DRAFT FINAL REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN
IRONDALE IRON AND STEEL PLANT
IRONDALE, WASHINGTON

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FOR
WASHINGTON STATE DEPARTMENT OF ECOLOGY
TOXICS CLEANUP PROGRAM

Draft Final Remedial Investigation/Feasibility Study Work Plan
Irondale Iron and Steel Plant
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REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN
IRONDALE IRON AND STEEL PLANT
IRONDALE, WASHINGTON

1.0 INTRODUCTION

This work plan describes proposed scope of services to perform a Remedial Investigation (RI)/Feasibility Study (FS) at the Irondale Iron and Steel Plant (Site). The Washington State Department of Ecology (Ecology) identified the Site as a Puget Sound Initiative cleanup site, based on the results of previous investigations and the Site's location on Puget Sound. The purpose of the Puget Sound Initiative is to improve the health and vitality of Puget Sound by the year 2020. The results of previous investigations, which are discussed in Section 3.0, show that past site operations resulted in the contamination of soil, sediment and possibly groundwater (although not previously tested) at levels that exceed the Model Toxics Control Act (MTCA) cleanup standards for total petroleum hydrocarbons (TPH) and metals.

The Site is located at 562 Moore Street East, Irondale, Washington, approximately 5 miles south of Port Townsend, Washington (see Figure 1). The Site is bounded by Port Townsend Bay to the east, residential properties to the south, southwest and northwest, and parklands to the north (Figures 1 and 2). The Site boundary is based on parcel maps available on Jefferson County's website. The site includes tax parcel numbers 001353001 and 901021002. This perimeter of the two parcels is shown on Figures 2 through 5.

The Site contains the remnants of the Irondale Iron and Steel Plant, which was nominated for the National Register of Historic Places in 1970. Information obtained by Hart Crowser indicates that no action was taken on this nomination (Hart Crowser, 1996). In 1983, the Site was listed on the National Parks Service Historic American Building Survey and Historic American Engineering Record (HABS/HAER). Large concrete and brick foundations of the former iron and steel plant still exist as well as significant quantities of operational debris. The upland portion of the Site is covered by mature alder and maple trees with a thick under story of shrubs, vines and forest duff, and grasses.

GeoEngineers is working in collaboration with Science Application International Corporation (SAIC) as a teaming partner on this project under Ecology's "Hazardous Substances Site Investigation & Remediation for the Toxics Cleanup Program Contract # C0700034; Work Assignment # SAIC017" held between SAIC and Ecology. GeoEngineers is responsible for completing the RI/FS and draft Cleanup Action Plan for both the upland and sediment portions of the Site, while SAIC will provide technical oversight and contract management.

The upland and sediment assessment activities will focus on impacts to soil, groundwater, surface water and sediment related to past activities at the Site. The layout of the property, including the approximate location of historical buildings, is shown in Figures 2 through 5.

1.1 PURPOSE

The purpose of the RI/FS work plan is to collect data necessary to characterize the Site adequately in order to develop and evaluate cleanup action alternatives in compliance with the MTCA (Washington Administrative Code [WAC] Chapter 173-340) and the Washington Sediment Management Standards (Chapter 173-204 WAC). The goals of the RI are to:

- Define the nature and extent of soil, sediment, surface water and groundwater contamination so that an FS and Cleanup Action Plan can be prepared;

- Conduct a terrestrial ecological evaluation to determine the impact to ecological receptors; and
- Support the development of the FS.

Specific objectives associated with the near-shore and shoreline fill areas, former buildings and chemical use areas, groundwater, surface water drainage at the northern end of the Site, and sediment are presented in Section 6.0.

1.2 WORK PLAN ORGANIZATION

This work plan was prepared in general accordance with Ecology guidance for RI/FS (WAC 173-340-350). The organization of the work plan is as follows:

- Section 1: Introduction
- Section 2: Site Description and History
- Section 3: Regulatory Screening Criteria
- Section 4: Previous Investigations
- Section 5: Preliminary Conceptual Site Model
- Section 6: Sampling and Analysis Plan (presents a summary of sampling objectives, procedures, frequency and location, and analytical requirements).
- Section 7: Terrestrial Ecological Evaluation
- Section 8: Feasibility Study
- Section 9: Limitations
- Section 10: References
- Appendix A: Quality Assurance Project Plan (QAPP)
- Appendix B: Health and Safety Plan (HASP)

2.0 SITE DESCRIPTION AND HISTORY

2.1 SITE HISTORY

The Site history described in this section was obtained from previous reports, primarily Jefferson County's 2001 Site Hazard Assessment (SHA; Jefferson County, 2001).

Industrial activities took place at the Site from 1881 through 1919. The plant produced the first batch of iron in 1881, and the steel production plant was operational beginning in 1909. The Irondale Iron and Steel Plant consisted of a blast furnace and cast house, steel production building (including three open-hearth furnaces and a steel rolling mill), boiler plant, six beehive kilns, miscellaneous support buildings (raw material warehouses, power house, machine shop, engine shop, etc), a 600-foot wharf and a 6,000-barrel aboveground storage tank (AST) for fuel oil. At its peak in 1910, the steel plant produced more than 700 tons of steel per day and employed 600. The plant was closed in 1911 and was reopened between 1917 and 1919 because of the demand for steel during World War I.

It is our understanding from conversations with Ecology that the only environmental cleanup known to have been conducted at the site is the removal of oily debris from the bottom of the AST. The date of this removal is not known.

Since 1919, no other waste-generating industry has used the Site. From the mid-1970s until 1999, the beach area east of the iron and steel plant was used for log storage for a nearby chipping facility. A chain-of-title report for the property, which was obtained by Ecology from Jefferson County Public Works, shows ownership by individuals, financial institutions and corporations. The Cotton Engineering and Shipbuilding Corporation, later known as the Cotton Family Limited Partnership, owned the property from 1943 until December 30, 2002, when the property was sold to Jefferson County, which has operated the site as Irondale Beach Park. In 2005, a man walking his dog on the beach at the Site identified what appeared to be free-phase petroleum hydrocarbons on the beach. Follow-up sampling by Ecology identified the material as weathered fuel oil, leading to Jefferson County's decision to close the park on December 5, 2005.

The Site is easily accessible by the public, and there is evidence of casual recreational use such as hiking and beachcombing.

2.2 TOPOGRAPHY AND GEOLOGY

The Site is located adjacent to Port Townsend Bay and includes upland and beach areas. Elevations at the Site range from sea level to 100 feet above sea level. The eastern near-shore portion of the Site is relatively level with an elevation of approximately 12 feet above mean sea level (AMSL). The western portion of the Site is located on sloping, uneven ground. The transition between the two areas is marked by a north-south trending steep break in slope. This slope is about 70 feet high in the southern portion of the Site and about 20 feet high in the northern portion of the Site. Other than the flatter near-shore area, most of the Site is heavily vegetated by shrubs and trees. The near-shore area has a sparse grass cover and includes a gravel access road. A surface water drainage stream with heavy growth of blackberry bushes exists along the northern boundary of the Site. The beach along the Site is gently sloping, with steeper slopes on the southern quarter of the Site.

According to the geologic map published by the Washington State Division of Geology and Earth Resources (Geology & Earth Resources, 2005), the Site is underlain by unconsolidated landslide deposits and land that has been disturbed during historical uses of the Site. Based on observations during the May 8, 2007 Site visit and information from the Hart Crowser investigation, the soil at the Site is composed largely of sand, dredged marine sediments (sand with varying amount of shells) and fill related to the former steel operation. Portions of the near-shore area of the Site that was used for log storage are underlain by bark and similar wood waste. The fill removal activities at the adjacent Chimacum Creek beach (north of Site) identified 1 to 2 feet of fill in the area nearest the Site (Eastern Washington University, August 2005). The beach is composed of granular marine sediments with varying amounts of eroded fill (brick and slag) present along portions of the Site.

2.3 GROUNDWATER AND SURFACE WATER

The primary sources of information reviewed to evaluate the occurrence and use of groundwater at the Site are the Washington State Well Log Viewer (Ecology, 2007) and the Washington Department of Ecology publication "Geology and Ground-Water Resources of Eastern Jefferson County, Washington," dated April 1981 (Ecology, 1981). According to these documents, there are no groundwater wells located on the Site. The closest well identified by these documents is located about ½ mile southwest of the Site and about ½ mile inland from Port Townsend Bay. This is considered too far a distance to be pertinent to this investigation.

Although there are no groundwater wells located on the Site, Hart Crowser installed monitoring wells north of the Site and encountered groundwater in several test pits located on the Site. This information indicates that the groundwater table is about 5 to 7 feet below ground surface (bgs) along the near-shore area. Information regarding the elevation of the water table, changes in groundwater elevation over time or groundwater flow direction was not available in the Hart Crowser reports available for review. Groundwater is presumed to flow towards Port Townsend Bay.

Precipitation is the main source of recharge to groundwater at the Site. Other sources of recharge may include septic drainage fields and stormwater/irrigation runoff related to residences located upgradient of the Site. The Ecology publication "Geology and Ground-Water Resources of Eastern Jefferson County, Washington," dated April 1981, describes the annual water budget for the Port Townsend area, which includes the area of the Site. The water budget described in that publication indicates that groundwater is recharged November through March but there is a deficit (no or limited recharge) during the remaining months of the year because of evapotranspiration. Overall, the annual water budget presented in the Ecology publication shows a small (0.6- to 4-inch) annual recharge to groundwater. The actual groundwater budget at the Site may vary as a result of different geology and site conditions than assumed in the Ecology study.

There is one known surface drainage stream located at the Site. This drainage stream enters the Site near the northwest Site boundary and discharges through a metal culvert on the beach near the northern corner of the Site. The sources of water contributing to this drainage stream are not known.

Information regarding tides affecting the Site is available from the Port Townsend National Oceanographic and Atmospheric Administration (NOAA) tide station (station ID 9444900) located about 5 miles from the Site. Information from this station describes a mean tidal range of 5.34 feet and a diurnal tidal range of 8.52 feet. The mean range represents the average difference in height between mean high water and mean low water. The diurnal range represents the difference in height between mean higher high water (MHHW) and mean lower low water (MLLW). The minimum water level is minus 4.22 feet below MLLW, and the maximum water level is 3.21 feet above MHHW. As a point of reference for the reader, the waterline shown in Figure 2 is estimated to represent a water level about 3 to 5 feet above MLLW. The date of the aerial photograph shown in Figure 2 is known (April 28, 2003), but the exact time the photograph was taken is not known. The estimate of the water level assumes it was taken midday and is based on a NOAA tide chart for that day.

2.4 GROUNDWATER AND SURFACE WATER USAGE

Port Townsend Bay is used for fishing and recreation. There are no known uses of the surface water in the drainage stream located at the Site.

There is no known groundwater supply well located at the Site. It is likely that groundwater beneath the site is not potable because: (1) it is sufficiently hydraulically connected to Port Townsend Bay that salt water intrusion makes it impracticable to use as a drinking water source; and (2) groundwater flows into Port Townsend Bay, making it improbable that there is, or could be, any interconnection between contaminated groundwater and any potential future source of potable water.

3.0 REGULATORY SCREENING CRITERIA

Regulatory screening criteria have been identified to evaluate historical data and to select analytical reporting limits for the chemical analyses that will be performed during the RI. The purpose of the screening criteria is to identify chemical concentrations that, if exceeded, could pose a risk to human health or the environment. Soil, sediment, and surface water criteria were identified using the following sources:

- Soil: MTCA Method A Soil Cleanup Levels for Unrestricted Land Uses and Method B soil direct contact cleanup levels (WAC 173-340-740)
- Sediment: Chapter 173-204 WAC, Sediment Management Standards
    - Table I – Marine Sediment Quality Standards
    - Table III – Puget Sound Marine Sediment Cleanup Screening Levels
- Surface Water: Aquatic marine chronic and human health (fish ingestion) water quality criteria (WQC) published in Chapter 173-201A WAC, Section 304 of the Clean Water Act, National Toxics Rule, and MTCA Method B Surface Water Cleanup Levels (WAC 173-340-730)

MTCA Method A and B Groundwater Cleanup Levels will not be used to evaluate groundwater data collected as part of this RI. Rather, groundwater data will be evaluated using the surface water criteria presented above. Regulatory screening criteria are used in this report for screening purposes, and are not intended to represent proposed or final cleanup levels.

4.0 PREVIOUS INVESTIGATIONS

This section discusses previous investigations at the Site. The approximate locations of previous soil, sediment and water samples are shown in Figure 3. The analytical data associated with these samples are included in this work plan as Tables 1 through 5. Sections 4.1 through 4.4 reiterate the conclusions of five environmental studies that have been completed at the Site. The analytical data are compared to current soil, sediment and surface water screening criteria to evaluate whether chemicals of concern are present and are of regulatory concern based on current criteria.

4.1 ENVIRONMENTAL ASSESSMENT (HART CROWSER, 1996)

Hart Crowser conducted an Environmental Assessment (EA) at the log chipping property in Irondale, Washington, in March 1996. The site evaluated in the EA consisted of the Irondale Iron and Steel Plant site (parcels 001353001 and 901021002) and the property immediately north of the Site (parcel 001353001). This section discusses only the work that Hart Crowser conducted on the Site.

In March 1996, the property north of the Site was used as a log chipping and storage facility, and logs were stored on the near-shore portion of the Site. The purpose of the EA was to assess the potential for past practices at the Site (including historic steel mill operations) to have adversely impacted subsurface conditions. Hart Crowser excavated nine test pits (TP-5, TP-6, TP-7, TP-8, TP-9, TP-10, TP-11, TP-12 and TP-19), obtained several soil samples from the test pits, water samples from test pits TP-11 and TP-12, two sediment samples at a depth of 6 inches from near-shore sediments at low tide, a surface soil sample from the location of the 6,000-gallon AST and two rock/slag samples (open-hearth furnace area and slag exposed on southern beach face). Soil, sediment, water and slag samples were analyzed for one or more of the following: petroleum hydrocarbons, volatile organic compounds (VOCs) and metals.

GeoEngineers compared the 1996 sample results to current soil, sediment, groundwater and surface water criteria. Table 1 shows that TPH (as reported using the WTPH-HCID method), arsenic, copper, iron, lead and zinc were detected in soil and slag at concentrations greater than their respective soil criteria. These exceedances are shown in Figure 3. The EA report (Hart Crowser, 1996; Table 1) indicated that arsenic and lead were detected in a toxic characteristic leaching procedure (TCLP) test conducted on soil sample TP-5, S-3 at concentrations greater than toxicity characteristic levels (40 CFR 261.24); however, based on a review of the text and tables of the EA report, it appears that arsenic and lead should have been reported in Table 1 of the EA report as not detected.

Table 2 presents the chemical analytical data from water samples W-4 and W-5 obtained from TP-11 and TP-12. According to Table 2 of the EA report, samples W-4 and W-5 were obtained from TP-12 and TP-11, respectively. However, the boring logs show that sample W-4 was obtained from TP-11 and sample W-5 was obtained from TP-12. These water samples were unfiltered samples obtained from the bottom of the test pits and were not considered “true” groundwater samples by Hart Crowser. Rather, they were simply an indication of groundwater quality. Table 2 shows that arsenic, copper, iron, lead, nickel and zinc were detected in water at concentrations greater than their respective groundwater or surface water criteria.

Based on a review of the 1996 sediment samples (Table 3) compared to sediment screening criteria, none of the detected concentrations of metals exceeded their respective sediment criteria.

4.2 SITE HAZARD ASSESSMENT (JEFFERSON COUNTY, 2001)

Jefferson County Health and Human Services (JCHHS) conducted a Site Hazard Assessment (SHA) in October 2001. Based on the results of the SHA, the Jefferson County Health Department recommended that no further action is required at the Site under MTCA; however, the Health Department did recommend that oil residue in the former AST foundation be removed to “prevent potential human exposure or release to the environment.”

JCHHS obtained seven surface soil samples, one slag sample and three sediment samples. Five soil samples and the slag and sediment samples were analyzed for metals. The other two soil samples were analyzed for TPH-diesel range organics (TPH-DRO) and TPH-residual range organics (TPH-RRO). TPH-RRO typically includes carbon ranges C_{25} to C_{36}, which is similar to oil-range petroleum hydrocarbons (i.e., heavy oil) evaluated in MTCA. The slag sample was also analyzed for TCLP chromium, copper, lead and zinc.

GeoEngineers compared the 2001 sample results to current soil and sediment criteria. Table 1 shows that TPH-RRO, arsenic, copper, lead, nickel and zinc were detected in soil or slag at concentrations greater than their respective soil criteria.

Table 3 shows that copper was detected in sediment sample BS3 at a concentration of 412 milligrams per kilogram (mg/kg), which is slightly greater than the sediment criteria of 390 mg/kg.

Chromium, copper, lead and zinc were not detected in the TCLP analysis of the slag sample (SS7).

4.3 INITIAL INVESTIGATION (ECOLOGY, 2005)

Ecology conducted an initial investigation in November 2005. The purpose of the investigation was to evaluate a complaint from a person who “detected petroleum odors and observed several bricks with fuel on them” at the Site. Ecology also noted petroleum odors during their investigation. As part of the investigation, Ecology obtained one soil/slag sample and three sediment samples. The soil/slag sample was analyzed for metals, while the sediment samples were analyzed for oil-range petroleum hydrocarbons.

GeoEngineers compared the 2005 sample results to current soil and sediment criteria. Table 1 shows that arsenic and copper were detected in soil/slag at concentrations greater than their respective soil criteria. Table 3 shows that oil-range petroleum hydrocarbons (identified in the Initial Investigation Field Report as severely weathered heavy fuel oil) were detected in sediment at concentrations ranging from 550 to 40,600 mg/kg.

Sediment screening criteria have not been developed for oil-range petroleum hydrocarbons. However, the heavy fuel oil concentration of 40,600 mg/kg is substantially greater than the MTCA Method A soil cleanup level of 2,000 mg/kg. Ecology recommended in 2005 that the site be listed on the Ecology database as a confirmed contaminated site and that a high-priority SHA be conducted per WAC 173-340-310(ii) based on the analytical results from their investigation.

4.4 SEDIMENT AND TISSUE SAMPLING (JEFFERSON COUNTY, 2007)

The Jefferson County Health Department obtained sediment and tissue (clam and oyster) samples at the Site in January 2001. Three sediment samples were obtained from 12 sampling locations (Locations 1 through 12) at depths of 6, 12 and 18 inches. Each sediment sample was analyzed for TPH using the NWTPH-HCID analytical method. According to the laboratory case narrative, 18 of the 36 sediment samples contained a small to significant amount of very weathered to extremely weathered heavy fuel oil. Six of the sediment samples were subsequently analyzed for oil-range petroleum hydrocarbons. Additionally, samples obtained at depths of 6 inches from Locations 3, 5, 7, 9 and 11 were analyzed for metals, while the samples from Locations 3, 5 and 7 collected at depths of 6 inches were analyzed for polycyclic aromatic hydrocarbons (PAHs).

Table 3 shows that oil-range petroleum hydrocarbons were detected in sediment at concentrations ranging from 170 to 2,300 mg/kg. Sediment screening criteria have not been developed for oil-range petroleum hydrocarbons. However, the heavy fuel oil concentration of 2,300 mg/kg is greater than the MTCA Method A soil cleanup level of 2,000 mg/kg. Metals and PAHs were not detected at concentrations greater than their respective sediment screening criteria, as shown in Tables 3 and 4.

Table 5 presents the tissue analytical results for one composite tissue sample obtained at the site. The tissue sample was analyzed for PAHs and metals. PAHs were not detected, while arsenic, cadmium, chromium, copper, lead, and zinc were detected at concentrations ranging from 0.46 to 21 mg/kg.

5.0 PRELIMINARY CONCEPTUAL SITE MODEL

The primary exposure pathways of concern for human health and the environment at the Site are: direct-contact with soil and sediment. The primary transport pathways of concern include soil to groundwater, groundwater to surface water and sediment, and erosion of soil into Port Townsend Bay.

Soil. Because the current and future use of the Site is as a public park, the primary concern for human health is direct exposure to site contaminants. Direct contact with surface soil is also the primary pathway of concern for terrestrial ecological exposure.

Groundwater. Groundwater at the Site is not likely to be used for drinking water; however, groundwater migrating underneath the Site to Port Townsend Bay may provide a contaminant transport pathway to surface water and sediment. The test pit water samples obtained by Hart Crowser give an indication of groundwater quality, but these samples were obtained over 10 years ago, and water tested does not represent groundwater at the Site.

Surface Water. A drainage ditch/stream is present on the north end of the Site. The stream runs near the northern boundary of the Site past the north end of the former steel production building and eventually drains into Port Townsend Bay. This stream has the potential to carry Site-related contamination and upstream contamination to Port Townsend Bay.

Sediment. Metals and TPH have been detected in sediment samples obtained at the Site. Pathways of concern include direct contact for human health and the environment and ingestion by ecological receptors and potentially human ingestion of shelfish.

6.0 SAMPLING ANALYSIS PLAN

6.1 GENERAL

The objective of the Sampling Analysis Plan (SAP) is to collect data necessary to characterize the Site adequately for the purpose of developing and evaluating cleanup action alternatives in compliance with MTCA and the Sediment Management Standards (SMS; Chapter 173-204 WAC; EPA, 1996). This SAP addresses both the upland and aquatic portions of the Site. Samples of soil, slag and fill, groundwater, surface water and sediment will be obtained from the Site during this RI. Test pits and borings will be the principal methods to explore the subsurface. The purposes of the test pits are: (1) to determine thickness and nature of fill; and (2) to provide access to collect soil samples for chemical analyses and field screening. In general, test pits will be approximately 3 feet wide and 4 to 8 feet long with depths varying between 4 and 8 feet bgs. Borings installed by direct-push or hollow-stem auger drilling methods will be used to obtain groundwater samples and construct groundwater monitoring wells. Sediment samples will be obtained from hand-dug explorations. Exploration methods are described in Section 6.4. In addition to analytical testing, data will also be collected by field screening, visual mapping of exposed fill and a geophysical survey. GeoEngineers has obtained verbal authorization from Ecology to complete borings and test pits at the Site as part of the RI/FS.

Samples obtained during this study will be submitted to an Ecology-certified laboratory for analysis of the contaminants of concern (COCs). Table 6 outlines the analyte list and chemical analytical testing rationale. Analytical methods will include one or more of the following:

Soil/fill

- Organic carbon by Plumb/EPA 160.1
- PAHs by SW-846 8270-SIM (see Appendix A, Table 4 for list of PAHs)
- Metals by SW-846 6010
- Diesel- and oil-range petroleum hydrocarbons by NWTPH-Dx with silica gel cleanup and extractable petroleum hydrocarbons (EPHs) by EPA Method 1664
- Leaching test for metals (EPA Method 1311 or 1312 depending on site conditions)

MTCA protocols (WAC 173-340-740(7)(a)) require that soil cleanup levels be based on the soil fraction less than 2 millimeters (mm) in size unless it is reasonable to assume that larger-size particles could be reduced to 2 mm or smaller size. Standard soil sampling protocol will be followed at this Site. The soil will not be screened to limit the chemical analyses to the soil fraction less than 2 mm in size.

Sediment

- Grain size by PSEP, total sulfides by EPA 376.2, total organic carbon/total solids by Plumb/EPA 160.1
- Total volatile solids (LOI) by ASTM
- Ammonia by EPA 350.1M

- TPH by NWTPH-HCID with follow-up diesel and oil-range hydrocarbons analysis as needed by NWTPH-Dx with silica gel cleanup.
- SMS Metals by EPA SW-846 6010/7471
- Semi-volatile organic compounds (SVOCs) by PSEP 8270
- SIM Semivolatiles by EPA 8270-SIM

Groundwater and Upland Surface Water

- Diesel- and oil-range petroleum hydrocarbons by NWTPH-Dx with silica gel cleanup and EPH by EPA Method 1664
- Metals by SW-846 6010
- PAHs by SW-846 8270-SIM (see Appendix A, Table 4 for list of PAHs)

A general summary of the SAP is presented in Table 6. The specific compounds for which analytical data will be obtained are identified in the tables associated with the QAPP (Appendix A). Proposed sampling locations are shown in Figure 5.

The sections below provide details on existing data, data collection objectives for this SAP and proposed sample locations for specific areas of the Site. We have organized the SAP into sections that describe data collection for:

- Near-shore and shoreline fill areas
- Former buildings and chemical use areas at the Site
- Groundwater
- Surface water drainage at the northern end of the Site
- Sediment

6.2 NEAR-SHORE AND SHORELINE FILL AREAS

Existing data summary: For purposes of this SAP, the near-shore and shoreline fill areas are defined as the relatively level open upland adjacent to the shore and the beach adjacent to the shoreline bank. This upland area is about 700 feet long and 125 feet wide between the existing park road and the shoreline. There are approximately 1,000 feet of shoreline bank on the Site. No samples were obtained from the shoreline bank in past investigations. Two test pits were excavated by Hart Crowser in the upland near-shore area (Figure 4). Test pit TP-11, located on the southern portion of the Site, was excavated to a depth of 7 feet bgs. Test pit TP-12, located about in the middle of the near-shore upland area, was excavated to a depth of about 7 feet bgs. Slag was not encountered in TP-12 but was encountered in TP-11. One soil sample from a depth of 4.5 to 6 feet bgs in TP-12 was analyzed by hydrocarbon identification (HCID). No detectable concentrations of TPH were identified in this sample. Two samples from depths of 0 to 2 feet bgs (TP-11 S-1) and 2.5 to 4.5 feet bgs (TP-11 S-2) were obtained from TP-11. Sample S-1 was analyzed by HCID, and no detectable

Photo 1: Nearshore fill area looking North

concentrations of TPH were identified. Sample S-2 was analyzed for metals of which arsenic, copper, iron and lead exceeded one or more screening level (Table 1).

Water was encountered in both test pits at a depth of approximately 6 feet bgs. Hart Crowser obtained samples of water (W-4 and W-5) from both test pits and had them analyzed for petroleum hydrocarbons (by HCID) and metals. Both samples were below detection levels for petroleum hydrocarbons. Lead (290 milligrams per liter [mg/L]) in the sample from TP-12 exceeded the MTCA Method A lead cleanup level of 15 micrograms per liter (ug/L), and arsenic (22 ug/L) in the sample from TP-11 exceeded the MTCA Method A arsenic cleanup level of 5 ug/l.

The shoreline fill area includes a prominent slag deposit that formed an erosion-resistant small headland near the former coke warehouse. Hart Crowser analyzed one sample (SS5) from this area and identified copper concentration of 79.5 mg/kg, which exceeds the ecological copper screening level of 50 mg/kg. Observations during the May 8, 2007, site visit indicate that the visible headland is composed of a hard red-colored slag and a more friable white-colored slag.

COC: The contaminants of concern (COCs) associated with fill are metals.

Data Objectives:

- Characterize fill stratigraphy and vertical extent.
- Evaluate if slag and associated COCs are present in the northern portion of the Site, specifically near the shoreline that may be subject to future habitat restoration proposed by Washington Department of Fish and Wildlife (WDFW) and JCHHS.
- Evaluate COC relationship to specific fill layers and confirm conceptual model hypotheses that COCs are associated only with fill containing slag material.
- Evaluate COCs near shoreline banks subject to ongoing wave erosion.
- Evaluate if COCs are present at concentrations that could pose a risk to human health and the environment.

Proposed Sampling: A non-intrusive geophysical survey will be conducted along the base of the shoreline bank and in the near-shore upland area. The objective of the survey is to determine the thickness and lateral extent of slag fill. Geophysical methods will include ground penetrating radar or electromagnetics. The geophysical survey will be completed prior to subsurface explorations so the test pit program can be modified if necessary based on the geophysical findings. Proposed geophysical transects are shown on Figure 5.

Four test pits will be excavated in the near-shore upland area between previous Hart Crowser test pit TP-11 and the northern parcel boundary. The test pits will be spaced approximately 170 feet apart. Up to three samples for chemical analysis will be obtained from each of these four test pits. Sample depths will depend on the nature of fill encountered, but it is anticipated that one sample will be obtained from the first slag layer encountered, one sample from the lower contact between this slag layer and native soil, and one sample from near the water table. If slag is not encountered, representative fill samples will be obtained at depths of approximately 0 to 2 feet, 2 to 4 feet and 6 to 8 feet. Wood fill from recent log storage operations and native soil above the first layer of slag fill will not be sampled for chemical analyses.

Test pits will be excavated at four locations adjacent to, but upland of the shoreline bank to identify thickness and stratigraphy of fill near the shoreline. These test pits are in addition to the test pits focused on characterizing the beehive kilns (section 6.3.1) and the AST (section 6.3.2). The depth of the test pits will be based on results from the geophysical survey, but based on existing information it is anticipated that they will be a maximum of 8 feet bgs. Samples representative of the different types of fill will be obtained and analyzed for metals in the area north of the former wharf and for metals and oil-range petroleum hydrocarbons in samples obtained south of the former wharf. Diesel- and oil-range petroleum hydrocarbons are being analyzed in these samples because they are located in areas that might have been impacted by fuel oil from the AST. Wood waste from recent log storage operations and native soil above the first layer of slag fill will not be sampled for chemical analyses.

Two composite samples will be obtained from the slag outcrop area. One composite will be representative of the red-colored slag and one composite will be representative of the white-colored, more friable slag. Each composite will be composed of four discrete subsamples obtained approximately 10 feet apart along the exposed face of the headland.

6.3 FORMER BUILDINGS AND CHEMICAL USE AREAS AT THE SITE

6.3.1 Beehive Kilns

Photo 2: Brick debris on beach from Beehive Kiln

Existing Data Summary: Based on the available maps showing former features of the Site, there were six beehive kilns located on the southern portion of the Site. During the site visit on May 8, 2007, brick remnants of three or four kilns were still visible on the beach along the shore bank. The kilns were used to produce charcoal used in the steel-making process. In 2007, Jefferson County collected sediment samples along the beach below the kilns (sample locations 2-8 shown in Figure 4). Samples collected from 6 inches bgs at these locations were analyzed by HCID and for metals. Selected sediment samples were also analyzed for oil-range petroleum hydrocarbons and PAHs. The sediment analytical results were below SMS screening criteria. The TPH results from Sample 3 are discussed further in section 6.3.2.

COC: The COCs are PAHs associated with the production of charcoal, metals associated with fill and oil-range petroleum hydrocarbons in the area near the AST.

Data Objectives:

- Evaluate if beehive kilns are a source of contamination.
- Evaluate if COCs are present at concentrations that could pose a risk to human health and the environment.
- Evaluate thickness and nature of fill, particularly slag near shoreline bank.
- Evaluate metal contamination, particularly copper and lead, that may be associated with slag fill.

Proposed Sampling: Three test pits will be excavated in the vicinity of the former kilns, at the locations shown in Figure 5. The test pits will be excavated to a depth of approximately 8 feet bgs or until native material with no field evidence of contamination is encountered, whichever is shallower. Up to three soil samples from each test pit will be submitted for chemical analyses for diesel- and oil-range petroleum hydrocarbons, PAHs and metals as shown in Table 6. The sample with the highest concentration of petroleum hydrocarbons will also be analyzed for EPHs. Test pit samples are planned to be obtained from depths of approximately 0 to 2 feet, 2 to 4 feet and 6 to 8 feet, or at the top of the water table. Actual sample depths may vary depending on types of fill encountered and field screening observations. Observations and analytical tests from these test pits will also help delineate the extent of oil related to the former AST.

6.3.2 AST and 2005 Oil Seep Area

Existing Data Summary: Hart Crowser completed one test pit (TP-5) located between the AST and the beach (Figure 4). The highest concentration of petroleum hydrocarbons was 1,085 mg/kg identified in a sample from 7 to 8 feet bgs in this test pit. Hart Crowser's report stated that no obvious oily residue was present in this test pit. JCHHS obtained samples on the beach below the AST and along the beach south of the AST. These samples were analyzed by HCID by Ecology's analytical laboratory located in Manchester, Washington. The results varied from non-detected to 2,300 mg/kg oil-range petroleum hydrocarbons. The highest concentration was identified in a sample obtained from a depth of 12 inches bgs at sample location 3, which is the closest beach sediment sample location to the AST. At this same location, the sample from 6 inches bgs contained 240 mg/kg and a sample from 18 inches bgs contained 170 mg/kg oil-range petroleum hydrocarbons. These results suggest that the oil is present in a relatively thin interval. Ecology obtained three samples on November 5, 2005, from the area where oil was observed on the beach in 2005. Three of these samples were analyzed by HCID, and the results showed heavy fuel oil at concentrations ranging from 550 mg/kg to 40,600 mg/kg. The oil was characterized by the laboratory as "extremely" and "very" weathered oil, as would be expected if the source is the 90-year-old AST. One of the JCHHS samples (Location 3) located near the AST was also analyzed for PAHs. The results were below screening levels.

COC: The COC are oil-range petroleum hydrocarbons and PAHs associated with the former AST and metals associated with fill.

Data Objectives:

- Evaluate extent of residual oil based on field screening and chemical analytical testing.
- Confirm lateral and vertical extent of residual oil based on chemical analytical testing.
- Evaluate if PAHs are associated with residual oil by chemical testing.
- Evaluate if free product is present.
- Evaluate extractable hydrocarbon concentration and composition.
- Evaluate thickness and nature of fill, particularly slag near the shoreline bank.
- Evaluate metal contamination, particularly copper and lead, that may be associated with slag fill.
- Evaluate if COCs are present at concentrations that could pose a risk to human health and the environment.

Proposed Sampling: Four test pits will be excavated in the area of the AST (Figure 5). One of these test pits will be excavated through the floor of the AST. The information from this test pit, in conjunction with the test pits located seaward of the AST, will help determine if residual oil is beneath the AST. The principal purpose of these test pits is to identify the horizontal and vertical extent of oil residue and confirm that the source of the oil is the AST. Water sheen field screening tests will be the principal tool used to determine the extent of residual oil in the test pits.

Soil samples from test pits will be submitted for chemical analyses for oil-range petroleum hydrocarbons, PAHs and metals as shown in Table 6. The sample with the highest concentration of oil-range petroleum hydrocarbons will also be analyzed for EPH. Samples from the test pits are planned to be obtained from depths of approximately 0 to 2 feet, 2 to 4 feet and 6 to 8 feet, or at the top of the water table or floating product, if encountered. Actual sample depths may vary depending on types of fill encountered and field screening observations. If present, a sample of the free product will be obtained for analyses for PAHs and oil-range hydrocarbons.

6.3.3 Power House, Engine House, and Boiler House

Existing Data Summary: JCHHS obtained one sample (SS3) in the vicinity of the former Power House (Figure 4). This sample was analyzed for metals (Table 1). Hart Crowser completed four test pits in the vicinity of the Power House and Engine House (TP-7. TP-8, TP-9 and TP-10). There is some uncertainty regarding the locations of Hart Crowser's test pits because text in their report states that TP-8 and TP-9 were located near the Blast Furnace building but the map included in their report shows the location of these test pits adjacent to the Engine House. We have assumed that the locations shown on the Hart Crowser map are correct. No samples were obtained from the Boiler House. A sample from a depth of 2 feet bgs in TP-9 contained 700 mg/kg oil-range petroleum hydrocarbons, and a sample from a depth of 1 foot bgs from TP-8 contained 220 mg/kg oil-range petroleum hydrocarbons. These results are below the MTCA Method A cleanup level but indicate that oil-range petroleum hydrocarbons may be present in at least the upper 2 feet of these test pits. Oil-range petroleum hydrocarbons were not detected in TP-10. Samples below a depth of 2 feet bgs were not analyzed for TPH. Samples from TP-7, TP-9 and TP-10 were analyzed for metals, and all results were less than MTCA Method A cleanup levels. The deepest sample analyzed for metals was obtained from a depth of 3 feet bgs. No samples from this area were analyzed for PAHs.

COC: The COC associated with these buildings are metals related to fill, and oil-range petroleum hydrocarbons and PAHs related to past chemical usage.

Data Objectives:

- Confirm previous results that indicate that COCs are not present in concentrations greater than regulatory cleanup levels.
- Evaluate if PAHs are present at concentrations that could pose a risk to human health and the environment.
- Characterize oil-range petroleum hydrocarbons in soil deeper than 2 feet bgs near previous test pit TP-9.
- Evaluate metal contamination, particularly copper and lead, that may be associated with fill.

Proposed Sampling: Two borings or test pits will be excavated adjacent to the Power House and Engine House (Figure 5). One boring will be located east of the Power House eastern foundation wall near the walking trail and one boring will be located near the previous test pit TP-9. This area is difficult to access with mechanical equipment because of uneven terrain and trees. If possible, a power auger or small excavator will be used to complete these explorations. If this is not feasible, a hand auger and shovel will be used. Samples for chemical analyses will be obtained from depths of approximately 0 to 2 feet and 2 to 4 feet bgs, or the total depth of the exploration.

6.3.4 Blast Furnace and Cast House

Existing Data Summary: No samples were obtained from the Blast Furnace and Cast House building area during previous site investigations.

COC: The COCs associated with this building are metals related to fill, and oil-range petroleum hydrocarbons and PAHs related to past chemical usage.

Data Objectives:

- Evaluate if COCs are present at concentrations that could pose a risk to human health and the environment.
- Evaluate the nature and thickness of fill adjacent to the eastern portion of the building foundation.

Proposed Sampling: One boring or test pit will be excavated adjacent to the eastern foundation of the Blast Furnace and Cast House. This area is difficult to access with mechanical equipment because of uneven terrain and trees. If possible, a power auger or small excavator will be used to complete this exploration. If this is not feasible, a hand auger and shovel will be used. Samples for chemical analyses will be obtained from depths of approximately 6 inches, 2 feet and 4 feet bgs, or the total depth of the exploration.

6.3.5 Steel Production Building

Existing Data Summary: Hart Crowser completed one test pit (TP-6) to a depth of 6 feet bgs inside the building footprint and also analyzed one sample of slag fill (SS-3). JCHHS obtained two surface soil samples (SS6 and SS7) from this area in 2001. All of these sample locations appear to be on the southern half of the building (Figure 4).

The analytical results from samples obtained from past investigations identified elevated concentrations of iron, lead and copper in the sample of slag fill (SS-3) and a sample obtained from a depth between 0.5 and 2 feet bgs in TP-6. The sample from TP-6 was also tested for the presence of petroleum hydrocarbons by Ecology HCID method. No petroleum hydrocarbons were detected in this sample.

Photo 3: Typical building foundation remnant

COC: The COCs associated with this building are metals related to fill and slag. Petroleum hydrocarbons are not thought to be COCs based on the non-detection value identified in the previous sample; however, this needs to be confirmed by additional testing.

Data Objectives:

- Evaluate if COCs are present at concentrations that could pose a risk to human health and the environment near the proposed park pathway and the northern portion of the building.
- Evaluate the nature and thickness of fill at test pit locations.
- Confirm that petroleum hydrocarbons are not a COC.

Proposed Sampling: Two borings or test pits will be excavated in the vicinity of the Steel Production Building (Figure 5). One exploration will be located near the eastern foundation on or near a park walking pathway. One exploration will be located near the middle of the northern portion of the building. This area is difficult to access with mechanical equipment because of uneven terrain and trees. If possible, a power auger or small excavator will be used to complete these explorations. If this is not feasible, a hand auger and shovel will be used. Samples for chemical analyses will be obtained from depths of approximately 0 to 2 feet and 2 to 4 feet bgs, or the total depth of the explorations.

6.3.6. Boiler Plant

Existing data summary: One sample of slag was obtained from the Boiler Plant area by JCHHS in 2001. This sample (SS5) was analyzed for metals (Figure 4). The metal concentrations were less than MTCA Method A cleanup levels, but the copper concentration of 79.5 mg/kg was greater than MTCA ecological screening level of 50 mg/kg. One test pit (TP-19) was excavated about 40 feet east of the Boiler Plant by Hart Crowser. This test pit ended in fill with red slag at a depth of 9 feet bgs. Sulfur-like odor was noted at the bottom of this test pit. During the May 8, 2007, site visit, a mound was visible at this location, suggesting the presence of fill.

COC: The COCs associated with this building are metals related to fill and petroleum hydrocarbons and PAHs which were not previously tested.

Data Objective:

- Evaluate if COCs are present at concentrations that could pose a risk to human health and the environment.
- Evaluate the nature and thickness of fill in the mound below the eastern side of the Boiler Plant.
- Evaluate the source of the sulfur-like odor, if present.

Proposed Sampling: One test pit will be excavated into the side of the slope below the eastern foundation of the Boiler Plant (Figure 5). This test pit will be near Hart Crower test pit TP-19. The anticipated total depth of the test pit will be approximately 12 feet, or to native soil, whichever is shallower. The test pit will be excavated into the side of the mound and downslope toward the park access road. Samples for chemical analyses will be obtained from depths bgs of approximately 0 to 2 feet, 2 to 4 feet and from fill at the deeper fill-native soil contact. If a sulfur odor is present, a sample of material from that location will also be obtained.

6.3.7 Blacksmith Shop and Machine Shop

Existing Data Summary: No samples were obtained from the Blacksmith Shop and Machine Shop area during previous site investigations.

COC: The COCs associated with this building are metals related to fill, and oil-range petroleum hydrocarbons and PAHs related to past chemical usage.

Data Objectives:

- Evaluate if COCs are present at concentrations that could pose a risk to human health and the environment.

Proposed Sampling: Samples will be obtained from one exploration located within the footprint of the former foundation (Figure 5). This area is difficult to access with mechanical equipment because of uneven terrain and trees so these samples will be obtained by hand digging an exploration to a depth of approximately 2 feet bgs. Samples for chemical analyses will be obtained from depths of approximately 0 to 6 inches and 6 inches to 2 feet bgs. These samples will be analyzed for oil-range petroleum hydrocarbons, PAHs and metals.

6.4 GROUNDWATER

Existing data summary: There are no groundwater monitoring wells located on the Site. Hart Crowser obtained some water samples from their test pits but noted that these samples do not constitute a "true" groundwater sample. GeoEngineers agrees that these samples are not representative of groundwater quality because of the collection method and turbidity noted in the samples. Therefore, specifics about groundwater quality and occurrence beneath the Site are unknown.

COC: Potential groundwater COCs include metals, PAHs, and oil-range petroleum hydrocarbons.

Data Objectives:

- Evaluate the nature and extent of dissolved-phase contaminants of selected downgradient locations from widely spaced wells in the near-shore upland.
- Evaluate if floating free product is present near the former AST.
- Evaluate groundwater flow direction and depth to the groundwater table.
- If groundwater is found to contain contaminants at concentrations above regulatory cleanup levels, a tidal influence study may be required to evaluate groundwater flow flux of dissolved-phase contaminants flowing into Port Townsend Bay, if any.

Proposed Sampling: Groundwater quality and occurrence will be explored by installing and sampling four groundwater monitoring wells and obtaining a one-time groundwater sample from an additional location. The one-time groundwater sample is proposed to reduce the number of permanent monitoring wells but still provide data on groundwater quality near features of interest. The table below summarizes the rationale and purpose of the proposed groundwater explorations.

Summary of Rationale and Purpose of Groundwater Sampling Locations

Location	Type	Rationale/Purpose
Downgradient of AST	Permanent groundwater monitoring well	Groundwater elevation data, evaluate presence of floating free product, water quality near potential conditional point of compliance
Downgradient of Power House building complex and in area with slag fill	Permanent groundwater monitoring well	Groundwater elevation data, evaluate water quality impacts from fill and Power House area, water quality near potential conditional point of compliance
Downgradient of Boiler Plant and Steel Production Building	Permanent groundwater monitoring well	Groundwater elevation data, evaluate water quality impacts from fill and Steel Plant area, evaluate water quality where sulfur odor noted in Hart Crowser test pit.
Near-shore in north portion of Site	Permanent groundwater monitoring well	Obtain water quality data to compare with upgradient well near Boiler Plant and evaluate near-shore groundwater quality.

Summary of Rationale and Purpose of Groundwater Sampling Locations (Continued)

Location	Type	Rationale/Purpose
Downgradient of Power House and potentially downgradient of AST	One-time groundwater sample	Evaluate potential for dissolved oil-range petroleum hydrocarbons north of AST. Evaluate COC concentration attenuation, if present, with data from downgradient permanent monitoring well.

The preferred drilling method for this work is direct-push technique. However, if soil conditions at a specific location (such as the presence of hard slag) prevent the use of direct-push drilling methods, hollow-stem auger drilling methods will be employed. The approximate location of the proposed groundwater monitoring wells and the boring for collection of one-time groundwater sample are shown in Figure 6. These locations may change depending on information obtained from the geophysical survey and test pit explorations.

Soil conditions encountered during drilling will be evaluated using field screening techniques and/or analytical testing. Soil samples will be obtained at approximately 2.5-foot-depth intervals for geologic description and field screening. One soil sample obtained near the water table from each boring will be submitted for chemical analyses of metals. Soil samples from borings located near the AST will also be analyzed for oil-range petroleum hydrocarbonsand PAHs.

Well construction protocols are described in detail in Section 6.7.5.

After completion of all groundwater monitoring wells, the vertical elevation of the wells will be professionally surveyed and one round of water levels and groundwater samples will be obtained. The groundwater samples will be submitted for chemical analysis of metals, oil-range petroleum hydrocarbons and PAHs as shown in Table 6.

If groundwater is impacted by contaminants related to the Site, a tidal influence study may be necessary to determine the flux of contaminants to Port Townsend Bay. Specifics for the tidal influence study, if needed, will be submitted separately as an addendum to this Work Plan.

6.5 SURFACE WATER IN UPLAND DRAINAGE

Existing data summary: There is one surface water drainage stream located on the Site. This drainage stream enters the Site near the northwest Site boundary and discharges through a metal culvert on the beach near the northern corner of the Site. Based on our review of existing data, no samples from this drainage stream were obtained in past investigations.

COC: Dissolved metals leaching from metal contaminated fill.

Data Objectives:

- Evaluate whether the drainage stream is a source of metals contamination to Port Townsend Bay.
- Evaluate whether contaminants, if detected, are present in surface water at concentrations that could pose a risk to human health and the environment.

Proposed Sampling: One sample will be obtained upgradient of where the stream enters the Site and one sample will be obtained at the point the stream discharges to the beach, below the mouth of the metal culvert. Both samples will be analyzed for metals.

6.6 SEDIMENT

Existing data summary: As described in Section 4, sediment samples were obtained in past investigations by JCHHS (2001 and 2007), Hart Crowser (1996) and Ecology (2005) at the approximate locations shown in Figure 3. Most samples were obtained from the southern portion of the Site, near the Beehive Kilns and AST. The analytical results from these samples suggest that: (1) the highest concentration of residual oil was detected between 6-inch and 18-inch depths based on the results from JCHHS sample location 3, however, deeper samples were not collected; (2) metals and PAHs are not present in sediment in this area at these depths at concentrations greater than screening levels; and (3) the highest concentrations of oil-range petroleum hydrocarbons are between JCHHS sample locations 2 and 6, directly east (seaward) of the AST. Lower concentrations of oil-range petroleum hydrocarbons are present in sediment samples obtained south of these locations (JCHHS sample locations 7 and 11).

Photo 4: Beach below AST

Additional sampling is required to investigate the presence of PAHs in sediment in the area where the oil-range petroleum hydrocarbons were detected during the previous sampling efforts.

COC: COCs detected at the site or potentially present at the site include metals associated with fill and oil-range petroleum hydrocarbons (and possibly PAHs) associated with residual oil in the area near the AST.

Data Objectives:

- Characterize sediment adjacent to the Site.
- Evaluate horizontal extent of residual oil and COCs in the intertidal area east of the AST.
- Evaluate COCs near former Coke warehouse and wharf.
- Collect data that satisfy SMS protocols to evaluate if COCs are present at concentrations that could pose a risk to biological resources and/or human health and the environment.

Proposed Sampling: Sediment samples will be obtained at sixteen locations as shown on Figure 5. More samples are proposed in the southern portion of the Site than the northern portion because: (1) greater sample density is required to define the extent of residual oil and potentially related PAHs in sediments; and (2) existing data indicate that residual oil is not present and less slag is present than in the northern portion.

Two explorations (sediment sample locations 1 and 3) will be located seaward of previous JCHHS sample location 3. The purpose of sampling at these locations is to define the seaward extent of oil-range petroleum hydrocarbons and COCs in this area. Additional explorations will be located seaward (to the extent feasible without using a boat or diver) if field screening in these explorations identify residual oil.

Two explorations (sediment sample locations 8 and 9 on Figure 5) are located near previous JCHHS sample locations 5, 7, and 11.

Sediment sample locations 4, 10, and 11 (Figure 5) along the former Coke warehouse and sediment sample locations 12, 13, 14, and 15 along the former wharf will be collected form a boat during a separate phase of work.

At each sample location a composite sample representing the interval from 0 to 4 inches will be obtained. These samples will be analyzed by HCID (with follow up TPH-Dx analyses as needed), metals and SVOCs, including PAHs. In addition to the 0- to 4-inch-depth sample, at each location samples will be collected from 4 inches to 2 feet, 2 feet to 3 feet, and 3 to 4 feet. These samples will be frozen and archived for potential analyses in the future, with the following exceptions. Samples with field evidence of contamination and the sample collected immediately below the sample with field evidence of contamination will be analyzed. Additionally, at sediment sample locations 1 and 2 (Figure 5) the samples obtained from 0.5 to 2 feet bgs will be analyzed even if evidence of contamination is not observed in the shallower sample. The reason for this is that a JCHHS sample from this area (JCHHS sample 3) contained elevated concentrations of TPH-Dx at a depth of 12-inches bgs.

Bioassays are not proposed for these samples. Additional sampling and bioassay tests may be required in the future if elevated levels of contaminants are identified.

6.7 GENERAL SAMPLING PROCEDURES

This section specifies the field procedures, field quality assurance/quality control (QA/QC) protocol, and the chemical testing program to be implemented during the RI.

6.7.1 Underground Utility Locate

Prior to drilling and test pit activities, an underground utility locate will be conducted in the area of the proposed boring and test pit locations to identify any subsurface utilities and/or potential underground physical hazards.

6.7.2 Surveying

Prior to drilling and test pit activities, a Washington State licensed professional land surveyor will establish a permanent benchmark and temporary benchmarks to delineate the MLLW in the area of the proposed sediment sample locations. During the investigation, these benchmarks will be used to determine the elevation of explorations.

Vertical Controls
Each monitoring well casing rim and ground surface elevation will be surveyed by GeoEngineers field personnel relative to the permanent benchmark. Elevations will be surveyed using a laser level, which has an accuracy of 0.01 feet.

Horizontal Controls
GeoEngineers field personnel will record the boring/monitoring well, test pit and surface water and sediment sampling locations, and other pertinent information, using hand-held Trimble GeoXT GPS units during sampling activities. GPS data collected in the field will be processed in the office using measurements from the nearest reference station to each collection point.

6.7.3 Soil Sampling

The planned boring and test pit locations described in this section may be modified if necessary to circumvent problems associated with surface access, utilities or subsurface obstructions.

Test Pits. The test pits will be excavated using a rubber-tire backhoe or mini-excavator. A member of GeoEngineers' staff will observe subsurface conditions in the test pits, and classify soil in general accordance with ASTM Standard D-2488. A log will be prepared for each test pit exploration. The log will include a summary of the soil and groundwater conditions observed, and field screening results. After completion of a test pit, the spoils will be returned to the pit in the order they were excavated and compacted to a dense, non-yielding state using the backhoe or excavator bucket.

Soil samples will be obtained from test pit excavations. Soil samples obtained at depths shallower than 3 feet bgs will be obtained directly from the test pit sidewalls using a stainless steel sampling spoon. Soil in the exposed test pit sidewall will not be sampled because it has been contacted by the excavator bucket. This “surficial” soil will be removed using a stainless steel sampling spoon. The “fresh” soil exposed during this process will then be sampled using a decontaminated sampling spoon or newly gloved (nitrile or latex) hand.

Test pit soil samples from depths greater than 3 feet bgs will be obtained directly from the backhoe/excavator bucket. These samples will be obtained from the center of the bucket using the procedures described above.

The samples will be placed into laboratory-supplied containers, lightly packed and capped with a plastic lid. The sand-sized and finer fractions of the soil will be targeted for collection. Sample containers will be labeled in the field and stored in an iced cooler prior to and during shipment to the chemical analytical laboratory.

Hand Borings. Hand-dug explorations may be required in areas inaccessible to mechanized equipment. These borings will probably be a maximum depth of 4 feet bgs. Prior to advancing the boring, surface duff and debris will be removed. The borings will be advanced using a drive sampler, shovel or similar tool. The soil cuttings removed from each sample interval will be placed in a stainless steel bowl for homogenization and field screening (see Section 6.7.4). The homogenized sample will be placed in a container provided by the analytical laboratory and submitted for chemical analysis. Each sample container will be securely capped, labeled and placed in a cooler with ice immediately upon collection.

Power Borings. Soil samples may be obtained from borings installed for collection of groundwater samples and installation of groundwater monitoring wells. These borings will be drilled by direct-push methods or by hollow-stem auger drilling methods. Six borings are planned.

Boring activities will be monitored continuously by a technical representative from GeoEngineers who will observe and classify the soil encountered and prepare detailed field notes. Soil samples obtained from the borings will be visually classified in general accordance with ASTM Standard D-2488. The samples also will be evaluated for the potential presence of hydrocarbon contamination and iron slag using field screening techniques. Observations of soil and groundwater conditions and soil field screening results for each exploration will be included in a boring log.

Soil samples will be obtained from the direct-push borings using a hydraulically advanced 4-foot long sampler with a disposable liner. The sample diameter is approximately 1.4 inches. Soil samples will be obtained from the hollow-stem auger soil borings at approximately 2.5-foot intervals using a standard penetration test (SPT) sampler. The sampler will be driven by a 140-pound hammer falling a vertical distance of approximately 30 inches. The number of blows required to advance the sampler the final 18 inches will be recorded on the boring logs. Soil cuttings (unused soil core) from the borings will be placed in labeled 55-gallon drums, except for the boring for the upgradient well. Cuttings from the upgradient well are presumed to not be contaminated and will be spread around the drill site. Cuttings from the upgradient well are presumed to not be contaminated and will be spread around the drill site. Soil samples will be obtained from the hollow-stem auger soil borings at approximately 2.5-foot intervals using a standard penetration test (SPT) sampler. The sampler will be driven by a 140-pound hammer falling a vertical distance of approximately 30 inches. The number of blows required to advance the sampler the final 18 inches will be recorded on the boring logs.

Soil samples to be submitted for chemical analysis will be obtained from a hollow-stem auger boring and a direct-push boring in a similar manner. At the target interval for the sample, the required volume of soil will be removed from the sampler and homogenized, placed into laboratory-supplied containers, lightly packed and capped with a plastic lid. The sand-sized and finer fractions of the soil will be targeted for collection. Samples will be selected for analysis based on field screening results and/or sample depth relative to groundwater depth.

Sample containers will be labeled in the field and stored in an iced cooler prior to and during shipment to the chemical analytical laboratory. Section 6.8 addresses the disposition of investigation-derived waste such as soil cuttings.

Composite Surface Slag/fill Samples. Two composite samples from the exposed slag headland will be obtained. Each composite will be composed of four discrete subsamples obtained approximately 10 feet apart along the exposed face of the headland. Subsamples will be composited in a stainless steel bowl and processed in the same manner as other soil samples. The location of each subsample will be recorded by flagging and photographs, as well as by GPS.

6.7.4 Field Screening

Soil samples will be field screened for evidence of possible contamination. Field screening results will be recorded on the field logs, and the results will be used as a general guideline to delineate areas of possible contamination. Screening results will be used to aid in the selection of soil samples to be submitted for chemical analysis. The following screening methods will be used: (1) visual screening; (2) water sheen screening; (3) headspace vapor screening; and (4) magnet and acid. Field screening results are site- and location-specific. The results may vary with temperature, moisture content, soil type and chemical constituent.

Visual Screening. The soil will be observed for unusual color and stains and/or odor indicative of possible contamination.

Water Sheen Screening. This is a qualitative field screening method that can help identify the presence or absence of petroleum hydrocarbons. A portion of the soil sample will be placed in a pan containing distilled water. The water surface will be observed for signs of sheen. The following sheen classifications will be used:

Classification	Identifier	Description
No Sheen	(NS)	No visible sheen on the water surface
Slight Sheen	(SS)	Light, colorless, dull sheen; spread is irregular, not rapid; sheen dissipates rapidly
Moderate Sheen	(MS)	Light to heavy sheen; may have some color/iridescence; spread is irregular to flowing, may be rapid; few remaining areas of no sheen on the water surface
Heavy Sheen	(HS)	Heavy sheen with color/iridescence; spread is rapid; entire water surface may be covered with sheen

Headspace Vapor Screening. This is a semi-quantitative field screening method that can help identify the presence or absence of volatile chemicals. Volatile chemicals at this site are only anticipated in conjunction with residual oil. A portion of the soil sample is placed into a resealable plastic bag for headspace vapor screening. Ambient air will be captured in the bag; the bag will be sealed and then shaken gently to expose the soil to the air trapped in the bag. The bag will remain closed for approximately 5 minutes at ambient temperature before the headspace vapors are measured. Vapors present within the sample bag's headspace will be measured by inserting the probe of a photoionization detector (PID) through a small opening in the bag. A PID measures the concentration of organic vapors ionizable by a 10.6 electron volt (eV) lamp in parts per million (ppm) and quantifies organic vapor concentrations in the range between 0.1 ppm and 2,000 ppm (isobutylene equivalent) with an accuracy of 1 ppm between 0 ppm and 100 ppm. The maximum value on the instrument and the ambient air temperature will be recorded on the field log for each sample. The PID will be calibrated to 100 ppm isobutylene.

Magnet: This is a qualitative screening method that can help determine the presence or absence of iron particles (slag). A portion of the soil sample will be place in a bag or similar container and massaged to break up larger particles. A magnet will be placed in the soil and the presence or absence of iron on the magnet will be visually assessed.

Acid: This is a qualitative screening method that can help identify if lime from the steel process is present in the sample. A weak hydrochloric acid solution discharged from an eye dropper style container will be placed on the sample. The absence or presence of a reaction will be noted. A reaction indicates that lime is present in the sample. A positive reaction may also be caused by seashells present in the dredge sand fill.

6.7.5 Monitoring Well Construction and Development

Monitoring wells will be constructed by a Washington State licensed driller in compliance with State standards. Installation of the monitoring wells will be observed by a GeoEngineers field technician, who will maintain a detailed log of the materials and depths of the well. Monitoring wells will be installed to a depth approximately 10 feet below the groundwater table. The total depth of the monitoring wells is anticipated to be approximately 12 to 20 feet bgs.

Wells constructed in hollow-stem auger borings will be 2-inch diameter schedule 40 polyvinyl chloride (PVC) well casing with 20-slot well screens. Wells constructed in direct-push borings will be 1-inch diameter PVC with pre-pack 10- or 20-slot well screen. The top of the well screens will be located approximately 5 feet above measured groundwater level, or within 2 feet of the ground surface, whichever is deeper. The well screen intervals may be modified based on field screening results or variations in soil type. Medium sand will be placed in the borehole annulus surrounding the slotted portion of the well. A bentonite seal will be placed from the top of the sand to the bottom of the concrete surface completion. The surface completion for the groundwater monitoring wells will be a 2-foot by 2-foot concrete box that extends above the ground approximately 6 inches. A lockable "Thermos"-type cap will be installed in the top of the PVC well casing.

Each monitoring well will be developed to remove water introduced into the well during drilling (if any), stabilize the filter pack and formation materials surrounding the well screen, and restore the hydraulic connection between the well screen and the surrounding soil. The well screen will be gently surged with a decontaminated stainless steel bailer several times after installation. The removal rate and volume of groundwater removed will be recorded during well development procedures. Well development water will be obtained and stored temporarily on-site in 30-gallon or 55-gallon drums. The depth to water in the monitoring well will be measured prior to development.

6.7.6 Groundwater Sampling

Monitoring wells. Groundwater levels and free product thicknesses, if present, will be measured in each monitoring well during each monitoring event. Groundwater levels will be measured to the nearest 0.01 foot using an electric water level indicator. Fluid levels in monitoring wells that contain free product will be measured using an ORS interface probe or similar device. The water and free product levels will be measured relative to the casing rim elevations.

Groundwater samples will be obtained using low-flow/low-turbidity sampling techniques to minimize the suspension of sediment in groundwater samples. Groundwater samples will be obtained from monitoring wells using a peristaltic pump and disposable polyethylene tubing. Specifically, groundwater will be pumped at approximately 0.5 liter per minute using a peristaltic pump through tubing placed within the screened interval. A Horiba U-22 water quality measuring system (with flow-through-cell) will be used to monitor the following water quality parameters during purging: electrical conductivity, dissolved oxygen, pH, salinity, total dissolved solids, turbidity, oxidation-reduction potential and temperature. Ambient groundwater conditions will have been reached once these parameters vary by less than 10 percent on three consecutive measurements. The stabilized field measurements will be documented in the field log book (for subsequent use in the RI), and then groundwater samples will be obtained. Purge water will be stored in labeled 55-gallon drums for subsequent characterization. Section 6.8 addresses the disposition of investigation-derived waste such as purge water.

One-Time (Strataprobe) Samples: At selected borings, an approximately 1.25-inch-diameter steel rod will be pushed about 4 feet below the water table and then pulled back to expose a temporary 4-foot-long stainless steel screen. Groundwater samples will be obtained from these temporary wells using low flow sampling methods described above. After collection of the water sample, the screen and rod will be removed and the boring abandoned. New tubing will be used at each boring, and all rods and well screens will be decontaminated between borings.

Groundwater samples will be obtained after a well is purged. Samples will be obtained by flowing water directly from the tubing into sample containers provided by the analytical laboratory. The samples will be free of bubbles, and headspace will not be present in the containers. Each sample container will be securely capped, labeled and placed in a cooler with ice immediately upon collection. The well casing plug and monument cover lid will be secured after each sampling event.

6.7.7 Surface Water Sampling

Surface water samples will be obtained by placing a clean, capped, glass sample collection container as close as possible to the drainage stream bottom, without introducing foreign objects or turbidity. The sample container will then be uncapped, allowing the water to enter, and then recapped prior to removal from the sampling location. If preservative is required in the sample container, the sample will be obtained using a laboratory-provided non-preserved container and then transferred to a laboratory provided container with preservative. Samples will be placed in a cooler with ice and delivered to the analytical laboratory within laboratory-specified holding times. Standard chain-of-custody procedures will be observed during transport of the samples to the laboratory.

Field parameters, including temperature, pH, conductivity, hardness, acidity and alkalinity, will be measured at each surface water sampling point.

6.7.8 Sediment Sampling

Sediment samples will be obtained from the exposed intertidal area of the Site during low tide using a hand shovel or other hand-held sampling utensils. Armoring (cobbles and boulders) will be removed from the surface at each location, and the underlying substrate will be excavated for chemical analyses. Approximately 2 quarts of sediment material will be obtained at each sampling location. Sample material will be obtained using a stainless steel spoon and placed in a stainless steel bowl for mixing prior to placement into laboratory-supplied sample containers.

The location of most samples will be as close to MLLW as possible. These samples will be located using the temporary survey monument marking MLLW.

The depth of each sample interval will be measured. The general character of sediment (size distribution, angularity), presence/absence of brick or slag, field screening results, and location of residual oil, if any, will be recorded for each sample interval.

6.7.9 Decontamination

The drilling equipment will be decontaminated before beginning each boring using a hot-water pressure washer. Reusable sampling/monitoring equipment (trowels, split spoons, bowls, etc.) that come in contact with soil or groundwater will be decontaminated before each use. Decontamination procedures for the equipment will consist of the following: (1) wash with nonphosphate detergent solution (Liqui-Nox and distilled water); (2) rinse with distilled water; and (3) place the decontaminated equipment on clean plastic sheeting or in a plastic bag. Wash water used to decontaminate the sampling equipment will be stored on-site in labeled 55-gallon drums for subsequent characterization and disposal.

6.7.10 Sample Handling

Sample handling procedures, including labeling, container and preservation requirements, and holding times are described in the QAPP (Appendix A). Archived samples will be kept frozen by the laboratory.

6.7.11 Field Equipment Calibration Procedures

Field equipment requiring calibration will be calibrated to known standards in accordance with manufacturers’ recommended schedules and procedures for each instrument. Calibration checks of the vapor measurement equipment will be conducted daily, and the instruments will be recalibrated if required. Calibration measurements will be recorded in the daily field logs. If field equipment becomes inoperable, it will be replaced with a properly calibrated instrument.

6.8 DISPOSITION OF INVESTIGATION-DERIVED MATERIALS

6.8.1 Soil

Soil removed from the test pit excavations will be replaced in the excavations. Soil cuttings from borings completed during this study will be placed in labeled and sealed 55-gallon drums with the exception of the boring for the upgradient well. The drums will be stored temporarily at a secure location selected by Jefferson County pending receipt of analytical results. If analytical results indicate that the soil contains COCs below regulatory levels, the soil will be placed on the ground at the Site, pending approval by Ecology and Jefferson County. If analytical results indicate that COCs are present above regulatory levels, the soil will be disposed of at a permitted disposal facility, pending approval by Ecology and Jefferson County.

6.8.2 Groundwater and Decontamination Water

Purge water removed from the monitoring wells and decontamination water generated during all sampling activities will be stored on-site in labeled 55-gallon drums. If analytical results indicate that the water contains COCs below regulatory levels, the water will be placed on the ground at the Site, pending approval by Ecology and Jefferson County. If analytical results indicate that COCs are present above regulatory levels, the water will be disposed of at a permitted disposal facility, pending approval by Ecology and Jefferson County.

6.8.3 Disposition of Incidental Waste

Incidental waste generated during sampling activities includes items such as gloves, Tyvek suits, spent respirator cartridges, disposable bailers, plastic sheeting, paper towels and similar expended and discarded field supplies. These materials are considered de minimis and will be disposed of at local trash receptacle or county disposal facility.

7.0 TERRESTRIAL ECOLOGICAL EVALUATION

As part of the RI, a terrestrial ecological evaluation will be conducted consistent with WAC 173-340-7490. The purpose of the terrestrial ecological evaluation is to:

- Determine whether site-related soil contamination poses an unacceptable risk to the terrestrial environment;
- Characterize the potential threat to terrestrial plants and animals exposed to the site-related soil contamination; and
- Establish site-specific cleanup levels for protection of terrestrial receptors, including plants, soil biota and wildlife.

8.0 FEASIBILITY STUDY

The FS will be conducted consistent with WAC 173-340-350(8). The scope of the FS will be determined based on the results of the RI. The FS will evaluate a reasonable number of cleanup action alternatives that “protect human health and the environment.” A permanent alternative will be evaluated unless not required as detailed in WAC 173-340-350(8)(c)(ii)(B).

This section lists the specific tasks that will be completed as part of the FS.

8.1 DEVELOP CLEANUP STANDARDS

Cleanup standards for media other than sediment will be developed in accordance with MTCA. Cleanup standards for the aquatic portion of the Site will be developed in accordance with the SMS.

8.1.1 Soil and Groundwater

Cleanup standards will consist of two components: cleanup levels and points of compliance. For each medium, the following process will be followed to identify cleanup levels:

- Identify potential exposure pathways for human and ecological receptors based on beneficial uses of land, groundwater and surface water.
- Evaluate the highest beneficial use and reasonable maximum exposure pathway(s).
- Select indicator hazardous substances.
- Select cleanup level for each indicator hazardous substance and medium.
- Evaluate cleanup levels relative to other applicable or relevant state and federal laws where appropriate.

Points of compliance will be proposed based on potential exposure pathways, technical practicability and consistency relative to similar sites, where appropriate.

8.1.2 Sediment

The SMS specify a process for developing cleanup standards for sediment. The SMS (WAC 173-204-570) provide for site cleanup standards that may range from sediment quality standard (SQS) to minimum cleanup level (MCUL) concentrations. The potential for natural recovery over a 10-year time frame may also be considered, if appropriate. Site units may be defined for areas of the Site if physical, chemical or biological differences (for example, navigation lanes or intertidal areas) at the Site create requirements for using different remediation levels or technologies. Determination of sediment remediation levels will consist, at a minimum, of the following steps:

- The concentrations of COCs and obtained during the RI will be mapped spatially to develop contours showing where concentrations of COC meet and exceed the SQS and the MCUL.
- The contouring will be used to define Site units; COCs and remediation levels may be different for each Site unit.

Cleanup to MCUL will be considered the minimum goal for active remediation of all sediment cleanups.

8.2 IDENTIFY AND SCREEN TECHNOLOGIES

Technologies with potential applicability to the cleanup of the Site will be identified and screened. Only those technologies with proven applicability for treatment of the identified indicator hazardous substances will be screened. The following approach will be used to identify and initially screen technologies:

- Identify cleanup technologies based on cost, net environmental benefit and technical feasibility.
- Evaluate implementability of the identified cleanup technologies. Specific identified cleanup technologies will be eliminated from further consideration on the basis of technical implementability or if the cost of the technology is disproportionate to the resulting environmental benefit. This initial screening step will consider the following information:
    - Contaminant distribution
    - Contaminant concentrations
    - Physical characteristics of the Site and affected media

8.3 DEVELOP AND EVALUATE CLEANUP ALTERNATIVES

Those technologies selected in Section 8.2 will be assembled into cleanup action alternatives and further evaluated against criteria specified in WAC 173-340-360 and Section 9.2 of the "Sediment Cleanup

Standard Users Manual" (Ecology, 1991), as updated. The "No Action" alternative will also be evaluated to provide a basis for comparison to the other proposed alternatives. The general process for this task will be:

- Develop remedial action objectives.
- Develop general response actions that satisfy the remedial action objectives, MTCA and other applicable or relevant state and federal laws, where appropriate.
- Assemble selected technologies into specific cleanup alternatives and identify remediation levels as appropriate.
- Develop preliminary design and order of magnitude cost estimates for each alternative.
- Evaluate cleanup alternatives based on criteria specified in MTCA, WAC 173-340-360 and "Sediment Standards User Manual" (Ecology 1991, as updated).
- Identify a preferred alternative and presented it in the FS report.

9.0 LIMITATIONS

This plan has been prepared for use by SAIC (GeoEngineers is subcontracted to SAIC for Ecology Contract # C0700034), its authorized agents and Washington State Department of Ecology. The information contained herein is not intended for use by others and it is not applicable to other sites. No other (third) party may rely on the product of our services unless we agree in advance and in writing to such reliance. This plan can be provided to contractors, maintenance and utility personnel or other third parties for informational purposes only. This is to provide our firm with reasonable protection against open-ended liability claims by third parties with whom there would otherwise be no contractual limits to their actions.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted environmental science practices in this area at the time this report was prepared. No warranty or other conditions, express or implied should be understood.

Any electronic form, facsimile or hard copy of the original document (email, text, table and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by GeoEngineers Inc. and will serve as the official document of record.

10.0 REFERENCES

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TABLE 1
SUMMARY OF CHEMICAL ANALYTICAL DATA
PETROLEUM AND METALS IN SOIL AND SLAG
DRAFT RI/FS WORK PLAN
IRONDALE IRON AND STEEL PLANT, IRONDALE, WASHINGTON

			Petroleum			Metals														TCLP	
Sample ID	Media	Sample Depth (feet bgs)	HCID (mg/kg)	TPH-D (mg/kg)	TPH-R (mg/kg)	Antimony (mg/kg)	Arsenic (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Thallium (mg/kg)	Zinc (mg/kg)	Arsenic (mg/L)	Lead (mg/L)
Hart Crowser (1996)																					
TP-5, S-3	Soil	5.0 - 6.0	--	--	--	--	**6**	--	0.5 U	**9.5**	**67**	**23,000**	**56**	0.13 U	**24**	--	--	--	**130**	0.05 U	0.03 U
TP-5, S-4	Soil	7.0 - 8.0	1,085	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP-6, S-1	Soil	0.5 - 2.0	--	--	--	--	**11**	--	--	**27**	**180**	**66,000**	**120**	0.13 U	**16**	--	--	--	**61**	0.05 U	0.03 U
TP-7, S-2	Soil	2.0 - 4.0	--	--	--	--	**1.7**	--	0.5 U	**12**	**17**	**13,000**	**27**	0.13 U	**25**	--	--	--	**29**	--	--
TP-8, S-1	Soil	0.0 - 1.0	220	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP-9, S-1	Soil	0.0 - 2.0	700	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP-9, S-2	Soil	3.0 - 5.0	--	--	--	--	**2.3**	--	0.5 U	**15**	**15**	14,000	5 U	0.13 U	**35**	--	--	--	**20**	--	--
TP-10, S-1	Soil	1.0 - 2.0	0.1 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP-10, S-3	Soil	6.5 - 8.0	--	--	--	--	**1.2**	--	0.5 U	**8.9**	**6.2**	**7,800**	5 U	0.13 U	**16**	--	--	--	**13**	--	--
TP-11, S-1	Soil	0.0 - 2.0	0.1 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP-11, S-2	Soil	2.5 - 4.5	--	--	--	--	**68**	--	0.71	**8.2**	**270**	**110,000**	**220**	0.13 U	**33**	--	--	--	**670**	0.05 U	0.03 U
TP-12, S-3	Soil	4.5 - 6.0	0.1 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP-19, S-2	Soil	6.0 - 8.0	--	--	--	--	**18**	--	0.5 U	**10**	**51**	**44,000**	5 U	0.13 U	**11**	--	--	--	**160**	0.05 U	--
SS-3	Slag	0.2 - 0.25	0.1 U	--	--	--	2.8 U	--	0.5 U	**83**	**420**	**320,000**	**2,200**	0.13 U	**12**	--	--	--	**81**	0.05 U	0.03 U
SS-4	Soil	surface	134,000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SS-5	Slag	0.25	--	--	--	--	**4.8**	--	0.5 U	**8.3**	**62**	**25,000**	**11**	0.13 U	**14**	--	--	--	**50**	--	--
Jefferson County (2001)																					
SS1	Soil	unknown	--	**230**	**950**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SS2	Soil	unknown	--	**2,000**	**16,000**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SS3	Soil	unknown	--	--	--	nd	**15.3**	nd	nd	**23.6**	**108**	--	**87.1**	**0.1**	**37**	nd	nd	nd	**409**	--	--
SS4	Soil	unknown	--	--	--	nd	**8.9**	nd	nd	**20.5**	**42.3**	--	**61.1**	**0.0**	**32.4**	nd	nd	nd	**268**	--	--
SS5	Soil	unknown	--	--	--	nd	**6.1**	nd	nd	**22.7**	**79.4**	--	nd	**0.1**	**29.4**	nd	nd	nd	**65.9**	--	--
SS6	Soil	unknown	--	--	--	nd	**5.4**	nd	nd	**32.6**	**48.7**	--	**24.7**	**0.1**	**45.9**	nd	nd	nd	**72.9**	--	--
SS7	Slag	unknown	--	--	--	nd	**10.7**	nd	nd	**111**	**318**	--	**1,910**	nd	**15.8**	nd	nd	nd	**144**	nd	nd
SS8	Soil	unknown	--	--	--	nd	**4.3**	nd	nd	**34.2**	**47.6**	--	nd	**0.1**	**45.4**	nd	nd	nd	**73.3**	--	--
Ecology (2005)																					
05444012; Location 003	Soil/Slag	0.5	--	--	--	**0.21**	**9.06**	**1.04**	**0.20**	**17.3**	**466**	--	**5.41**	0.005 U	**22.3**	0.50 UJ	**0.20**	0.10 U	**33**	--	--
Applicable Screening Criteria																					
MTCA Method A[1]	--	--	--	2,000	2,000	--	20	--	2	19/2000	--	--	250	2	--	--	--	--	--	--	--
MTCA Method B[2]	--	--	--	--	--	32	0.67	160	80	120,000	3,000	24,000	--	24	1,600	400	400	5.6	1,600	--	--
Ecological ISC[3]	--	--	--	--	--	5	7	10	4	42	50	--	50	0.1	30	--	--	--	86	--	--
Background[4]	--	--	--	--	--	--	7	0.6	1	48	36	58,700	24	0.07	48	--	--	--	85	--	--
TCLP Values[5]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5	5

Notes:

[1] MTCA Method A Soil Cleanup Levels for Unrestricted Land Use (Table 740-1; Chapter 173-340 WAC)

[2] MTCA Method B Soil Cleanup Levels based on soil direct contact. WAC 173-340-740 (Equations 740-1 and 740-2)

[3] Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals (Table 749-3; Chapter 173-340 WAC)

[4] Natural Background Soil Metals Concentrations in Washington State (Ecology, 1994). Puget Sound Region values presented.

[5] Maximum concentration of contaminants for the Toxicity Characteristics Leaching Procedure (40 CFR 261.24).

mg/kg = milligrams per kilogram
mg/L = milligrams per liter
"--" = not analyzed or not applicable
"U" indicates analyte not detected. The number reported is the method reporting limit.
TPH-D = Total Petroleum Hydrocarbons - Diesel Range Organics
TPH-R = Total Petroleum Hydrocarbons - Residual Range Organics
HCID = Hydrocarbon Identification
TCLP = Toxicity Characteristics Leaching Procedure
bgs = below ground surface
nd = Not detected
Bold indicates analyte detection.
Shading indicates concentration exceeds at least one screening criteria and background.

TABLE 2
SUMMARY OF CHEMICAL ANALYTICAL DATA
PETROLEUM AND METALS IN GROUNDWATER
DRAFT RI/FS WORK PLAN
IRONDALE IRON AND STEEL PLANT, IRONDALE, WASHINGTON

			Petroleum	Metals								
Sample ID	Media	Sample Depth (feet bgs)	HCID (mg/L)	Arsenic (µg/L)	Cadmium (µg/L)	Chromium (µg/L)	Copper (µg/L)	Iron (µg/L)	Lead (µg/L)	Mercury (µg/L)	Nickel (µg/L)	Zinc (µg/L)
Hart Crowser (1996)[1,2]												
TP11, W-5	Water	6	0.2 U	**4**	5 U	10 U	**330**	**33,000**	**290**	0.2 U	**26**	**870**
TP12, W-4	Water	5	0.2 U	**22**	5 U	10 U	10 U	**8,800**	3 U	0.2 U	**27**	**26**
Applicable Screening Criteria												
Aquatic Life Marine Chronic[3]	--	--	--	36	8.8	--	2.4	--	8.1	0.025	8.2	81
Human Health Marine[4]	--	--	--	0.14	--	--	--	--	--	0.15	4,600	26,000
MTCA Method B Surface Water[5]	--	--	--	0.098	20	240,000	2,700	--	--	--	1,100	17,000

Notes:

[1] It is not clear based on a review of the Hart Crowser report (1996) which test pits (TP-11 or TP-12) samples W-4 and W-5 were collected from. Table 2 of the Hart Crowser report presents the data as shown in this table. However, our review of the Hart Crowser report leads us to believe that sample W-4 was obtained from TP-11 and W-5 was obtained from TP-12.

[2] These samples likely are not representative of groundwater because they were obtained from with test pit explorations and not groundwater monitoring wells.

[2] Lowest available aquatic life marine chronic criteria from Chapter 173-201A, Clean Water Act Section 304, and National Toxics Rule (40 CFR 131)

[3] Lowest available human health marine criteria from Clean Water Act Section 304 and National Toxics Rule (40 CFR 131)

[4] MTCA Method B surface water cleanup level [WAC 173-340-730(3)(b)(iii)]

mg/L = milligrams per liter

µg/L = micrograms per liter

"--" = not analyzed or not applicable

"U" indicates analyte not detected. The number reported is the method reporting limit.

bgs = below ground surface

Bold indicates analyte detection.

Shading indicates concentration exceeds at least one screening criteria.

TABLE 3
SUMMARY OF CHEMICAL ANALYTICAL DATA
PETROLEUM AND METALS IN SEDIMENT
DRAFT RI/FS WORK PLAN
IRONDALE IRON AND STEEL PLANT, IRONDALE, WASHINGTON

		Sample Depth	Petroleum			Metals													
Sample ID	Media	(inches)	HCID (mg/kg)	TPH-Dx (mg/kg)	TOC %	Antimony (mg/kg)	Arsenic (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Thallium (mg/kg)	Zinc (mg/kg)
Hart Crowser (1996)																			
SS-1	Sediment	6	0.1 U	--	--	--	**1.8**	--	0.5 U	**7.2**	**7.1**	**8,400**	5 U	0.13 U	**14**	--	--	--	**15**
SS-2	Sediment	6	0.1 U	--	--	--	**3.1**	--	0.5 U	**9.9**	**22**	**7,200**	7.7	0.13 U	**7.6**	--	--	--	**17**
Jefferson County (2001)																			
BS1	Sediment	unknown	--	--	--	nd	**2.7**	nd	nd	**15.1**	**4.9**	--	nd	0.0	**21**	nd	nd	nd	**17.6**
BS2	Sediment	unknown	--	--	--	nd	**4.8**	nd	nd	**11.4**	**10.8**	--	nd	nd	**20.4**	nd	nd	nd	**22.3**
BS3	Sediment	unknown	--	--	--	nd	**4.0**	**1.2**	nd	**11**	**412**	--	nd	nd	**14.8**	nd	nd	nd	**47.1**
Ecology (2005)																			
05284010; Location 001	Sediment	0.3 to 0.5	--	40,600	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
05284011; Location 002	Sediment	0.25	--	550	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
05444013; Location 004	Sediment	0.25	--	1,000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Jefferson County (2007)																			
07034900, Location 1	Sediment	6	nd	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034901, Location 1	Sediment	12	nd	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034902, Location 1	Sediment	18	nd	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034903, Location 2	Sediment	6	EW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034904, Location 2	Sediment	12	EW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034905, Location 2	Sediment	18	EW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034906, Location 3	Sediment	6	EW	240	0.34 J	0.20 U	5.0	--	0.11	21	50.6	33,300	12.4	0.0072	28.3	--	0.10 U	--	69
07034907, Location 3	Sediment	12	EW	2,300	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034908, Location 3	Sediment	18	EW	610	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034909, Location 4	Sediment	6	EW	170	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034910, Location 4	Sediment	12	EW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034911, Location 4	Sediment	18	EW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034912, Location 5	Sediment	6	VW	110	1.65 J	0.20 U	4.1	--	0.12	26.7	34.0	28,900	14.3	0.0095	31.5	--	0.10 U	--	55
07034913, Location 5	Sediment	12	VW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034914, Location 5	Sediment	18	VW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034915, Location 6	Sediment	6	nd	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034916, Location 6	Sediment	12	nd	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034917, Location 6	Sediment	18	nd	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034918, Location 7	Sediment	6	VW	180	2.21 J	0.20 U	4.7	--	0.11	24 J	35.6 J	23,000	16.7	0.012	32.6	--	0.10 U	--	86
07034919, Location 7	Sediment	12	nd	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034920, Location 7	Sediment	18	VW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034921, Location 8	Sediment	6	nd	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034922, Location 8	Sediment	12	nd	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034923, Location 8	Sediment	18	nd	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034924, Location 9	Sediment	6	nd	--	0.59 J	0.20 U	3.0	--	0.16	26.8	28.8	18,000	5.92	0.012	38.7	--	0.10 U	--	47
07034925, Location 9	Sediment	12	nd	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034926, Location 9	Sediment	18	nd	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034927, Location 10	Sediment	6	nd	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034928, Location 10	Sediment	12	nd	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034929, Location 10	Sediment	18	nd	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034930, Location 11	Sediment	6	nd	--	0.30 J	0.20 U	3.3	--	0.11	23.6	31.1	17,600	10.3	0.006	25.7	--	0.10 U	--	53
07034931, Location 11	Sediment	12	nd	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034932, Location 11	Sediment	18	VW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034933, Location 12	Sediment	6	EW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034934, Location 12	Sediment	12	EW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
07034935, Location 12	Sediment	18	EW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Applicable Screening Criteria																			
Sediment Criteria - SQS[1]	--	--	--	--	--	--	57	--	5.1	260	390	--	450	0.41	--	--	6.1	--	410
Sediment Criteria - CSL[2]	--	--	--	--	--	--	93	--	6.7	270	390	--	530	0.59	--	--	6.1	--	960

Notes:

[1] Marine Sediment Quality Standards - Chemical Criteria (Table I; Chapter 173-204 WAC - Sediment Management Standards)

[2] Puget Sound Marine Sediment Cleanup Screening Levels and Minimum Cleanup Levels - Chemical Criteria (Table III; Chapter 173-204 WAC - Sediment Management Standards)

mg/kg = milligrams per kilogram

"--" = not analyzed or not applicable

"J" indicates an estimated concentration.

"U" indicates analyte not detected. The number reported is the method reporting limit.

nd = Not detected

TOC = Total organic carbon

EW = Extremely weathered heavy fuel oil

VW = Very weathered heavy fuel oil

Bold indicates analyte detection.

Shading indicates concentration exceeds at least one screening criteria.

TABLE 4
SUMMARY OF CHEMICAL ANALYTICAL DATA
POLYCYCLIC AROMATIC HYDROCARBONS IN SEDIMENT
DRAFT RI/FS WORK PLAN
IRONDALE IRON AND STEEL PLANT, IRONDALE, WASHINGTON

Sample ID	Media	Sample Depth (inches)	TOC %	Polycyclic Aromatic Hydrocarbons										
				1-Methylnaphthalene (mg/kg)	**2-Chloronaphthalene (mg/kg)**	**2-Methylnaphthalene (mg/kg)**	**Acenaphthene (mg/kg)**	**Acenaphthylene (mg/kg)**	**Anthracene (mg/kg)**	**Benzo(a)anthracene (mg/kg)**	**Benzo(a)pyrene (mg/kg)**	**Benzo(b)fluoranthene (mg/kg)**	**Benzo(ghi)perylene (mg/kg)**	**Benzo(k)fluoranthene (mg/kg)**
Jefferson County (2007)														
07034906, Location 3	Sediment	6	0.34 J	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.018	0.012	0.012
07034912, Location 5	Sediment	6	1.65 J	0.012	0.012	0.012	0.012	0.012	0.012	0.039	0.02	0.039	0.012	0.016
07034918, Location 7	Sediment	6	2.21 J	0.012	0.012	0.012	0.012	0.012	0.012	0.018	0.012	0.027	0.012	0.012
Applicable MTCA Cleanup Levels														
Sediment Criteria - SQS[1]	--	--	--	--	--	38	16	66	220	110	99	230	31	230
Sediment Criteria - CSL[2]	--	--	--	--	--	64	57	66	1,200	270	210	450	78	450

Sample ID	Media	Sample Depth (inches)	TOC %	Polycyclic Aromatic Hydrocarbons										
				Carbazole (mg/kg)	**Chrysene (mg/kg)**	**Dibenzo(a,h)anthracene (mg/kg)**	**Dibenzofuran (mg/kg)**	**Fluoranthene (mg/kg)**	**Fluorene (mg/kg)**	**Indeno(1, 2, 3-cd)pyrene (mg/kg)**	**Naphthalene (mg/kg)**	**Phenanthrene (mg/kg)**	**Pyrene (mg/kg)**	**Retene (mg/kg)**
Jefferson County (2007)														
07034906, Location 3	Sediment	6	0.34 J	0.231	0.015	0.023	0.023	0.012	0.012	0.012	0.012	0.044	0.026	0.772
07034912, Location 5	Sediment	6	1.65 J	0.239	0.067	0.024	0	0.083	0	0	0.012	0	0.078	1.6
07034918, Location 7	Sediment	6	2.21 J	0.242	0.03	0.024	0	0.012	0	0	0.012	0	0.031	0.682
Applicable MTCA Cleanup Levels														
Sediment Criteria - SQS[1]	--	--	--	--	110	12	--	160	23	34	99	100	1,000	--
Sediment Criteria - CSL[2]	--	--	--	--	460	33	--	1,200	79	88	170	480	1,400	--

Notes:

[1] Marine Sediment Quality Standards - Chemical Criteria (Table I; Chapter 173-204 WAC - Sediment Management Standards)

[2] Puget Sound Marine Sediment Cleanup Screening Levels and Minimum Cleanup Levels - Chemical Criteria (Table III; Chapter 173-204 WAC - Sediment Management Standards)

mg/kg = milligrams per kilogram

"--" = not analyzed or not applicable

"J" indicates an estimated concentration.

TOC = Total Organic Carbon

Bold indicates analyte detection.

Shading indicates concentration exceeds at least one screening criteria.

TABLE 5
SUMMARY OF CHEMICAL ANALYTICAL DATA
POLYCYCLIC AROMATIC HYDROCARBONS AND METALS IN TISSUE
DRAFT RI/FS WORK PLAN

IRONDALE IRON AND STEEL PLANT, IRONDALE, WASHINGTON

Analyte	Results (mg/kg)
Jefferson County (2007)	
PAHs	
2-Methylnaphthalene	9.9 U
Acenaphthene	9.9 U
Acenaphthylene	9.9 U
Anthracene	9.9 U
Benzo(a)anthracene	9.9 U
Benzo(a)pyrene	9.9 U
Benzo(b)fluoranthene	9.9 U
Benzo(g,h,i)perylene	9.9 U
Benzo(k)fluoranthene	9.9 U
Chrysene	9.9 U
Dibenz(a,h)anthracene	9.9 U
Dibenzofuran	9.9 U
Fluoranthene	9.9 U
Fluorene	9.9 U
Indeno(1,2,3-cd)pyrene	9.9 U
Naphthalene	9.9 U
Phenanthrene	9.9 U
Pyrene	9.9 U
Metals	
Arsenic	**2**
Cadmium	**0.46**
Chromium	**0.6**
Copper	**8.44**
Lead	**0.8**
Mercury	0.01 U
Silver	0.06 U
Zinc	**21.0**

Notes:

mg/kg = milligrams per kilogram

"U" indicates analyte not detected. The number reported is the method reporting limit.

Bold indicates analyte detection.

TABLE 6
SAMPLING AND ANALYSIS PLAN
DRAFT FINAL RI/FS WORK PLAN
IRONDALE IRON AND STEEL PLANT, IRONDALE, WASHINGTON

UPLAND

Sampling Area (reference to Text section of Work Plan)	Sample Matrix	Type of Exploration	Sample IDs	Number of Explorations [1]	Approximate Sample Depths (feet bgs)[3]	Number of Samples	Approximate Type and Number of Chemical Analyses[2,3]				Organic Carbon	Metals Leaching test[4]	Comments
							As,Cu,Fe,Pb,Ni,Zn	Oil-Range Hydrocarbons	Extractable Petroleum Hydrocarbons	PAHs			
SOIL SAMPLING AND ANALYSIS													
Nearshore Upland Fill Area (Section 6.2)	Soil/fill	Test pits	TP12-19	8	0-2; 2-4, 6-8	24	24	8	0	0	1	1	Actual sample depths will depend on the nature of fill encountered, samples representative of the different types of fill will be collected . PAH analysis only in samples with detectable levels of ORH. Samples for ORH analysis will be selected based on field screening observations. One sample from a test pit with no evidence of
Slag on Shoreline Headland (Section 6.2)	Slag	Composited grab sample	Slag 1-2	2	Surface	2	2	0	0	0	0	0	One composite representative of the red colored slag and one composite representative of the white colored more friable slag will be collected. Each composite will be composed of four discrete sub-samples collected approximately 10 feet apart along the exposed face of the headland.
Beehive Kilns (Section 6.3.1)	Soil/fill	Test pits	TP9-11	3	0-2; 2-4, 6-8	9	9	3	1	3	0	0	Actual sample depths will depend on the nature of fill encountered, samples representative of the different types of fill will be collected . PAH analysis only in samples with detectable levels of ORH. Samples for ORH analysis will be selected based on field screening observations. Samples with highest concentration of ORH will be analyzed for extractable petroleum hydrocarbons.
6000 Barrel AST (Section 6.3.2)	Soil/fill	Test Pits	TP5-8	4	0-2; 2-4, 6-8	12	12	12	1	4	0	0	
Power House, Engine House, Boiler House (Section 6.3.3)	Soil/fill	Hand auger or Test Pit	TP2-3	2	0-2 and 2-4	4	4	1	0	1	0	0	None
Blast Furnace and Cast House (Section 6.3.4)	Soil/fill	Hand auger or Test Pit	TP4	1	0-2 and 2-4	2	2	1	0	1	0	0	None
Steel Production Building (Section 6.3.5)	Soil/fill	Hand auger or Test Pit	TP21-22	2	0-2 and 2-4	4	4	1	0	1	0	1	ORH will only be tested in samples with field screening evidence of hydrocarbons. PAH analysis only in samples with detectable levels of ORH. One sample of slag fill will be analyzed for metal leaching potential.
Boiler Plant (Section 6.3.6)	Soil/fill	Test Pit	TP20	1	0-2; 2-4, 6-8	3	3	1	0	1	0	0	
Blacksmith Shop & Machine Shop (Section 6.3.7)	Soil/fill	Hand auger or Test Pit	TP1	1	0-2 and 2-4	2	2	1	0	1	0	0	
Soil Borings for Groundwater Sampling (Section 6.4)	Soil/fill	Direct push or Hollow Stem Auger	DP1-5	5	near water table	5	5	0	0	0	0	0	None
SOIL TOTAL						67	67	28	2	12	1	2	
FREE PRODUCT, GROUNDWATER, AND SURFACE WATER SAMPLING AND ANALYSIS													
Free product (if present)	Product	Grab Sample	--	--	--	1	0	1	0	1	0	0	None
Groundwater (Section 6.4)	Groundwater	4 monitoring wells, 1 grab sample	DP1 MW1-4	5	Shallow groundwater	5	5	5	1	5	0	0	One sample from groundwater monitoring well located near AST will be analyzed for extractable petroleum hydrocarbons.
Surface Water (Section 6.5)	Surface Water in Upland Drainage	grab	SW1-2	--	Surface	2	2	0	0	0	0	0	None
SAMPLING AND ANALYSIS TOTAL						75	74	34	3	18	1	2	
GEOPHYSICS													
Geophysics (Section 6.2)	Soil/fill	Ground Penetrating Radar or Electromagnetic survey	--	Upland nearshore area and along shoreline bank									None

Aquatic

Sampling Area (reference to Text section of Work Plan)	Sample Matrix	Type of Exploration		Number of Explorations [1]	Chemical Analyses Sample Depth (inches bgs)[3]	Number of Samples	As, Cu, Cd, Cr, Pb, Hg, Ag, Zn (Fe)	HCID	SVOCs	Comments
SEDIMENT SAMPLING AND ANALYSIS										
Sediment (Section 6.6)	Sediment	Grab Sample	SED1-16	16	0-4, 4-24, 24-36, 36-48	64	18-64	18-64	18-64	Deeper samples will only be tested if field observations indicate contamination is present, with the following exception; 1) the 4"-24" interval from locations 1 and 2 will be analyzed.

Notes:

[1] Proposed exploration locations are shown in Figure 5.

[2] The number of analyses shown does not include chemical analyses that will be completed for quality assurance/quality control (QA/QC) purposes.

[3] Analytical methods are outlined in Section 6.0 Actual number of samples and sample depth will depend on conditions encountered in each exploration. Groundwater and surface water will be tested for total dissolved metals.

[4] Leaching lest will be in accordance with 173-340-747 for metals.

As = arsenic, Cd = cadmium, Cr = chromium, Cu = copper, Fe = iron, Pb=lead, Hg = mercury, Ni = nickel, Zn = zinc

bgs = Below ground surface

PAH = Polycyclic aromatic hydrocarbons

-- = analytical testing not planned

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Map Revised: May 24, 2007

Vicinity Map

Irondale Iron and Steel Plant
Irondale, Washington

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Figure 1

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: ESRI Data & Maps, Street Maps 2005

Transverse Mercator, Zone 10 N North, North American Datum 1983
North arrow oriented to grid north

Office: SEA Path: P:\0\0504042\00\GIS\050404200 FIG-1.mxd

Map Revised: June 19, 2007

Reference: Aerial photo (April 2003) from Jefferson County (http:maps.co.jefferson.wa.us, accessed May 2007).
Former structures from PDF files provided by Hart Crowser, entitled Site and Exploration Plan Irondale Site.

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for infomation purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Site Plan

Irondale Iron and Steel Plant
Irondale, Washington

GeoEngineers

Figure 2

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Office:SEA

Legend

⊙	Soil Sample Locations HartCrowser 1996
◎	Soil Sample Locations Jefferson County 2001
⬢	Sediment Sample Locations HartCrowser 1996
●	Sediment Sample Locations Jefferson County 2001
△	Sediment Sample Locations Jefferson County 2007
▣	Test Pit Locations HartCrowser 1996
—	Former Structures
-·-	Site Boundary

Previous Sampling Locations

Irondale Iron and Steel Plant
Irondale, Washington

GeoEngineers

Figure 3

Reference: Aerial photo (April 2003) from Jefferson County (http:maps.co.jefferson.wa.us, accessed May 2007).
Former structures, sediment and test pit locations from PDF files provided by Hart Crowser, entitled Site and Exploration Plan Irondale Site.
SS and BS samples from Jefferson County map entitled "Figure 1 Samples Site Plan Circa 1910).
Notes:
1. The locations of all features shown are approximate.
2. This drawing is for infomation purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Map Revised: June 19, 2007

Path: P:\0\0504042\00\GIS\050404200_FIG-3.mxd

Office:SEA

Map Revised: June 19, 2007

Previous Sampling Locations with Exceedances of Regulatory Criteria

Irondale Iron and Steel Plant
Irondale, Washington

GEOENGINEERS

Figure 4

Reference: Aerial photo (April 2003) from Jefferson County (http:maps.co.jefferson.wa.us, accessed May 2007).
Former structures, sediment and test pit locations from PDF files provided by Hart Crowser, entitled Site and Exploration Plan Irondale Site.
SS and BS samples from Jefferson County map entitled "Figure 1 Samples Site Plan Circa 1910).

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for infomation purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Path: P:\0\0504042\00\GIS\050404200_FIG-4.mxd

Office:SEA

Map Revised: June 20, 2007

Reference: Aerial photo (April 2003) from Jefferson County (http:maps.co.jefferson.wa.us, accessed May 2007).
Former structures from PDF files provided by Hart Crowser, entitled Site and Exploration Plan Irondale Site.

Notes:
1. Sediment Samples 4 and 11-15 will be collected by boat during another phase of work.
2.The locations of all features shown are approximate.
3. This drawing is for infomation purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

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Proposed Sample Locations

Irondale Iron and Steel Plant
Irondale, Washington

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Figure 5

APPENDIX A

QUALITY ASSURANCE PROJECT PLAN

Quality Assurance Project Plan
Investigation/Feasibility Study
Irondale, Washington
File No. 0504-042-00

June 5, 2007

Prepared for:

Washington State Department of Ecology
Toxics Cleanup Program
300 Desmond Drive
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Attention: Steve Teel

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TITLE AND APPROVAL PAGE
QUALITY ASSURANCE PROJECT PLAN
RI/FS – IRONDALE IRON AND STEEL PLANT

Contractor
Project Manager: ______________________________ ______________
Date

Contractor
QA Manager: ______________________________ ______________
Date

Laboratory
Project Manager: ______________________________ ______________
Date

Data Validation Contractor
Project Manager: ______________________________ ______________
Date

WA Dept. of Ecology
Project Manager: ______________________________ ______________
Date

Distribution List

This list identifies all individuals to receive a copy of the approved QA Project Plan either in hard copy or electronic format, as well as any subsequent revisions.

Washington State Department of Ecology, Project Manager: Steve Teel

Science Applications International Corporation, Project Manager: Mark Dagel

Project Manager: Neil Morton, GeoEngineers

Program Manager: Dave Cook, GeoEngineers

Laboratory Manager: To be determined

QA/QC Manager: Rob Smith, GeoEngineers

Field Coordinator: Ron Bek, GeoEngineers

Data Quality Management: Linda Bohannon, EcoChem

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REMEDIAL INVESTIGATION/FEASIBILITY STUDY
IRONDALE, WASHINGTON
FOR
WASHINGTON STATE DEPARTMENT OF ECOLOGY

1.0 BACKGROUND

A project summary, site description, and summary of site history are included in the Draft RI/FS Work Plan.

2.0 PROJECT DESCRIPTION

The purpose of the RI/FS is to define the nature and extent of contamination in soil, sediment, groundwater, surface water, and to evaluate the feasibility of appropriate remedies. The RI/FS must be completed so that remedies are addressed systematically and cohesively.

This Quality Assurance Project Plan (QAPP) was developed for the RI/FS activities at Irondale, WA. The QAPP serves as the primary guide for the integration of quality assurance (QA) and quality control (QC) functions into project activities. The QAPP compiles the organization, objectives, and specific quality assurance and quality control activities required for project implementation and assessment This QAPP is based on guidelines specified in Washington Administrative Code (WAC) 173, Chapter 173-340 and Ecology guidance (February, 2001).

Throughout the project, environmental measurements will be conducted to produce data that are scientifically valid, of known and acceptable quality, and meet established objectives. QA/QC procedures will be implemented so that precision, accuracy, representativeness, completeness, and comparability (PARCC) of data generated meet the specified data quality objectives.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The key project personnel are described in this section. Descriptions of the responsibilities, lines of authority and communication for the team members, with regard to quality assurance and quality control, are provided below. This organization facilitates the efficient production of project work, allows for an independent quality review, and permits resolution of any QA issues before submittal.

3.1 PROJECT LEADERSHIP AND MANAGEMENT

Within GeoEngineers there are two levels of project responsibility; the Principal-in-Charge and the Project Manager. The Principal-in-Charge is ultimately responsible for technical quality, schedule, budge, and staff resources for the project. This person is responsible to Ecology for fulfilling contractual and administrative control of the project, providing technical oversight, and providing overall review of project deliverables. David A. Cook, LG, RBP is the Principle-in-Charge.

The Project Manager's duties consist of providing concise technical work statements for project tasks, selecting project team members, determining and coordinating subcontractor participation, providing technical direction to and supervising the field staff, establishing budgets and schedules, adhering to budgets and schedules, allocating resources for field tasks, supervising field personnel, providing technical oversight, and providing overall production and review of project deliverables. Neil Morton is the Project Manager for activities at the site.

3.2 FIELD COORDINATOR

The Field Coordinator is responsible for the daily management of activities in the field. Ron Bek, LG is the Field Coordinator for activities at the site. Specific responsibilities include the following:

- Coordinate data collection activities to be consistent with information requirements.
- Supervise the compilation of field data and laboratory analytical results.
- Assure that data are correctly and completely reported.
- Implement and oversee field sampling in accordance with project plans.
- Coordinate work with on-site subcontractors.
- Schedule sample shipment with the analytical laboratory.
- Monitors that appropriate sampling, testing, and measurement procedures are followed.
- Coordinate the transfer of field data, sample tracking forms, and log books to the Project Manager for data reduction and validation.
- Participate in QA corrective actions as required.

3.3 QUALITY ASSURANCE LEADER

The GeoEngineers project QA Leader is Rob Smith. The Project QA Leader is responsible for coordinating QA/QC activities as they relate to the acquisition of field data. The QA Leader has the following responsibilities:

- Responds to laboratory data, QA needs, resolves issues, and answers requests for guidance and assistance.
- Reviews the implementation of the QAPP and the adequacy of the data generated from a quality perspective.
- Maintains the authority to implement corrective actions as necessary.
- Reviews and approves the laboratory QA Plan.
- Evaluates the laboratory's final QA report for any condition that adversely impacts data generation.
- Ensures that appropriate sampling, testing, and analysis procedures are followed and that correct quality control checks are implemented.
- Monitors subcontractor compliance with data quality requirements.

3.4 DATA VALIDATION CONTRACTOR

In addition, the Data Validation Contractor (EcoChem, Inc.) is responsible for QA oversight for analytical data quality evaluation and validation.

The Data Validation Contractor provides coordination of the QA/QC activities as they relate to Analytical data quality. Specific responsibilities include the following:

- Serve as the official contact for laboratory data quality control (QC) concerns.
- Respond to laboratory data QC issues, resolves chemistry data quality issues, and answers requests for guidance and assistance.

- Prepare the QAPP and then evaluates the adequacy of the data generated from a quality perspective.
- Implement corrective actions as necessary.
- Evaluate and validate the laboratory analytical data and applies qualifiers as necessary.
- Ensure that correct quality control checks for sampling, testing, and analysis procedures are implemented and documented.

3.5 LABORATORY PROJECT MANAGEMENT

The subcontracted laboratory (laboratories) conducting sample analyses for this project is (are) required to obtain approval from the QA Leader or Data Validation Contractor before the initiation of sample analysis to assure that the laboratory QA plan complies with the project QA objectives. The Laboratory's QA Coordinator will ensure that the Laboratory QA Plan is followed and is responsible for project quality control (QC). Specific responsibilities of this position include:

- Ensure implementation of the Laboratory *Quality Assurance Plan*.
- Serve as the laboratory point of contact.
- Activate corrective action for out-of-control events.
- Issue the final laboratory data reports, both hardcopy and EDD.
- Comply with the specifications established in the project plans as related to laboratory services.
- Participate in QA audits and compliance inspections (as applicable).

4.0 QUALITY ASSURANCE OBJECTIVES

The overall quality objective for the data used to support RI/FS activities is that the data are of known, acceptable, and documented quality. This objective can be achieved by establishing the following goals for data quality:

- Implement the procedures outlined in this QAPP for field sampling, sample custody, equipment operation and calibration, laboratory analysis, and data reporting so that consistency and thoroughness of data generation are facilitated.
- Achieve the acceptable level of quality required so that data generated are scientifically valid and of known and documented quality. This will be accomplished by establishing measurement quality objectives (MQO) for the key quality indicators i.e., precision, bias (accuracy), representativeness, completeness, and comparability, and by evaluating data against these MQO.

4.1 MEASUREMENT QUALITY OBJECTIVES (MQO)

Usability of the data will be based on both quantitative (precision, accuracy/bias, and completeness) and qualitative (representativeness and comparability) quality assurance objectives. The measurement goals for the project data, based on the data quality indicators discussed in the following sections. A summary of the project MQO is provided in Table 1. Tables 2 through 7 present the analytes and corresponding target reporting limits.

4.1.1 Precision

Precision is a measure of the variability in the results of replicate measurements due to random error. Random errors are always present because of normal variability in the many factors that affect measurement results. Precision can also be affected by the variations of the actual concentrations in the media being sampled (Ecology, 2004). The closer the measured values are to each other, the more precise the measurement process. Precision error may affect data usefulness. Good precision is indicative of relative consistency and comparability between different samples.

Field precision will be assessed through the collection and measurement of field duplicates at a rate of one duplicate per 20 field samples, or a minimum of 1 per day. These analyses measure both field and Laboratory precision. The results, therefore, may have more variability than Laboratory duplicates that measure only Laboratory performance. It is expected that soil duplicate results will have a greater variance than water matrices due to difficulties associated with collecting identical field duplicate samples.

Laboratory precision is assessed through analysis of duplicate spiked and/or unspiked samples, as specified by the analytical method. Specific discussion of the different types of laboratory duplicate samples is found in Section 10.1.

The RPD value will be calculated according to the following formula:

$$RPD\,(\%) = \frac{|D_1 - D_2|}{(D_1 + D_2)/2}\ X\ 100,$$

Where:

D_1=Concentration of analyte in sample.

D_2=Concentration of analyte in duplicate sample.

The calculation applies to split samples, replicate analyses, duplicate spiked environmental samples (matrix spike duplicates), and laboratory control duplicates. The RPD will be calculated for samples and compared to the applicable criteria. Precision may also be expressed as the percent difference (%D) between replicate analyses. During data validation, DV Contractor will evaluate all RPD values and take action as described in *National Functional Guidelines for Organic Data Review* (USEPA 1999) and *National Functional Guidelines Inorganic Data Review* (USEPA 2002).

4.1.2 Bias (Accuracy)

Accuracy is a measure of bias in the analytic process. The closer the measurement value is to the true value, the greater the accuracy. This measure is defined as the difference between the reported values versus the actual values and is often measured with the addition of a known compound to a sample. The amount of known compound reported in the sample, or percent recovery, assists in determining the performance of the analytical system in correctly quantifying the compounds of interest. Since most environmental data collected represent one point spatially and temporally rather than an average of values, accuracy plays a greater role than precision in assessing the results. In general, if the percent recovery is low, non-detect results may indicate that compounds of interest are not present when in fact these compounds are present. Detected compounds may be biased low or reported at a value less than actual environmental conditions. The reverse is true when recoveries are high. Non-detect values are considered accurate while detected results may be higher than the true value.

Accuracy will be expressed as the percent recovery of a surrogate compound (also know as "system monitoring compound"), a matrix spike result, or from a standard reference material where:

$$Recovery\,(\%) = \frac{Sample\ Result}{Spike\ Amount}\ X\ 100$$

The DV Contractor will evaluate all %R values and take action as described in *National Functional Guidelines for Organic Data Review* (USEPA 1999) and *National Functional Guidelines Inorganic Data Review* (USEPA 2002).

4.1.3 Sensitivity

Analytical methods have quantitative limitations at a given statistical level of confidence that are often expressed as the method detection limit (MDL). Although results reported near the MDL provide insight to site conditions, quality assurance requires that analytical methods achieve a consistently reliable level of quantitation known as the practical quantitation limit (PQL). The Laboratory will provide numerical results for all analytes and report them as detected above the PQL or undetected at the PQL.

Analytical detection limits for the target analytes are helpful in providing statistically useful data. Intended data uses, such as comparison to regulatory criteria or risk assessment, usually dictate specific target reporting levels necessary to fulfill stated objectives. The analytical methods and processes selected should provide a PQL lower than the target reporting level (e.g., lowest regulatory cleanup level) under ideal conditions. The reporting limit listed in Tables 2 through 7 are considered "target" reporting limits because several factors may influence laboratory practical quantitation limits and individual sample quantitation limits. First, physical conditions of soil (e.g., moisture, compaction, composition) affect detection limits. Second, analytical procedures may require sample dilutions and/or clean up and reanalysis to accurately quantify a particular analyte at concentrations above the range of the instrument. The effect is that other analytes may be reported as undetected at a PQL much higher than a specified regulatory cleanup level. Data users must be aware that high non-detect values, although correctly reported, can bias statistical summaries and careful interpretation is required to correctly characterize site conditions. During data validation, evaluation will be made and the most appropriate result for each analyte will be reported.

4.1.4 Representativeness, Completeness and Comparability

To be considered representative, a data set should accurately and precisely represent the actual site conditions. The determination of the representativeness of the data will be performed by completing the following:

- Comparing actual sampling procedures to those prescribed within the Field Sampling Plan (FSP) and this QAPP.
- Comparing analytical results from field duplicates to determine variation in the analytical results.
- Invalidating non-representative data or identifying data that is questionable or qualitative. Only representative data will be used in subsequent data reduction, validation, and reporting activities.

Completeness will establish whether a sufficient amount of valid measurements were obtained to meet project goals. The number of samples and results expected establishes the comparative basis for completeness and is defined as a ratio of acceptable measurements (including estimated data) obtained to the total number of planned measurements for an activity. Completeness (C) can be calculated as follows:

$$\%C = \frac{\underline{(\text{number of acceptable data points}) \times 100}}{(\text{total number of data points})}$$

The completeness goal is 95 percent useable data for samples/analyses planned. If the completeness goal is not achieved an evaluation will be made to determine if the data are adequate to meet study objectives.

Comparability expresses the confidence with which one set of data can be compared to another. Since numeric goals do not exist for comparability, a statement of comparability will be prepared to determine overall usefulness of data sets, following the determination of both precision and accuracy. This statement will be included in RI/FS final reports.

5.0 SAMPLING PROCESS DESIGN

Section 6.0 of the Draft RI/FS Work Plan presents design of the proposed sampling program for the collection of chemical and physical data at Irondale. The data are intended to augment existing data for use in the current RI/FS. The quality of data collected depends critically on the quality of the sampling process and field activities. Field activities and practices must be planned and implemented to ensure the integrity of the samples and resulting data.

6.0 SAMPLE COLLECTION, HANDLING AND CUSTODY

6.1 SAMPLE CONTAINERS AND LABELING

The Field Coordinator will establish field protocols to manage field sample collection, handling, and documentation. Samples obtained during this study will be placed in appropriate pre-cleaned containers Sample containers, preservation and holding times are listed in Table 8.

Holding times are defined as the time between sample collection and extraction, sample collection and analysis, or sample extraction and analysis. Some analytical methods specify a holding time for analysis only. If a sample exceeds a holding time, then the results may be biased low. During data validation, DV Contractor will evaluate all holding time values and take action as described in *National Functional Guidelines for Organic Data Review* (USEPA 1999) and *National Functional Guidelines Inorganic Data Review* (USEPA 2002).

6.1.1 Sample Designation

Each sample collected during the field activities will be identified by a unique sample designation. The sample designation will be included on the sample label. For soil samples, the designation will also be included with the corresponding sample information on the appropriate boring or test pit log. The following designation system will be used for this project.

Samples collected will be assigned a unique identification code based on a consistent sample designation scheme. The sample designation scheme is designed to suit the needs of the field staff, data management, and data users.

Samples will consist of three components separated by a dash. These components are station code, date, and sample interval. The sample designation is as follows:

Station CodeDate Sample Number

SSnnYYMMDDXX

6.1.1.1 Station Code

The station code component is a four-character code that uniquely identifies each sampling station. The station code component has two parts: a two or three letter station designation "SS" followed by a two number sequential component "nn"; the sequential component will begin at 01 (i.e., 01, 02, 03, etc.).

- HSA – Hollow Stem Auger
- DP – Direct-Push
- TP – Test Pit
- MW – Monitoring Well
- GW – Groundwater Sample from Temporary Well
- SW – Surface Water
- SED – Sediment

6.1.1.2 Date

The date component is a six-character code that presents the date that the sample was collected in the following format: year, month, day (YYMMDD).

6.1.1.3 Sample Depth

The sample depth applies to soil only and identifies the depth (in feet) at which the sample was collected.

6.1.1.4 Examples

Examples of complete sample numbers with descriptions are as follows:

- HSA05-070715-2.5 = the second soil sample collected at station HSA05 on July 15, 2007 from a depth of 2.5 feet.
- MW02-070715 = A groundwater samples collected from monitoring well MW02 on July 15, 2007.

Under the sample designation method described above, the identifier will be unique (i.e., no two samples will have the same identifier), and informative (i.e., location, date, and sample interval). This designation will facilitate overall data management and submittal into Ecology's EIMS database.

6.1.2 Sample Labeling

Sample information will be printed legibly onto the sample labels in indelible ink. Field identification will be sufficient to enable cross reference with the project logbook. For chain-of-custody purposes, all QA/QC samples will be subject to the same custodial procedures and documentation as field samples.

To minimize handling of sample containers, labels will be completed before sample collection to the extent possible. The label will be filled out completely in the field and attached firmly to the sample container. The sample label will provide the following information:

- GeoEngineers job number
- Sample designation

- Date of sample collection (month/day/year)
- Time of sample collection (hours:minutes)
- Chemical analyses to be conducted
- Sample preservation, if applicable
- Initials of sampler

6.1.3 Field Log Books

The sample collection activities will be noted in the field log books. The Field Coordinator will monitor consistency between the FSP, sample containers/labels, field logbooks, and the chain-of-custody.

6.2 SAMPLE STORAGE ON SITE

Samples will be placed in a cooler with proper icing immediately after they are collected. The objective of the cold storage will be to attain a sample temperature of 4 degrees Celsius. Field samplers will make every attempt to have the samples delivered to the Laboratory with adequate holding time remaining. Holding times will be observed during sample storage.

6.3 SAMPLING EQUIPMENT DECONTAMINATION

The drilling equipment will be decontaminated before use, between drilling each boring and after use, and will include pressure washing. Reusable sampling/monitoring equipment (trowels, groundwater sampling equipment, and water level measurement instruments, etc.) that comes in contact with soil or groundwater will be decontaminated before each use. Decontamination procedures will follow specifications outlined in the work plan (Section 6.7.9).

6.4 SAMPLE CUSTODY PROCEDURES

Chain-of-custody procedures are used to maintain and document sample possession. For the purposes of this project, sample identification must be traceable from collection through data use. The principal documents used are:

- Sample labels
- Sample custody seals
- Field sampling records
- Chain-of-custody forms
- Shipping records
- Laboratory routing records

After collection, samples will be maintained in the sampler’s custody until formally transferred to another party. Strict chain-of-custody procedures will be followed to maximize sample integrity and accountability during the project. The chain-of-custody will begin when the sample is collected and will be maintained until final disposal of the sample.

6.4.1 Field Custody and Chain-Of-Custody Forms

The Field Coordinator or designated representative is responsible for the custody of the samples until they are formally transferred to another party or delivered to the analytical laboratory. For purposes of this project, a sample is under a person's custody if the sample meets any of the following criteria:

- In possession of the sampling personnel or Field Manager
- In a person's plain view after being in his/her possession
- Inside a cooler in a person's plain view
- Inside any locked space, such as a cooler or locked vehicle, to which the field representative has the only immediately available key

Any transfer of samples will be accompanied by a properly completed chain-of-custody form. When transferring the possession of samples, both the individuals relinquishing and receiving the samples will sign, date, and record the time on the chain-of-custody form. This form is signed by the sampler and any others who subsequently hold custody of the sample, including another person, mobile laboratory, permanent laboratory, or secure storage area. A copy of the chain-of-custody form will be retained by the sampler and maintained in the project files. The original form will accompany the samples.

The chain-of-custody forms will contain, at the minimum, the following information:

- Project name and number
- Sample designation
- Signature or initials of the sampler
- Date and time of sample collection
- Sample matrix (soil, water, etc.) and number of containers from each sampling point, including preservatives used, if any.
- Analysis to be performed
- Signatures of all persons involved in the chain of possession, inclusive dates and times of possession

The chain-of-custody form will also be used to indicate which analyses are to be performed on each sample. This enables the laboratory to ascertain at the time of sample receipt whether all of the samples that are expected have arrived.

6.4.2 Sample Transportation

All coolers containing samples will be sealed with a custody seal. Couriers handling sample shipments will not be required to sign off on the chain-of-custody form as long as the custody seals remain intact.

6.4.3 Laboratory Custody and Sample Routing Forms

A designated laboratory sample custodian will accept custody of the samples and verify that the chain-of-custody form matches the samples received. Samples will be logged in and assigned a unique laboratory sample identification number. Samples and sample aliquots, including sample extracts, will be tracked through laboratory analysis using laboratory sampling routing forms. Details of the Laboratory sample control, record-keeping, and document control should be included in the Laboratory *Quality Assurance Manual*.

6.5 FIELD DOCUMENTATION

Field documentation provides important information about potential problems or special circumstances surrounding sample collection. Field personnel will maintain daily field logs while on-site. The field logs will be prepared on field report forms or in a bound logbook. Field forms will become part of the project files at the conclusion of this field exploration. The handling, use, and maintenance of field log books are the field coordinator's responsibilities.

At a minimum, the following information will be recorded during the collection of each sample:

- Sampler's name(s)
- Date and time of sample collection
- Designation of sample as composite or discrete
- Type of sample (soil or water)
- Type of sampling equipment used
- Field instrument readings, if any
- Field observations and details that are pertinent to the integrity/condition of the samples (e.g., weather conditions, performance of the sampling equipment, sample depth control, sample disturbance, etc.)
- Sample preservation, if any
- Shipping arrangements (overnight air bill number), if applicable
- Name of recipient laboratory

In addition to the sampling information, the following specific information also will be recorded in the field log for each day of sampling:

- Time of arrival/entry on Site and time of Site departure
- Other personnel present at the Site
- Summary of pertinent meetings or discussions with regulatory agency or contractor personnel
- Deviations from sampling plans, Site safety plans, and QAPP procedures
- Changes in personnel and responsibilities with reasons for the changes
- Levels of safety protection
- Calibration readings for any equipment used and equipment model and serial number

7.0 MEASUREMENT PROCEDURES

7.1 LABORATORY MEASUREMENT PROCEDURES

Chemical analysis methods were selected on the basis of detection and quantitation limits and the level of analytical quality control needed to meet data quality objectives and intended data uses. Standard EPA and ASTM methods will be used for all analyses. Analytical methods are from the following documents:

- Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd edition. (USEPA, 1986).

- Standard Methods for the Examination of Water and Wastewater, 17th Edition (American Public Health Association, 1989).

The contracted Laboratory will be included in the analytical planning and will provide the Contractor with documented performance characteristics (precision, bias/accuracy and sensitivity) for all requested analytical methods. Where possible, methods will be chosen to provide method detection limits (MDL) five to ten times below the target reporting limit [aka lowest concentration of interest)]. Additional considerations for specific method selection or modification may be:

- Definition of the parameter and the forms to be measured (i.e., dissolved and/or total metals)
- Concentration ranges
- Number of samples to be analyzed per analytical batch
- Sample size available
- Holding time requirements
- Cost of analysis

Reference methods, analytes, matrices, CAS No., target reporting limits, and reference levels listed in Tables 2 through 7. Soil and surface water reference levels were identified using the following sources:

- Soil: MTCA Method A Soil Cleanup Levels for Unrestricted Land Uses and Method B soil direct contact cleanup levels (WAC 173-340-740).
- Sediment: Chapter 173-204 WAC, Sediment Management Standards
  - Table I – Marine Sediment Quality Standards and
  - Table III – Puget Sound Marine Sediment Cleanup Screening Levels.
- Surface Water: Aquatic marine chronic and human health (fish ingestion) water quality criteria (WQC) published in Chapter 173-201A WAC, Section 304 of the Clean Water Act, National Toxics Rule, and MTCA Method B Surface Water Cleanup Levels (WAC 173-340-730).

The target reporting limits in Tables 2 through 7 are the lowest soil, sediment, and surface water reference levels for each analyte.

Expected range of results and schedule of sample delivery are not known at the time of QAPP preparation. Laboratory practical quantitation limits (PQL) will be appended to the QAPP when Laboratory selection and contracting is complete.

7.2 FIELD MEASUREMENT PROCEDURES

Field equipment will be used in general accordance with the manufacturer's recommendations.

8.0 QUALITY CONTROL

8.1 ANALYTICAL QUALITY CONTROL

Quality control sample types and required frequency are summarized in Table 9.

8.1.1 Laboratory Instrument Calibration

Several types of calibrations are used, depending on the method, to determine whether the linearity of the instrument is in control and to assure that the sample results reflect accurate and precise measurements.

The laboratory calibration procedures will be performed in accordance with the analytical methods cited and laboratory standard operating procedures. Calibration documentation will be retained at the laboratory and readily available for review. Preparing and analyzing calibration standards at appropriate levels for the analytes of interest monitor instrument calibration.

Calibration check standards are analyzed before and after each batch of samples. If recovery is not within acceptable method criteria, the standards and all samples will be reanalyzed.

8.1.2 Laboratory Method Blanks

According to the *National Functional Guidelines for Organic Data Review* (USEPA 1999) and *National Functional Guidelines Inorganic Data Review* (USEPA 2002):

“The purpose of laboratory (or field) blank analyses is to determine the existence and magnitude of contamination resulting from laboratory (or field) activities. The criteria for evaluation of blanks apply to any blank associated with the samples (e.g., method blanks, instrument blanks, trip blanks, and equipment blanks)”.

Method blanks are created in the laboratory during sample preparation and follow samples throughout the analysis process. Frequency of method blanks will be one per 20 or fewer field samples per matrix.

Method blanks are laboratory quality control (QC) samples that consist of either a soil like material having undergone a contaminant destruction process or DI water. Method blanks will be extracted and analyzed at a minimum of 5% or with each batch of 20 samples or fewer for each matrix. If a substance is found in the method blank then one (or more) of the following occurred:

- Measurement apparatus or containers were not properly cleaned and contained contaminants.
- Reagents used in the process were contaminated with a substance(s) of interest.
- Contaminated analytical equipment was not properly cleaned.
- Volatile substances in the air contaminated the samples during preparation or analysis.

Given method blank results, validation guidelines aid in determining which substances in samples are considered “real,” and which ones are attributable to the analytical process.

During data validation, DV Contractor will evaluate all method and field blank sample results and take action as described in *National Functional Guidelines for Organic Data Review* (USEPA 1999) and *National Functional Guidelines Inorganic Data Review* (USEPA 2002); professional judgment will be applied as necessary.

8.1.3 Matrix Spike/Spike Duplicates (Ms/Msd)

Laboratory precision will be determined by splitting spiked or unspiked samples. This allows the analyst to determine the precision of the preparation and analytical techniques used to analyze the duplicate sample. Matrix spike samples are prepared by choosing a sample at random from each sample shipment received at the laboratory or is pre-selected by field personnel and labeled accordingly; dividing the sample into equal aliquots, and then spiking each of the aliquots with a known concentration.

Matrix spike/matrix spike duplicate sample analyses are used to determine accuracy and precision and to assess interferences caused by the physical or chemical properties of the sample itself. Matrix spike samples are prepared by spiking a known amount of one or more of the target analytes at a concentration of 5 to 10 times higher than the expected sample result. Matrix spikes will be prepared and analyzed at a minimum of 5% or with each batch of 20 samples or fewer for each matrix.

MS/MSD data are reviewed in combination with other data quality indicators (e.g., LCS/LCSD) to determine matrix effects. In some cases, matrix affects cannot be determined due to dilution and/or high levels of related substances in the sample.

8.1.4 Laboratory Control Spikes/Spike Duplicates (Lcs/Lcsd)

The purpose of the laboratory control spike samples (also known as blank spikes) is to aid in assessment of overall accuracy and precision of the entire analytical process e.g., sample preparation, instrument performance, and analyst performance. LCS will be prepared and analyzed at a minimum of 5% or with each batch of 20 samples or fewer for each matrix. LCS are similar to matrix spikes however, the LCS spike media is “clean” or contaminant free.

8.1.5 Laboratory Replicates/Duplicates

Precision for inorganic analytes is monitored by analysis of sample replicates/duplicates. Laboratory duplicate sample analysis, for inorganic analytes, will be prepared and analyzed at a minimum of 5% or with each batch of 20 samples or fewer for each matrix.

8.1.6 Surrogate Spikes

Surrogate spike compounds are used during analysis for organic analytes in order to verify the accuracy of the instrument being used and assess extraction efficiency. Surrogates are substances similar to, but not one of, the target analytes. A known concentration of surrogate is added to the sample and passed through the instrument, recording the surrogate recovery. Each surrogate used has an acceptable range of percent recovery, listed in Table 1. If a surrogate recovery is low, sample results may be biased low and depending on the recovery value, a possibility of false negatives may exist. Conversely, when recoveries are above the specified range of acceptance a possibility of false positives exist, although non-detected results are considered accurate.

8.2 FIELD QUALITY CONTROL

8.2.1 Field Equipment Calibration Procedures

Field equipment requiring calibration will be calibrated to known standards in accordance with manufactures recommended schedules and procedures for each instrument. Calibration checks of the vapor measurement equipment will be conducted daily and the instruments will be recalibrated if required. Calibration measurements will be recorded in the daily field logs. If field equipment becomes inoperable, it will be replaced with a properly calibrated instrument.

8.2.2 Equipment (Rinsate) Blanks

Equipment blank samples will be collected once per matrix. Equipment blank samples, collected by routing laboratory-provided deionized water (for inorganic analyses), or organic-free water (for organic analyses) through decontaminated sampling equipment, will be analyzed to check procedural contamination and/or ambient conditions and/or sample container contamination at that may cause sample contamination. If disposable sampling equipment is used, equipment rinsate blanks are not required.

8.2.3 Field Duplicates

Field duplicates serve as measures for precision. Under ideal field conditions, field duplicates are created when a volume of the sample matrix is thoroughly mixed, placed in separate containers, and identified as different samples. This tests both the precision and consistency of laboratory analytical procedures and methods, and the consistency of the sampling techniques used by field personnel.

Groundwater, surface water, and leachate field duplicates will be collected at a rate of 1 per 20 samples.

8.2.4 Trip Blanks

Trip blank samples, consisting of organic-free water poured into 40 ml sample vials at the laboratory under contaminant-free conditions, will be provided by the Laboratory for each sample cooler. Trip blank samples will be handled in a manner consistent with actual field samples, but will not be opened and will be shipped back to the laboratory with the samples. Trip blank samples are analyzed for volatile organic compounds (VOC) and will provide a measure of potential cross-contamination volatile organic compounds during shipment and handling.

8.3 CORRECTIVE ACTION

Corrective action is the process of identifying, recommending, approving and implementing measures to counter unacceptable procedures or QC performance outside established criteria. Corrective action can occur during field activities, laboratory analyses, data validation and data assessment.

Corrective actions should be designed to correct the problem and to minimize the possibility of its recurrence. Examples of corrective actions are modification of nonconforming procedures, forms or worksheets; institution of a quality check, etc. Proposed corrective actions should be reviewed and approved by the QA Manager prior to implementation. An example Corrective Action Report is provided as Figure 1. Significant non-compliance and corrective actions will be discussed in quality assurance reports to Contractor Project Management and Department of Ecology, as appropriate.

8.3.1 Field Corrective Action

Project personnel will be responsible for reporting technical or QA non-conformances or deficiencies of any activity or issued document to the Field Manager. The Field Manager will consult with the Contractor QA Manager to determine whether the situation warrants a reportable nonconformance and subsequent corrective action. If so, a CAR will be initiated by the Contractor QA Manager.

Corrective actions will be implemented and documented in the field record log. No staff member will initiate corrective action without prior communication of findings using the process described above.

8.3.2 Laboratory Corrective Action

Corrective action by the laboratory may occur prior to, during and or initial analyses. Conditions such as broken sample containers, multiple phases, low/high pH readings and potentially high concentration samples may be identified during sample log-in or prior to analysis.

Laboratory corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, instrument sensitivity, etc. If the problem persists, or cannot be identified, the problem should be referred to the supervisor, manager and/or Laboratory QA Manager for further investigation and possible formal corrective action.

The contracted Laboratory's *Quality Assurance Plan* should include specific procedures for identification and documentation of nonconformance and implementation and reporting of corrective actions.

8.3.3 Corrective Actions Resulting From Data Validation

If necessary, the DV Contractor will contact the laboratory for further information, clarification, or needed re-submissions and/or corrective actions. All communications will be documented and included with the data validation report as an appendix.

In cases where a deficiency or problem is a recurring nonconformance, requiring more extensive corrective action, it should be documented on a formal CAR. The CAR will be sent to the organization responsible for the corrective action, and a copy routed to the Contractor QA Manager. When the corrective action is complete, the DV Contractor will complete the CAR.

9.0 DATA MANAGEMENT PROCEDURES

9.1 DATA REPORTING

Soil, surface water, groundwater and leachate samples, collected by Contractor will be received by Laboratory as sample delivery groups (SDG). A SDG is defined as all samples received by Laboratory on a given day. The samples are then analyzed as an analytical lot (or QC batch), defined as a group of samples that are analyzed by a specified method and supported by appropriate batch-specific quality control samples. The number of samples in a lot is determined by the rate-delimiting step in the method e.g., 12-hour calibration or extraction batch, etc. Results for each lot are reported using an electronic data deliverable (EDD) compatible with the EIM system, and documented in a hardcopy package consisting of summary tables and supporting data appropriate for the level of review.

9.1.1 Hardcopy Level 3 Data Package

When Level 3 data packages are requested, the laboratory will provide the hardcopy deliverables as listed in Table 10**.** All items indicated with a "1" or a "2" in the "Required" column are essential to the Level 3 data package. In addition, the following data and information are required:

- Sample results must be associated with appropriate units, must include estimated concentrations for target analytes that are > IDL but < PQL (or LQL) and must identify the appropriate data flags (e.g., "J" for detections below the PQL). Reporting limits should be adjusted for sample dilution and/or initial sample volume or weight.
- The method number, report number, sample matrix, percent solids, collection date, receipt date, extraction date, analysis date and analysis time should be identified on each page of sample results.
- Chain-of-custody documentation should be provided.
- A summary table of percent solids for all solid matrix samples (if applicable).
- A summary table of particle size distribution for all sediment samples (if applicable).

- Method blank results with unique identification of each method blank.
- Trip blank results with unique identification of each trip blank.
- One laboratory duplicate performed per batch. The calculation of the relative percent difference (RPD) should be reported.
- Extraction and run-logs.
- Consistent use of the same calibration and check standards.
- Use of calibration standards that bracket the sample concentrations and quantitation limits.
- Total ion chromatograms for polycyclic aromatic hydrocarbon (PAH), fuel, or other manually integrated analyses.

9.1.2 Hardcopy Level 4 Data Package

When Level 4 data packages are requested, the laboratory will provide the hardcopy deliverables as listed in Table 10**.** All items indicated with a "1", "2" or "3" in the "Required" column are essential to the Level 4 data package and all raw analytical data must be submitted. All additional data and information listed above is also required.

9.1.3 Electronic Data Deliverable (Edd)

The electronic data deliverable (EDD) provided by Laboratory will be provided in the format compatible EarthSoft's EQuIS system. The list of valid values (e.g. CAS numbers, analytical methods, etc.) will be consistent with codes used in the Department of Ecology's Environmental Information Management System (EIM).

9.2 SUBMITTAL OF DATA TO EIM

The Environmental Information Management System (EIM) is the main database for environmental monitoring data. EIM contains records on physical, chemical, and biological analyses and measurements. Supplementary information about the data (metadata) is also stored, including information about environmental studies, monitoring locations, and data quality. GeoEngineers will provide EIM submittals within 90 days of final Department of Ecology approval of remedial investigation reports.

9.2.1 Application Of Qualifiers To EDD

After primary validation and secondary review, the DV Contractor will add useablity qualifiers and final concentrations to the Laboratory EDD. All manual data entry will be verified to the source document (e.g., COC, hardcopy data package and/or qualified Sample Result Summary, etc.).

9.2.2 Submittal To Ecology EIM

Project data will be submitted to the Ecology EIM in three parts: study information, sample location data, analytical result data. The DV Contractor will be responsible for coordination and implementing this effort.

9.3 RECORDS MANAGEMENT

DV Contractor will inventory and store all analytical data, including all re-submissions collected during data validation efforts, worksheets, and original data validation reports.

10.0 QUALITY ASSURANCE AUDITS AND REPORTS

Internal performance audits (aka surveillance) of field, laboratory and validation activities will be conducted to verify that sampling, analysis, data validation and data management are performed in accordance with the procedures established in the Irondale FSP and this QAPP.

10.1 INTERNAL FIELD AUDIT

10.1.1 Field Audit Responsibility and Frequency

It is the responsibility of the Contractor Field Manager to routinely perform internal system audits of field activities including sampling and field measurements and determine if corrective action verification is required.

10.1.2 Field Audit Procedure

The internal field audits will include examination of field sampling records, field instrument operating records, sample collection, handling, decontamination, and packaging in compliance with the established procedures, QA procedures, COC, etc. Deficiencies and subsequent corrective actions will be documented following corrective action process discussed in Section 8.3**.** The results of the audit should be shared with the field team to enhance sampling performance where applicable.

10.2 INTERNAL LABORATORY AUDITS

The Laboratory QA Manager is responsible for conducting internal proficiency and QA system audits in accordance with the Laboratory *Quality Assurance Plan*. The contractor Laboratory will be accredited with the State of Washington and therefore, the *Quality Assurance Plan* has been evaluated and accepted.

10.3 QUALITY ASSURANCE REPORTS

Reports will be prepared throughout the course of the project that describe the status and results of the quality assurance review. The types of reports and their expected frequency are as follows:

- Audit findings and correction summary reports will be prepared by the Contractor QA Manager, presented to the Contractor Project Manager and Field Manager, and added to the permanent project files. These reports summarize the results of the field and lab audits and the outcome of any corrective actions.
- Data quality reports (DQR), compiled for designated site areas or sampling events (as requested by the Contractor), will be prepared by the DV Contractor, presented to the Contractor Project Manager, and added to the permanent project files. If additional data qualifiers are recommended based on non-conformance issues in the field, this information will also be included in the report, but the data qualifiers will not be added without the concurrence of the DV Contractor and Contractor Project Manager.

11.0 DATA VERIFICATION AND VALIDATION

Technical data from field and laboratory analyses are combined to characterize the performance of the remediation. Documented verification of this data is crucial. Consistent, documented data reduction techniques, for both hand calculations and computer analyses, and standardized technical data validation are equally important in the verification of the technical data.

11.1 DATA REDUCTION AND PEER REVIEW

Procedures for ensuring the correctness of the data reduction process are discussed in this section. Data, both field and laboratory generated, are reduced either manually on calculation sheets or by computer on formatted printouts. Responsibilities for the data reduction process are delegated as follows:

- Technical personnel will document and review their own work and are responsible for the correctness of the work.
- Calculations will receive a method and calculation check by a secondary reviewer prior to reporting (peer review).
- The Contractor QA Manager will be responsible for ensuring that data reduction is performed according to protocols discussed in this QAPP.

11.1.1 Hand and Computer Calculations

Hand calculations will be recorded on calculation sheets, written legibly and in a logical progression. Spreadsheet calculations will be printed out in both equation form and calculation form. Calculations will be reviewed by chemist or scientist of a professional level equal to or higher than that of the originator, and the review will be documented on a checklist or review form. Both the originator and secondary reviewer are responsible for the correctness of the calculations. The calculation sheet and review form will document the following (at a minimum):

- Project title and project number
- Initials and date of originator
- Initials and date of secondary reviewer
- Basis for calculation
- Assumptions made or assumptions inherent in the calculation
- Complete reference for each source of input data
- Methods used for calculation
- Results of calculation

11.1.2 In-Laboratory Data Reduction and Review

Data generated by the laboratory will be reviewed prior to data release. The laboratory will perform three levels of data review:

- Analytical level
- Data section level
- Final quality review

The three-tiered review process should be documented in the Laboratory *Quality Assurance Manual*.

11.2 DATA VALIDATION

The DV Contractor will be responsible for all data validation.

The level of data validation (Level 3 or Level 4) will be determined by the most stringent end-use of the data e.g., any data that may be associated with risk assessment (human health and ecological) will receive a Level 4 validation; data from the samples collected for the remedial investigation/feasibility only will receive Level 3 validation with up to 10% receiving Level 4 on an as-needed basis.

11.2.1 Validation Process

The Laboratory will fax copies of the chain-of-custody to Contractor and DV Contractor as the samples are received. This will enable Contractor to track all samples collected and DV Contractor to verify the sample IDs for content and format prior to data receipt.

Validation will include evaluation of all appropriate QC elements including, but not limited to:

- Holding times
- Instrument tuning and analytical system performance
- Initial and continuing calibrations
- Preparation of analytical standards and samples
- Analytical results from internal standards, method blanks, spiked samples (matrix, surrogate), replicate samples; interference check samples
- Laboratory and sample detection and reporting limits
- Analyte identification and quantification (including tentatively identified compounds) **Level 4 only**
- Data reduction (transcription check and recalculation of results) **Level 4 only**

A system of primary data validation and secondary/peer review will be used by the DV Contractor. All primary data validation and subsequent quality control reviews will be documented on a series of worksheets and checklists. In addition, final review and approval by the DV Contractor Project Manager will be documented and maintained in the project files.

DV Contractor will follow a documented Quality Assurance program, implemented by a comprehensive set of standard operating procedures (SOPs). The SOPs will cover all technical facets of the data validation as well as auxiliary processes e.g., data log-in and tracking, database security and archive, document control, quality control, software use and verification, algorithm verification, verification of manually input data, corrective action and training.

11.3 FIELD MEASUREMENT EVALUATION

Field data will be reviewed at the end of each day by following the quality control checks outlined below and procedures in the FSP. Field data documentation will be checked against the applicable criteria as follows:

- Sample collection information.
- Field instrumentation and calibration.
- Sample collection protocol.
- Sample containers, preservation and volume.
- Field QC samples collected at the frequency specified.
- Sample documentation and chain-of-custody (COC) protocols.

- Sample shipment.

Cooler receipt forms and sample condition forms provided by the laboratory will be reviewed by the Field Manager for out-of-control incidents. Sample collection information will be reviewed for correctness before inclusion in the RI/FS final report.

12.0 DATA QUALITY ASSESSMENT

After the data have been verified and validated a usability assessment will be performed. The project data are only meaningful by relating the data to the intended use of the data. If the MQO have been met, the quality of the data should be useable for to study and design remedial alternatives and ecological health.

The assessment will include evaluation of representativeness, comparability and a comparison of actual completeness to the 95% criteria. Also, the sampling design will be evaluated to determine whether the design produced the information that was needed to meet the project objectives.

FIGURE 1: CORRECTIVE ACTION REPORT

A. Problem Identification

Identified By: ______________________________ Date Identified: ______________________

Project(s)Affected (if appropriate):____

QA System/SOP Affected: ____

Description of Problem:____

____

____

____

____

B. Proposed Corrective Action and Approval to Proceed

Description:____

____

____

____

____

____

Proposed By: ______________________________ Date Proposed:____________________

P.M./QA Manager. Approval of Proposed Corrective Action (if appropriate): ______________________

After Sections A and B are complete, turn in to the QA Director for approval of proposed corrective action and assignment of a CAR number. A copy of this form will be returned to the person(s) responsible for implementation of the corrective action.

QA Approval of Proposed Corrective Action: ______________________

C. Corrective Action Sign-Off

The corrective action as described in Section B of this form has been implemented.

Comments/Additional Information: ____

____

____

Implemented By:______________________________ Date: ____________________

After sign-off, submit this form to the Quality Assurance Director for verification and filing. Attach any evidence of the corrective action e.g., worksheet, memo, etc.

D. QA Verification/Closure

____

____

Method of verification (observation, documentation, etc.) ______________________________

Verified By: ______________________________ Date Verified: ____________________

TABLE 1
MEASUREMENT QUALITY OBJECTIVES
DRAFT RI/FS WORK PLAN, IRONDALE
IRONDALE, WASHINGTON

		Check Standard (LCS) %R Limits[3,4]		Matrix Spike (MS) %R Limits3,4		Surrogate Standards (SS) %R Limits [2,3,4]	Duplicate Samples MSD or Lab Duplicate RPD Limits[5]		Field Duplicate Samples RPD Limits[5]	
Laboratory Analysis	Reference Method	Soil/Sediments	Water	Soil/Sediments	Water		Soil/Sediments	**Water**	Soil/Sediments	**Water**
SVOC	PSEP 8270 and EPA 8270-SIM	30%-150%	NA	50%-150%	NA	20%-135%	35%	NA	50%	NA
PAH	EPA 8270 SIM	30%-150%	40%-150%	50%-150%	50%-150%	20%-135%	35%	20%	50%	35%
Diesel and Oil Range Hydrocarbons	NWTPH-Dx	50%-150%	50%-150%	50%-150%	50%-150%	50%-150%	35%	20%	50%	35%
EPH	EPA 1664	50%-150%	50%-150%	50%-150%	50%-150%	50%-150%	35%	20%	50%	35%
Metals/Mercury	EPA 6010/7471	80%-120%	80%-120%	75%-125%	75%-125%	NA	35%	20%	50%	35%
Grain Size	PSEP	NA	NA	NA	NA	NA	35%	NA	50%	NA
TOC/Solids	Plumb/EPA 160.1	80%-120%	NA	75%-125%	NA	NA	35%	NA	50%	NA
TVS	ASTM	80%-120%	NA	75%-125%	NA	NA	35%	NA	50%	NA
Ammonia	EPA 350.1M	80%-120%	NA	75%-125%	NA	NA	35%	NA	50%	NA
Sulfide	EPA 376.2	80%-120%	NA	75%-125%	NA	NA	35%	NA	50%	NA
pH[1]	Field Measurement	±0.1 pH units	±0.1 pH units	NA	NA	NA	±0.5 pH units	±0.5 pH units	±0.5 pH units	±0.5 pH units

Notes:

[1] pH is measured in the field and accuracy is ensured by calibration of the instrument before and after use.

[2] Individual surrogate recoveries are compound specific

[3] Recovery Ranges are estimates. Actual ranges will be provided by the laboratory when contracted.

[4] Percent Recovery Limits are expressed as ranges based on laboratory control limits. Limits will vary for individual analytes

[5] RPD contol limits are only applicable if the concentration are greater than 5 times the method reporting limit (MRL). For results less than 5 times the MRL, the difference between the sample and duplicate must be less than 2X the MRL for soils and 1X the MRL for waters.

SVOC = Semivolatile Organic Compound
PAH = Polycyclic Aromatic Hydrocarbons
EPH = Extractable Petroleum Hydrocarbons
TOC = Total Organic Carbon
TVS = Total Volatile Solids
LCS = Laboratory Control Sample
MS/MSD = Matrix Spike/Matrix Spike Duplicate
RPD = Relative Percent Difference
NA = Not Applicable

TABLE 2
Analytes and Target Reporting Limits
Metals by SW846 6010B/6020/7470/7471, IRONDALE

IRONDALE, WASHINGTON

Soil

Analyte	CAS RN	PQL (mg/kg)	Target ReportingLimit (mg/kg)	MTCA Method A, Unrestricted Land Use (mg/kg)	MTCA Method B, Carcinogen (mg/kg)	MTCA Method B, Non-carcinogen (mg/kg)
arsenic	7440-38-2	TBD	0.7	20.0	0.7	24
copper	7440-50-8	TBD	3000	--	--	3000
iron	7439-89-6	TBD	--	--	--	--
lead	7439-92-1	TBD	250	250	--	--
nickel	7440-02-0	TBD	1600	--	--	1600
zinc	7440-66-6	TBD	24000	--	--	24000

Sediment

Analyte	CAS RN	PQL (mg/kg)	Target ReportingLimit (mg/kg)	Puget Sound Marine Sediment Quality Standards (mg/kg)	Puget Sound Marine Sediment Cleanup Screening (mg/kg)
arsenic	7440-38-2	TBD	57	57	93
cadmium	7440-43-9	TBD	5.1	5.1	6.7
chromium	7440-47-3	TBD	260	260	270
copper	7440-50-8	TBD	390	390	390
lead	7439-92-1	TBD	450	450	530
mercury	7439-97-6	TBD	0.41	0.41	0.59
silver	7440-22-4	TBD	6.1	6.1	6.1
zinc	7440-66-6	TBD	410	410	960

Water

Analytes	CAS RN	PQL (µg/L)	Target Reporting Limit (µg/L)	Aquatic Life - Marine/Chronic - Ch. 173-201A WAC (µg/L)	Aquatic Life - Marine/Chronic - Clean Water Act §304 (µg/L)	Aquatic Life - Marine/Chronic - National Toxics Rule, 40 CFR 131 (µg/L)	Human Health – Marine – Clean Water Act §304 (µg/L)	Human Health – Marine – National Toxics Rule, 40 CFR 131 (µg/L)	MTCA Method B, Carcinogen (µg/L)	MTCA Method B, Non-Carcinogen (µg/L)
arsenic	7440-38-2	TBD	0.098	36	36	36	0.14	0.14	0.098	18
copper	7440-50-8	TBD	2.4	3.1	3.1	2.4	--	--	--	2700
iron	7439-89-6	TBD	--	--	--	--	--	--	--	--
lead	7439-92-1	TBD	8.1	8.1	8.1	8.1	--	--	--	--
nickel	7440-02-0	TBD	8.2	8.2	8.2	8.2	4600	4600	--	1100
zinc	7440-66-6	TBD	81	81	81	81	26000	--	--	17000

Note: Target Reporting Limit is the lowest value from the listed regulatory levels. Also referred to by WA Dept. of Ecology as" lowest concentration of interest"
There is no regulatory limit for iron. A typical laboratory reporting limit was used for this analyte.
Sediments will be analyzed for SMS metals. These include: antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc.
PQL = Practical Quantitation Limit. This should be less than the Target Reporting Limit.
TBD = To Be Determined. PQLs will be supplied by laboratory. There may be cases where the laboratory can not meet the Target Reporting Limit.

TABLE 3
Analytes and Target Reporting Limits
SVOC by SW846 8270C and 8270 SIM, IRONDALE

IRONDALE, WASHINGTON

Sediment

Analyte	CAS RN	PQL (mg/kg)	Target ReportingLimit (mg/kg)	Puget Sound Marine Sediment Quality Standards (mg/kg organic carbon)
1,2-dichlorobenzene	95-50-1	TBD	2.3	2.3
1,4-dichlorobenzene	106-46-7	TBD	3.1	3.1
1,2,4-trichlorobenzene	120-81-1	TBD	0.81	0.81
2,4-dimethylphenol	105-67-9	TBD	0.029	0.029
2-methylnaphthalene	91-57-6	TBD	38	38
2-methylphenol	95-48-7	TBD	0.063	0.063
4-methylphenol	106-44-5	TBD	0.67	0.67
acenaphthene	83-32-9	TBD	16	16
acenaphthylene	208-96-8	TBD	66	66
anthracene	120-12-7	TBD	220	220
benzo(a)anthracene	56-55-3	TBD	110	110
benzo(a)pyrene	50-32-8	TBD	99	99
benzo(b)fluoranthene	205-99-2	TBD	230	230
benzo(ghi)perylene	191-24-2	TBD	31	31
benzo(k)fluoranthene	207-08-9	TBD	230	230
benzoic acid	65-85-0	TBD	0.65	0.65
benzyl alcohol	100-51-6	TBD	0.057	0.057
bis(2-ethylhexyl) phthalate	117-81-7	TBD	47	47
butyl benzyl phthalate	85-68-7	TBD	4.9	4.9
chrysene	218-01-9	TBD	110	110
dibenz(a,h)anthracene	53-70-3	TBD	12	12
dibenzofuran	132-64-9	TBD	15	15
diethyl phthalate	84-66-2	TBD	61	61
dimethyl phthalate	131-11-3	TBD	53	53
di-n-butyl phthalate	84-74-2	TBD	220	220
di-n-octyl phthalate	117-84-0	TBD	58	58
fluoranthene	206-44-0	TBD	160	160
fluorene	86-73-7	TBD	23	23
hexachlorobenzene	118-74-1	TBD	0.38	0.38

TABLE 3
Analytes and Target Reporting Limits
SVOC by SW846 8270C and 8270 SIM, IRONDALE

IRONDALE, WASHINGTON

Sediment

Analyte	CAS RN	PQL (mg/kg)	Target ReportingLimit (mg/kg)	Puget Sound Marine Sediment Quality Standards (mg/kg organic carbon)
hexachlorobutadiene	87-68-3	TBD	3.9	3.9
indeno(1,2,3-cd)pyrene	193-39-5	TBD	34	34
naphthalene	91-20-3	TBD	99	99
n-nitrosodiphenylamine	86-30-6	TBD	11	11
pentachlorophenol	87-86-5	TBD	0.36	0.36
phenanthrene	85-01-8	TBD	100	100
phenol	108-95-2	TBD	0.42	0.42
pyrene	129-00-0	TBD	1000	1000

Note: Target Reporting Limit is the lowest value from the listed regulatory levels. Also referred to by WA Dept. of Ecology as" lowest concentration of interest"
*** -** conc. is mg/kg dry wt. Not based on organic carbon
PQL = Practical Quantitation Limit. This should be less than the Target Reporting Limit.
TBD = To Be Determined. PQLs will be supplied by laboratory. There may be cases where the laboratory can not meet the Target Reporting Limit.

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TABLE 4
Analytes and Target Reporting Limits
PAH by SW846 8270C SIM, IRONDALE

IRONDALE, WASHINGTON

Soil

Analyte	CAS RN	PQL (mg/kg)	Target ReportingLimit (mg/kg)	MTCA Method A, Unrestricted Land Use (mg/kg)	MTCA Method B, Carcinogen (mg/kg)	MTCA Method B, Non-carcinogen (mg/kg)
1-methylnaphthalene	90-12-0	TBD	5	5	--	320
2-methylnaphthalene	91-57-6	TBD	5	5	--	320
acenaphthene	83-32-9	TBD	4800	--	--	4800
acenaphthylene	208-96-8	TBD	--	--	--	--
anthracene	120-12-7	TBD	24000	--	--	24000
benzo(a)anthracene	56-55-3	TBD	0.14	--	0.14	--
benzo(a)pyrene	50-32-8	TBD	0.10	0.10	0.14	--
benzo(b)fluoranthene	205-99-2	TBD	0.14	--	0.14	--
benzo(ghi)perylene	191-24-2	TBD	--	--	--	--
benzo(k)fluoranthene	207-08-9	TBD	0.14	--	0.14	--
chrysene	218-01-9	TBD	0.14	--	0.14	--
dibenz(a,h)anthracene	53-70-3	TBD	0.14	--	0.14	--
dibenzofuran	132-64-9	TBD	160	--	--	160
fluoranthene	206-44-0	TBD	3200	--	--	3200
fluorene	86-73-7	TBD	3200	--	--	3200
indeno(1,2,3-cd)pyrene	193-39-5	TBD	0.14	--	0.14	--
naphthalene	91-20-3	TBD	5	5	--	1600
phenanthrene	85-01-8	TBD	--	--	--	--
pyrene	129-00-0	TBD	2400	--	--	2400

Note: Target Reporting Limit is the lowest value from the listed regulatory levels. Also referred to by WA Dept. of Ecology as'' lowest concentration of interest'

PQL = Practical Quantitation Limit. This should be less than the Target Reporting Limit.

TBD = To Be Determined. PQLs will be supplied by laboratory. There may be cases where the laboratory can not meet the Target Reporting Limit

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TABLE 5
Analytes and Target Reporting Limits
PAH by SW846 8270C SIM, IRONDALE

IRONDALE, WASHINGTON

Water

Analyte	CAS RN	PQL (µg/L)	Target Reporting Limit (µg/L)	Aquatic Life - Marine/Chronic - Ch. 173-201A WAC (µg/L)	Aquatic Life - Marine/Chronic - Clean Water Act §304 (µg/L)	Aquatic Life - Marine/Chronic - National Toxics Rule, 40 CFR 131 (µg/L)	Human Health – Marine – Clean Water Act §304 (µg/L)	Human Health – Marine – National Toxics Rule, 40 CFR 131 (µg/L)	Method B, Carcinogen (µg/L)	Method B, Non-Carcinogen (µg/L)
2-methylnaphthalene	91-57-6	TBD	0	--	--	--	--	--	--	--
acenaphthene	83-32-9	TBD	640	--	--	--	990	--	--	640
acenaphthylene	208-96-8	TBD	0.2	--	--	--	--	--	--	--
anthracene	120-12-7	TBD	26000	--	--	--	40000	110000	--	26000
benzo(a)anthracene	56-55-3	TBD	0.018	--	--	--	0.018	0.031	0.030	--
benzo(a)pyrene	50-32-8	TBD	0.018	--	--	--	0.018	0.031	0.030	--
benzo(b)fluoranthene	205-99-2	TBD	0.018	--	--	--	0.018	0.031	0.030	--
benzo(ghi)perylene	191-24-2	TBD	--	--	--	--	--	--	--	--
benzo(k)fluoranthene	207-08-9	TBD	0.018	--	--	--	0.018	0.031	0.030	--
chrysene	218-01-9	TBD	0.018	--	--	--	0.018	0.031	0.030	--
dibenz(a,h)anthracene	53-70-3	TBD	0.018	--	--	--	0.018	0.031	0.030	--
dibenzofuran	132-64-9	TBD	1	--	--	--	--	--	--	--
fluoranthene	206-44-0	TBD	90	--	--	--	140	370	--	90
fluorene	86-73-7	TBD	3500	--	--	--	5300	14000	--	3500
indeno(1,2,3-cd)pyrene	193-39-5	TBD	0.018	--	--	--	0.018	0.031	0.030	--
naphthalene	91-20-3	TBD	4900	--	--	--	--	--	--	4900
phenanthrene	85-01-8	TBD	0.2	--	--	--	--	--	--	--
pyrene	129-00-0	TBD	2600	--	--	--	4000	11000	--	2600

Note: Target Reporting Limit is the lowest value from the listed regulatory levels. Also referred to by WA Dept. of Ecology as" lowest concentration of interest"
Regulatory limits were not available for all compounds. Standard laboratory reporting limits were stated for these analytes.
PQL = Practical Quantitation Limit. This should be less than the Target Reporting Limit.
TBD = To Be Determined. PQLs will be supplied by laboratory. There may be cases where the laboratory can not meet the Target Reporting Limit.

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TABLE 6
Analytes and Target Reporting Limits
TOTAL PETROLUEM HYDROCARBONS by NWTPHDx
EXTRACTABLE PETROLEUM HYDROCARBONS by EPA 1664 - IRONDALE

IRONDALE, WASHINGTON

Soil

Analtye	CAS RN	PQL (mg/kg)	Target ReportingLimit (mg/kg)	MTCA Method A, Unrestricted Land Use (mg/kg)
Diesel and Oil Range Organics	NA	TBD	2000	2000
EPH	NA	TBD	2000	--

Note: Target Reporting Limit is the lowest value from the listed regulatory levels. Also referred to by WA Dept. of Ecology as" lowest concentration of interest'
PQL = Practical Quantitation Limit. This should be less than the Target Reporting Limit.
TBD = To Be Determined. PQLs will be supplied by laboratory. There may be cases where the laboratory can not meet the Target Reporting Limit

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Water

Analtye	CAS RN	PQL (mgL)	Target ReportingLimit (ug/L)	MTCA Method A, Groundwater (ug/L)
Diesel and Oil Range Organics	NA	TBD	500	500
EPH	NA	TBD	500	--

Note: Target Reporting Limit is the lowest value from the listed regulatory levels. Also referred to by WA Dept. of Ecology as" lowest concentration of interest'
PQL = Practical Quantitation Limit. This should be less than the Target Reporting Limit.
TBD = To Be Determined. PQLs will be supplied by laboratory. There may be cases where the laboratory can not meet the Target Reporting Limit

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TABLE 7
Analytes and Target Reporting Limits
CONVENTIONAL PARAMETERS, IRONDALE

IRONDALE, WASHINGTON

Soil

Analyte	CAS RN	PQL (mg/kg)
Total Organic Carbon	NA	TBD

Sediment

Analyte	CAS RN	PQL (mg/kg)
Grain Size	NA	TBD
Total Organic Carbon	NA	TBD
Total Volatile Solids	NA	TBD
Ammonia	NA	TBD
Sulfide	NA	TBD

Note: Target Reporting Limit is the lowest value from the listed regulatory levels. Also referred to by WA Dept. of Ecology as" lowest concentration of interest'

PQL = Practical Quantitation Limit. This should be less than the Target Reporting Limit.

TBD = To Be Determined. PQLs will be supplied by laboratory. There may be cases where the laboratory can not meet the Target Reporting Limit

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TABLE 8
Sample Containers, Preservation and Holding Times, IRONDALE
IRONDALE, WASHINGTON

		Soils/Sediments				Waters			
Analysis	Method	Minimum Sample Size	Sample Containers	Sample Preservation	Holding Times	Minimum Sample Size	Sample Containers	Sample Preservation	Holding Times
SVOC	PSEP-8270 and EPA 8270-SIM	100 g	4 or 8 oz glass widemouth with Teflon-lined lid	Cool 4°C	14 days to extraction, 40 days from extraction to analysis	1 L	1 liter amber glass with Teflon-lined lid	Cool 4°C	7 days to extraction 40 days from extraction to analysis
PAH	EPA 8270-SIM	100 g	8 oz glass widemouth with Teflon-lined lid	Cool 4°C	14 days to extraction, 40 days from extractiom to analysis	1 L	1 liter amber glass with Teflon-lined lid	Cool 4°C	7 days to extraction 40 days from extraction to analysis
Diesel and Oil Range Hydrocarbons	NWTPH-Dx	100 g		Cool 4°C	14 days to extraction, 40 days from extractiom to analysis	1 L	1 liter amber glass with Teflon-lined lid	Cool 4 C, HCl to pH < 2	14 days to extraction 40 days from extraction to analysis
EPH	EPA 1664	100 g		Cool 4°C	14 days to extraction, 40 days from extractiom to analysis	1 L	1 liter amber glass with Teflon-lined lid	Cool 4 C, HCl to pH < 2	14 days to extraction 40 days from extraction to analysis
Metals Mercury	6010/7471	100 g	4 or 8 oz glass widemouth with Teflon-lined lid	Cool 4°C	180 days/ 28 days for Mercury	500 mL	1 L poly bottle	HNO_3 - pH<2	180 days (28 days for Mercury)
Grain Size	PSEP	100 g	32 oz glass widemouth with Teflon-lined lid	Cool 4°C	180 Days	NA	NA	NA	NA
TVS	ASTM	100 g		Cool 4°C	7 days	NA	NA	NA	NA
TOC/Solids	Plumb/160.1	100 g	4 oz glass widemouth with Teflon-lined lid	Cool 4°C	28 Days	NA	NA	NA	NA
Ammonia	EPA 350.1M	100 g		Cool 4°C	28 days	NA	NA	NA	NA
Sulfide	EPA 376.2	100 g	2 oz glass widemouth with Teflon-lined lid	Cool 4°C Zinc Acetate	7days	NA	NA	NA	NA

Note: Holding Times are based on elapsed time from date of collection

SVOC = Semivolatile Organic Compound
PAH = Polycyclic Aromatic Hydrocarbons
EPH = Extractable Petroleum Hydrocarbons
TOC = Total Organic Carbon
TVS = Total Volatile Solids
HCl = Hydrochloric Acid
HNO_3 = Nitric Acid
oz = ounce
mL = milliliter
L = liter
g = gram

TABLE 9
Quality Control Sample Types and Frequency, IRONDALE
IRONDALE, WASHINGTON

Parameter	Field QC				Laboratory QC			
	Field Duplicates		Equipment Rinsates[1]		Method Blanks	LCS	MS / MSD	Lab Duplicates
	Rate	Applicable Matrix	Rate	Applicable Matrix				
SVOCs	NA	NA	1/matrix	Sed	1/batch	1/batch	1 set/batch	NA
PAHs	1/20 samples for each matrix	GW	1/matrix	S, GW	1/batch	1/batch	1 set/batch	NA
Diesel and Oil Range Hydrocarbons	1/20 samples for each matrix	GW	1/matrix	S, Sed, GW	1/batch	1/batch	NA	1/batch
EPH	NA	NA	1/matrix	NA	1/batch	1/batch	NA	1/batch
Metals/Mercury	1/20 samples for each matrix	GW, SW	1/matrix	S, Sed, GW	1/batch	1/batch	1 MS/batch	1/batch
Grain Size	NA	NA	NA	NA	NA	NA	NA	triplicate/batch
TOC/Total Solids	NA	NA	NA	NA	1/batch	1/batch	1 MS/batch	1/batch
TVS	NA	NA	NA	NA	1/batch	NA	NA	1/batch
Ammonia	NA	NA	NA	NA	1/batch	1/batch	1 MS/batch	1/batch
Sulfide	NA	NA	NA	NA	1/batch	1/batch	1 MS/batch	1/batch

Note: An analytical lot or batch is defined as a group of samples taken through a preparation procedure and sharing a method blank, LCS, and MS/ MSD (or MS and lab duplicate). No more than 20 field samples can be contained in one batch.

[1] Equipment rinsates will not be collected if disposable equipment is used.

LCS = Laboratory control sample
MS = Matrix spike sample
MSD = Matrix spike duplicate sample
SVOC = Semivolatile Organic Compound
PAH = Polycyclic Aromatic Hydrocarbons
EPH = Extractable Petroleum Hydrocarbons
TOC = Total Organic Carbon
TVS = Total Volatile Solids

Sed = Sediment
S = Soil
GW = Groundwater
SW = Surface water

SEAT:\00\Working\Draft Work Plan\Irondale QAPP Table 9 QC type & frequency

APPENDIX B

HEALTH AND SAFETY PLAN

GEOENGINEERS, INC.
SITE HEALTH AND SAFETY PLAN CHECKLIST
IRONDALE IRON AND STEEL PLANT

This checklist is to be used in conjunction with the GeoEngineers Safety Program Manual. Together, the program and this checklist constitute the site safety plan for this site. This plan is to be used by GeoEngineers personnel on this site. If the work entails potential exposures to other substances or unusual situations, additional safety and health information will be included and the plan will be approved by the GeoEngineers Health and Safety Manager. All plans are to be used in conjunction with current standards and policies outlined in the GeoEngineers Health and Safety Program Manual.

1.0 GENERAL PROJECT INFORMATION

Project Name:	Irondale Iron and Steel Plant
Project Number:	504-042-00
Type of Project:	Environmental
Start/Completion:	June/July 2007
Subcontractors:	To be determined

Liability Clause - This Site Safety Plan is intended for use by GeoEngineers Employees only. It does not extend to the other contractors or subcontractors working on this site. If requested by subcontractors, this site safety plan may be used as a minimum guideline for those entities to develop safety plans or procedures for their own staff to work under. In this case, Form C-3 shall be signed by the subcontractor.

2.0 SCOPE OF WORK

The general scope of work is as follows:

- Test pits, borings (hollow stem or direct push), installation of monitoring wells, surface water and sediment sampling.

3.0 PERSONNEL/CONTACT INFORMATION PHONE NUMBERS

TITLE	NAME	TELEPHONE NUMBERS
Site Safety and Health Supervisor	Ron Bek	(360) 303-2819
Project Manager	Neil Morton/ Jay Lucas	(206) 239-3238
Health and Safety Program Manager	Leah Alcyon, CIH	(206) 728-2674
Field Engineer/Geologist	Ron Bek	(360) 303-2819
Client	Ecology – Steve Teel	(360) 407-6205
Current Owner	Jefferson County – Frank Gifford	(360) 385-9175

Site Safety and Health Supervisor -- The individual present at a hazardous waste site responsible to the employer and who has the authority and knowledge necessary to establish the site-specific health and safety plan and verify compliance with applicable safety and health requirements.

4.0 EMERGENCY INFORMATION

Hospital Name and Address:
Central Kitsap Urgent Care
10513 Silverdale Way NW, Silverdale, WA 98383

Phone Numbers (Hospital ER): (360) 692-9852 (in emergency call 911)   (360) 692-9852

Starting from: Project site 34.6 mi (about 50 mins)
Arriving at: Emergency Dept.
Route to Hospital Map:

Head west on E Moore St toward 3rd Ave
Turn left at 4th Ave (.2 mi)
Turn right at Irondale Rd (.8 mi)
Turn left at WA-19 (11.6 mi)
Turn left at WA-104 (6.6 mi)
Turn right at WA-3 (14 miles)
Take the WA-303 S exit toward E Bremerton (.1 mi)
Keep left at the fork, follow signs for Silverdale (.2 mi)
Turn left at Clear Creek Rd NW (.2 mi)
Continue on Kitsap Mall Blvd NW (.4 mi)
Turn left at Silverdale Way NW (.4 mi)

Ambulance:	9-1-1
Poison Control:	Seattle (206) 253-2121; Other (800) 732-6985
Police:	9-1-1
Fire:	9-1-1
Location of Nearest Telephone:	Cell phones are carried by field personnel.
Nearest Fire Extinguisher:	Located in the GEI vehicle on site.
Nearest First-Aid Kit:	Located in the GEI vehicle on site.

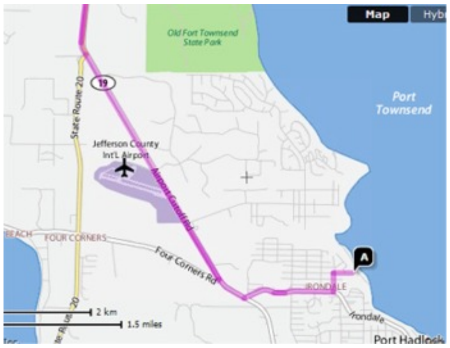
Madrona Hill Urgent Care (clinic that is closer)

Address: 2500 W Sims Way # 1, Port Townsend, WA 98368 (4.3 miles from site)
Phone: (360) 344-3663

Head **west** on **E Moore St** toward **3rd Ave (.1 mi)**
Turn **left** at **4th Ave (.2 mi)**
Turn **right** at **Irondale Rd (.8 mi)**
Turn **right** at **WA-19 (2.5 mi)**
Slight **right** at **WA-20**

Route to Clinic

Head **west** on **E Moore St** toward **3rd Ave (.1 mi)**
Turn **left** at **4th Ave (.2 mi)**
Turn **right** at **Irondale Rd (.8 mi)**
Turn **right** at **WA-19 (2.5 mi)**
Slight **right** at **WA-20**



4.1 STANDARD EMERGENCY PROCEDURES

1. Get help -
   - send another worker to phone 911 (if necessary)
   - as soon as feasible, notify GeoEngineers' project manager
2. Reduce risk to injured person -
   - turn off equipment
   - move person from injury location (if possible)
   - keep person warm
   - perform CPR (if necessary)
3. Transport injured person to medical treatment facility (if necessary) -
   - by ambulance (if necessary) or GeoEngineers vehicle
   - stay with person at medical facility
   - keep GeoEngineers manager apprised of situation and notify human resources manager of situation

5.0 PERSONNEL TRAINING RECORDS

Name of Employee	Level of Training (24/ 40 hr)	Date of Last Training	HAZWOPER Supervisor Training	First Aid/ CPR	Respirator Fit Test
Ron Bek	40 hr	May 11, 07		Oct 9, 06	Feb 05 (due)

6.0 KNOWN (OR ANTICIPATED) HAZARDS

Note: A hazard assessment will be completed at every site prior to beginning field activities. Updates will be included in the daily log. This list is a summary of hazards listed on the form.

6.1 PHYSICAL HAZARDS

X	Drill rig
X	Back hoe
	Track hoe (test pits)
	Crane
	Front End Loader
	Excavations/trenching (1:1 slopes for Type B soil)
	Shored/braced excavation if greater than 4 feet of depth
	Overhead hazards/power lines
X	Tripping/puncture hazards (debris on-site, steep slopes or pits, historical building foundations)
	Unusual traffic hazard – Street traffic and railroad tracks

6.2 PHYSICAL HAZARD MITIGATION MEASURES OR PROCEDURES

- Work areas will be marked with reflective cones, barricades and/or caution tape. Personnel will wear blaze orange vests for increased visibility by vehicle and equipment operators.
- Field personnel will be aware constantly of the location and motion of heavy equipment. A safe distance will be maintained between personnel and the equipment. Personnel will be visible to the operator at all times and will remain out of the swing and/or direction of the equipment apparatus. Personnel will approach operating heavy equipment only when they are certain the operator has indicated it is safe to do so.
- Heavy equipment and/or vehicles used on this site will not work within 20 feet of overhead utility lines without first ensuring that the lines are not energized. This distance may be reduced to 10 feet depending on the client and the use of a safety watch.

  Overhead Power Line Clearance Safety

  Working equipment around overhead power lines requires distance and a spotter. Before a job begins, call the utility company and find out voltage in lines. Have the equipment de-energized if possible. Ensure that the equipment remains de-energized by using some type of lockout and tag procedure, and ensure that the electrician uses grounding lines when they are required.
- Keep a safe distance from energized parts which is a minimum of 10 feet for 50 kV and under. The minimum distance will be more for higher voltages (above 50kV). The only exception is for trained and qualified electrical workers using insulated tools designed for high voltage lines.
- Don't operate equipment around overhead power lines unless you are authorized and trained to do so. If an object (scaffolds, crane, etc.) must be moved in the area of overhead power lines, appoint a competent worker whose sole responsibility is to observe the clearance between the power lines and the object. Warn others if the minimum distance is not maintained.
- Never touch an overhead line if it has been brought down by machinery or has fallen. Never assume lines are dead. When a machine is in contact with an overhead line, **DO NOT** allow

anyone to come near or touch the machine. Stay away from the machine and summon outside assistance. Never touch a person who is in contact with a live power line.

- If you are in a vehicle that is in contact with an overhead power line, **DON'T LEAVE THE VEHICLE**. As long as you stay inside and avoid touching metal on the vehicle, you may avoid an electrical hazard. If you need to get out to summon help or because of fire, jump out without touching any wires or the machine, keep your feet together, and hop to safety.
- When mechanical equipment is being operated near overhead power lines, employees standing on the ground may not contact the equipment unless it is located so that the required clearance cannot be violated even at the maximum reach of the equipment.
- When working near overhead power lines, the use of nonconductive wooden or fiberglass ladders is recommended. Aluminum ladders and metal scaffolds or frames are efficient conductors of electricity.
- Avoid storing materials under or near overhead power lines.
- Personnel entry into unshored or unsloped excavations deeper than 4 feet is not allowed. Any trenching and shoring requirements will follow guidelines established in WAC 296-155, the Washington State Construction standards or OSHA 1926.651 Excavation Requirements. In the event that a worker is required to enter an excavation deeper than 4 feet, a trench box or other acceptable shoring will be employed or the side walls of the excavation will be sloped according to the soil type and guidelines as outlined in OSHA/WISHA regulations. If the shoring/sloping deviates from that outlined in the WAC, it will be designed and stamped by a PE. Prior to entry, personnel will conduct air monitoring as described later in this plan. All hazardous encumbrances and excavated material will be stockpiled at least 2 feet from the edge of a trench or open pit. If concentrations of volatile gases accumulate within an open trench or excavation, the means of entering shall adhere to confined space entry and air monitoring procedures outlined under the air monitoring recommendations in this plan and the GeoEngineers Safety Program Manual.
- Personnel will avoid tripping hazards, steep slopes, pit and other hazardous encumbrances. If it becomes necessary to work within 6 feet of the edge of a pit, slope, pier or other potentially hazardous area, appropriate fall protection measures will be implemented by the Site Safety and Health Supervisor in accordance with OSHA/WISHA regulations and the GEI Safety Program manual.

Engineering controls:

	TRENCH SHORING (1:1 SLOPE FOR TYPE B SOILS)
X	**LOCATION WORK SPACES UPWIND/WIND DIRECTION MONITORING**
	OTHER SOIL COVERS (AS NEEDED)
	OTHER (SPECIFY)____

6.3 CHEMICAL HAZARDS (POTENTIALLY PRESENT AT SITE)

Petroleum Hydrocarbons: metals (), PAHs

______ Naphthalenes or paraffins
______ Aromatic hydrocarbons (benzene, ethylbenzene, toluene, xylenes [BETX])
______ Gasoline
___X___ Diesel fuel
___X___ Waste oil
______ Other petroleum fuels (list) ________________

6.4 HAZARDS FROM OTHER ORGANIC COMPOUNDS (PRESENT OR POTENTIALLY PRESENT AT SITE)

______ PCBs Polychlorinated biphenyls
___X___ PAHs (polycyclic aromatic hydrocarbons)
______ Pesticides/Herbicides
______ VOCs (volatile organic compounds)
______ SVOCs (Semivolatile organic compounds)
______ Dioxins/ Furans

6.5 METALS (POTENTIALLY PRESENT AT SITE) As, Cu, Fe, Pb, Ni, Zn

___X___ Lead
___X___ Copper
______ Chromium
___X___ Zinc
___X___ Other metals (arsenic, iron, nickel)

Summary of Chemical Hazards

Compound/ Description	Exposure Limits/IDLH^b	Exposure Routes	Toxic Characteristics
Diesel Fuel—liquid with a characteristic odor	None established by OSHA, but ACGIH has adopted 100 mg/m^3 for a TWA (as total hydrocarbons)	Ingestion, inhalation, skin absorption, skin and eye contact	Irritated eyes, skin, and mucous membrane; fatigue; blurred vision; dizziness; slurred speech; confusion; convulsions; and headache, and dermatitis
Mineral Oil – As a mist	The current OSHA PEL for mineral oil mist is 5 mg/m^3 of air as an 8-hr TWA	If the oil is not a mist, then route of exposure is skin and eye contact	Exposure to oil mists can cause eye, skin, and upper respiratory tract irritation
Mineral based crankcase oil – may contain metals, gas, antifreeze and PAHs	It depends on the contaminants	Ingestion, inhalation, skin absorption, skin and eye contact	It depends on the contaminants.
Polycyclic aromatic hydrocarbons (PAH) as coal tar pitch volatiles	PEL 0.2 mg/m^3 TLV 0.2 mg/m^3 REL 0.1 mg/m^3 IDLH 80 mg/m^3	Inhalation, ingestion, skin and/or eye contact	Dermatitis, bronchitis, potential carcinogen

Summary of Metals Hazards

Compound/ Description	Exposure Limits/IDLH[b]	Exposure Routes	Toxic Characteristics[d]
Arsenic	PEL 0.01 mg/m^3 TLV 0.01 mg/m^3 Ceiling 0.002 mg/m^3 IDLH 5 mg/m^3	Inhalation, skin absorption, ingestion, skin and/or eye contact	Ulcerated nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin, potential carcinogen
Copper (dusts and mists)	PEL 1 mg/m^3 TLV 1 mg/m^3 REL 1 mg/m^3 IDLH 100 mg/m^3	Inhalation, ingestion, skin and/or eye contact	Irritated eyes and respiratory system, coughing, difficulty breathing, wheezing, potential carcinogen
Lead (and inorganic compounds as lead)	PEL 0.05 mg/m^3 TLV 0.05 mg/m^3 REL 0.05 mg/m^3 IDLH 100 mg/m^3	Inhalation, ingestion, skin and/or eye contact	Lassitude (weakness, exhaustion), insomnia, facial pallor, anorexia, weight loss, malnutrition, constipation, abdominal pain, colic, anemia, gingival lead line, tremor, wrist and ankle paralysis, encephalopathy, kidney disease, irritated eyes, hypotension

6.6 CHEMICAL HAZARD MITIGATION MEASURES OR PROCEDURES

Air monitoring will be conducted for VOC vapors and for establishing the level of respiratory protection. A PID will used on site at all times and if ambient air sampling indicates chemical contamination, respirators will be utilized.

- Half face combination organic vapor/HEPA cartridge respirators will be available on site to be used as necessary. P100 cartridges are used for protection against dust and metals while the combination organic vapor/HEPA cartridges are protective against both dust and vapor.
- Level D PPE will be worn at all times on site. Potentially exposed personnel will wash gloves, hands, face, and other pertinent items to prevent hand-to-mouth contact. This will be done prior to hand-to-mouth activities including eating, smoking, etc. Adequate personnel and equipment decontamination will be used to decrease potential ingestion and inhalation.Individual PELs or action limits are not expected to be exceeded given the planned activities. If there are waste oil contaminants in the soil and conditions are damp, airborne dust is not likely to be an issue. If conditions are dry and dust is visible during site activities, personnel will use P100 cartridges on their respirators.

6.7 BIOLOGICAL HAZARDS

	Poison Ivy or other vegetation	
	Insects or snakes	
	Used hypodermic needs or other infectious hazards	**Do not pick up or contact**
	Others	

6.8 BIOLOGICAL HAZARD MITIGATION MEASURES OR PROCEDURES

Site personnel shall avoid contact with or exposures to potential biological hazards encountered.

Additional Hazards None anticipated.

6.9 ADDITIONAL HAZARDS (UPDATE IN DAILY LOG)

Include evaluation of:

- *Physical Hazards* (excavations and shoring, equipment, traffic, tripping, heat stress, cold stress and others)
- *Chemical Hazards* (odors, spills, free product, airborne particulates and others present)
- *Biological Hazards* (snakes, spiders, other animals, discarded needles, poison ivy and others present)

7.0 LIST OF FIELD ACTIVITIES

Check the activities to be completed during the project	
X	Site reconnaissance
X	Exploratory borings
	Construction monitoring
X	Surveying
X	Test pit explorations
X	Monitoring well installation
X	Monitoring well development
X	Soil sample collection
X	Field screening of soil samples
	Vapor measurements
X	Groundwater sampling
X	Groundwater depth measurement
X	Product sample collection
X	Soil stockpile testing
X	Sediment sampling
	Underground storage tank (UST) removal monitoring
	Remediation system monitoring

8.0 SITE DESCRIPTION (ATTACH ANY ADDITIONAL SITE PLAN DETAILS AND CHEMICAL ANALYSES)

8.1 SITE HISTORY: FILL IN WRITTEN DESCRIPTION HERE

Historical industrial site that is overgrown.

Address/Location: ____
Site topography: ____
Predominant wind direction: North
Site drainage: Into Puget Sound
____ Municipal drain
X Surface water drainage –
____ Engineered site drains
____ Other
Utility check complete: To be completed prior to drilling – see documentation Utility Checklist
Traffic or vehicle access control plans: ____
Site access control (exclusion zone) defined by: Yellow caution tape
____ Fence
____ Survey tape
____ Traffic cones
____ Other (traffic control barriers as required by the city)

Hot zone/exclusion zone (Define): ***Within 10 feet of borings***

Contamination reduction zone (Define): ***Decontamination will be set up and area will be delineated***
This needs to be detailed for the site at the time of set up.

8.2 PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment (PPE). Minimum level of protective equipment for these sites is Level D. After the initial and/or daily hazard assessment has been completed, select the appropriate protective gear (PPE) to preserve worker safety. Task-specific levels of PPE shall be reviewed with field personnel during the pre-work briefing conducted prior to the start of site operations.

Check applicable personal protection gear to be used:

X Hardhat (if overhead hazards, or client requests)
X Steel-toed boots (if crushing hazards are a potential or if client requests)
X Safety glasses (if dust, particles, or other hazards are present or client requests)
X Hearing protection (if it is difficult to carry on a conversation 3 feet away)
X Rubber boots (if wet conditions)
X Safety vest (required by saw mill owner/operator)

Gloves (specify):

X Nitrile
________ Latex
________ Liners
________ Leather
________ Other (specify) ___________________________________

Protective clothing:

X **Tyvek (if dry conditions are encountered, Tyvek is sufficient)**
________ Saranex (personnel shall use Saranex if liquids are handled or splash may be an issue)
X Cotton
X Rain gear (as needed)
X Layered warm clothing (as needed)

Inhalation hazard protection:

X Level D
X Level C (respirators with organic vapor filters/ P100 filters)

Limitations of Protective Clothing

PPE clothing ensembles designated for use during site activities shall be selected to provide protection against known or anticipated hazards. However, no protective garment, glove, or boot is entirely chemical-resistant, nor does any PPE provide protection against all types of hazards. To obtain optimum performance from PPE, site personnel shall be trained in the proper use and inspection of PPE. This training shall include the following:

- Inspect PPE before and during use for imperfect seams, non-uniform coatings, tears, poorly functioning closures, or other defects. If the integrity of the PPE is compromised in any manner, proceed to the contamination reduction zone and replace the PPE.
- Inspect PPE during use for visible signs of chemical permeation such as swelling, discoloration, stiffness, brittleness, cracks, tears, or other signs of punctures. If the integrity of the PPE is compromised in any manner, proceed to the contamination reduction zone and replace the PPE.
- Disposable PPE should not be reused after breaks unless it has been properly decontaminated.

Respirator Selection, Use, and Maintenance

GeoEngineers has developed a written respiratory protection program in compliance with OSHA requirements contained in 29 CFR 1910.134. Site personnel shall be trained on the proper use, maintenance, and limitations of respirators. Site personnel that are required to wear respiratory protection shall be medically qualified to wear respiratory protection in accordance with 29 CFR 1910.134. Site personnel that will use a tight-fitting respirator must have passed a qualitative or quantitative fit test conducted in accordance with an OSHA-accepted fit test protocol. Fit testing must be repeated annually or whenever a new type of respirator is used.

Respirator Cartridges

If site personnel are required to wear air-purifying respirators, the appropriate cartridges shall be selected to protect personnel from known or anticipated site contaminants. The respirator/cartridge combination shall be certified and approved by NIOSH. A cartridge change-out schedule shall be developed based on known site contaminants, anticipated contaminant concentrations, and data supplied by the cartridge manufacturer related to the absorption capacity of the cartridge for specific contaminants. Site personnel shall be made aware of the cartridge change-out schedule prior to the initiation of site activities. Site personnel shall also be instructed to change respirator cartridges if they detect increased resistance during inhalation or detect vapor breakthrough by smell, taste, or feel although breakthrough is not an acceptable method of determining the change-out schedule. At a minimum, cartridges should be changed a minimum of once daily.

Respirator Inspection and Cleaning

The Site Safety and Health Supervisor shall periodically (i.e., weekly) inspect respirators at the project site. Site personnel shall inspect respirators prior to each use in accordance with the manufacturer’s instructions. In addition, site personnel wearing a tight-fitting respirator shall perform a positive and negative pressure user seal check each time the respirator is donned to ensure proper fit and function. User seal checks shall be performed in accordance with the GeoEngineers respiratory protection program or the respirator manufacturer’s instructions.

Respirators shall be hygienically cleaned as often as necessary to maintain the equipment in a sanitary condition. At a minimum, respirators shall be cleaned at the end of each work shift. Respirator cleaning procedures shall include an initial soap/water cleaning, a water rinse, a sanitizing soaking, and a final water rinse. One capful of bleach per one gallon of water can be used to create the sanitizing soak solution. When not in use, respirators shall be stored to protect against damage, hazardous chemicals, sunlight, dust, excessive temperatures, and excessive moisture. In addition, respirators shall be stored to prevent deformation of the face piece and exhalation valve.

Facial Hair and Corrective Lenses

Site personnel with facial hair that interferes with the sealing surface of a respirator shall not be permitted to wear respiratory protection or work in areas where respiratory protection is required. Normal eyeglasses cannot be worn under full-face respirators because the temple bars interfere with the sealing surface of the respirator. Site personnel requiring corrective lenses will be provided with spectacle inserts designed for use with full-face respirators. Contact lenses should not be worn with respiratory protection.

9.0 AIR MONITORING PLAN

Work upwind if at all possible. The PID will not detect methane and a 4 gas meter typically used for confined spaces is recommended.

AIR MONITORING PLAN DUST/ METALS

The contaminants listed above present the greatest risk to site personnel through inhalation and ingestion of soil particles. Sediment sampling also found concentrations of heavy metals in soil which could result in exposures close to the PEL if conditions are dry and dusty. Their inhalation/ingestion hazards should be significantly mitigated by wet conditions while excavating contaminated soil. If drilling or excavation activities generate visible dust, the SSO will be notified immediately to assess the need for air monitoring and lab analysis for inhalable and respirable particulates.

Check instrumentation to be used:
X PID (Photoionization Detector)
X Other (i.e., detector tubes): Recommended if PID is measuring VOCs

Check monitoring frequency/locations: and type (specify: work space, borehole, breathing zone):
X **15 minutes - Continuous during soil disturbance activities or handling samples**
______ 15 minutes
______ 30 minutes
______ Hourly (in breathing zone during excavations, drilling, sampling)

Additional personal air monitoring for specific chemical exposure:

Action levels:

- The workspace will be monitored using a photoionization detector (PID). These instruments must be properly maintained, calibrated and charged (refer to the instrument manuals for details). Zero this meter in the same relative humidity as the area it will be used in and allow at least a 10-minute warm-up prior to zeroing. Do not zero in a contaminated area. The PID can be tuned to read chemicals specifically if there are not multiple contaminants on site. It can be tuned to detect one chemical with response factor entered into the equipment, but the PID picks up all volatile organic compounds (VOCs) present. Ionization potential (IP) of chemical has to be less than lamp (11.7/ 10.6eV). The ppm readout on the instrument is relative to the IP of isobutylene (calibration gas), so conversion must be made in order to estimate ppm of the chemical on-site.
- An initial vapor measurement survey of the site should be conducted to detect "hot spots" if contaminated soil is exposed at the surface. Vapor measurement surveys of the workspace should be conducted at least hourly or more often if persistent petroleum-related odors are detected. Additionally, if vapor concentrations exceed 5 ppm above background continuously for a 5-minute period as measured in the breathing zone, upgrade to Level C PPE or move to a noncontaminated area.
- Standard industrial hygiene/safety procedure is to require that action be taken to reduce worker exposure to organic vapors when vapor concentrations exceed ½ the TLV. Because of the variety of chemicals, the PID will not indicate exposure to a specific PEL and is therefore not a preferred tool for determining worker exposure to chemicals. If odors are detected, then employees will upgrade to respirator with Organic Vapor cartridges and will contact the Health and Safety Program Manager for other sampling options.

Air Monitoring Action Levels

Contaminant	Activity	Monitoring Device	Frequency of Monitoring Breathing Zone	Action Level	Action
Organic Vapors	Environmental Remedial Actions	PID	Start of shift; prior to excavation entry; every 30 to 60 minutes and in event of odors	Background to 5 parts per million (ppm) in breathing zone	Use Level D or Modified Level D PPE
Organic Vapors	Environmental Remedial Actions	PID	Start of shift; prior to excavation entry; every 30 to 60 minutes and in event of odors	5 to 25 ppm in breathing zone	Upgrade to Level C PPE
Organic Vapors	Environmental Remedial Actions	PID	Start of shift; prior to excavation entry; every 30 to 60 minutes	> 25 ppm in breathing zone	Stop work and evacuate the area. Contact Certified Industrial Hygienist (CIH) for guidance.
Combustible Atmosphere	Environmental Remedial Actions	PID	Start of shift; prior to excavation entry; every 30 to 60 minutes	<10% LEL or <1000 ppm	Depends on contaminant. The PEL is usually exceeded before the LEL.
Combustible Atmosphere	Environmental Remedial Actions	PID Or 4 gas meter	Start of shift; prior to excavation entry; every 30 to 60 minutes	>10% LEL or >1000 ppm	Stop work and evacuate the site. Contact CIH for guidance.
Oxygen Deficient/Enriched Atmosphere	Environmental Remedial Actions Confined Spaces	Oxygen meter Or 4 gas meter	Start of shift; prior to excavation entry; every 30 to 60 minutes	>19.5<23.5%	Continue work if inside range. If outside range, exit area and contact CIH.

10.0 DECONTAMINATION PROCEDURES

Decontamination consists of removing outer protective tyvek clothing and washing soiled boots and gloves using bucket and brush provided on-site in the contamination reduction zone. Inner gloves will then be removed, and respirator, hands and face will be washed in either a portable wash station or a bathroom facility in the support zone. Employees will perform decontamination procedures and wash prior to eating, drinking or leaving the site. ***Used PPE to be placed in on-site drum.***

Specify other site specific decontamination procedures:

11.0 WASTE DISPOSAL OR STORAGE

PPE disposal (specify): To drums to be stored on-site pending characterization and disposal.

Drill cutting/excavated sediment disposal or storage:

______ On-site, pending analysis and further action
__X__ Secured (list method) ___________Drums_____________________________________
______ Other (describe destination, responsible parties): _________________________________

12.0 DOCUMENTATION EXPECTED TO BE COMPLETED

NOTE: The Field Log is to contain the following information:

Updates on hazard assessments, field decisions, conversations with subs, client or other parties.
Air monitoring/calibration results; personnel, locations monitored, activity at the time of monitoring
Actions taken
Action level for upgrading PPE and rationale
Meteorological conditions (temperature, wind direction, wind speed, humidity, rain, snow, etc.).

Required forms:

Field Log
Health and Safety Plan acknowledgment by GEI employees (Form C-2)
Contractors Health and Safety Plan Disclaimer (Form C-3)
Conditional forms available at GeoEngineers office: Accident Report (Form C-4)

13.0 APPROVALS

1. Plan Prepared ______________________ ______________
Signature Date

2. Plan Approval ______________________ ______________
PM Signature Date

3. Health & Safety Officer Leah Alcyon, CIH ______________
Health & Safety Program Manager Date

FORM C-1
HEALTH AND SAFETY MEETING

IRONDALE IRON AND STEEL PLANT

All personnel participating in this project must receive initial health and safety orientation. Thereafter, brief tailgate safety meetings will be held as deemed necessary by the Site Safety and Health Supervisor.

The orientation and the tailgate safety meetings shall include a discussion of emergency response, site communications and site hazards.

Date	Topics	Attendee	Company Name	Employee Initials

FORM C-2
SITE SAFETY PLAN – GEOENGINEERS' EMPLOYEE ACKNOWLEDGMENT

IRONDALE IRON AND STEEL PLANT

(All GeoEngineers' site workers complete this form, which should remain attached to the safety plan checklist and filed with other project documentation).

I, ____, do hereby verify that a copy of the current Safety Plan has been provided by GeoEngineers, Inc., for my review and personal use. I have read the document completely and acknowledge a full understanding of the safety procedures and protocol for my responsibilities on site. I agree to comply with all required, specified safety regulations and procedures. I understand that I will be informed immediately of any changes that would affect site personnel safety.

Signed ______________________________ Date ______________________

Range of Dates From: ______________________________
To: ______________________________

Signed ______________________________ Date ______________________

Range of Dates From: ______________________________
To: ______________________________

Signed ______________________________ Date ______________________

Range of Dates From: ______________________________
To: ______________________________

Signed ______________________________ Date ______________________

FORM C-3
SUBCONTRACTOR AND SITE VISITOR SITE SAFETY FORM

IRONDALE IRON AND STEEL PLANT

I, ____, verify that a copy of the current site Safety Plan has been provided by GeoEngineers, Inc. to inform me of the hazardous substances on site and to provide safety procedures and protocols that will be used by GeoEngineers' staff at the site. By signing below, I agree that the safety of my employees is the responsibility of the undersigned company.

Signed ______________________________ Date ______________________

Firm: ____

Signed ______________________________ Date ______________________

Firm: ____

Signed ______________________________ Date ______________________

Firm: ____

Signed ______________________________ Date ______________________

Firm: ____

Signed ______________________________ Date ______________________

Firm: ____

Signed ______________________________ Date ______________________

Firm: ____