303	8/7/2008	0.00100 U	NA	0.0576	0.00200 U	176	0.00800 U	NA	0.00800 U	1.32 J	0.00146	NA	52.3	0.273	NA	0.000200 U	0.0151	0.0100 U	0.0522	NA	7.00	477 J	245
	12/10/2008	0.00100 U	NA	NA	NA	NA	0.00800 U	NA	NA	1.53	0.00100 U	NA	57.7	0.0808	NA	NA	NA	NA	0.0259	NA	5.38	790	250
	5/12/2009	0.00100 U	NA	NA	NA	NA	0.00800 U	NA	NA	NA	0.00100 U	NA	NA	0.266	NA	NA	NA	NA	0.0267	NA	NA	374	NA
	10/28/2009	0.00100 U	0.00100 U	NA	NA	NA	0.00800 U	0.00800 U	NA	NA	0.00100 U	0.00100 U	NA	0.205	0.131	NA	NA	NA	0.0306	0.0149	NA	424	NA
	10/28/2009 (DUP)	0.00100 U	0.00100 U	NA	NA	NA	0.00800 U	0.00800 U	NA	NA	0.00100 U	0.00100 U	NA	0.227	0.125	NA	NA	NA	0.0318	0.0154	NA	458	NA
MW-2	08/05/08 *	NA	NA	NA	<0.0020	71.7	<0.0060	NA	<0.00100	<0.060	<0.0075	NA	22.1	<0.0040	NA	<0.00020	NA	<0.0050	<0.0100	NA	0.854	73.2	277
	12/10/2008	0.00139	NA	NA	NA	NA	0.00866	NA	NA	1.76	0.00100 U	NA	25.7	0.0989	NA	NA	NA	NA	0.0135	NA	5.89	54.3	245
	5/12/2009	0.00100 U	NA	NA	NA	NA	0.00991	NA	NA	NA	0.00100 U	NA	NA	0.0257	NA	NA	NA	NA	0.0100 U	NA	NA	88.0	NA
	10/07/2009*	NA	NA	NA	<0.0020	70.2	<0.0060	NA	<0.00100	0.111	<0.00300	<0.00300	22.4	0.0053	NA	NA	NA	<0.0050	<0.00300	<0.00300	6.02	44.6	242
MW-7	08/05/08 *	NA	NA	NA	<0.0020	70.7	1.52	NA	<0.00100	6.52	<0.0075	NA	23.6	0.0995	NA	<0.00020	NA	<0.0050	<0.0100	NA	5.60	36.5	238
	12/10/2008	0.00117	NA	NA	NA	NA	0.00800 U	NA	NA	0.114	0.00100 U	NA	23.2	0.0221	NA	NA	NA	NA	0.0100 U	NA	1.51	74.0	210
	5/12/2009	0.00115	NA	NA	NA	NA	0.0113	NA	NA	NA	0.00100 U	NA	NA	0.0100 U	NA	NA	NA	NA	0.0100 U	NA	NA	112	NA
	10/07/2009*	NA	NA	NA	<0.0020	63.0	<0.0060	NA	0.0121	<0.060	<0.00300	<0.00300	20.9	<0.0040	NA	NA	NA	<0.0050	0.00952	<0.00300	1.25	67.0	208
Seep	8/7/2008	0.00100 U	NA	0.397	0.00283	99.5	0.0453	NA	0.0741	53.5 J	0.00178	NA	37.0	1.11	NA	0.000200 U	0.00132	0.0100 U	0.300	NA	8.00	88.5 J	310
	5/12/2009	**0.00977**	<0.00100	NA	NA	NA	0.0378	<0.00800	NA	NA	**0.0244**	<0.00100	NA	1.68	<0.0100	NA	NA	NA	0.216	<0.0100	NA	95.0	NA
MTCA Method A Screening Levels		0.005		NE	0.005	NE	0.05		NE	NE	0.015		NE	NE		0.002	NE	NE	NE		NE	NE	NE
MTCA Method B Screening Levels		0.000058		3.2	0.008	NE	24 (Cr^{+3}) 0.048 (Cr^{+6})		0.59	NE	NE		NE	2.2		0.0048	0.08	0.08	4.8		NE	NE	NE

Notes:

Chemical analyses by TestAmerica, Spokane, Washington.

* Chemical analysis by SVL Analytical, Kellogg, Idaho. Samples collected by TAI/TWI.

Bolded values indicate the MTCA Method A or B groundwater screening levels were exceeded.

Model Toxics Control Act (MTCA) Cleanup Regulation, WAC 173-340. MTCA Method A and B values are from Ecology website CLARC tables downloaded November 2009 (https://fortress.wa.gov/ecy/clarc/reporting/CLARCReporting.aspx).

Field parameters measured using a Horriba 22. Temperature in degrees Celcius. pH='power of hydrogen'. Turbidity = Nephelometric Turbidity Units (NTUs). Dissolved Oygen =mg/l

< = Not detected above the reporting limit shown

DUP = Field duplicate

GW = Groundwater

J = Estimated value

mg/L = milligrams per liter

NA = Not analyzed

NE = Not established

U = Not detected above the reporting limit shown

APPENDIX A

LABORATORY DATA

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

SPOKANE, WA 11922 E. 1ST AVENUE
SPOKANE VALLEY, WA 99206
ph: (509) 924.9200 fax: (509) 924.9290

June 25, 2009

Gary Panther
URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

RE: POM TDF 1+2

Enclosed are the results of analyses for samples received by the laboratory on 05/13/09 08:50. The following list is a summary of the Work Orders contained in this report, generated on 06/25/09 09:56.

If you have any questions concerning this report, please feel free to contact me.

Work Order	Project	ProjectNumber
SSE0055	POM TDF 1+2	36298248.00002

TestAmerica Spokane

Randee Decker

Randee Decker, Project Manager

URS Corp.	Project Name:	**POM TDF 1+2**		
920 N. Argonne Road Suite 300	Project Number:	36298248.00002		Report Created:
Spokane, WA 99212	Project Manager:	Gary Panther		06/25/09 09:56

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MW-301	SSE0055-01	Water	05/12/09 09:00	05/13/09 08:50
MW-303	SSE0055-02	Water	05/12/09 10:00	05/13/09 08:50
MW-302	SSE0055-03	Water	05/12/09 11:00	05/13/09 08:50
MW-203	SSE0055-04	Water	05/12/09 12:30	05/13/09 08:50
MW-201	SSE0055-05	Water	05/12/09 12:00	05/13/09 08:50
MW-2	SSE0055-06	Water	05/12/09 13:00	05/13/09 08:50
MW-7	SSE0055-07	Water	05/12/09 14:00	05/13/09 08:50
Seep	SSE0055-08	Water	05/12/09 15:00	05/13/09 08:50
Dup	SSE0055-09	Water	05/12/09 00:00	05/13/09 08:50

Randee Decker, Project Manager

URS Corp.	Project Name:	**POM TDF 1+2**	
920 N. Argonne Road Suite 300	Project Number:	36298248.00002	Report Created:
Spokane, WA 99212	Project Manager:	Gary Panther	06/25/09 09:56

Total Metals by EPA 200 Series Methods

TestAmerica Spokane

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SSE0055-01 (MW-301)		**Water**			**Sampled: 05/12/09 09:00**					
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	9050076	05/18/09 09:23	05/18/09 13:30	
Manganese	"	ND	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.0160**	-----	0.0100	"	"	"	"	"	
SSE0055-02 (MW-303)		**Water**			**Sampled: 05/12/09 10:00**					
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	9050076	05/18/09 09:23	05/18/09 13:37	
Manganese	"	**0.266**	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.0267**	-----	0.0100	"	"	"	"	"	
SSE0055-03 (MW-302)		**Water**			**Sampled: 05/12/09 11:00**					
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	9050076	05/18/09 09:23	05/18/09 13:43	
Manganese	"	**3.28**	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.0580**	-----	0.0100	"	"	"	"	"	
SSE0055-04 (MW-203)		**Water**			**Sampled: 05/12/09 12:30**					
Chromium	EPA 200.7	**0.00817**	-----	0.00800	mg/l	1x	9050076	05/18/09 09:23	05/18/09 14:05	
Manganese	"	**0.0871**	-----	0.0100	"	"	"	"	"	
Zinc	"	ND	-----	0.0100	"	"	"	"	"	
SSE0055-05 (MW-201)		**Water**			**Sampled: 05/12/09 12:00**					
Chromium	EPA 200.7	**0.0102**	-----	0.00800	mg/l	1x	9050076	05/18/09 09:23	05/18/09 14:12	
Manganese	"	**0.0131**	-----	0.0100	"	"	"	"	"	
Zinc	"	ND	-----	0.0100	"	"	"	"	"	
SSE0055-06 (MW-2)		**Water**			**Sampled: 05/12/09 13:00**					
Chromium	EPA 200.7	**0.00991**	-----	0.00800	mg/l	1x	9050076	05/18/09 09:23	05/18/09 14:19	
Manganese	"	**0.0257**	-----	0.0100	"	"	"	"	"	
Zinc	"	ND	-----	0.0100	"	"	"	"	"	
SSE0055-07 (MW-7)		**Water**			**Sampled: 05/12/09 14:00**					
Chromium	EPA 200.7	**0.0113**	-----	0.00800	mg/l	1x	9050076	05/18/09 09:23	05/18/09 14:25	
Manganese	"	ND	-----	0.0100	"	"	"	"	"	
Zinc	"	ND	-----	0.0100	"	"	"	"	"	

TestAmerica Spokane

Randee Decker

Randee Decker, Project Manager

Total Metals by EPA 200 Series Methods

TestAmerica Spokane

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SSE0055-08 (Seep)		**Water**			**Sampled: 05/12/09 15:00**					
Chromium	EPA 200.7	**0.0378**	-----	0.00800	mg/l	1x	9050076	05/18/09 09:23	05/18/09 14:32	
Manganese	"	**1.68**	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.216**	-----	0.0100	"	"	"	"	"	
SSE0055-09 (Dup)		**Water**			**Sampled: 05/12/09 00:00**					
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	9050076	05/18/09 09:23	05/18/09 14:38	
Manganese	"	**3.36**	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.0624**	-----	0.0100	"	"	"	"	"	

Dissolved Metals by EPA 200 Series Methods

TestAmerica Spokane

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SSE0055-08 (Seep)		**Water**				**Sampled: 05/12/09 15:00**				
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	9060097	06/18/09 07:15	06/18/09 13:34	
Manganese	"	ND	-----	0.0100	"	"	"	"	"	
Zinc	"	ND	-----	0.0100	"	"	"	"	"	

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **POM TDF 1+2**
Project Number: 36298248.00002
Project Manager: Gary Panther

Report Created:
06/25/09 09:56

Anions by EPA Method 300.0

TestAmerica Spokane

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SSE0055-01 (MW-301)		**Water**			**Sampled: 05/12/09 09:00**					
Sulfate	EPA 300.0	**684**	-----	25.0	mg/l	50x	9050085	05/19/09 08:52	05/19/09 13:15	
SSE0055-02 (MW-303)		**Water**			**Sampled: 05/12/09 10:00**					
Sulfate	EPA 300.0	**374**	-----	25.0	mg/l	50x	9050085	05/19/09 08:52	05/19/09 13:28	
SSE0055-03 (MW-302)		**Water**			**Sampled: 05/12/09 11:00**					
Sulfate	EPA 300.0	**449**	-----	25.0	mg/l	50x	9050085	05/19/09 08:52	05/19/09 13:41	
SSE0055-04 (MW-203)		**Water**			**Sampled: 05/12/09 12:30**					
Sulfate	EPA 300.0	**450**	-----	25.0	mg/l	50x	9050085	05/19/09 08:52	05/19/09 13:54	
SSE0055-05 (MW-201)		**Water**			**Sampled: 05/12/09 12:00**					
Sulfate	EPA 300.0	**30.6**	-----	2.50	mg/l	5x	9050085	05/19/09 08:52	05/19/09 16:43	
SSE0055-06 (MW-2)		**Water**			**Sampled: 05/12/09 13:00**					
Sulfate	EPA 300.0	**88.0**	-----	25.0	mg/l	50x	9050085	05/19/09 08:52	05/19/09 14:34	
SSE0055-07 (MW-7)		**Water**			**Sampled: 05/12/09 14:00**					
Sulfate	EPA 300.0	**112**	-----	25.0	mg/l	50x	9050085	05/19/09 08:52	05/19/09 14:47	
SSE0055-08 (Seep)		**Water**			**Sampled: 05/12/09 15:00**					
Sulfate	EPA 300.0	**95.0**	-----	25.0	mg/l	50x	9050085	05/19/09 08:52	05/19/09 16:04	
SSE0055-09 (Dup)		**Water**			**Sampled: 05/12/09 00:00**					
Sulfate	EPA 300.0	**426**	-----	25.0	mg/l	50x	9050085	05/19/09 08:52	05/19/09 16:17	

Randee Decker, Project Manager

Total Metals by EPA 200 Series Methods

TestAmerica Seattle

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SSE0055-01 (MW-301)		**Water**			**Sampled: 05/12/09 09:00**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	9E19061	05/19/09 22:31	05/20/09 11:49	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
SSE0055-02 (MW-303)		**Water**			**Sampled: 05/12/09 10:00**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	9E19061	05/19/09 22:31	05/20/09 21:29	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
SSE0055-03 (MW-302)		**Water**			**Sampled: 05/12/09 11:00**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	9E19061	05/19/09 22:31	05/20/09 21:55	
Lead	"	**0.00133**	-----	0.00100	"	"	"	"	"	
SSE0055-04 (MW-203)		**Water**			**Sampled: 05/12/09 12:30**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	9E19061	05/19/09 22:31	05/20/09 22:01	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
SSE0055-05 (MW-201)		**Water**			**Sampled: 05/12/09 12:00**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	9E19061	05/19/09 22:31	05/20/09 22:07	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
SSE0055-06 (MW-2)		**Water**			**Sampled: 05/12/09 13:00**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	9E19061	05/19/09 22:31	05/20/09 22:14	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
SSE0055-07 (MW-7)		**Water**			**Sampled: 05/12/09 14:00**					
Arsenic	EPA 200.8	**0.00115**	-----	0.00100	mg/l	1x	9E19061	05/19/09 22:31	05/20/09 22:20	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
SSE0055-08 (Seep)		**Water**			**Sampled: 05/12/09 15:00**					
Arsenic	EPA 200.8	**0.00977**	-----	0.00100	mg/l	1x	9E19061	05/19/09 22:31	05/20/09 22:26	
Lead	"	**0.0244**	-----	0.00100	"	"	"	"	"	

TestAmerica Spokane

Randee Decker, Project Manager

Total Metals by EPA 200 Series Methods

TestAmerica Seattle

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SSE0055-09 (Dup)		**Water**				**Sampled: 05/12/09 00:00**				
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	9E19061	05/19/09 22:31	05/20/09 22:33	
Lead	"	ND	-----	0.00100	"	"	"	"	"	

Dissolved Metals per EPA 200 Series Methods

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SSE0055-08 (Seep)		**Water**			**Sampled: 05/12/09 15:00**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	9060757	06/22/09 09:08	06/22/09 18:27	
Lead	"	ND	-----	0.00100	"	"	"	"	"	

URS Corp.	Project Name:	**POM TDF 1+2**	
920 N. Argonne Road Suite 300	Project Number:	36298248.00002	Report Created:
Spokane, WA 99212	Project Manager:	Gary Panther	06/25/09 09:56

Total Metals by EPA 200 Series Methods - Laboratory Quality Control Results

TestAmerica Spokane

QC Batch: 9050076 **Water Preparation Method: Metals**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (9050076-BLK1)								**Extracted: 05/18/09 09:23**						
Zinc	EPA 200.7	ND	---	0.0100	mg/l	1x	--	--	--	--	--	--	05/18/09 15:24	
Chromium	"	ND	---	0.00800	"	"	--	--	--	--	--	--	"	
Manganese	"	ND	---	0.0100	"	"	--	--	--	--	--	--	"	
LCS (9050076-BS1)								**Extracted: 05/18/09 09:23**						
Chromium	EPA 200.7	1.07	---	0.00800	mg/l	1x	--	1.00	107%	(85-115)	--	--	05/18/09 12:54	
Manganese	"	1.10	---	0.0100	"	"	--	"	110%	"	--	--	"	
Zinc	"	1.09	---	0.0100	"	"	--	"	109%	"	--	--	"	
Duplicate (9050076-DUP1)				**QC Source: SSE0028-01**				**Extracted: 05/18/09 09:23**						
Chromium	EPA 200.7	ND	---	0.00800	mg/l	1x	ND	--	--	--	83.2%	(20)	05/18/09 14:51	R2
Zinc	"	0.0299	---	0.0100	"	"	0.0306	--	--	--	2.31%	"	"	
Manganese	"	ND	---	0.0100	"	"	ND	--	--	--	NR	"	"	
Matrix Spike (9050076-MS1)				**QC Source: SSE0028-01**				**Extracted: 05/18/09 09:23**						
Zinc	EPA 200.7	1.12	---	0.0100	mg/l	1x	0.0306	1.00	109%	(70-130)	--	--	05/18/09 14:56	
Manganese	"	1.10	---	0.0100	"	"	ND	"	110%	(75-125)	--	--	"	
Chromium	"	1.08	---	0.00800	"	"	0.00583	"	107%	"	--	--	"	
Matrix Spike Dup (9050076-MSD1)				**QC Source: SSE0028-01**				**Extracted: 05/18/09 09:23**						
Chromium	EPA 200.7	1.02	---	0.00800	mg/l	1x	0.00583	1.00	102%	(75-125)	5.21%	(20)	05/18/09 15:03	
Zinc	"	1.07	---	0.0100	"	"	0.0306	"	104%	(70-130)	4.94%	"	"	
Manganese	"	1.09	---	0.0100	"	"	ND	"	109%	(75-125)	0.664%	"	"	

Dissolved Metals by EPA 200 Series Methods - Laboratory Quality Control Results

TestAmerica Spokane

QC Batch: 9060097 **Water Preparation Method: Metals**

Blank (9060097-BLK1) **Extracted: 06/18/09 07:15**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Manganese	EPA 200.7	ND	---	0.0100	mg/l	1x	--	--	--	--	--	--	06/18/09 13:29	
Chromium	"	ND	---	0.00800	"	"	--	--	--	--	--	--	"	
Zinc	"	ND	---	0.0100	"	"	--	--	--	--	--	--	"	

LCS (9060097-BS1) **Extracted: 06/18/09 07:15**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Zinc	EPA 200.7	1.08	---	0.0100	mg/l	1x	--	1.00	108%	(85-115)	--	--	06/18/09 13:25	
Chromium	"	1.04	---	0.00800	"	"	--	"	104%	"	--	--	"	
Manganese	"	1.10	---	0.0100	"	"	--	"	110%	"	--	--	"	

Duplicate (9060097-DUP1) **QC Source: SSF0074-01** **Extracted: 06/18/09 07:15**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Chromium	EPA 200.7	0.0282	---	0.00800	mg/l	1x	0.0274	--	--	--	3.13%	(20)	06/18/09 15:46	
Manganese	"	ND	---	0.0100	"	"	ND	--	--	--	28.1%	"	"	R4
Zinc	"	0.0423	---	0.0100	"	"	0.0456	--	--	--	7.53%	"	"	

Matrix Spike (9060097-MS1) **QC Source: SSF0074-01** **Extracted: 06/18/09 07:15**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Chromium	EPA 200.7	1.07	---	0.00800	mg/l	1x	0.0274	1.00	104%	(75-125)	--	--	06/18/09 15:51	
Manganese	"	1.09	---	0.0100	"	"	0.00609	"	108%	"	--	--	"	
Zinc	"	1.20	---	0.0100	"	"	0.0456	"	116%	"	--	--	"	

Matrix Spike Dup (9060097-MSD1) **QC Source: SSF0074-01** **Extracted: 06/18/09 07:15**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Zinc	EPA 200.7	1.20	---	0.0100	mg/l	1x	0.0456	1.00	115%	(75-125)	0.488%	(20)	06/18/09 15:56	
Chromium	"	1.06	---	0.00800	"	"	0.0274	"	103%	"	0.739%	"	"	
Manganese	"	1.08	---	0.0100	"	"	0.00609	"	108%	"	0.608%	"	"	

TestAmerica Spokane

Randee Decker, Project Manager

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **POM TDF 1+2**
Project Number: 36298248.00002
Project Manager: Gary Panther

Report Created:
06/25/09 09:56

Anions by EPA Method 300.0 - Laboratory Quality Control Results

TestAmerica Spokane

QC Batch: 9050085 **Water Preparation Method: Wet Chem**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (9050085-BLK1)								**Extracted: 05/19/09 08:52**						
Sulfate	EPA 300.0	ND	---	0.500	mg/l	1x	--	--	--	--	--	--	05/19/09 11:04	
LCS (9050085-BS1)								**Extracted: 05/19/09 08:52**						
Sulfate	EPA 300.0	4.70	---	0.500	mg/l	1x	--	5.00	94.0%	(90-110)	--	--	05/19/09 11:30	
Duplicate (9050085-DUP1)				**QC Source: SSE0055-04**				**Extracted: 05/19/09 08:52**						
Sulfate	EPA 300.0	428	---	25.0	mg/l	50x	450	--	--	--	5.01%	(15.7)	05/19/09 14:07	
Matrix Spike (9050085-MS1)				**QC Source: SSE0055-05**				**Extracted: 05/19/09 08:52**						
Sulfate	EPA 300.0	50.6	---	2.50	mg/l	5x	30.6	25.0	79.8%	(80-120)	--	--	05/19/09 16:56	M8
Matrix Spike Dup (9050085-MSD1)				**QC Source: SSE0055-05**				**Extracted: 05/19/09 08:52**						
Sulfate	EPA 300.0	49.8	---	2.50	mg/l	5x	30.6	25.0	77.0%	(80-120)	1.39%	(10)	05/19/09 17:09	M8

TestAmerica Spokane

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Randee Decker

Randee Decker, Project Manager

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **POM TDF 1+2**
Project Number: 36298248.00002
Project Manager: Gary Panther

Report Created:
06/25/09 09:56

Total Metals by EPA 200 Series Methods - Laboratory Quality Control Results

TestAmerica Seattle

QC Batch: 9E19061 **Water Preparation Method: EPA 200 Series**

Blank (9E19061-BLK1) **Extracted: 05/19/09 22:31**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Lead	EPA 200.8	ND	---	0.00100	mg/l	1x	--	--	--	--	--	--	05/20/09 11:11	
Arsenic	"	ND	---	0.00100	"	"	--	--	--	--	--	--	"	

LCS (9E19061-BS1) **Extracted: 05/19/09 22:31**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Arsenic	EPA 200.8	0.0747	---	0.00100	mg/l	1x	--	0.0800	93.4%	(85-115)	--	--	05/20/09 11:18	
Lead	"	0.0771	---	0.00100	"	"	--	"	96.3%	"	--	--	"	

Duplicate (9E19061-DUP1) **QC Source: BSE0202-02** **Extracted: 05/19/09 22:31**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Lead	EPA 200.8	ND	---	0.00100	mg/l	1x	ND	--	--	--	11.1%	(20)	05/20/09 11:37	
Arsenic	"	ND	---	0.00100	"	"	ND	--	--	--	NR	"	"	

Matrix Spike (9E19061-MS1) **QC Source: BSE0202-02** **Extracted: 05/19/09 22:31**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Lead	EPA 200.8	0.0776	---	0.00100	mg/l	1x	0.000380	0.0800	96.5%	(75-125)	--	--	05/20/09 11:24	
Arsenic	"	0.0761	---	0.00100	"	"	ND	"	95.1%	"	--	--	"	

Matrix Spike (9E19061-MS2) **QC Source: SSE0055-01** **Extracted: 05/19/09 22:31**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Lead	EPA 200.8	0.0772	---	0.00100	mg/l	1x	0.000250	0.0800	96.1%	(75-125)	--	--	05/20/09 11:30	
Arsenic	"	0.0778	---	0.00100	"	"	ND	"	97.3%	"	--	--	"	

TestAmerica Spokane

Randee Decker, Project Manager

Dissolved Metals per EPA 200 Series Methods - Laboratory Quality Control Results

TestAmerica Portland

QC Batch: 9060757 **Water Preparation Method: EPA 200/3005 Diss**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (9060757-BLK1)										**Extracted: 06/22/09 09:08**				
Arsenic	EPA 200.8	ND	---	0.00100	mg/l	1x	--	--	--	--	--	--	06/22/09 17:19	
Lead	"	ND	---	0.00100	"	"	--	--	--	--	--	--	"	
LCS (9060757-BS1)										**Extracted: 06/22/09 09:08**				
Arsenic	EPA 200.8	0.0978	---	0.00100	mg/l	1x	--	0.100	97.8%	(85-115)	--	--	06/22/09 17:24	
Lead	"	0.0933	---	0.00100	"	"	--	"	93.3%	"	--	--	"	
Duplicate (9060757-DUP1)				**QC Source: PSF0522-01**						**Extracted: 06/22/09 09:08**				
Arsenic	EPA 200.8	0.00291	---	0.00100	mg/l	1x	0.00297	--	--	--	2.04%	(20)	06/22/09 17:35	
Lead	"	ND	---	0.00100	"	"	ND	--	--	--	NR	"	"	
Matrix Spike (9060757-MS1)				**QC Source: PSF0522-02**						**Extracted: 06/22/09 09:08**				
Arsenic	EPA 200.8	0.0988	---	0.00100	mg/l	1x	ND	0.100	98.8%	(70-130)	--	--	06/22/09 17:45	
Lead	"	0.0866	---	0.00100	"	"	ND	"	86.6%	"	--	--	"	

Randee Decker, Project Manager

Notes and Definitions

Report Specific Notes:

M8 - The MS and/or MSD were below the acceptance limits. See Blank Spike (LCS).

R2 - The RPD exceeded the acceptance limit.

R4 - Due to the low levels of analyte in the sample, the duplicate RPD calculation does not provide useful information.

Laboratory Reporting Conventions:

DET - Analyte DETECTED at or above the Reporting Limit. Qualitative Analyses only.

ND - Analyte NOT DETECTED at or above the reporting limit (MDL or MRL, as appropriate).

NR/NA - Not Reported / Not Available

dry - Sample results reported on a Dry Weight Basis. Results and Reporting Limits have been corrected for Percent Dry Weight.

wet - Sample results and reporting limits reported on a Wet Weight Basis (as received). Results with neither 'wet' nor 'dry' are reported on a Wet Weight Basis.

RPD - RELATIVE PERCENT DIFFERENCE (RPDs calculated using Results, not Percent Recoveries).

MRL - METHOD REPORTING LIMIT. Reporting Level at, or above, the lowest level standard of the Calibration Table.

MDL* - METHOD DETECTION LIMIT. Reporting Level at, or above, the statistically derived limit based on 40CFR, Part 136, Appendix B. *MDLs are listed on the report only if the data has been evaluated below the MRL. Results between the MDL and MRL are reported as Estimated Results.

Dil - Dilutions are calculated based on deviations from the standard dilution performed for an analysis, and may not represent the dilution found on the analytical raw data.

Reporting Limits - Reporting limits (MDLs and MRLs) are adjusted based on variations in sample preparation amounts, analytical dilutions and percent solids, where applicable.

Electronic Signature - Electronic Signature added in accordance with TestAmerica's *Electronic Reporting and Electronic Signatures Policy.* Application of electronic signature indicates that the report has been reviewed and approved for release by the laboratory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

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2000 W International Airport Rd Ste A10, Anchorage, AK 99502-1119 907-563-9200 FAX 563-9210 ☐

CHAIN OF CUSTODY REPORT

Work Order #: SSG0055

CLIENT: URS Corp
REPORT TO: Gary D. Panther
ADDRESS: 920 N. Argonne RD. Suite 300
Spokane WA 99212
PHONE: 509-954-5090 FAX: GARY_PANTHER@URSCORP.com

INVOICE TO: URS Corp. - Spokane
MARGARET_Pitt@URSCORP.com
P.O. NUMBER: 36298248.00002

PROJECT NAME: POM TDF1+2
PROJECT NUMBER:
SAMPLED BY: GDP

TURNAROUND REQUEST
in Business Days *

Organic & Inorganic Analyses
☒ 10 STD. ☐ 7 ☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐ <1

Petroleum Hydrocarbon Analyses
☐ 5 STD. ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐ <1

☐ **OTHER** Specify:

** Turnaround Requests less than standard may incur Rush Charges.*

	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	AS	CR	Pb	Mn	ZN	SO4								MATRIX (W, S, O)	# OF CONT.	LOCATION/ COMMENTS	TA WO ID
1	MW-301	5-12-09 9:00	—	—	—	—	—	—								W	3		-01
2	MW-303	↓ 10:00	—	—	—	—	—	—								↓	↓		-02
3	MW-302	11:00	—	—	—	—	—	—											-03
4	MW-203	12:30	—	—	—	—	—	—											-04
5	MW-201	12:00	—	—	—	—	—	—											-05
6	MW-2	13:00	—	—	—	—	—	—											-06
7	MW-7	14:00	—	—	—	—	—	—											-07
8	SEEP	15:00	—	—	—	—	—										2		-08
9	DUP		—	—	—	—	—	—									3		-09
10																			

PRESERVATIVE

REQUESTED ANALYSES

RELEASED BY: Gary D Panther DATE: 5-13-09
PRINT NAME: GARY D. PANTHER FIRM: URS Corp TIME: 8:50

RECEIVED BY: C Hanson DATE: 5/13/09
PRINT NAME: C Hanson FIRM: TestAmerica TIME: 850

RELEASED BY: DATE:
PRINT NAME: FIRM: TIME:

RECEIVED BY: DATE:
PRINT NAME: FIRM: TIME:

ADDITIONAL REMARKS:
HOLD DISOLVED SAMPLES

TEMP: 4.6

PAGE 1 OF

TAL-1000(0408)

SPOKANE, WA 11922 E. 1ST AVENUE
SPOKANE VALLEY, WA 99206
ph: (509) 924.9200 fax: (509) 924.9290

November 12, 2009

Gary Panther
URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

RE: TDF-1

Enclosed are the results of analyses for samples received by the laboratory on 10/29/09 08:15. The following list is a summary of the Work Orders contained in this report, generated on 11/12/09 16:19.

If you have any questions concerning this report, please feel free to contact me.

Work Order	Project	ProjectNumber
SSJ0158	TDF-1	36298248

TestAmerica Spokane

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Randee Decker

Randee Decker, Project Manager

URS Corp.	Project Name:	**TDF-1**		
920 N. Argonne Road Suite 300	Project Number:	36298248	Report Created:	
Spokane, WA 99212	Project Manager:	Gary Panther	11/12/09 16:19	

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MW-301	SSJ0158-01	Water	10/28/09 10:00	10/29/09 08:15
MW-303	SSJ0158-02	Water	10/28/09 10:30	10/29/09 08:15
MW-302	SSJ0158-03	Water	10/28/09 11:00	10/29/09 08:15
MW-203	SSJ0158-04	Water	10/28/09 12:00	10/29/09 08:15
MW-201	SSJ0158-05	Water	10/28/09 12:30	10/29/09 08:15
Dup	SSJ0158-06	Water	10/28/09 00:00	10/29/09 08:15

TestAmerica Spokane

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Randee Decker

Randee Decker, Project Manager

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
11/12/09 16:19

Total Metals by EPA 200 Series Methods

TestAmerica Spokane

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SSJ0158-01 (MW-301)		**Water**			**Sampled: 10/28/09 10:00**					
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	9110046	11/09/09 07:20	11/09/09 15:16	
Manganese	"	ND	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.0235**	-----	0.0100	"	"	"	"	"	
SSJ0158-02 (MW-303)		**Water**			**Sampled: 10/28/09 10:30**					
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	9110046	11/09/09 07:20	11/09/09 15:27	
Manganese	"	**0.205**	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.0306**	-----	0.0100	"	"	"	"	"	
SSJ0158-03 (MW-302)		**Water**			**Sampled: 10/28/09 11:00**					
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	9110046	11/09/09 07:20	11/09/09 15:34	
Manganese	"	**4.40**	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.0681**	-----	0.0100	"	"	"	"	"	
SSJ0158-04 (MW-203)		**Water**			**Sampled: 10/28/09 12:00**					
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	9110046	11/09/09 07:20	11/09/09 15:41	
Manganese	"	**0.188**	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.0153**	-----	0.0100	"	"	"	"	"	
SSJ0158-05 (MW-201)		**Water**			**Sampled: 10/28/09 12:30**					
Chromium	EPA 200.7	**0.0198**	-----	0.00800	mg/l	1x	9110046	11/09/09 07:20	11/09/09 15:47	
Manganese	"	**0.252**	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.0614**	-----	0.0100	"	"	"	"	"	
SSJ0158-06 (Dup)		**Water**			**Sampled: 10/28/09 00:00**					
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	9110046	11/09/09 07:20	11/09/09 15:54	
Manganese	"	**0.227**	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.0318**	-----	0.0100	"	"	"	"	"	

TestAmerica Spokane

Randee Decker, Project Manager

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
11/12/09 16:19

Dissolved Metals by EPA 200 Series Methods

TestAmerica Spokane

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SSJ0158-01 (MW-301)			**Water**			**Sampled: 10/28/09 10:00**				
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	9110046	11/09/09 07:20	11/09/09 16:00	
Manganese	"	ND	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.0160**	-----	0.0100	"	"	"	"	"	
SSJ0158-02 (MW-303)			**Water**			**Sampled: 10/28/09 10:30**				
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	9110046	11/09/09 07:20	11/09/09 16:07	
Manganese	"	**0.131**	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.0149**	-----	0.0100	"	"	"	"	"	
SSJ0158-03 (MW-302)			**Water**			**Sampled: 10/28/09 11:00**				
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	9110046	11/09/09 07:20	11/09/09 16:29	
Manganese	"	**2.50**	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.0297**	-----	0.0100	"	"	"	"	"	
SSJ0158-04 (MW-203)			**Water**			**Sampled: 10/28/09 12:00**				
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	9110046	11/09/09 07:20	11/09/09 16:35	
Manganese	"	**0.174**	-----	0.0100	"	"	"	"	"	
Zinc	"	ND	-----	0.0100	"	"	"	"	"	
SSJ0158-05 (MW-201)			**Water**			**Sampled: 10/28/09 12:30**				
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	9110046	11/09/09 07:20	11/09/09 16:42	
Manganese	"	**0.0126**	-----	0.0100	"	"	"	"	"	
Zinc	"	ND	-----	0.0100	"	"	"	"	"	
SSJ0158-06 (Dup)			**Water**			**Sampled: 10/28/09 00:00**				
Chromium	EPA 200.7	ND	-----	0.00800	mg/l	1x	9110046	11/09/09 07:20	11/09/09 16:48	
Manganese	"	**0.125**	-----	0.0100	"	"	"	"	"	
Zinc	"	**0.0154**	-----	0.0100	"	"	"	"	"	

TestAmerica Spokane

Randee Decker, Project Manager

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
11/12/09 16:19

Anions by EPA Method 300.0

TestAmerica Spokane

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SSJ0158-01 (MW-301)		**Water**			**Sampled: 10/28/09 10:00**					
Sulfate	EPA 300.0	**868**	-----	25.0	mg/l	50x	9100174	10/29/09 10:37	10/29/09 17:08	
SSJ0158-02 (MW-303)		**Water**			**Sampled: 10/28/09 10:30**					
Sulfate	EPA 300.0	**424**	-----	25.0	mg/l	50x	9100174	10/29/09 10:37	10/29/09 17:43	
SSJ0158-03 (MW-302)		**Water**			**Sampled: 10/28/09 11:00**					
Sulfate	EPA 300.0	**488**	-----	25.0	mg/l	50x	9100174	10/29/09 10:37	10/29/09 18:01	
SSJ0158-04 (MW-203)		**Water**			**Sampled: 10/28/09 12:00**					
Sulfate	EPA 300.0	**514**	-----	25.0	mg/l	50x	9100174	10/29/09 10:37	10/29/09 18:18	
SSJ0158-05 (MW-201)		**Water**			**Sampled: 10/28/09 12:30**					
Sulfate	EPA 300.0	**27.8**	-----	2.50	mg/l	5x	9100174	10/29/09 10:37	10/29/09 18:36	
SSJ0158-06 (Dup)		**Water**			**Sampled: 10/28/09 00:00**					
Sulfate	EPA 300.0	**458**	-----	25.0	mg/l	50x	9100174	10/29/09 10:37	10/29/09 18:54	

Total Metals per EPA 200 Series Methods

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SSJ0158-01 (MW-301)		**Water**			**Sampled: 10/28/09 10:00**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	9110196	11/06/09 07:47	11/06/09 16:18	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
SSJ0158-02 (MW-303)		**Water**			**Sampled: 10/28/09 10:30**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	9110196	11/06/09 07:47	11/06/09 16:25	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
SSJ0158-03 (MW-302)		**Water**			**Sampled: 10/28/09 11:00**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	9110196	11/06/09 07:47	11/06/09 16:33	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
SSJ0158-04 (MW-203)		**Water**			**Sampled: 10/28/09 12:00**					
Arsenic	EPA 200.8	**0.00143**	-----	0.00100	mg/l	1x	9110196	11/06/09 07:47	11/06/09 16:41	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
SSJ0158-05 (MW-201)		**Water**			**Sampled: 10/28/09 12:30**					
Arsenic	EPA 200.8	**0.00207**	-----	0.00100	mg/l	1x	9110196	11/06/09 07:47	11/06/09 16:49	
Lead	"	**0.00545**	-----	0.00100	"	"	"	"	"	
SSJ0158-06 (Dup)		**Water**			**Sampled: 10/28/09 00:00**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	9110196	11/06/09 07:47	11/06/09 16:57	
Lead	"	ND	-----	0.00100	"	"	"	"	"	

Dissolved Metals per EPA 200 Series Methods

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
SSJ0158-01 (MW-301)		**Water**			**Sampled: 10/28/09 10:00**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	9110154	11/05/09 08:06	11/06/09 18:10	
Lead	"	ND	-----	0.00100	"	"	"	"	11/05/09 20:53	
SSJ0158-02 (MW-303)		**Water**			**Sampled: 10/28/09 10:30**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	9110154	11/05/09 08:06	11/06/09 18:16	
Lead	"	ND	-----	0.00100	"	"	"	"	11/05/09 20:58	
SSJ0158-03 (MW-302)		**Water**			**Sampled: 10/28/09 11:00**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	9110154	11/05/09 08:06	11/06/09 18:21	
Lead	"	ND	-----	0.00100	"	"	"	"	11/05/09 21:04	
SSJ0158-04 (MW-203)		**Water**			**Sampled: 10/28/09 12:00**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	9110154	11/05/09 08:06	11/06/09 18:27	
Lead	"	ND	-----	0.00100	"	"	"	"	11/05/09 21:10	
SSJ0158-05 (MW-201)		**Water**			**Sampled: 10/28/09 12:30**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	9110154	11/05/09 08:06	11/06/09 22:12	
Lead	"	ND	-----	0.00100	"	"	"	"	11/05/09 21:15	
SSJ0158-06 (Dup)		**Water**			**Sampled: 10/28/09 00:00**					
Arsenic	EPA 200.8	ND	-----	0.00100	mg/l	1x	9110154	11/05/09 08:06	11/06/09 18:38	
Lead	"	ND	-----	0.00100	"	"	"	"	11/05/09 21:32	

TestAmerica Spokane

Randee Decker

Randee Decker, Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Total Metals by EPA 200 Series Methods - Laboratory Quality Control Results

TestAmerica Spokane

QC Batch: 9110046 **Water Preparation Method: Metals**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (9110046-BLK1)									**Extracted: 11/09/09 07:20**					
Zinc	EPA 200.7	ND	---	0.0100	mg/l	1x	--	--	--	--	--	--	11/09/09 15:11	
Manganese	"	ND	---	0.0100	"	"	--	--	--	--	--	--	"	
Chromium	"	ND	---	0.00800	"	"	--	--	--	--	--	--	"	
LCS (9110046-BS1)									**Extracted: 11/09/09 07:20**					
Manganese	EPA 200.7	1.05	---	0.0100	mg/l	1x	--	1.00	105%	(85-115)	--	--	11/09/09 14:49	
Chromium	"	1.04	---	0.00800	"	"	--	"	104%	"	--	--	"	
Zinc	"	1.11	---	0.0100	"	"	--	"	111%	"	--	--	"	
Duplicate (9110046-DUP1)					**QC Source: SSJ0158-01**				**Extracted: 11/09/09 07:20**					
Chromium	EPA 200.7	ND	---	0.00800	mg/l	1x	ND	--	--	--	NR	(20)	11/09/09 18:29	
Manganese	"	ND	---	0.0100	"	"	ND	--	--	--	NR	"	"	
Zinc	"	0.0230	---	0.0100	"	"	0.0235	--	--	--	2.32%	"	"	
Matrix Spike (9110046-MS1)					**QC Source: SSJ0158-01**				**Extracted: 11/09/09 07:20**					
Zinc	EPA 200.7	1.02	---	0.0100	mg/l	1x	0.0235	1.00	99.8%	(70-130)	--	--	11/09/09 18:36	
Chromium	"	1.00	---	0.00800	"	"	ND	"	100%	(75-125)	--	--	"	
Manganese	"	1.02	---	0.0100	"	"	ND	"	102%	"	--	--	"	
Matrix Spike Dup (9110046-MSD1)					**QC Source: SSJ0158-01**				**Extracted: 11/09/09 07:20**					
Zinc	EPA 200.7	1.03	---	0.0100	mg/l	1x	0.0235	1.00	101%	(70-130)	1.26%	(20)	11/09/09 18:41	
Manganese	"	1.02	---	0.0100	"	"	ND	"	102%	(75-125)	0.275%	"	"	
Chromium	"	1.01	---	0.00800	"	"	ND	"	101%	"	0.897%	"	"	

TestAmerica Spokane

Randee Decker, Project Manager

Dissolved Metals by EPA 200 Series Methods - Laboratory Quality Control Results

TestAmerica Spokane

QC Batch: 9110046 **Water Preparation Method: Metals**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (9110046-BLK1)								**Extracted: 11/09/09 07:20**						
Manganese	EPA 200.7	ND	---	0.0100	mg/l	1x	--	--	--	--	--	--	11/09/09 15:11	
Zinc	"	ND	---	0.0100	"	"	--	--	--	--	--	--	"	
Chromium	"	ND	---	0.00800	"	"	--	--	--	--	--	--	"	
LCS (9110046-BS1)								**Extracted: 11/09/09 07:20**						
Zinc	EPA 200.7	1.11	---	0.0100	mg/l	1x	--	1.00	111%	(85-115)	--	--	11/09/09 14:49	
Manganese	"	1.05	---	0.0100	"	"	--	"	105%	"	--	--	"	
Chromium	"	1.04	---	0.00800	"	"	--	"	104%	"	--	--	"	
Duplicate (9110046-DUP1)				**QC Source: SSJ0158-01**				**Extracted: 11/09/09 07:20**						
Chromium	EPA 200.7	ND	---	0.00800	mg/l	1x	ND	--	--	--	NR	(20)	11/09/09 18:29	
Manganese	"	ND	---	0.0100	"	"	ND	--	--	--	NR	"	"	
Zinc	"	0.0230	---	0.0100	"	"	0.0160	--	--	--	35.9%	"	"	R2
Matrix Spike (9110046-MS1)				**QC Source: SSJ0158-01**				**Extracted: 11/09/09 07:20**						
Chromium	EPA 200.7	1.00	---	0.00800	mg/l	1x	ND	1.00	100%	(75-125)	--	--	11/09/09 18:36	
Manganese	"	1.02	---	0.0100	"	"	ND	"	102%	"	--	--	"	
Zinc	"	1.02	---	0.0100	"	"	0.0160	"	101%	"	--	--	"	
Matrix Spike Dup (9110046-MSD1)				**QC Source: SSJ0158-01**				**Extracted: 11/09/09 07:20**						
Chromium	EPA 200.7	1.01	---	0.00800	mg/l	1x	ND	1.00	101%	(75-125)	0.897%	(20)	11/09/09 18:41	
Manganese	"	1.02	---	0.0100	"	"	ND	"	102%	"	0.275%	"	"	
Zinc	"	1.03	---	0.0100	"	"	0.0160	"	102%	"	1.26%	"	"	

Anions by EPA Method 300.0 - Laboratory Quality Control Results

TestAmerica Spokane

QC Batch: 9100174 **Water Preparation Method: Wet Chem**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (9100174-BLK1)										**Extracted: 10/29/09 10:37**				
Sulfate	EPA 300.0	ND	---	0.500	mg/l	1x	--	--	--	--	--	--	10/29/09 13:05	
LCS (9100174-BS1)										**Extracted: 10/29/09 10:37**				
Sulfate	EPA 300.0	5.40	---	0.500	mg/l	1x	--	5.00	108%	(90-110)	--	--	10/29/09 12:47	M3
Duplicate (9100174-DUP1)						**QC Source: SSJ0158-01**				**Extracted: 10/29/09 10:37**				
Sulfate	EPA 300.0	859	---	25.0	mg/l	50x	868	--	--	--	1.10%	(15.7)	10/29/09 17:25	

URS Corp.	Project Name:	**TDF-1**	
920 N. Argonne Road Suite 300	Project Number:	36298248	Report Created:
Spokane, WA 99212	Project Manager:	Gary Panther	11/12/09 16:19

Total Metals per EPA 200 Series Methods - Laboratory Quality Control Results

TestAmerica Portland

QC Batch: 9110196 **Water Preparation Method: EPA 200/3005**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (9110196-BLK1)									**Extracted: 11/06/09 07:47**					
Arsenic	EPA 200.8	ND	---	0.00100	mg/l	1x	--	--	--	--	--	--	11/06/09 14:35	
Lead	"	ND	---	0.00100	"	"	--	--	--	--	--	--	"	
LCS (9110196-BS1)									**Extracted: 11/06/09 07:47**					
Arsenic	EPA 200.8	0.0969	---	0.00100	mg/l	1x	--	0.100	96.9%	(85-115)	--	--	11/06/09 14:43	
Lead	"	0.0999	---	0.00100	"	"	--	"	99.9%	"	--	--	"	
Duplicate (9110196-DUP1)					**QC Source: PSK0050-02**				**Extracted: 11/06/09 07:47**					
Arsenic	EPA 200.8	ND	---	0.00100	mg/l	1x	ND	--	--	--	NR	(20)	11/06/09 15:23	
Lead	"	ND	---	0.00100	"	"	ND	--	--	--	NR	"	"	
Matrix Spike (9110196-MS1)					**QC Source: PSK0050-02**				**Extracted: 11/06/09 07:47**					
Arsenic	EPA 200.8	0.0983	---	0.00100	mg/l	1x	ND	0.100	98.3%	(70-130)	--	--	11/06/09 15:38	
Lead	"	0.101	---	0.00100	"	"	ND	"	101%	(75-125)	--	--	"	
Matrix Spike (9110196-MS2)					**QC Source: PSK0108-11**				**Extracted: 11/06/09 07:47**					
Arsenic	EPA 200.8	0.0970	---	0.00100	mg/l	1x	ND	0.100	97.0%	(70-130)	--	--	11/06/09 17:20	
Lead	"	0.101	---	0.00100	"	"	0.00220	"	98.9%	(75-125)	--	--	"	

Randee Decker, Project Manager

URS Corp.
920 N. Argonne Road Suite 300
Spokane, WA 99212

Project Name: **TDF-1**
Project Number: 36298248
Project Manager: Gary Panther

Report Created:
11/12/09 16:19

Dissolved Metals per EPA 200 Series Methods - Laboratory Quality Control Results

TestAmerica Portland

QC Batch: 9110154 **Water Preparation Method: EPA 200/3005 Diss**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (9110154-BLK1)								**Extracted: 11/05/09 08:06**						
Arsenic	EPA 200.8	ND	---	0.00100	mg/l	1x	--	--	--	--	--	--	11/06/09 17:59	
Lead	"	ND	---	0.00100	"	"	--	--	--	--	--	--	11/05/09 20:24	
LCS (9110154-BS1)								**Extracted: 11/05/09 08:06**						
Arsenic	EPA 200.8	0.0924	---	0.00100	mg/l	1x	--	0.100	92.4%	(85-115)	--	--	11/06/09 18:04	
Lead	"	0.0875	---	0.00100	"	"	--	"	87.5%	"	--	--	11/05/09 20:30	
Duplicate (9110154-DUP1)				**QC Source: SSJ0158-06**				**Extracted: 11/05/09 08:06**						
Arsenic	EPA 200.8	ND	---	0.00100	mg/l	1x	ND	--	--	--	NR	(20)	11/06/09 18:44	
Lead	"	ND	---	0.00100	"	"	ND	--	--	--	NR	"	11/05/09 21:38	
Matrix Spike (9110154-MS1)				**QC Source: SSJ0158-06**				**Extracted: 11/05/09 08:06**						
Arsenic	EPA 200.8	0.186	---	0.00100	mg/l	1x	ND	0.200	92.8%	(70-130)	--	--	11/06/09 18:50	
Lead	"	0.167	---	0.00100	"	"	ND	"	83.4%	"	--	--	11/05/09 21:44	

TestAmerica Spokane

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Randee Decker, Project Manager

CERTIFICATION SUMMARY

Subcontracted Laboratories

TestAmerica Portland

9405 SW Nimbus Ave. - Beaverton, OR 97008

Method Performed: EPA 200.8
Samples: SSJ0158-01, SSJ0158-02, SSJ0158-03, SSJ0158-04, SSJ0158-05, SSJ0158-06

Any abnormalities or departures from sample acceptance policy shall be documented on the 'Sample Receipt and Temperature Log Form' and 'Sample Non-conformance Form' (if applicable) included with this report.

For information concerning certifications of this facility or another TestAmerica facility, please visit our website at www.TestAmericaInc.com

Samples collected by TestAmerica Field Services personnel are noted on the Chain of Custody (COC) .

Notes and Definitions

Report Specific Notes:

M3 - Results exceeded the linear range in the MS/MSD and therefore are not available for reporting. The batch was accepted based on acceptable recovery in the Blank Spike (LCS).

R2 - The RPD exceeded the acceptance limit.

Laboratory Reporting Conventions:

DET - Analyte DETECTED at or above the Reporting Limit. Qualitative Analyses only.

ND - Analyte NOT DETECTED at or above the reporting limit (MDL or MRL, as appropriate).

NR/NA - Not Reported / Not Available

dry - Sample results reported on a Dry Weight Basis. Results and Reporting Limits have been corrected for Percent Dry Weight.

wet - Sample results and reporting limits reported on a Wet Weight Basis (as received). Results with neither 'wet' nor 'dry' are reported on a Wet Weight Basis.

RPD - RELATIVE PERCENT DIFFERENCE (RPDs calculated using Results, not Percent Recoveries).

MRL - METHOD REPORTING LIMIT. Reporting Level at, or above, the lowest level standard of the Calibration Table.

MDL* - METHOD DETECTION LIMIT. Reporting Level at, or above, the statistically derived limit based on 40CFR, Part 136, Appendix B. *MDLs are listed on the report only if the data has been evaluated below the MRL. Results between the MDL and MRL are reported as Estimated Results.

Dil - Dilutions are calculated based on deviations from the standard dilution performed for an analysis, and may not represent the dilution found on the analytical raw data.

Reporting Limits - Reporting limits (MDLs and MRLs) are adjusted based on variations in sample preparation amounts, analytical dilutions and percent solids, where applicable.

Electronic Signature - Electronic Signature added in accordance with TestAmerica's *Electronic Reporting and Electronic Signatures Policy.* Application of electronic signature indicates that the report has been reviewed and approved for release by the laboratory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

11720 North Creek Pkwy N Suite 400, Bothell, WA 98011-8244	425-420-9200 FAX 420-9210	☐
11922 E. First Ave, Spokane, WA 99206-5302	509-924-9200 FAX 924-9290	☐
9405 SW Nimbus Ave,Beaverton, OR 97008-7145	503-906-9200 FAX 906-9210	☐
2000 W International Airport Rd Ste A10, Anchorage, AK 99502-1119	907-563-9200 FAX 563-9210	☐

CHAIN OF CUSTODY REPORT

Work Order #: SSJ0158

CLIENT: URS

REPORT TO: GARY PANTHER

ADDRESS:

PHONE: 509 954-5090 FAX:

INVOICE TO: URS Corp

c/o margaret_pitt@urscorp.com

P.O. NUMBER:

PROJECT NAME: POW TOF 1+2

PROJECT NUMBER: 3629 8248

SAMPLED BY: GDP

TURNAROUND REQUEST

in Business Days *

Organic & Inorganic Analyses

☒ 10 STD. ☐ 7 ☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐ <1

Petroleum Hydrocarbon Analyses

☒ STD. ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐ <1

☐ OTHER Specify:

** Turnaround Requests less than standard may incur Rush Charges.*

PRESERVATIVE

REQUESTED ANALYSES

	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME		~~#~~ SO4	As, Cr Pb, Zn, Mn												MATRIX (W, S, O)	# OF CONT.	LOCATION/ COMMENTS	TA WO ID
1	MW-301	10.28.09	10:00	↓	↓												W	2		-01
2	MW-303	↓	10:30														↓	↓		-02
3	MW-302		11:00																	-03
4	MW-203		12:00																	-04
5	MW-201		12:30																	-05
6	Dup		—																	-06
7																				
8																				
9																				
10																				

RELEASED BY: Gary D Panther
PRINT NAME: GARY D. PANTHER FIRM: URS Corp DATE: 10.29.09 TIME: 8:15

RECEIVED BY:
PRINT NAME: Chris Williams FIRM: TA-Spokane DATE: 10/29/09 TIME: 8:15

RELEASED BY:
PRINT NAME: FIRM: DATE: TIME:

RECEIVED BY:
PRINT NAME: FIRM: DATE: TIME:

ADDITIONAL REMARKS:

TOTAL + DISS.

TEMP: 2.1°C

PAGE 1 OF 1

TAL-1000(0408)

Cominco - Pend Oreille Mine
PO Box 7
Metaline Falls, WA 99153

Project Name: Quarterly
Work Order: **W9J0270**
Reported: 23-Oct-09 13:47

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Sampled By	Date Received
091007-MW2	W9J0270-01	Ground Water	07-Oct-09 13:20	KD	09-Oct-2009
091007-MW5	W9J0270-02	Ground Water	07-Oct-09 16:10	KD	09-Oct-2009
091007-MW6	W9J0270-03	Ground Water	07-Oct-09 15:08	KD	09-Oct-2009
091007-MW7	W9J0270-04	Ground Water	07-Oct-09 14:12	KD	09-Oct-2009

Solid samples are analyzed on an as-received, wet-weight basis, unless otherwise requested.
Sample preparation is defined by the client as per their Data Quality Objectives.
This report supercedes any previous reports for this Work Order. The complete report includes pages for each sample, a full QC report, and a notes section.
The results presented in this report relate only to the samples, and meet all requirements of the NELAC Standards unless otherwise noted.

Cominco - Pend Oreille Mine
PO Box 7
Metaline Falls, WA 99153

Project Name: Quarterly
Work Order: **W9J0270**
Reported: 23-Oct-09 13:47

Client Sample ID: **091007-MW2**
SVL Sample ID: **W9J0270-01 (Ground Water)**

Sample Report Page 1 of 1

Sampled: 07-Oct-09 13:20
Received: 09-Oct-09
Sampled By: KD

Metals (Total)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.00006		W942104	JAA	10/20/09 11:12	

Metals (Total Recoverable--reportable as Total per 40 CFR 136)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
EPA 200.7	Aluminum	< 0.080	mg/L	0.080	0.010		W942038	FEH	10/19/09 17:26	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0002		W942038	FEH	10/19/09 17:27	
EPA 200.7	**Calcium**	70.2	mg/L	0.040	0.006		W942038	FEH	10/19/09 17:26	
EPA 200.7	Chromium	< 0.0060	mg/L	0.0060	0.0004		W942038	FEH	10/19/09 17:27	
EPA 200.7	**Iron**	0.111	mg/L	0.060	0.009		W942038	FEH	10/19/09 17:26	
EPA 200.7	**Magnesium**	22.4	mg/L	0.060	0.009		W942038	FEH	10/19/09 17:26	
EPA 200.7	**Manganese**	0.0053	mg/L	0.0040	0.0010		W942038	FEH	10/19/09 17:26	
EPA 200.7	**Potassium**	2.09	mg/L	0.50	0.04		W942038	FEH	10/19/09 17:26	
EPA 200.7	**Silica (SiO2)**	19.4	mg/L	0.17	0.04		W942038	FEH	10/19/09 17:26	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0002		W942038	FEH	10/19/09 17:27	
EPA 200.7	**Sodium**	3.74	mg/L	0.50	0.01		W942038	FEH	10/19/09 17:26	
EPA 200.8	Copper	< 0.00100	mg/L	0.00100	0.00009	2.5	W942250	KWH	10/21/09 12:01	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000066	2.5	W942250	KWH	10/21/09 12:01	
EPA 200.8	Zinc	< 0.00300	mg/L	0.00300	0.00060	2.5	W942250	KWH	10/21/09 12:01	
SM 2340B	**Hardness (as CaCO3)**	267	mg/L	0.347	0.052		N/A	FEH	10/19/09 17:26	

Metals (Dissolved)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
EPA 200.8	Copper	< 0.00100	mg/L	0.00100	0.000073		W942243	KWH	10/21/09 12:23	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000053		W942243	KWH	10/21/09 12:23	
EPA 200.8	Zinc	< 0.00300	mg/L	0.00300	0.00048		W942243	KWH	10/21/09 12:23	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
EPA 120.1	**Specific conductance**	475	µmhos/cm	1.00			W942017	JMS	10/12/09 07:51	
EPA 350.1	Ammonia as N	< 0.030	mg/L	0.030	0.007		W942203	TJK	10/19/09 18:27	
EPA 353.2	**Nitrate/Nitrite as N**	0.286	mg/L	0.0500	0.0084		W943238	TJK	10/22/09 11:07	
SM 2320B	**Bicarbonate**	242	mg/L	1.0	0.3		W942031	DKS	10/14/09 13:46	
SM 2320B	Carbonate	< 1.0	mg/L	1.0	0.3		W942031	DKS	10/14/09 13:46	
SM 2320B	**Total Alkalinity**	242	mg/L	1.0	0.3		W942031	DKS	10/14/09 13:46	
SM 2540 C	**Total Diss. Solids**	306	mg/L	10	4		W941392	JMS	10/12/09 10:06	
SM 2540 D	Total Susp. Solids	< 5.0	mg/L	5.0	4.2		W941393	JMS	10/12/09 10:06	
SM 4500-P-E	**Orthophosphate as P**	0.03	mg/L	0.01	0.006		W941373	SM	10/09/09 15:15	H3

Anions by Ion Chromatography

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
EPA 300.0	**Chloride**	6.02	mg/L	0.200	0.050		W943091	EML	10/22/09 23:28	
EPA 300.0	Fluoride	< 0.100	mg/L	0.100	0.023		W943091	EML	10/22/09 23:28	
EPA 300.0	**Sulfate as SO4**	44.6	mg/L	1.50	0.18	5	W943091	EML	10/22/09 23:58	D2

Cation/Anion Balance and TDS Ratios

Cation Sum: 5.57 meq/L Anion Sum: 5.96 meq/L C/A Balance: -3.36 % Calculated TDS: 296 TDS/cTDS: 1.04 TDS/eC: 0.64

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

Cominco - Pend Oreille Mine
PO Box 7
Metaline Falls, WA 99153

Project Name: Quarterly
Work Order: **W9J0270**
Reported: 23-Oct-09 13:47

Client Sample ID: **091007-MW5**
SVL Sample ID: **W9J0270-02 (Ground Water)**

Sample Report Page 1 of 1

Sampled: 07-Oct-09 16:10
Received: 09-Oct-09
Sampled By: KD

Metals (Total)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.00006		W942104	JAA	10/20/09 11:13	

Metals (Total Recoverable--reportable as Total per 40 CFR 136)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
EPA 200.7	Aluminum	< 0.080	mg/L	0.080	0.010		W942038	FEH	10/19/09 17:44	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0002		W942038	FEH	10/19/09 17:45	
EPA 200.7	**Calcium**	177	mg/L	0.040	0.006		W942038	FEH	10/19/09 17:43	
EPA 200.7	Chromium	< 0.0060	mg/L	0.0060	0.0004		W942038	FEH	10/19/09 17:45	
EPA 200.7	Iron	< 0.060	mg/L	0.060	0.009		W942038	FEH	10/19/09 17:44	
EPA 200.7	**Magnesium**	75.6	mg/L	0.060	0.009		W942038	FEH	10/19/09 17:43	
EPA 200.7	Manganese	< 0.0040	mg/L	0.0040	0.0010		W942038	FEH	10/19/09 17:44	
EPA 200.7	**Potassium**	3.93	mg/L	0.50	0.04		W942038	FEH	10/19/09 17:43	
EPA 200.7	**Silica (SiO2)**	24.3	mg/L	0.17	0.04		W942038	FEH	10/19/09 17:43	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0002		W942038	FEH	10/19/09 17:45	
EPA 200.7	**Sodium**	7.62	mg/L	0.50	0.01		W942038	FEH	10/19/09 17:43	
EPA 200.8	Copper	< 0.00100	mg/L	0.00100	0.00009	2.5	W942250	KWH	10/21/09 12:08	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000066	2.5	W942250	KWH	10/21/09 12:08	
EPA 200.8	Zinc	< 0.00300	mg/L	0.00300	0.00060	2.5	W942250	KWH	10/21/09 12:08	
SM 2340B	**Hardness (as CaCO3)**	754	mg/L	0.347	0.052		N/A	FEH	10/19/09 17:43	

Metals (Dissolved)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
EPA 200.8	Copper	< 0.00100	mg/L	0.00100	0.000073		W942243	KWH	10/21/09 12:25	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000053		W942243	KWH	10/21/09 12:25	
EPA 200.8	Zinc	< 0.00300	mg/L	0.00300	0.00048		W942243	KWH	10/21/09 12:25	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
EPA 120.1	**Specific conductance**	1080	µmhos/cm	1.00			W942017	JMS	10/12/09 07:51	
EPA 350.1	Ammonia as N	< 0.030	mg/L	0.030	0.007		W942203	TJK	10/19/09 18:28	
EPA 353.2	**Nitrate/Nitrite as N**	0.145	mg/L	0.0500	0.0084		W943238	TJK	10/22/09 11:08	
SM 2320B	**Bicarbonate**	333	mg/L	1.0	0.3		W942031	DKS	10/14/09 13:52	
SM 2320B	Carbonate	< 1.0	mg/L	1.0	0.3		W942031	DKS	10/14/09 13:52	
SM 2320B	**Total Alkalinity**	333	mg/L	1.0	0.3		W942031	DKS	10/14/09 13:52	
SM 2540 C	**Total Diss. Solids**	980	mg/L	10	4		W941392	JMS	10/12/09 10:06	
SM 2540 D	Total Susp. Solids	< 5.0	mg/L	5.0	4.2		W941393	JMS	10/12/09 10:06	
SM 4500-P-E	**Orthophosphate as P**	0.07	mg/L	0.01	0.006		W941373	SM	10/09/09 15:15	

Anions by Ion Chromatography

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
EPA 300.0	**Chloride**	4.31	mg/L	0.200	0.050		W943091	EML	10/23/09 00:48	
EPA 300.0	Fluoride	< 0.100	mg/L	0.100	0.023		W943091	EML	10/23/09 00:48	
EPA 300.0	**Sulfate as SO4**	439	mg/L	7.50	0.90	25	W943091	EML	10/23/09 00:58	D2

Cation/Anion Balance and TDS Ratios

Cation Sum: 15.5 meq/L Anion Sum: 15.9 meq/L C/A Balance: -1.40 % Calculated TDS: 908 TDS/cTDS: 1.08 TDS/eC: 0.91

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

Cominco - Pend Oreille Mine
PO Box 7
Metaline Falls, WA 99153

Project Name: Quarterly
Work Order: **W9J0270**
Reported: 23-Oct-09 13:47

Client Sample ID: **091007-MW6**
SVL Sample ID: **W9J0270-03 (Ground Water)**

Sample Report Page 1 of 1

Sampled: 07-Oct-09 15:08
Received: 09-Oct-09
Sampled By: KD

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total)										
EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.00006		W942104	JAA	10/20/09 11:18	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.7	Aluminum	< 0.080	mg/L	0.080	0.010		W942038	FEH	10/19/09 17:49	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0002		W942038	FEH	10/19/09 17:51	
EPA 200.7	**Calcium**	83.0	mg/L	0.040	0.006		W942038	FEH	10/19/09 17:49	
EPA 200.7	Chromium	< 0.0060	mg/L	0.0060	0.0004		W942038	FEH	10/19/09 17:51	
EPA 200.7	Iron	< 0.060	mg/L	0.060	0.009		W942038	FEH	10/19/09 17:49	
EPA 200.7	**Magnesium**	27.4	mg/L	0.060	0.009		W942038	FEH	10/19/09 17:49	
EPA 200.7	Manganese	< 0.0040	mg/L	0.0040	0.0010		W942038	FEH	10/19/09 17:49	
EPA 200.7	**Potassium**	2.77	mg/L	0.50	0.04		W942038	FEH	10/19/09 17:49	
EPA 200.7	**Silica (SiO2)**	18.2	mg/L	0.17	0.04		W942038	FEH	10/19/09 17:49	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0002		W942038	FEH	10/19/09 17:51	
EPA 200.7	**Sodium**	3.84	mg/L	0.50	0.01		W942038	FEH	10/19/09 17:49	
EPA 200.8	**Copper**	0.0101	mg/L	0.00100	0.00009	2.5	W942250	KWH	10/21/09 12:09	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000066	2.5	W942250	KWH	10/21/09 12:09	
EPA 200.8	**Zinc**	0.0119	mg/L	0.00300	0.00060	2.5	W942250	KWH	10/21/09 12:09	
SM 2340B	**Hardness (as CaCO3)**	320	mg/L	0.347	0.052		N/A	FEH	10/19/09 17:49	
Metals (Dissolved)										
EPA 200.8	Copper	< 0.00100	mg/L	0.00100	0.000073		W942243	KWH	10/21/09 12:26	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000053		W942243	KWH	10/21/09 12:26	
EPA 200.8	**Zinc**	0.00671	mg/L	0.00300	0.00048		W942243	KWH	10/21/09 12:26	
Classical Chemistry Parameters										
EPA 120.1	**Specific conductance**	589	µmhos/cm	1.00			W942017	JMS	10/12/09 07:51	
EPA 350.1	Ammonia as N	< 0.030	mg/L	0.030	0.007		W942203	TJK	10/19/09 18:35	
EPA 353.2	Nitrate/Nitrite as N	< 0.0500	mg/L	0.0500	0.0084		W943238	TJK	10/22/09 11:09	
SM 2320B	**Bicarbonate**	239	mg/L	1.0	0.3		W942031	DKS	10/14/09 14:01	
SM 2320B	Carbonate	< 1.0	mg/L	1.0	0.3		W942031	DKS	10/14/09 14:01	
SM 2320B	**Total Alkalinity**	239	mg/L	1.0	0.3		W942031	DKS	10/14/09 14:01	
SM 2540 C	**Total Diss. Solids**	401	mg/L	10	4		W941392	JMS	10/12/09 10:06	
SM 2540 D	Total Susp. Solids	< 5.0	mg/L	5.0	4.2		W941393	JMS	10/12/09 10:06	
SM 4500-P-E	**Orthophosphate as P**	0.09	mg/L	0.01	0.006		W941373	SM	10/09/09 15:15	H1
Anions by Ion Chromatography										
EPA 300.0	**Chloride**	2.20	mg/L	1.00	0.250	5	W943091	EML	10/23/09 01:18	D1
EPA 300.0	Fluoride	< 0.100	mg/L	0.100	0.023		W943091	EML	10/23/09 01:08	
EPA 300.0	**Sulfate as SO4**	110	mg/L	1.50	0.18	5	W943091	EML	10/23/09 01:18	D2

Cation/Anion Balance and TDS Ratios

Cation Sum: 6.64 meq/L Anion Sum: 7.13 meq/L C/A Balance: -3.60 % Calculated TDS: 373 TDS/cTDS: 1.08 TDS/eC: 0.68

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

Cominco - Pend Oreille Mine
PO Box 7
Metaline Falls, WA 99153

Project Name: Quarterly
Work Order: **W9J0270**
Reported: 23-Oct-09 13:47

Client Sample ID: **091007-MW7**
SVL Sample ID: **W9J0270-04 (Ground Water)**

Sample Report Page 1 of 1

Sampled: 07-Oct-09 14:12
Received: 09-Oct-09
Sampled By: KD

Metals (Total)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.00006		W942104	JAA	10/20/09 11:20	

Metals (Total Recoverable--reportable as Total per 40 CFR 136)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
EPA 200.7	Aluminum	< 0.080	mg/L	0.080	0.010		W942038	FEH	10/19/09 17:55	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0002		W942038	FEH	10/19/09 17:57	
EPA 200.7	**Calcium**	63.0	mg/L	0.040	0.006		W942038	FEH	10/19/09 17:55	
EPA 200.7	Chromium	< 0.0060	mg/L	0.0060	0.0004		W942038	FEH	10/19/09 17:57	
EPA 200.7	Iron	< 0.060	mg/L	0.060	0.009		W942038	FEH	10/19/09 17:55	
EPA 200.7	**Magnesium**	20.9	mg/L	0.060	0.009		W942038	FEH	10/19/09 17:55	
EPA 200.7	Manganese	< 0.0040	mg/L	0.0040	0.0010		W942038	FEH	10/19/09 17:55	
EPA 200.7	**Potassium**	2.36	mg/L	0.50	0.04		W942038	FEH	10/19/09 17:55	
EPA 200.7	**Silica (SiO2)**	17.8	mg/L	0.17	0.04		W942038	FEH	10/19/09 17:55	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0002		W942038	FEH	10/19/09 17:56	
EPA 200.7	**Sodium**	3.27	mg/L	0.50	0.01		W942038	FEH	10/19/09 17:55	
EPA 200.8	**Copper**	0.0121	mg/L	0.00100	0.00009	2.5	W942250	KWH	10/21/09 12:11	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000066	2.5	W942250	KWH	10/21/09 12:11	
EPA 200.8	**Zinc**	0.00952	mg/L	0.00300	0.00060	2.5	W942250	KWH	10/21/09 12:11	
SM 2340B	**Hardness (as CaCO3)**	244	mg/L	0.347	0.052		N/A	FEH	10/19/09 17:55	

Metals (Dissolved)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
EPA 200.8	Copper	< 0.00100	mg/L	0.00100	0.000073		W942243	KWH	10/21/09 12:28	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000053		W942243	KWH	10/21/09 12:28	
EPA 200.8	Zinc	< 0.00300	mg/L	0.00300	0.00048		W942243	KWH	10/21/09 12:28	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
EPA 120.1	**Specific conductance**	464	µmhos/cm	1.00			W942017	JMS	10/12/09 07:51	
EPA 350.1	Ammonia as N	< 0.030	mg/L	0.030	0.007		W942203	TJK	10/19/09 18:36	
EPA 353.2	**Nitrate/Nitrite as N**	0.0679	mg/L	0.0500	0.0084		W943238	TJK	10/22/09 11:10	
SM 2320B	**Bicarbonate**	208	mg/L	1.0	0.3		W942031	DKS	10/14/09 14:08	
SM 2320B	Carbonate	< 1.0	mg/L	1.0	0.3		W942031	DKS	10/14/09 14:08	
SM 2320B	**Total Alkalinity**	208	mg/L	1.0	0.3		W942031	DKS	10/14/09 14:08	
SM 2540 C	**Total Diss. Solids**	307	mg/L	10	4		W941392	JMS	10/12/09 10:06	
SM 2540 D	Total Susp. Solids	< 5.0	mg/L	5.0	4.2		W941393	JMS	10/12/09 10:06	
SM 4500-P-E	**Orthophosphate as P**	0.05	mg/L	0.01	0.006		W941373	SM	10/09/09 15:15	H1

Anions by Ion Chromatography

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
EPA 300.0	**Chloride**	1.25	mg/L	0.200	0.050		W943091	EML	10/23/09 01:28	
EPA 300.0	Fluoride	< 0.100	mg/L	0.100	0.023		W943091	EML	10/23/09 01:28	
EPA 300.0	**Sulfate as SO4**	67.0	mg/L	1.50	0.18	5	W943091	EML	10/23/09 01:58	D2

Cation/Anion Balance and TDS Ratios

Cation Sum: 5.07 meq/L Anion Sum: 5.59 meq/L C/A Balance: -4.92 % Calculated TDS: 283 TDS/cTDS: 1.08 TDS/eC: 0.66

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

Cominco - Pend Oreille Mine
PO Box 7
Metaline Falls, WA 99153

Project Name: Quarterly
Work Order: **W9J0270**
Reported: 23-Oct-09 13:47

Quality Control - BLANK Data

Metals (Total)

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
EPA 245.1	Mercury	mg/L	<0.00020	0.00006	0.00020	W942104	20-Oct-09	

Metals (Total Recoverable--reportable as Total per 40 CFR 136)

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
EPA 200.7	Aluminum	mg/L	<0.080	0.010	0.080	W942038	19-Oct-09	
EPA 200.7	Cadmium	mg/L	<0.0020	0.0002	0.0020	W942038	19-Oct-09	
EPA 200.7	Calcium	mg/L	<0.040	0.006	0.040	W942038	19-Oct-09	
EPA 200.7	Chromium	mg/L	<0.0060	0.0004	0.0060	W942038	19-Oct-09	
EPA 200.7	Iron	mg/L	<0.060	0.009	0.060	W942038	19-Oct-09	
EPA 200.7	Magnesium	mg/L	<0.060	0.009	0.060	W942038	19-Oct-09	
EPA 200.7	Manganese	mg/L	<0.0040	0.0010	0.0040	W942038	19-Oct-09	
EPA 200.7	Potassium	mg/L	<0.50	0.04	0.50	W942038	19-Oct-09	
EPA 200.7	Silica (SiO2)	mg/L	<0.17	0.04	0.17	W942038	19-Oct-09	
EPA 200.7	Silver	mg/L	<0.0050	0.0002	0.0050	W942038	19-Oct-09	
EPA 200.7	Sodium	mg/L	<0.50	0.01	0.50	W942038	19-Oct-09	
EPA 200.8	Copper	mg/L	<0.00100	0.00009	0.00100	W942250	21-Oct-09	
EPA 200.8	Lead	mg/L	<0.00300	0.000066	0.00300	W942250	21-Oct-09	
EPA 200.8	Zinc	mg/L	<0.00300	0.00060	0.00300	W942250	21-Oct-09	

Metals (Dissolved)

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
EPA 200.8	Copper	mg/L	<0.00100	0.000073	0.00100	W942243	21-Oct-09	
EPA 200.8	Lead	mg/L	<0.00300	0.000053	0.00300	W942243	21-Oct-09	
EPA 200.8	Zinc	mg/L	<0.00300	0.00048	0.00300	W942243	21-Oct-09	

Classical Chemistry Parameters

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
EPA 120.1	Specific conductance	µmhos/cm	<1.00		1.00	W942017	10-Oct-09	
EPA 120.1	Specific conductance	µmhos/cm	<1.00		1.00	W942017	12-Oct-09	
EPA 350.1	Ammonia as N	mg/L	<0.030	0.007	0.030	W942203	19-Oct-09	
EPA 353.2	Nitrate/Nitrite as N	mg/L	<0.0500	0.0084	0.0500	W943238	22-Oct-09	
SM 4500-P-E	Orthophosphate as P	mg/L	<0.01	0.006	0.01	W941373	09-Oct-09	

Anions by Ion Chromatography

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
EPA 300.0	Fluoride	mg/L	<0.100	0.023	0.100	W943091	22-Oct-09	
EPA 300.0	Chloride	mg/L	<0.200	0.050	0.200	W943091	22-Oct-09	
EPA 300.0	Sulfate as SO4	mg/L	<0.30	0.04	0.30	W943091	22-Oct-09	

Quality Control - LABORATORY CONTROL SAMPLE Data

Metals (Total)

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
EPA 245.1	Mercury	mg/L	0.00473	0.00500	94.6	85 - 115	W942104	20-Oct-09	

Metals (Total Recoverable--reportable as Total per 40 CFR 136)

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
EPA 200.7	Aluminum	mg/L	0.887	1.00	88.7	85 - 115	W942038	19-Oct-09	
EPA 200.7	Cadmium	mg/L	0.933	1.00	93.3	85 - 115	W942038	19-Oct-09	
EPA 200.7	Calcium	mg/L	18.7	20.0	93.3	85 - 115	W942038	19-Oct-09	
EPA 200.7	Chromium	mg/L	0.992	1.00	99.2	85 - 115	W942038	19-Oct-09	
EPA 200.7	Iron	mg/L	9.19	10.0	91.9	85 - 115	W942038	19-Oct-09	
EPA 200.7	Magnesium	mg/L	18.8	20.0	93.8	85 - 115	W942038	19-Oct-09	
EPA 200.7	Manganese	mg/L	0.912	1.00	91.2	85 - 115	W942038	19-Oct-09	
EPA 200.7	Potassium	mg/L	18.3	20.0	91.6	85 - 115	W942038	19-Oct-09	
EPA 200.7	Silica (SiO2)	mg/L	9.83	10.7	91.9	85 - 115	W942038	19-Oct-09	
EPA 200.7	Silver	mg/L	0.0454	0.0500	90.8	85 - 115	W942038	19-Oct-09	
EPA 200.7	Sodium	mg/L	18.1	19.0	95.2	85 - 115	W942038	19-Oct-09	
EPA 200.8	Copper	mg/L	0.0254	0.0250	102	85 - 115	W942250	21-Oct-09	

Quality Control - LABORATORY CONTROL SAMPLE Data (Continued)

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136) (Continued)									
EPA 200.8	Lead	mg/L	0.0259	0.0250	103	85 - 115	W942250	21-Oct-09	
EPA 200.8	Zinc	mg/L	0.0265	0.0250	106	85 - 115	W942250	21-Oct-09	
Metals (Dissolved)									
EPA 200.8	Copper	mg/L	0.0246	0.0250	98.5	85 - 115	W942243	21-Oct-09	
EPA 200.8	Lead	mg/L	0.0244	0.0250	97.5	85 - 115	W942243	21-Oct-09	
EPA 200.8	Zinc	mg/L	0.0233	0.0250	93.3	85 - 115	W942243	21-Oct-09	
Classical Chemistry Parameters									
EPA 120.1	Specific conductance	µmhos/cm	403	413	97.6	85 - 115	W942017	10-Oct-09	
EPA 120.1	Specific conductance	µmhos/cm	396	413	95.9	85 - 115	W942017	12-Oct-09	
EPA 350.1	Ammonia as N	mg/L	0.720	0.750	96.1	90 - 110	W942203	19-Oct-09	
EPA 353.2	Nitrate/Nitrite as N	mg/L	1.94	2.00	96.8	90 - 110	W943238	22-Oct-09	
SM 4500-P-E	Orthophosphate as P	mg/L	0.79	0.794	99.1	90 - 110	W941373	09-Oct-09	
Anions by Ion Chromatography									
EPA 300.0	Fluoride	mg/L	2.44	2.50	97.5	90 - 110	W943091	22-Oct-09	
EPA 300.0	Chloride	mg/L	5.02	5.00	100	90 - 110	W943091	22-Oct-09	
EPA 300.0	Sulfate as SO4	mg/L	9.90	10.0	99.0	90 - 110	W943091	22-Oct-09	

Quality Control - DUPLICATE Data

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Metals (Total)									
EPA 245.1	Mercury	mg/L	<0.00020	<0.00020	UDL	20	W942104	20-Oct-09	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)									
EPA 200.7	Aluminum	mg/L	<0.080	<0.080	<RL	20	W942038	19-Oct-09	
EPA 200.7	Cadmium	mg/L	<0.0020	<0.0020	UDL	20	W942038	19-Oct-09	
EPA 200.7	Calcium	mg/L	72.0	70.2	2.4	20	W942038	19-Oct-09	
EPA 200.7	Chromium	mg/L	<0.0060	<0.0060	<RL	20	W942038	19-Oct-09	
EPA 200.7	Iron	mg/L	0.145	0.111	27.2	20	W942038	19-Oct-09	R3
EPA 200.7	Magnesium	mg/L	22.9	22.4	2.5	20	W942038	19-Oct-09	
EPA 200.7	Manganese	mg/L	0.0053	0.0053	0.2	20	W942038	19-Oct-09	
EPA 200.7	Potassium	mg/L	2.15	2.09	2.9	20	W942038	19-Oct-09	
EPA 200.7	Silica (SiO2)	mg/L	19.9	19.4	2.6	20	W942038	19-Oct-09	
EPA 200.7	Silver	mg/L	<0.0050	<0.0050	<RL	20	W942038	19-Oct-09	
EPA 200.7	Sodium	mg/L	3.85	3.74	2.8	20	W942038	19-Oct-09	
EPA 200.8	Copper	mg/L	<0.00100	<0.00100	<RL	20	W942250	21-Oct-09	
EPA 200.8	Lead	mg/L	<0.00300	<0.00300	<RL	20	W942250	21-Oct-09	
EPA 200.8	Zinc	mg/L	<0.00500	<0.00500	<RL	20	W942250	21-Oct-09	
Metals (Dissolved)									
EPA 200.8	Copper	mg/L	<0.00100	<0.00100	<RL	20	W942243	21-Oct-09	
EPA 200.8	Lead	mg/L	<0.00300	<0.00300	UDL	20	W942243	21-Oct-09	
EPA 200.8	Zinc	mg/L	<0.00400	<0.00400	<RL	20	W942243	21-Oct-09	
Classical Chemistry Parameters									
EPA 120.1	Specific conductance	µmhos/cm	490	475	3.2	20	W942017	12-Oct-09	
EPA 120.1	Specific conductance	µmhos/cm	5750	5700	0.9	20	W942017	10-Oct-09	
EPA 350.1	Ammonia as N	mg/L	0.064	0.051	22.5	20	W942203	19-Oct-09	R3
EPA 353.2	Nitrate/Nitrite as N	mg/L	3.23	3.23	0.1	20	W943238	22-Oct-09	
SM 2320B	Total Alkalinity	mg/L	246	242	1.7	20	W942031	14-Oct-09	
SM 2320B	Bicarbonate	mg/L	246	242	1.7	20	W942031	14-Oct-09	

Quality Control - DUPLICATE Data (Continued)

Classical Chemistry Parameters (Continued)

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
SM 2320B	Carbonate	mg/L	<1.0	<1.0	UDL	20	W942031	14-Oct-09	
SM 2540 C	Total Diss. Solids	mg/L	299	307	2.6	20	W941392	12-Oct-09	
SM 2540 D	Total Susp. Solids	mg/L	<5.0	<5.0	UDL	20	W941393	12-Oct-09	
SM 4500-P-E	Orthophosphate as P	mg/L	0.03	0.03	0.0	20	W941373	09-Oct-09	

Anions by Ion Chromatography

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
EPA 300.0	Fluoride	mg/L	<0.100	<0.100	<RL	20	W943091	23-Oct-09	
EPA 300.0	Chloride	mg/L	5.99	6.02	0.6	20	W943091	23-Oct-09	
EPA 300.0	Sulfate as SO4	mg/L	44.0	44.6	1.4	20	W943091	23-Oct-09	D2

Quality Control - MATRIX SPIKE Data

Metals (Total)

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
EPA 245.1	Mercury	mg/L	0.00098	<0.00020	0.00100	98.0	70 - 130	W942104	20-Oct-09	
EPA 245.1	Mercury	mg/L	0.00200	0.00118	0.00100	82.0	70 - 130	W942104	20-Oct-09	

Metals (Total Recoverable--reportable as Total per 40 CFR 136)

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
EPA 200.7	Aluminum	mg/L	0.952	<0.080	1.00	89.5	70 - 130	W942038	19-Oct-09	
EPA 200.7	Cadmium	mg/L	0.896	<0.0020	1.00	89.6	70 - 130	W942038	19-Oct-09	
EPA 200.7	Calcium	mg/L	84.6	70.2	20.0	71.8	70 - 130	W942038	19-Oct-09	
EPA 200.7	Chromium	mg/L	0.975	<0.0060	1.00	97.3	70 - 130	W942038	19-Oct-09	
EPA 200.7	Iron	mg/L	9.16	0.111	10.0	90.5	70 - 130	W942038	19-Oct-09	
EPA 200.7	Magnesium	mg/L	39.4	22.4	20.0	85.2	70 - 130	W942038	19-Oct-09	
EPA 200.7	Manganese	mg/L	0.904	0.0053	1.00	89.8	70 - 130	W942038	19-Oct-09	
EPA 200.7	Potassium	mg/L	20.6	2.09	20.0	92.4	70 - 130	W942038	19-Oct-09	
EPA 200.7	Silica (SiO2)	mg/L	28.0	19.4	10.7	80.2	70 - 130	W942038	19-Oct-09	
EPA 200.7	Silver	mg/L	0.0454	<0.0050	0.0500	90.3	70 - 130	W942038	19-Oct-09	
EPA 200.7	Sodium	mg/L	21.9	3.74	19.0	95.4	70 - 130	W942038	19-Oct-09	
EPA 200.8	Copper	mg/L	0.0227	<0.00100	0.0250	89.0	70 - 130	W942250	21-Oct-09	
EPA 200.8	Lead	mg/L	0.0224	<0.003000	0.0250	88.7	70 - 130	W942250	21-Oct-09	
EPA 200.8	Zinc	mg/L	0.0241	<0.00500	0.0250	88.9	70 - 130	W942250	21-Oct-09	

Metals (Dissolved)

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
EPA 200.8	Copper	mg/L	0.0236	<0.00100	0.0250	91.0	70 - 130	W942243	21-Oct-09	
EPA 200.8	Lead	mg/L	0.0225	<0.003000	0.0250	90.1	70 - 130	W942243	21-Oct-09	
EPA 200.8	Zinc	mg/L	0.0274	<0.00404	0.0250	107	70 - 130	W942243	21-Oct-09	

Classical Chemistry Parameters

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
EPA 350.1	Ammonia as N	mg/L	0.538	0.051	0.500	97.4	90 - 110	W942203	19-Oct-09	
EPA 350.1	Ammonia as N	mg/L	0.462	<0.030	0.500	90.8	90 - 110	W942203	19-Oct-09	
EPA 353.2	Nitrate/Nitrite as N	mg/L	1.02	<0.0500	1.00	99.8	90 - 110	W943238	22-Oct-09	
EPA 353.2	Nitrate/Nitrite as N	mg/L	4.29	3.23	1.00	106	90 - 110	W943238	22-Oct-09	
SM 4500-P-E	Orthophosphate as P	mg/L	0.50	0.03	0.500	93.7	75 - 125	W941373	09-Oct-09	

Anions by Ion Chromatography

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
EPA 300.0	Fluoride	mg/L	2.20	<0.100	2.00	108	90 - 110	W943091	23-Oct-09	
EPA 300.0	Fluoride	mg/L	2.35	0.191	2.00	108	90 - 110	W943091	23-Oct-09	
EPA 300.0	Chloride	mg/L	8.84	6.02	3.00	93.8	90 - 110	W943091	23-Oct-09	
EPA 300.0	Chloride	mg/L	21.7	18.8	3.00	97.3	90 - 110	W943091	23-Oct-09	D2,M3
EPA 300.0	Sulfate as SO4	mg/L	52.9	44.6	10.0	R > 4S	90 - 110	W943091	23-Oct-09	D2,M3
EPA 300.0	Sulfate as SO4	mg/L	42.6	33.8	10.0	88.1	90 - 110	W943091	23-Oct-09	M2

Cominco - Pend Oreille Mine
PO Box 7
Metaline Falls, WA 99153

Project Name: Quarterly
Work Order: **W9J0270**
Reported: 23-Oct-09 13:47

Notes and Definitions

D1	Sample required dilution due to matrix.
D2	Sample required dilution due to high concentration of target analyte.
H1	Sample analysis performed past holding time.
H3	Sample was received and analyzed past holding time.
M2	Matrix spike recovery was low, but the LCS recovery was acceptable.
M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to spike level. The LCS was acceptable.
R3	There is no control limit for the RPD if the concentration in the sample is less than five times the reporting limit
LCS	Laboratory Control Sample (Blank Spike)
RPD	Relative Percent Difference
UDL	A result is less than the detection limit
R > 4S	% recovery not applicable, sample concentration more than four times greater than spike level
<RL	A result is less than the reporting limit
MRL	Method Reporting Limit
MDL	Method Detection Limit
N/A	Not Applicable

December 28, 2009

DRAFT

Mr. Kevin Dunn
Teck Washington Incorporated
P. O. Box 7
1382 Pend Oreille Mine Road
Metaline Falls, WA 99153

Re: Report
TDF-1 Slope Stabilization Concept
Development for Amended RI/FS
Pend Oreille Mine TDF-1 and TDF-2
Metaline Falls, Washington
URS Job No.: 36298248

Dear Mr. Dunn,

URS Corporation is pleased to present this report to Teck Washington Incorporated on our slope stabilization concept development for Tailings Disposal Facility #1 (TDF-1) at the Pend Oreille Mine and the re-evaluation of an appropriate slope angle for long term stability of TDF-1. This report is based on Work Order No. 0930 Amendment 1 dated July 22, 2009.

The stability analyses of TDF-1 indicate that a 2H:1V slope is stable through the zone 1 tailings and represents a considerable cost savings and reduced environmental damage over the 2.5H:1V slope recommended in the draft RI/FS. Based on the costs provided in the draft RI/FS report, the cost savings associated with a steeper final slope is approximately $185,000.

We trust this report provides you with the information you require. Should you have questions regarding the information presented in this report or need further assistance, please contact us.

Sincerely,
URS Corporation

TODD SUMNER PARKINGTON
STATE OF WASHINGTON
36073
REGISTERED PROFESSIONAL ENGINEER

Todd S. Parkington, PE
Senior Geotechnical Engineer

Cecil M. Urlich, PE
Principal Geotechnical Engineer

DRAFT

1.0 INTRODUCTION

Teck Washington Incorporated (TWI) is conducting a Remedial Investigation/Feasibility Study (RI/FS) to select remedial alternatives for closure of the Pend Oreille Mine tailings disposal facilities (TDF) #1 and #2 near Metaline Falls, Washington. The RI/FS is being conducted under Agreed Order No. 2585 between Teck American Incorporated (TAI) and the Washington State Department of Ecology (Ecology). A draft "Remedial Investigation/Feasibility Study Report for the Pend Oreille Mine Tailing Disposal Facilities TDF-1 and TDF-2, Metaline Falls, Washington" was prepared for TAI by Golder Associates (Golder) and submitted to Ecology on October 17, 2006.

URS Corporation (URS) was retained by TWI to prepare a final RI/FS for the Pend Oreille Mine TDF-1 and TDF-2. Development of the final RI/FS consists of responding to comments from Ecology in response to the draft RI/FS, collecting additional data to address hydrogeological data gaps identified by Ecology, conducting an engineering review of the TDF-1 slope stability analysis conducted during preparation of the draft RI/FS, preparing an addendum to the RI/FS presenting data collected to fill the identified hydrogeological data gaps, and preparing documentation that finalizes the draft RI/FS.

As part of the draft RI/FS, Golder evaluated the stability of the outer slope of TDF-1. Based on a review of the draft RI/FS report, URS opined that the final grades presented in the draft RI/FS were too conservative. The primary basis for this URS opinion was a Golder assumption that the tailings are homogenous with uniform strength properties throughout the tailings, and the URS knowledge of TDF-1 that was obtained by a legacy firm, Dames & Moore, as a result of a geotechnical investigation in 1988 and a stabilization design in 1997 that was constructed in 1998.

2.0 SCOPE OF WORK

The portion of the URS scope of work that is the subject of this "Appendix F – Geotechnical Memorandum" was identified as Task 3 in "Proposal for Amended RI/FS of Pend Oreille Mine TDF-1/TDF-2" prepared by URS on March 20, 2009. Task 3 consisted of an engineering review of the tailings part of the draft RI/FS, with specific objectives of reviewing the slope stability calculations and methodology, and advising TWI if the recommended final grades for Alternatives 3 through 6 of the draft RI/FS were overly conservative and if they could be optimized by leaving steeper slopes with less tailings removal.

The URS scope of work also included a task to re-evaluate the stability of the proposed final slope of TDF-1 and evaluate means of stabilizing TDF-1 by optimizing steeper slopes or alternative methods. This additional work was identified as Task 7 and included slope stability analyses to develop a least-cost, technically feasible, safe and acceptable concept for permanently stabilizing the outer slope of TDF-1. The scope of work for Task 7 was included in Work Order No. 0930 Amendment 1, TDF-1 Slope Stabilization Concept Development for Amended RI/FS, Pend Oreille Mine TDF-1/TDF-2 prepared by URS on July 23, 2009.

Another significant factor is the presence of a maturing tree and vegetation growth on the surface of TDF-1 which would be compromised along with a relatively large environmental impact by the removal of significant amounts of tailings from the outer slope and crest of TDF-1. The surface of TDF-1 is the likely repository of tailings removed from the slope which would result in even more vegetation removed than that on the re-graded slope.

3.0 SITE CONDITIONS

3.1 CONSTRUCTION OF TDF-1

TDF-1 is located approximately 0.5 miles northeast of the mine and is sited on a bedrock terrace on a hillside about 0.25 miles east and 200 feet above the Pend Oreille River. The facility is approximately 19 acres in area and measures approximately 1,600 feet north to south by 500 feet east to west with a maximum depth of 68 feet. TDF-1 operated between 1968 and 1973.

TDF-1 was developed by building a low earth fill starter dam along the outer edge of the facility in a roughly horseshoe shape against the hillside and discharging tailings from a pipeline with spigots. The pipeline and spigots were mounted on a wood trestle just in from the crest of the dam. The relatively fluid tailings were allowed to flow away from the spigots into the facility, resulting in coarser tailings being deposited against the starter dam, while finer tailings settled out in the pond formed near the hillside portion of the facility. Tailings water was decanted from the pond through three sets of vertical wood crib towers and horizontal steel pipes.

As the tailings filled to the level of the starter dam, boards were set up along the outer edge to contain the tailings. The boards were 24 inches high and placed with 30-inch wide steps between each successive set of boards. This resulted in a 1.35 horizontal to 1 vertical (1.35H:1V) slope on the outer face of TDF-1 and a maximum height of 68 feet. The wooden boards are still on the slope in deteriorated condition. The wood crib decant towers were raised with the raising of the outboard slopes. Seepage reportedly occurred through the lower part of TDF-1 throughout its life, and the toe along the north part of the slope was buttressed with waste rock.

The method of tailings disposal resulted in coarser tailings along the outer part of TDF-1 and finer tailings closer to the hillside. Coarser tailings are typically stronger and drier than finer tailings. As a result, grading actions to flatten the outer slope will tend to remove drier and stronger tailings and potentially expose weaker and wetter tailings. From the point of view of slope stability, it is therefore best to minimize the volume of tailings removed during grading.

Initial slope stabilization work was completed in 1987 by lowering a decant tower to reduce the pond area in an effort to lower the water table and increase slope stability.

A rock buttress with a road on top was placed at the toe of the outer slope of TDF-1 in 1998 to reduce the risk of liquefaction induced failure of the tailings. In addition, the remaining decant tower was modified and the interceptor ditches were placed to reduce the amount of water ponded on top of the facility. This work was an interim project and was not intended to provide a closed facility.

3.2 SITE DESCRIPTION

TDF-1 forms a relatively flat bench on the side of a slope descending to the Pend Oreille River approximately 600 feet to the northwest. The outer slope of TDF-1, at about 1.35H:1V, is generally steeper than the natural slopes around it. The top of TDF-1 is nearly flat with a slight slope back into the natural hillside away from the river.

Small trees, grass and moss grow on both the slopes and the top of the facility. Vegetative growth on the slopes appears to be somewhat inhibited by the presence of the boards used to contain the tailings and construct the slope. URS photographic records and staff memories of the tailings surface indicate that the trees and vegetation grew and matured between 1988 and 2009. Considering that tailings were last placed on TDF-1 in 1973, this maturity represents 35 years of tree and vegetation growth.

Below the toe of the buttress that was placed in 1998 along most of the length of the facility is an approximately 24-inch diameter plastic drain pipe. For a short distance near the center of the length of the slope the pipe is replaced with an open, lined ditch. Below the pipe / ditch the slope continues at a varying angle down to the Pend Oreille River. The steepest slopes below the pipe occur near the center of the facility with gentler slopes at both the north and south ends.

3.3 GEOLOGIC SETTING

The TDF-1 site is located within the Pend Oreille River valley in an area consisting of Cambrian-through Silurian/Devonian-aged sedimentary carbonate and slate bedrock that has been folded and faulted to create a prominent mountainous topography. Recent glaciations in the Quaternary Period further shaped the land into dissected highlands and glacial valleys. A more detailed discussion of site geologic setting, including bedrock occurrence and formation descriptions, is provided in the draft RI/FS report.

3.4 SUBSURFACE CONDITIONS

Subsurface conditions at TDF-1 were evaluated by reviewing exploration logs from previous geotechnical investigations at the site as well as from the logs of four test pits that were excavated in 2009 at the toe of the buttress for this Task 7 stability evaluation.

The previous explorations that were relied on include borings drilled by Dames & Moore in 1988, cone penetrometer tests (CPTs) performed by Golder in 1996, and monitoring wells installed for a groundwater study by URS in 2008. The Dames & Moore and Golder explorations were completed in the tailings, while the URS explorations were completed downgradient of the toe of the facility.

The Dames & Moore borings and the Golder CPTs were used to characterize the tailings and evaluate the foundation soils below the tailings. The test pits and monitoring wells by URS were used to evaluate the foundation soils beneath the existing rock buttress.

In addition, water level data collected by mine personnel from piezometers and monitoring wells in and around the tailings facility were used to estimate the water level in the tailings and the foundation soils beneath the tailings.

The four test pits excavated as part of Task 7 were completed on October 28, 2009 and labeled as TP-1, TP-2, TP-3 and TP-4. Logs of these test pits are attached. They were excavated at accessible locations along the toe of the buttress to better understand the foundation materials beneath the buttress. From previous explorations, it was known that part of the buttress was underlain by rock and that some portion near the north end was likely underlain by soil, but the location of the transition was unknown. Results of the initial stability analyses indicated that the stability would be significantly affected by the depth to rock beneath the toe of the buttress. Therefore, the test pits were excavated to better define the depth to rock below the buttress along the length of the facility.

3.4.1 Tailings

Geotechnical engineers classify soils into units based on their engineering characteristics. These units are then assigned soil properties based on the results of field and laboratory tests for use in analyses such as slope stability evaluations. When assigning soil properties, the least favorable test results are given more weight to avoid under-designing a structure. In the draft RI/FS, the tailings were classified into a single soil unit. Therefore, the soil properties assigned to the tailings unit were derived primarily from the least favorable test results produced in the fine-grained silt and clay tailings that were deposited away from the face of the facility.

Based on previous experience with tailings disposal facilities that were constructed in a manner similar to TDF-1, URS has classified the tailings into three different units or zones:

- Zone 1 consists of primarily fine sand tailings located nearest to the outer face of the slope where the tailings were discharged (by the method of spigotting).
- Zone 2 is a silt to sand transition zone between zones 1 and 3 with generally finer particles than zone 1 and coarser particles than zone 3.
- Zone 3 consists of primarily fine-grained silt and clay sized particles tailings deposited in the decant pool on the hill side of the facility.

The most critical soil property for slope stability analyses is the shear strength. Shear strength measures the ability of a soil to resist motion along a given plane that is usually referred to as the failure plane. Shear strength is dependent on the soil type and the normal force (generally the weight of soil or overburden pressure) applied to the failure plane. Shear strength is generally divided into two components:

- Angle of internal friction, which relates the normal force to the shear strength, or rate at which the shear strength increases with increasing normal force. The higher the friction angle, the faster shear strength increases with the depth of the failure plane.
- Cohesion, which is the portion of the shear strength that is independent of the normal force. Some soils, especially fine-grained soils like silts and clays, exhibit some shear strength even when there is no overburden pressure.

Sands and gravels are coarse-grained soils and are generally modeled as cohesionless. This means that all of the shear strength is dependent on the overburden pressure. In general, larger grain sizes result in larger friction angles. The angularity of the individual grains and the density of the soil also affect the friction angle. If the soil includes some fines, there may be a minor amount of cohesion, which is often neglected. Depending on the nature of the soil, this type of behavior may extend into the coarse silt range.

Silts and clays are fine-grained soils and often require a more complex modeling approach. Under rapid loading conditions, fine-grained soils may behave as if the shear strength is entirely independent of the overburden pressure (friction angle equal to zero). If a load is maintained, fine-grained soil behavior exhibits shear strength that includes both a friction angle and cohesion. The extent to which this more complex behavior occurs is related to both the grain-size of the soil particles and the mineralogy make-up of the soil.

Tailings at TDF-1 generally range in particle size from fine sand to coarse silt. Although the tailings likely have some minor cohesion, this has been neglected for these analyses.

The historic method of construction of TDF-1 by spigotting tailings in from the crest of the tailings facility resulted in a decrease in particle size with distance from the crest. Therefore, a decrease in angle of internal friction is expected in from the crest. The exploration logs were reviewed to estimate the friction angle of the tailings based on distance from the crest, and the tailings were divided into zones 1, 2 and 3 as described above. The widths of the zones were assigned based on engineering judgment to correlate with the observed data, and are presented in the following table. Some of the estimated values were further reduced for use in the calculation for conservatism.

Zone	Estimated Friction Angle (degrees)	Friction Angle used in Calculations (degrees)	Estimated Zone Width (feet)	Zone Width used in Calculations (feet)
1	38 to 40	36	70	50
2	34	33	110	110
3	29 to 31	30	n/a*	n/a*

*Zone 3 consists of the remaining width of TDF-1.

For the current study, the shear strength parameters for the tailings materials (zones 1, 2, and 3) were estimated by correlating three different data sources as summarized below:

- **Cone Penetrometer Test (CPT).** Friction angles were estimated using correlations with measured electric CPT tip resistance, which are obtained as a continuous record with depth (Mayne 2007; Kulhawy and Mayne 1990; Robertson and Robertson 2006; Senneset et al 1989). CPT data is widely regarded in the industry as the most repeatable and defensible empirical method of interpreting the strength of layered deposits such as tailings (Youd et al 2003; Idriss & Boulanger 2008) and more accurately reflects the layered nature of tailings compared to Standard Penetration Test (SPT) data.

- **Standard Penetration Test (SPT) N-Value.** Friction angles were estimated using correlations with N-value (blows per foot) obtained from SPT blow counts in the borings (Hatanaka and Uchida 1996). The measured N-values are variable in nature, are not continuous, and are affected by the actual drilling method and equipment such as drilling mud presence, hammer type, and rod size. For these reasons, SPT correlations were considered less reliable than CPT correlations and laboratory test data for establishing soil strength parameters. Furthermore, SPT data in layered systems is not able to portray the variability in the data as effectively as CPT does. Recognizing that the Hatanaka and Uchida correlations were developed for non-tailings soil, it is expected that the correlations will be somewhat conservative for tailings, which are more angular than naturally occurring soils (Vick 1990).

- **Laboratory Testing.** Drained shear strength values were obtained from stress-path plots of consolidated undrained triaxial tests and from consolidated drained direct simple shear (DSS) tests on "undisturbed" samples that were collected from the borings.

The values for tailings friction angles given in the table above are higher for zones 1 and 2 than were used in the draft RI/FS. The value for zone 3 equals the value used in the draft RI/FS. This difference was derived from the draft RI/FS conservative assumption that the tailings are a single unit with lower friction angles encountered in zone 3 used for all of the tailings.

3.4.2 Foundation Soils

The subsurface investigations outlined above indicate that the majority of TDF-1 is underlain by rock generally identified as slate. This was confirmed for the toe of the buttress by test pits TP-1, TP-2, and TP-4 excavated for this stability analysis. In the case of TP-1, bedrock was encountered under 6 feet of stiff silt.

In the northeastern 200 to 300 feet, TDF-1 is underlain by glaciofluvial deposits. The borings drilled through the tailings in this area indicate that these deposits are very dense sands and gravels or hard silts. Monitoring well MW-302 which is near the northeast end of the toe of the facility encountered soft silt overlying medium dense gravel to a depth of 15 feet beneath the surface. The presence of soft silt was confirmed at the toe of TDF-1 in the same area by test pit TP-3. However, TP-2, excavated at the toe approximately 50 feet south of TP-3, encountered slate at a depth of 1 foot below the ground surface.

For the slope stability calculations, slate rock was assumed to underlie the TDF-1 tailings and buttress for all but the north cross section. For the north cross section, very dense glaciofluvial deposits were assumed to underlie the tailings with a small section of medium dense glaciofluvial deposits underlying the rock buttress.

The rock was assumed to be impenetrable to potential slip surfaces. An angle of internal friction of 42 degrees was considered appropriate for the very dense glaciofluvial deposits and was used for these deposits in the stability analyses. This deposit was assumed to be cohesionless. The angle of internal friction for the very dense glaciofluvial deposits was conservatively estimated based on the blow count for the single SPT from this material and the description in the boring log as a sand and gravel. Bowles (1988) indicates that granular soils with blow counts greater than 40 to 45 blows per foot may have friction angles up to 50 degrees. The angle of internal friction that was used by URS for the very dense glaciofluvial deposits is greater than the 38 degrees used in the draft RI/FS report.

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For the medium dense glaciofluvial deposits, an angle of internal friction of 38 degrees was used. This deposit was assumed to be cohesionless. The nature and extent of the medium dense glaciofluvial deposits were estimated from a single monitoring well and a single test pit. For design of the buttress, further subsurface investigation should be conducted to better define this soil unit. This is not considered to be a significant issue as the areal extent of this soil unit is relatively limited.

3.4.3 Rockfill Buttress

The strength of the rockfill buttress along TDF-1 was assumed to be an angle of internal friction of 38 degrees, and zero cohesion. These strengths are reasonable for rockfill and are consistent with the values presented in the previous TDF-1 reports. The 1998 Dames & Moore report indicates that the strength of the mine waste rock fill was estimated from typical values of cohesion and friction angles given in literature for slates, shales, argillites and phyllite.

3.4.4 Groundwater

URS updated the estimate of groundwater depths in the TDF-1 tailings and underlying foundation soils based on readings through 2009 from the five piezometers installed in the tailings (PO1 through PO5). A single phreatic surface was assumed for both the tailings and foundation soils, as the available data seem to indicate a consistent ground water level for both soil units at least within the depths of interest for the slope stability calculations.

3.5 SEISMICITY

For the purposes of these additional slope stability analyses of TDF-1, URS has used the peak ground acceleration (PGA) value of 0.13 for the site as recommended by Golder in the draft RI/FS Appendix G. This PGA value was based on the PGA reported by the United States Geologic Survey for the latitude and longitude of the mine site with a recurrence interval of approximately 2500 years (2 percent probability of exceedance in 50 years).

This PGA value may be somewhat conservative as this is the level used as the maximum credible earthquake (MCE) for design of structures in the International Building Code (IBC). The IBC allows for a two-thirds reduction from the MCE to a maximum design earthquake (MDE). Further consideration of the design level earthquake should be made during final design.

4.0 SLOPE STABILITY ANALYSES

URS considered three different possible methods for stabilizing the TDF-1 slope other than the 2.5H:1V slope recommended in the draft RI/FS. These three methods were:

- Sloping the tailings at 2H:1V.
- Sloping the tailings at 2H:1V and increasing the size of the rockfill buttress to reduce the volume of tailings that would need to be moved.
- Using tiebacks to increase the strength of the slope.

The tieback method was not considered in detail in the stability analyses as it would require mobilization of a specialty contractor to install the tiebacks and is considered to be significantly more expensive than the first two methods. Based on our understanding of the typical project costs, it is anticipated that this would be considerably more expensive than moving tailings and waste rock on the site.

4.1 METHOD OF ANALYSIS

Slope stability analyses were performed using the commercially available software SLOPE/W (2007) by Geo-Slope International, which uses the two-dimensional limit equilibrium method of slices to estimate the factor of safety against slope instability. The calculation of the factor of safety can be performed using one of several methods. For this project, Spencer's Method was used.

SLOPE/W features unique random techniques for generation of potential failure surfaces for subsequent determination of the most critical surfaces and their corresponding factors of safety. These techniques generate circular failure surfaces, surfaces of sliding block character, or more general irregular surfaces of random shape.

4.2 CROSS SECTIONS

To evaluate the stability of the TDF-1 slope, the slope was divided into three generalized cross sections representative of the site based on a combination of topography and foundation soils. The three cross sections are as follows:

- North – A cross section through the north part of TDF-1, assuming dense glaciofluvial deposits beneath most of the tailings, with a wedge of medium dense glaciofluvial deposits beneath the toe of the buttress. The slope in this area below the facility is moderately steep, allowing for possible expansion of the buttress, if needed.

- Mid – A cross section through the middle of TDF-1, assuming rock below the tailings and the buttress. The slope below the facility at this section becomes as steep as 2H:1V within a short distance of the toe of the existing buttress. Therefore, only a small expansion of the buttress is possible in this area.

- South – A cross section through the south part of TDF-1, assuming rock below the tailings and the buttress. The slope below the facility in this area is moderate, allowing for possible expansion of the buttress, if needed.

The soil parameters are as described in section 2.0, above, and are indicated on the attached figures along with the location of the ground water table.

For the analyses, the cross sections were altered from the existing conditions as follows:

- The top of the existing buttress was assumed to remain at its current elevation. For the north and south cross sections, additional rock fill was added to produce a 2H:1V slope for the buttress. For the mid cross section, a combination of additional fill and a reduction in the width of the top of the buttress was used to produce a 2H:1V slope for the buttress. The mid cross section was treated differently due to the relatively steep natural slope below the facility.

- Above the buttress, tailings were removed to produce a 2H:1V slope.

4.3 STATIC ANALYSIS RESULTS

As discussed in the draft RI/FS, a minimum factor of safety of at least 1.5 for static conditions is required by the Ecology Dam Safety Section (DSS), and is also required by most national and state agencies that regulate dams. The results of the static analyses for the cross sections with the modifications described above are presented in the table below. Graphical representations of the static analyses are presented on figures 1, 3 and 5 for the north, mid and south cross sections respectively.

Cross Section	Factor of Safety
North	1.51
Mid	1.51
South	1.51

Due to the presence of the medium dense glaciofluvial deposits below the toe of the existing buttress at the north end of the facility, an expansion of the buttress downslope was required to meet the minimum factor of safety.

4.4 SEISMIC ANALYSIS RESULTS

For purposes of Task 7, the stability of TDF-1 was evaluated using a pseudo-static approach in which the force induced by an earthquake is applied to the slope as a static horizontal force referred to as the seismic coefficient. Results are reported as factors of safety against movement in the same manner as for static slope stability analyses.

The pseudo-static approach provides relatively quick but conservative estimates of slope stability under seismic loading, and was the standard of practice. However, this approach has now been superseded by more realistic methods of analyses known as deformation analyses. A deformation analysis provides an estimate of the deformation of an earth embankment after seismic loading regardless of how low the seismic factor of safety is when calculated by a pseudo-static analysis.

DSS requires deformation analyses for seismic evaluation of dams which include tailings facilities. Therefore, Ecology does not specify a minimum required factor of safety for pseudo-static stability analyses. As TDF-1 no longer retains water, a pseudo-static analysis factor of safety of 1.1 should provide a reasonable guide for estimating a stable slope configuration under seismic loading that would meet the requirements of DSS.

For the seismic stability analyses, a seismic coefficient of 0.13g equal to the PGA was used as recommended in the draft RI/FS. This recommendation was based on the assumptions that the 2,500-year PGA is appropriate for the structure, that half of the PGA is appropriate for estimating the pseudo-static coefficient, and that the PGA would be amplified by a factor of 2 from the top of rock to the top of TDF-1. URS believes that these assumptions are conservative but reasonable for evaluating the feasibility of a steeper slope than used in the draft RI/FS.

The results of the seismic analyses for the cross sections with the modifications described above are presented in the table below. Graphical representations of the seismic analyses are presented on the attached figures 2, 4 and 6 for the north, mid and south cross sections respectively.

Cross Section	Factor of Safety
North	1.11
Mid	1.12
South	1.12

The draft RI/FS indicated that liquefaction of the tailings near the crest of the embankment would not occur, but that tailings away from the crest were likely to liquefy during an earthquake. The draft RI/FS opined that sufficient strength remained in the outer tailings to retain the liquefied soils but did not provide any analysis to support the opinion. For consistency with the draft RI/FS, URS did not consider the effect of liquefaction on the tailings. However, our review of the data indicates that tailings zones 2 and 3 are likely subject to liquefaction and may affect the factor of safety for seismic conditions. Zone 1 is likely not subject to liquefaction.

The impact of the occurrence of liquefaction in zones 2 and 3 needs to be evaluated. We anticipate that the impact of liquefaction in zones 2 and 3 would require some expansion of the rockfill buttress to maintain an acceptable factor of safety.

4.5 INCREASED BUTTRESS

In addition to the current configuration of TDF-1 as described above, the three cross sections were analyzed using a larger buttress. These additional analyses were performed to evaluate the possible optimization of using a larger rockfill buttress to reduce the volume of tailings that would need to be moved.

As the rockfill has a higher angle of internal friction than the outer zone 1 tailings, the results indicate that generally any combination of buttress and sloped tailings (that does not reduce the size of the existing buttress) with an overall slope of 2H:1V, will produce adequate factors of safety.

4.6 GEOGRID REINFORCEMENT OF THE BUTTRESS

The rockfill buttress could be reinforced with geogrid during placement. Geogrid is a plastic non-woven grid that is normally added at regular intervals (typically every two feet) within a fill as it is placed. The addition of geogrid allows for steeper slope angles. Geogrid could be considered as part of an expanded buttress during design.

The incremental cost of adding geogrid to a constructed buttress is a relatively small percentage of the cost of placing the buttress fill. An excellent example of a successful geogrid installation was the URS stabilization of a failing Pend Oreille Railroad slope at Metaline Falls in 1998.

4.7 Cost Impacts

4.7.1 Change in Tailings Slope Angle

The draft RI/FS considered six alternatives (Alternatives 1 to 6) for stabilization and remediation of TDF-1. Alternative 1 was a "no action" alternative, and was deemed not acceptable for stability reasons.

Alternatives 3 to 6 included re-grading the tailings slope to 2.5H:1V which is considerably flatter than the existing slopes. Re-grading of the Alternative 3 to 6 slopes to a steeper 2H:1V slope than a 2.5H:1V slope would decrease the cost of each alternative by the same amount. Therefore, the relative costs of these four alternatives to each other would remain the same. Alternative 2 does not include re-grading the tailings, therefore the cost of this alternative would not change due to a change in allowable slope grade.

The draft RI/FS estimated that 60,342 cubic yards of tailings would need to be excavated from the slope and spread on top of TDF-1 at a cost of $7 per cubic yard. By basic geometry, assuming an initial tailings slope of 1.35H:1V, a 2H:1V slope would require the removal of only 56.5 percent of the tailings that a 2.5H:1V slope would require. This would reduce the amount of tailings to be moved from 60,342 to 34,093 cubic yards. The cost savings associated with the reduced tailings volume would be approximately $185,000.

4.7.2 Change in Buttress Slope Angle

The stability analyses revealed that the existing 1.5H:1V slope of the buttress does not meet the required factors of safety and should therefore be re-graded to a 2H:1V slope either by adding rockfill to the slope of the buttress (as assumed in the analyses) or by reducing the width of the road at the top of the buttress while leaving the toe in its current location.

As the draft RI/FS did not anticipate the need for this re-grading, it was not included in the cost estimates. We anticipate that the cost impact of this re-grading will be relatively minor, as the same equipment used to re-grade the tailings could be used to re-grade the buttress or, if the buttress is enlarged, the flatter slope would be included as part of the buttress design.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The stability analyses of TDF-1 indicate that a 2H:1V slope is stable through the zone 1 tailings and represents a considerable cost savings and reduced environmental damage over the 2.5H:1V slope recommended in the draft RI/FS. Based on the costs provided in the draft RI/FS report, the cost savings associated with a steeper final slope is approximately $185,000.

If rock fill is available to expand the buttress, the volume of tailings to be moved can be further reduced by adding rock fill to the toe of TDF-1 and maintaining an overall 2H:1V slope through the rock fill and tailings combined. Although not considered in the analyses for this report, the addition of geogrid to an expanded buttress would result in a steeper slope angle for the buttress. The extent of an expanded buttress and use of geogrid should be based on the relative cost versus simply sloping the tailings.

These results differ from the results presented in the draft RI/FS due to the differences in how the tailings were characterized. Accounting for the higher strength tailings present near the crest of the facility allows for a steeper final slope.

Another important factor to be considered is that the removal of less tailings will result in the need for less tailings to be placed on the top of TDF-1, which will involve less disturbance and environmental impact to the maturing tree and vegetation growth on the surface of TDF-1.

The design must consider changes in the slope configuration due to slope changes below the toe of TDF-1. Due to the limited space between the toe of the existing buttress and the top of a 2H:1V slope near the middle of the TDF-1 crest, very little rock fill could be added without moving tailings.

The north cross section indicates that a larger buttress than the existing one is needed due to the presence of weaker glaciofluvial deposits below the toe of the existing buttress. This is not considered to be a significant issue as the length of embankment affected is relatively limited.

It is recommended that additional stability analyses be performed to evaluate the impact of liquefaction on the stability of the tailings pile slope and to better define the size of buttress needed for the north end of the embankment. Liquefaction of the tailings was not considered in the slope stability analyses performed for the draft RI/FS.

6.0 REFERENCES

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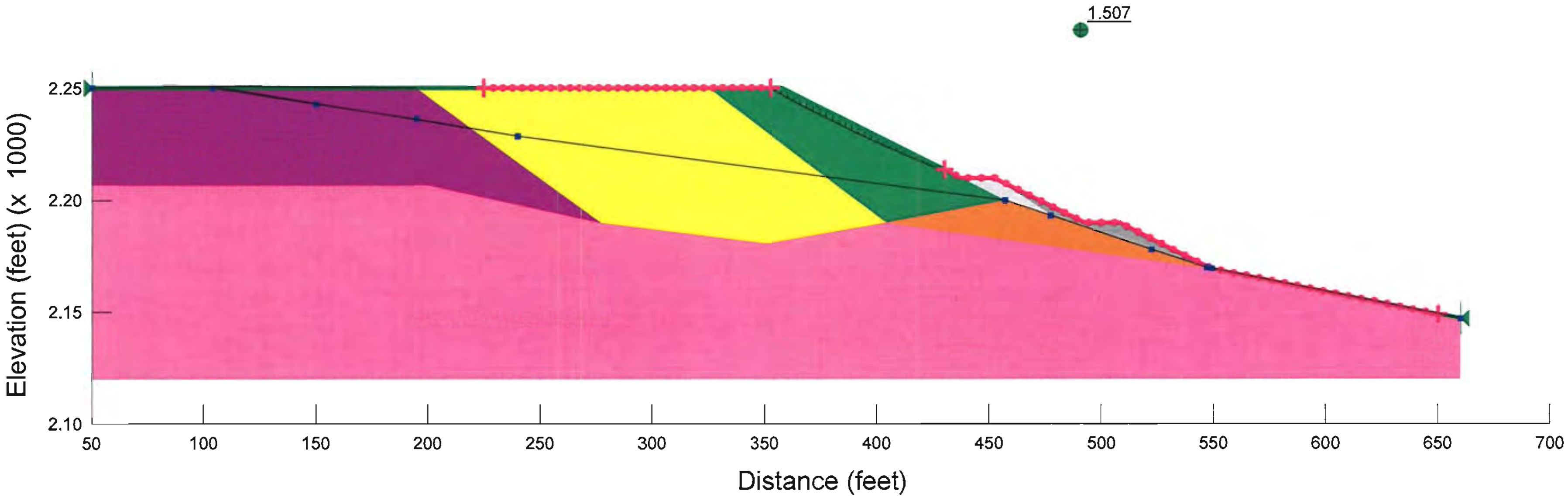
North Cross section, Static

Name: Bedrock Model: Mohr-Coulomb Unit Weight: 165 Cohesion: 2000 Phi: 25 Phi-B: 0 Piezometric Line: 1
Name: Sand/ Gravel -Dense Model: Mohr-Coulomb Unit Weight: 135 Cohesion: 0 Phi: 42 Phi-B: 0 Piezometric Line: 1
Name: Tailings-Zone 1 Model: Mohr-Coulomb Unit Weight: 123 Cohesion: 0 Phi: 36 Phi-B: 0 Piezometric Line: 1
Name: Buttress Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38 Phi-B: 0 Piezometric Line: 1
Name: Tailings-Zone 2 Model: Mohr-Coulomb Unit Weight: 119 Cohesion: 0 Phi: 33 Phi-B: 0 Piezometric Line: 1
Name: Old Buttress Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38 Phi-B: 0 Piezometric Line: 1
Name: Tailings-Zone 3 Model: Mohr-Coulomb Unit Weight: 119 Cohesion: 0 Phi: 30 Phi-B: 0 Piezometric Line: 1
Name: Liquefied Tailings Model: Mohr-Coulomb Unit Weight: 119 Cohesion: 445 Phi: 0 Phi-B: 0 Piezometric Line: 1
Name: Sand/ Gravel -Loose to Medium Desnse Model: Mohr-Coulomb Unit Weight: 135 Cohesion: 0 Phi: 38 Phi-B: 0 Piezometric Line: 1



Pend Oreille Mine

Figure 1

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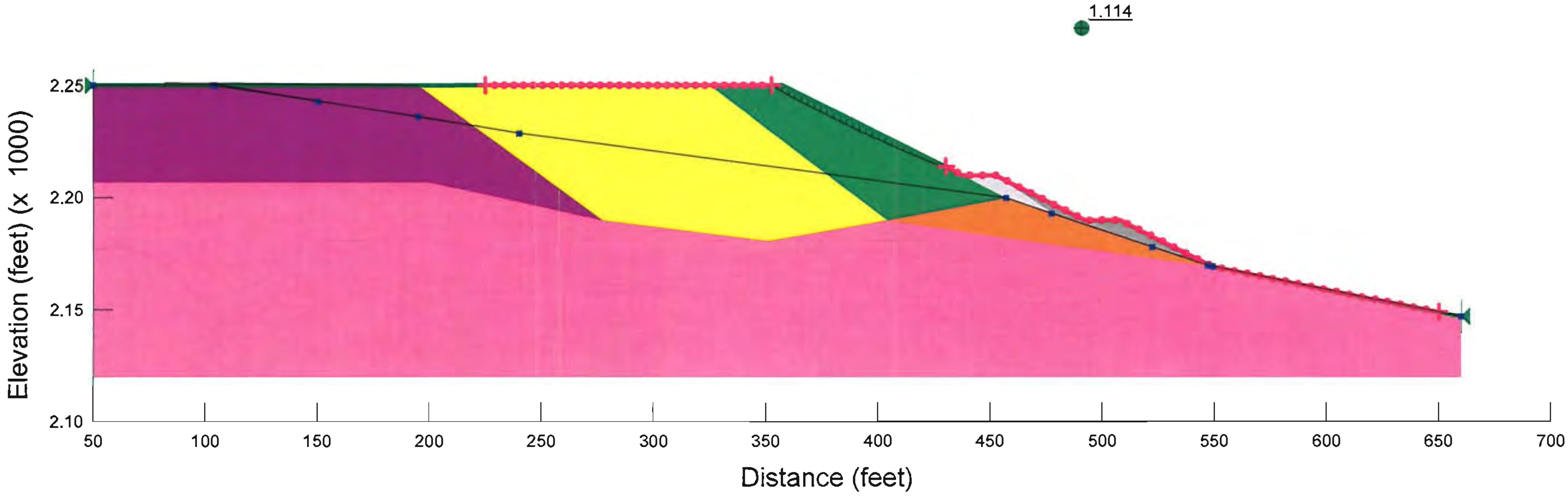
North Cross section, Seismic

Name: Bedrock Model: Mohr-Coulomb Unit Weight: 165 Cohesion: 2000 Phi: 25 Phi-B: 0 Piezometric Line: 1
Name: Sand/ Gravel -Dense Model: Mohr-Coulomb Unit Weight: 135 Cohesion: 0 Phi: 42 Phi-B: 0 Piezometric Line: 1
Name: Tailings-Zone 1 Model: Mohr-Coulomb Unit Weight: 123 Cohesion: 0 Phi: 36 Phi-B: 0 Piezometric Line: 1
Name: Buttress Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38 Phi-B: 0 Piezometric Line: 1
Name: Tailings-Zone 2 Model: Mohr-Coulomb Unit Weight: 119 Cohesion: 0 Phi: 33 Phi-B: 0 Piezometric Line: 1
Name: Old Buttress Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38 Phi-B: 0 Piezometric Line: 1
Name: Tailings-Zone 3 Model: Mohr-Coulomb Unit Weight: 119 Cohesion: 0 Phi: 30 Phi-B: 0 Piezometric Line: 1
Name: Liquefied Tailings Model: Mohr-Coulomb Unit Weight: 119 Cohesion: 445 Phi: 0 Phi-B: 0 Piezometric Line: 1
Name: Sand/ Gravel -Loose to Medium Desnse Model: Mohr-Coulomb Unit Weight: 135 Cohesion: 0 Phi: 38 Phi-B: 0 Piezometric Line: 1



Pend Oreille Mine

Figure 2

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Mid Cross Section, Static

Name: Bedrock Model: Mohr-Coulomb Unit Weight: 165 Cohesion: 2000 Phi: 25 Phi-B: 0 Piezometric Line: 1
Name: Sand/ Gravel Model: Mohr-Coulomb Unit Weight: 135 Cohesion: 0 Phi: 38 Phi-B: 0 Piezometric Line: 1
Name: Tailings-Zone 1 Model: Mohr-Coulomb Unit Weight: 123 Cohesion: 0 Phi: 36 Phi-B: 0 Piezometric Line: 1
Name: Existing Buttress Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38 Phi-B: 0 Piezometric Line: 1
Name: Tailings-Zone 2 Model: Mohr-Coulomb Unit Weight: 119 Cohesion: 0 Phi: 33 Phi-B: 0 Piezometric Line: 1
Name: New Buttress Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38 Phi-B: 0 Piezometric Line: 1
Name: Liquefied Tailings Model: Mohr-Coulomb Unit Weight: 119 Cohesion: 445 Phi: 0 Phi-B: 0 Piezometric Line: 1
Name: Tailings-Zone 3 Model: Mohr-Coulomb Unit Weight: 119 Cohesion: 0 Phi: 30 Phi-B: 0 Piezometric Line: 1

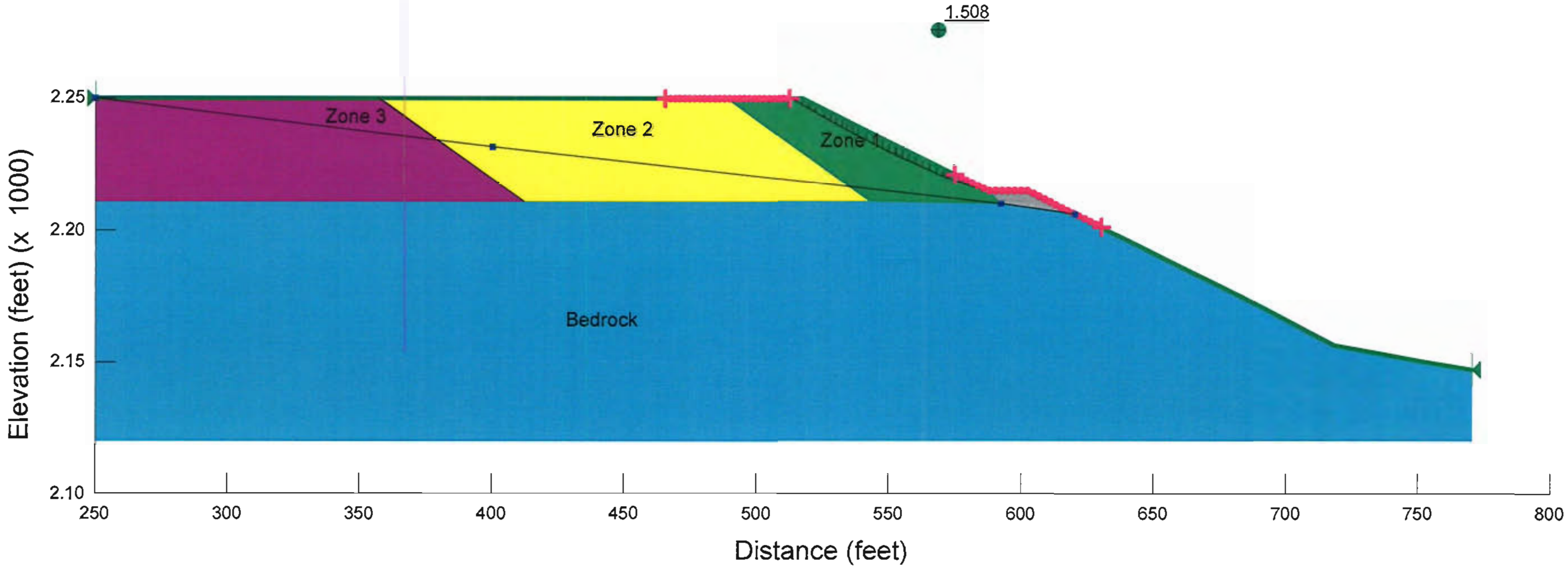
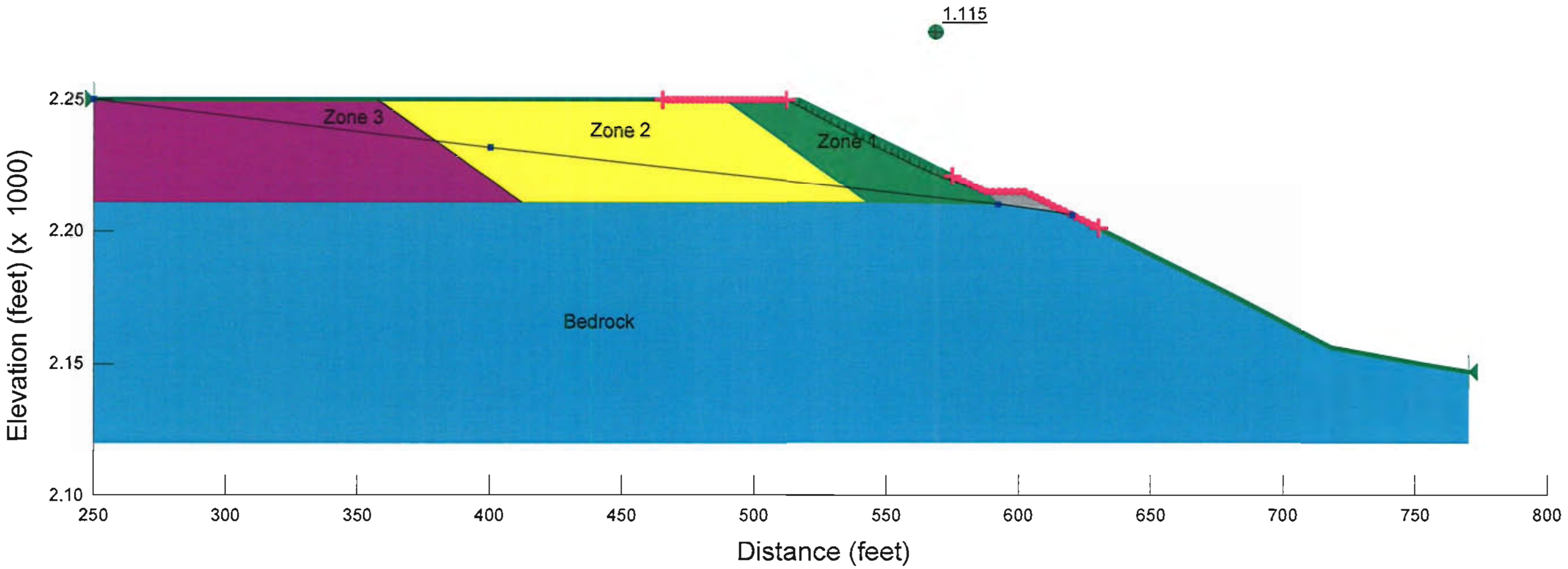


Figure 3

Mid Cross Section, Seismic

Name: Bedrock Model: Mohr-Coulomb Unit Weight: 165 Cohesion: 2000 Phi: 25 Phi-B: 0 Piezometric Line: 1
Name: Sand/ Gravel Model: Mohr-Coulomb Unit Weight: 135 Cohesion: 0 Phi: 38 Phi-B: 0 Piezometric Line: 1
Name: Tailings-Zone 1 Model: Mohr-Coulomb Unit Weight: 123 Cohesion: 0 Phi: 36 Phi-B: 0 Piezometric Line: 1
Name: Existing Buttress Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38 Phi-B: 0 Piezometric Line: 1
Name: Tailings-Zone 2 Model: Mohr-Coulomb Unit Weight: 119 Cohesion: 0 Phi: 33 Phi-B: 0 Piezometric Line: 1
Name: New Buttress Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38 Phi-B: 0 Piezometric Line: 1
Name: Liquefied Tailings Model: Mohr-Coulomb Unit Weight: 119 Cohesion: 445 Phi: 0 Phi-B: 0 Piezometric Line: 1
Name: Tailings-Zone 3 Model: Mohr-Coulomb Unit Weight: 119 Cohesion: 0 Phi: 30 Phi-B: 0 Piezometric Line: 1



Pend Oreille Mine

Figure 4

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South Cross Section, Static

Name: Bedrock Model: Mohr-Coulomb Unit Weight: 165 Cohesion: 2000 Phi: 25 Phi-B: 0 Piezometric Line: 1
Name: Sand/ Gravel Model: Mohr-Coulomb Unit Weight: 135 Cohesion: 0 Phi: 38 Phi-B: 0 Piezometric Line: 1
Name: Tailings-Zone 1 Model: Mohr-Coulomb Unit Weight: 123 Cohesion: 0 Phi: 36 Phi-B: 0 Piezometric Line: 1
Name: Existing Buttress Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38 Phi-B: 0 Piezometric Line: 1
Name: Tailings-Zone 2 Model: Mohr-Coulomb Unit Weight: 119 Cohesion: 0 Phi: 33 Phi-B: 0 Piezometric Line: 1
Name: New Buttress Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38 Phi-B: 0 Piezometric Line: 1
Name: Liquefied Tailings Model: Mohr-Coulomb Unit Weight: 119 Cohesion: 445 Phi: 0 Phi-B: 0 Piezometric Line: 1
Name: Tailings-Zone 3 Model: Mohr-Coulomb Unit Weight: 119 Cohesion: 0 Phi: 30 Phi-B: 0 Piezometric Line: 1

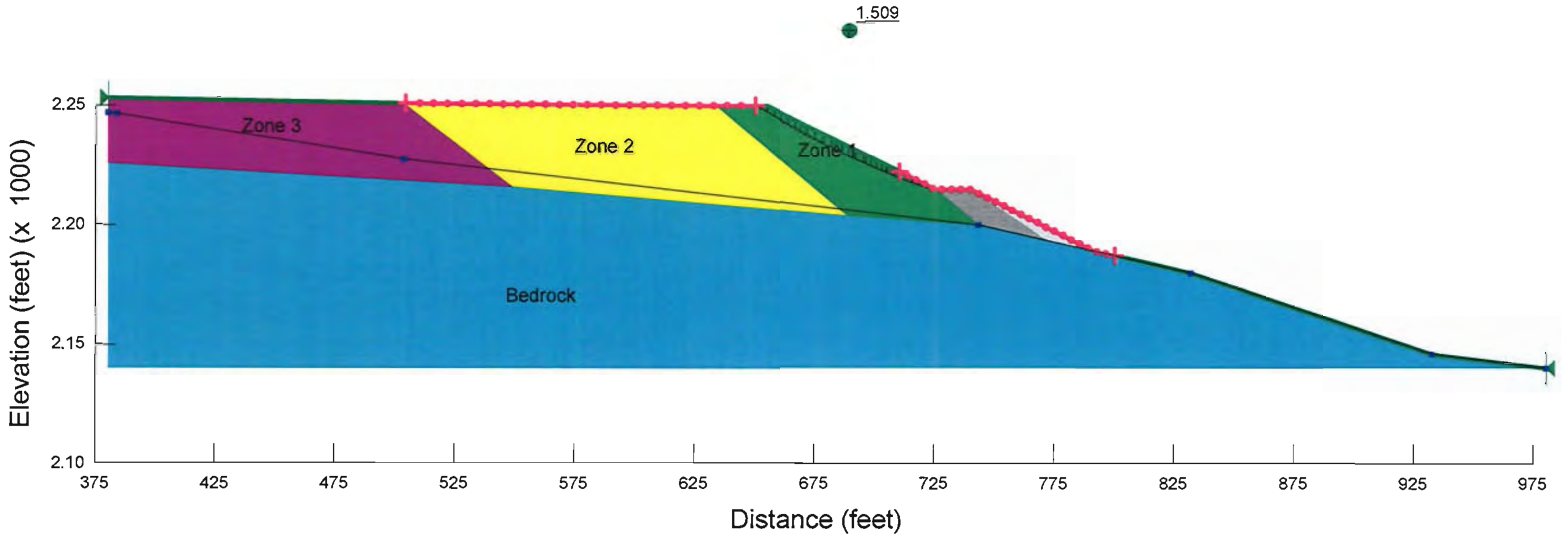

Figure 5

South Cross Section, Seismic

Name: Bedrock Model: Mohr-Coulomb Unit Weight: 165 Cohesion: 2000 Phi: 25 Phi-B: 0 Piezometric Line: 1
Name: Sand/ Gravel Model: Mohr-Coulomb Unit Weight: 135 Cohesion: 0 Phi: 38 Phi-B: 0 Piezometric Line: 1
Name: Tailings-Zone 1 Model: Mohr-Coulomb Unit Weight: 123 Cohesion: 0 Phi: 36 Phi-B: 0 Piezometric Line: 1
Name: Existing Buttress Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38 Phi-B: 0 Piezometric Line: 1
Name: Tailings-Zone 2 Model: Mohr-Coulomb Unit Weight: 119 Cohesion: 0 Phi: 33 Phi-B: 0 Piezometric Line: 1
Name: New Buttress Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38 Phi-B: 0 Piezometric Line: 1
Name: Liquefied Tailings Model: Mohr-Coulomb Unit Weight: 119 Cohesion: 445 Phi: 0 Phi-B: 0 Piezometric Line: 1
Name: Tailings-Zone 3 Model: Mohr-Coulomb Unit Weight: 119 Cohesion: 0 Phi: 30 Phi-B: 0 Piezometric Line: 1

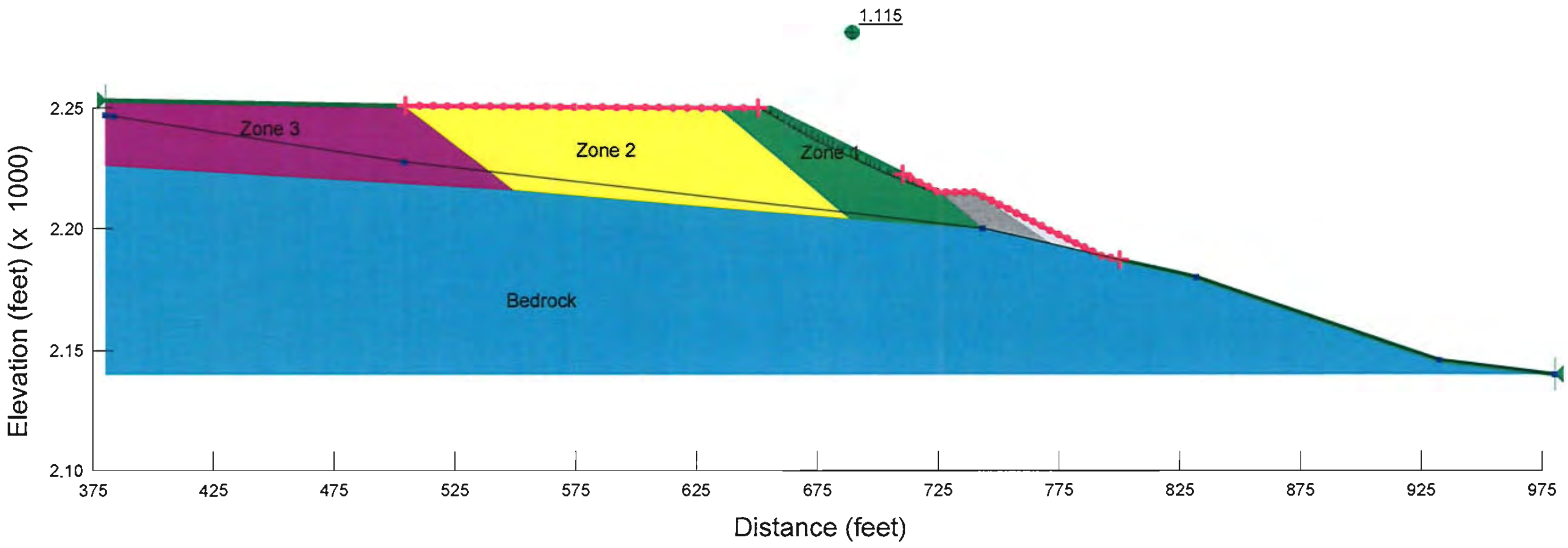

Figure 6

Project: Pend Oreille Mine
Project Location: **Metaline Falls, WA**
Project Number: **36298248**

Log of Test Pit TP-1

Sheet 1 of 1

Date(s) Excavated	**10/28/09**	Logged By	**TSP**	Checked By	**TSP**
Excavation Equipment	**Excavater Excavation**	Excavation Contractor		Total Depth of Test Pit	**7 feet**
Excavation Dimensions	**ft x ft**	Pit Alignment		Ground Surface Elevation	
Groundwater Level		Sampling Method(s)	**Grab**		

Coordinates **Northing** **Easting**

Location **TDF #1, Toe of the existing buttress, near the south end**

Elevation feet	Depth, feet	Type	Number	Graphic Log	USCS	MATERIAL DESCRIPTION	Fines Content (%<#200 Sieve)	Dry Unit Weight, pcf	Moisture Content, %	REMARKS AND OTHER TESTS
	0					*Topsoil*				
					ML	Brown sandy SILT (moist) (stiff)				
	2		1							
					ML	Orange-brown SILT (moist) (stiff)				
	4									
						Grades to gray.				
	6					Slate				
						Test pit completed at a depth of 7 feet below the ground surface. No groundwater encountered.				
	8									
	10									

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Project: Pend Oreille Mine **Project Location: Metaline Falls, WA** **Project Number: 36298248**	## Log of Test Pit TP-2 Sheet 1 of 1

Date(s) Excavated	10/28/09	Logged By	TSP	Checked By	TSP
Excavation Equipment	Excavater Excavation	Excavation Contractor		Total Depth of Test Pit	2.5 feet
Excavation Dimensions	ft x ft	Pit Alignment		Ground Surface Elevation	
Groundwater Level		Sampling Method(s)	Grab		
Coordinates	Northing Easting	Location	TDF #1, Toe of the existing buttress, near the north end, 50 fee MW-302		

Elevation feet	Depth, feet	Type	Number	Graphic Log	USCS	MATERIAL DESCRIPTION	Fines Content (% <#200 Sieve)	Dry Unit Weight, pcf	Moisture Content, %	REMARKS AND OTHER TESTS
	0				SM	Gray silty SAND (possible tailings) (wet) (soft)				
			1			Weathered Slate				
	2									
						Test pit completed at a depth of 2.5 feet below the ground surface. No groundwater encountered.				
	4									
	6									
	8									
	10									

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Figure -8

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Project: Pend Oreille Mine
Project Location: Metaline Falls, WA
Project Number: 36298248

Log of Test Pit TP-3

Sheet 1 of 1

Date(s) Excavated	**10/28/09**	Logged By	**TSP**	Checked By	**TSP**
Excavation Equipment	**Excavater Excavation**	Excavation Contractor		Total Depth of Test Pit	**5 feet**
Excavation Dimensions	**ft x ft**	Pit Alignment		Ground Surface Elevation	
Groundwater Level		Sampling Method(s)	**Grab**		

Coordinates **Northing** **Easting**

Location **TDF #1, Toe of the existing buttress, near the north end, 5 feet MW-302**

Elevation feet	Depth, feet	Type	Number	Graphic Log	USCS	MATERIAL DESCRIPTION	Fines Content (%<#200 Sieve)	Dry Unit Weight, pcf	Moisture Content, %	REMARKS AND OTHER TESTS
	0					Topsoil.				
					ML	Brown SILT (soft) (wet)				
	2									
		G	1							
						Grades to medium stiff to stiff				
	4									
						Test pit terminated at a depth of 5 feet below the ground surface. Further excavation at this location would have risked damage to an adjacent above ground water pipe. No groundwater encountered				
	6									
	8									
	10									

URS

Figure -9

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Project: Pend Oreille Mine **Project Location: Metaline Falls, WA** **Project Number: 36298248**	## Log of Test Pit TP-4 Sheet 1 of 1

Date(s) Excavated	**10/28/09**	Logged By	**TSP**	Checked By	**TSP**
Excavation Equipment	**Excavater Excavation**	Excavation Contractor		Total Depth of Test Pit	**1 feet**
Excavation Dimensions	**ft x ft**	Pit Alignment		Ground Surface Elevation	
Groundwater Level		Sampling Method(s)	**Grab**		
Coordinates	**Northing** **Easting**	Location	**TDF #1, Toe of the existing buttress, near the center**		

Elevation feet	Depth, feet	Type	Number	Graphic Log	USCS	MATERIAL DESCRIPTION	Fines Content (%<#200 Sieve)	Dry Unit Weight, pcf	Moisture Content, %	REMARKS AND OTHER TESTS
	0			▤		Weathered Slate.				
						Test pit completed at a depth of 1 foot below the ground surface. No groundwater encountered.				
	2									
	4									
	6									
	8									
	10									

Figure -10