Remedial Investigation Work Plan

Kosmos Mill Oil Cleanup

Kosmos Flats Area

Prepared for

Tacoma Public Utilities

December 6, 2019
19499-00

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Prepared by

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Kosmos Flats area

1.0 INTRODUCTION

In April of 2019, a seep of Bunker C oil was discovered along the Rainey Creek bank in the Kosmos Flats area (Figure 1) and reported to the Washington State Department of Ecology (Ecology). Tacoma Public Utilities (TPU) immediately began investigating the seep and implementing measures to mitigate risks to human and environmental health. The Site, as defined by the Model Toxics Control Act (MTCA) stipulated in Washington Administrative Code (WAC) 173-340-200, currently includes parts of the former Kosmos Lumber Mill and the Rainey Creek bank as shown as the area of potential effect in Figure 2. Additional seeps of oil have been observed in the past month (October 2019) along the Rainey Creek bank. On behalf of TPU, Hart Crowser has prepared this remedial investigation work plan (RI work plan) to develop the framework for characterizing the nature and extent of environmental impacts and better define the Site. A remedial investigation and feasibility study report (RI/FS) will be completed following this investigation to better understand the source and extent of the oil seeps, and to evaluate potential cleanup actions as necessary.

1.1 PURPOSE AND OBJECTIVES

The purpose of this RI work plan is to document the scope, technical approach, and implementation details for completing the Site RI/FS. The purpose of the RI is to generate data of sufficient quality to characterize the nature and extent of impacts in environmental media, including soil and groundwater; to evaluate data relative to appropriate cleanup levels (CULs); and to support an evaluation of potential cleanup actions. The objective of the RI/FS is to identify contaminants of potential concern (COPCs) at the Site and their source(s). The primary COPC appears to be Bunker C oil and other COPCs commonly found with Bunker C (such as other intermediate and/or and heavy fuel oils).

The RI work plan provides an overview of pertinent background information, an initial evaluation of existing data for the Site (including a preliminary Conceptual Site Model [CSM]), the identification of data needs to support the risk assessment and evaluation of remedial alternatives, and a scope of work designed to address the identified data needs. This work plan includes other components such as the Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP), which is provided in Appendix A; and site-specific Health and Safety Plan (HASP), which is provided in Appendix B.

1.2 REGULATORY FRAMEWORK

The RI work plan will be implemented in general accordance with guidance put forth in MTCA WAC 173-340. Under MTCA, an RI/FS is required to be developed once a site is prioritized for remedial action (WAC 173-340-350; Ecology 2007). The purpose of the RI/FS Report is to recommend a cleanup action, as described in WAC 173-340-360 through 173-340-390, based on the collection, development, and evaluation of a sufficient site-specific data set.

1.3 WORK PLAN ORGANIZATION

This RI work plan for the Site complies with MTCA requirements and is organized as follows:

- **Section 2.0—Background and Physical Setting:** Provides background information of the Site, including current and historical land use, surface features, and local geology and hydrogeology.
- **Section 3.0—Previous Investigations and Data Evaluation:** Details past investigations and remedial work performed at the Site and cultural and natural resources present on the Site.
- **Section 4.0—Preliminary Conceptual Site Model:** Presents the preliminary CSM for the Site, potential sources, fate and transport of COCs, and human and ecological exposure pathways.
- **Section 5.0—Remedial Investigation Scope of Work:** Presents the sampling objectives and approach as well as the scope and data collection activities.
- **Section 6.0—Project Management Plan:** Identifies key project personal and the anticipated project timeline.

2.0 BACKGROUND AND PHYSICAL SETTING

The background and physical setting information summarized below are based on site visits and review of prior environmental data and documents.

2.1 SITE DESCRIPTION AND HISTORY

The Site is located south of the town of Morton, Washington, off Champion Haul Road (see Figure 1). The Riffe Lake reservoir is currently a part of the power generating system operated by TPU. During the winter months the water levels in the reservoir drop. Historically spring rainfall and snow melt flood the Site the rest of the year. In recent years, (due to seismic safety concerns), water levels at the Site have not been maintained flood levels, elevation 749, allowing for vegetation to grow on the plateau of the Site, which is at approximately elevation 768. The oil seeps are at elevations 730 and 723 and are located on the eastern side of the Rainey Creek bank (Figure 2), near the former Kosmos Mill site. In October a sheen was discovered on Rainey Creek’s water surface. As an initial protective measure, TPU installed oil absorbent Best Management Practices (BMPs) and boom in Rainey Creek to mitigate oil flow.

Before the creation of the reservoir the Site was a part of the Kosmos town lumber mill which was abandoned and demolished prior to 1968. There is little readily available information regarding the historic lumber mill and its operations. Topographic maps from 1962 and 1963 from the former site and a few photos of the mill operations are available.

2.2 ADJACENT SITES

Hart Crowser completed a search of Ecology’s online databases and reviewed records for any listed sites within a 1-mile radius of the Site. The findings of the records review indicated a single adjacent site within 0.5 mile of the Site, which is described below. To the north of the Site is the former Kosmos Townsite which is also situated in the Rainey Valley. Most of the townsite was located between Frost Creek to the north and Rainey Creek to the south. The townsite was located on a flood plain and experiences similar flood events as the Site. TPU purchased the townsite in the 1960s and relocated all of its inhabitants. This former townsite was flooded as part of the reservoir construction around 1968.

Between September 1992 and December 1992, five areas in the Kosmos Townsite were investigated for underground storage tanks (USTs) after the discovery of a partially exposed UST (DOWL 1993). Ten USTs were found in four of the five areas ranging in size from 500-gallons to 2500-gallons. Only one of the USTs in Area 3 contained petroleum product (gasoline), the remaining USTs contained water or soil. All five of the areas had contaminated soil above MTCA Method A CULs. Additionally, ten groundwater monitoring wells were installed around the contaminated sites and groundwater monitoring proceeded for two sampling periods in October 1992 and April 1993.

Approximately 15,000 cubic yards of contaminated soil was excavated from the townsite and remediated on-site by a mobile, low-temperature thermal desorption unit. The remediated soil was used as backfill for the excavations. Groundwater data collected by DOWL showed that contaminants did not migrate away from the UST perimeter set by the monitoring wells, but concentrations above MTCA CULs were detected in the anticipated central area of the contaminated plume.

2.3 PHYSICAL SETTING

The Site is located in the Rainey Valley next to Riffe Lake. The Site is bounded by Rainey Creek to the north and west, Champion Haul Road to the east, and Riffe Lake to the south. The Site topography generally slopes to the south towards Riffe Lake, but the local topography near the oil seep gradually slopes to the northwest towards Rainey Creek.

The general public can enter the Site by foot, and the surrounding land and water is used for recreational activities.

2.3.1 GEOLOGY AND HYDROGEOLOGY

Soil near the surface of the Site was classified as organic silts and organic silty clays of fill material (AIRO 1993). Because of the close proximity of the Site to the Kosmos Townsite and limited readily available data, it is assumed that the Site's geology and hydrogeology will be similar to that of the Kosmos Townsite. Information gathered during remedial investigation activities will be used to supplement available data on soil classification at the Site.

Soil near the surface at the Kosmos Townsite generally consisted of organic loam with scattered, rounded gravel 5 to 8 feet below ground surface (bgs). The soil then gradually transitioned to silty sands with fractured cobbles approximately 14 feet bgs. Groundwater was generally encountered around 9 to 11 feet bgs and flowed to the southwest, towards Riffe Lake. However, groundwater measurements have shown that Frost Creek has been a local source of groundwater recharge (DOWL 1993).

3.0 PREVIOUS INVESTIGATIONS AND DATA EVALUATION

3.1 SITE INVESTIGATIONS

In 1992, two USTs were discovered on the Site. AIRO Environmental Services, Inc. (AIRO 1993) removed the USTs and excavated any contaminated soil associated with the USTs. The first tank, located at Site D, located south of the seep area (not included in Figure 2), was a 500-gallon steel UST and partially exposed along an earthen bank. The tank was filled with lake water which appear to have a sheen or indication of petroleum product. AIRO collected samples from the lake water inside the UST and analyzed for polychlorinated biphenyls (PCBs) and total halogens, and neither were detected at or above laboratory reporting limits. The second UST at Site A (Figure 2), was a 5,000-gallon Bunker C fuel tank below ground level next to the mill site foundations and contained petroleum product. The product removed from the tank was classified as dangerous waste due to the presence of halogenated hydrocarbon. The soil directly surrounding the UST was contaminated with heavy oil-range petroleum above MTCA Method A soil cleanup levels. Approximately 87 cubic yards of soil was disposed of at the Kitsap County Landfill.

3.2 CULTURAL AND NATURAL RESOURCES

The Site is located on the Former Kosmos Lumber Mill and south of the Kosmos Townsite. The town and lumbermill were established in the early 1904 and had approximately 500 residents. In 1968 the Mossyrock Dam was built to provide power for Tacoma, forcing the town to be abandoned and the buildings razed. The former Kosmos Town and Mill site has been identified, evaluated, and concurred upon by the Department of Archaeology and Historic Preservation as not a National Register-eligible archaeological site. However, remnants or historic features may still be found during construction that require further documentation. Pre-historic artifacts or sites are not anticipated to be impacted. Tacoma Power or their designee will be observing the test pit excavations; if any cultural resource artifacts are encountered, cultural resource field staff (subcontracted by TPU) shall follow Tacoma Power's Plan and Procedures for Dealing with the Unanticipated Discovery of Cultural Resources.

4.0 PRELIMINARY CONCEPTUAL SITE MODEL

A CSM describes potential chemical sources, release mechanisms, environmental transport processes, exposure routes, and receptors. The primary purpose of the CSM is to describe pathways by which human and ecological receptors could be exposed to site-related chemicals. A complete exposure pathway consists of four necessary elements: (1) a source and mechanism of chemical release to the environment, (2) an environmental transport medium for a release chemical, (3) a point of potential contact with the impacted medium (referred to as the exposure point), and (4) an exposure route (e.g., soil ingestion) at the exposure point.

A preliminary CSM was developed for the Site as a part of the RI work plan. This preliminary CSM is based on findings from previous investigations and remedial actions at the former Kosmos Mill and Town; it appears that the historical operation of the former mill and USTs associated with the mill operation may have contributed to contamination of soil and groundwater at the Site. Contaminants in soil and groundwater at the Site have the potential to migrate through a number of pathways to the Rainey Creek bank, resulting in possible exposures to human and/or ecological receptors. Data generated from the proposed RI investigation will be used to develop a comprehensive and updated CSM for the Site to be used during the RI/FS process.

4.1 POTENTIAL SOURCES AND RELEASE MECHANISMS

Possible contaminant sources for the oil seep are unknown leaky USTs (LUSTs) and piping or petroleum-impacted soil associated with the former USTs, unknown LUSTs, and/or unknown sources. Information gathered from the proposed RI investigation will be used to determine possible sources and source locations.

4.2 FATE AND TRANSPORT PROCESSES

The fate and transport processes of heavy fuel oil depends on the composition of the contaminant and the environment affected by the contaminant. In general, when heavy fuel enters the environment the individual products comprising the fuel partition to various environmental compartments according to their own physical-chemical properties (API 2012). Data generated from the proposed RI investigation will be used to understand the fate and transport processes at the Site.

The primary mechanisms likely to influence the fate and transport of chemicals at the Site include natural biodegradation of organic chemicals, sorption to soil, advection and dispersion in groundwater, volatilization of volatile chemicals from soil or groundwater to air, leaching of chemicals from soil to groundwater, and discharge of chemically impacted groundwater to surface water. The relative importance of these processes varies, depending on the chemical and physical properties of the released contaminant. The properties of soil and the dynamics of groundwater flow also affect contaminant fate and transport.

The Site is partially vegetated and mostly unpaved. Therefore, the soil-to-groundwater migration pathway is potentially complete because of the potential for infiltration of precipitation through unpaved areas and through cracks in the former foundations into the vadose-zone soil. Leaching of near-surface soil impacts during precipitation events could result in impacts to shallow groundwater at the site.

Volatile contaminants may partition to the vapor phase in the source areas or downgradient of the source areas via groundwater transport of dissolved-phase contamination. However, there are currently no structures at the site, so the potential vapor phase is less of a concern and considered incomplete.

The Site is immediately adjacent to Rainey Creek and Riffe Lake downstream. Given the close proximity to the Site, there is potential for the dissolved-phase contamination and nonaqueous phase liquid (NAPL) to migrate downgradient of the source area and impact surface water. However, the lateral extent of any potential groundwater plume has not been delineated. Therefore, the pathway for discharge of chemically impacted groundwater to surface water and sediment in Rainey Creek and Riffe Lake is considered potentially complete.

4.3 HUMAN HEALTH AND ECOLOGICAL EXPOSURE

4.3.1 Human Health Exposure Scenarios

The Site had at one point been used as a lumber mill and contained USTs, railroad tracks, and buildings used by the lumber mill or associated rail lines. The Site is currently vacant, but accessible by the public as a wildlife area. The current Site uses are expected to continue into the foreseeable future.

Rainey Creek and Riffe Lake, which are directly adjacent to the Site and approximately 1,500 feet to the southwest, respectively, as well as the land on and around the Site provide habitat that may attract recreational visitors.

Based on these uses, human receptors may include construction workers and recreational users. The following pathways are potentially complete for human exposure:

Construction Workers—Construction workers could potentially be exposed to chemicals in environmental media on the site by the following pathways:

- Direct skin contact with or incidental ingestion of chemically impacted soil in excavations on the Site.
- Inhalation of wind-borne particulates on or migrating offsite from chemically impacted soil in excavations on the Site.
- Inhalation of outdoor air vapors emanating from soil or groundwater with volatile chemical impacts on-site or migrating off the Site.
- Dermal contact with, incidental ingestion of, or inhalation of vapors emanating from chemically impacted, shallow groundwater on-site or migrating off the site as encountered in excavations below the water table.

Recreational Visitors— The Site and the surrounding area is currently closed to recreational visitors. However, Riffe Lake is still accessible to the general public, who could potentially be exposed to chemicals migrating to the water by the following pathways:

- Direct skin contact with and incidental ingestion of surface water or sediment from Rainey Creek or Riffe Lake that has been chemically impacted via discharges of chemically impacted groundwater migrating off-site.
- Ingestion of chemicals bioaccumulated in the tissue of fish from chemically impacted surface water or sediment in Rainey Creek and Riffe Lake.
- Direct skin contact with and incidental ingestion of chemically impacted soil near the seepage area.
- Inhalation of wind-borne particulates on or migrating off-site from chemically impacted soil.

- Inhalation of outdoor air vapors emanating from soil or groundwater with volatile chemical impacts on or migrating off the Site.

4.3.2 Terrestrial Ecological Receptors

A simplified terrestrial ecological evaluation (TEE) will be completed for the Site to assess the potential for ecological exposure. The intent of a simplified TEE is to ensure protection of terrestrial plants, soil biota, and terrestrial wildlife at the Site, as provided under WAC 173-340-7490(3)(b). MTCA specifies that the simplified TEE process is intended to identify sites that do not have a substantial potential to pose a threat of significant adverse effects to terrestrial ecological receptors. Therefore, a simplified TEE may be used to remove a site from further terrestrial ecological consideration during the RI and cleanup process (WAC 173- 340-7492).

4.3.3 Aquatic Ecological Receptors

Aquatic ecological receptors may be exposed to chemically impacted shallow soil, surface water, sediment, and/or fish tissue at the site by the following pathways:

- Direct contact with and ingestion of surface water or sediment in in Rainey Creek and Riffe Lake that has been chemically impacted via discharges of chemically impacted groundwater migrating off-site.

- Ingestion of chemicals bioaccumulated in the tissue of fish from chemically impacted surface water or sediment in in Rainey Creek and Riffe Lake.

5.0 REMEDIAL INVESTIGATION SCOPE OF WORK

The field investigations will be conducted in general accordance with the methods and protocol described in the SAP/QAAP (Appendix A).

5.1 REMEDIAL INVESTIGATION DATA GAPS AND OBJECTIVES

Previous investigations have identified impacts to soil and groundwater at the Site caused by a release of petroleum from UST and an interim cleanup action was performed. However additional assessment at the Site is needed to characterize the current nature and extent of impacts. The RI objectives in addressing data gaps as they relate to hazardous substances potentially present and known at the site include the following:

- Evaluation of contaminant migration pathways.

- Determination of the nature, extent, and distribution of hazardous substances in environmental media at the Site. This analysis will focus on the vertical and horizontal extent of contamination in soil and groundwater. Figures and cross-sections will be provided identifying the elevations and areas that are impacted.

- Identify the potential source of the oil seeps.

- Assessment of reasonably likely future human and ecological receptors identified in the preliminary CSM discussed above (Section 4). Further evaluation of potential chemical sources, contaminant migration pathways and the nature, extent, and distribution of hazardous substances in affected media.

- Through the risk screening, evaluation of the risk to human health and the environment from releases of hazardous substances.

- Generation or use of data of sufficient quality for site characterization and risk screening.

- Development of the information necessary to conduct a preliminary evaluation and design of source control measures to address contaminant releases from the site, if deemed necessary.

5.2 PREFERENTIAL PATHWAY ASSESSMENT

Subsurface conditions at the Site are currently unknown and can only be inferred upon based on limited data from other nearby investigations. Preferential pathways depend on soil conditions, contaminant concentrations, and contaminant concentration, along with other factors. Information gathered from the proposed RI investigation will be used to supplement the oil seep investigation data and to determine possible pathways.

5.3 RISK SCREENING

Hart Crowser will assess the potential risk posed to human health and to ecological receptors by COCPs detected in soil and/or groundwater by comparing detected concentrations to the preliminary CULs discussed below.

Soil analytical results will be compared to MTCA Method A CULs for unrestricted land use. If chemicals detected are not included in the Method A list or the site is determined to be complex (e.g., multiple chemicals of potential concern or potential impacts to surface water), then MTCA Method B CULs will be used.

6.0 PROJECT MANAGEMENT PLAN

6.1 KEY PROJECT PERSONNEL

Julie Wukelic is the Principal Engineer for Hart Crowser. Ms. Wukelic will be kept informed of the status of the project and of project activities. She will be provided with data, reports, and other project-related documents prepared by Hart Crowser before their submittal to the Client and/or Ecology. She will be responsible for communicating with the property owner, participating in discussions with Ecology, and coordinating on-site activities with the property owner and Hart Crowser.

Angie Goodwin is the Project Manager for Hart Crowser and will coordinate with project task leaders and will communicate with Ms. Wukelic. She will be responsible for allocating the resources necessary to ensure that the objectives of the site assessment are and for preparing the RI/FS report. Ms. Goodwin will review data, reports, and other project-related documents prepared by Hart Crowser before their submittal to the Client or to Ecology. Ms. Goodwin will also assist project staff with technical issues.

Andrew Kaparos is the environmental engineer for Hart Crowser. Mr. Kaparos will be responsible for implementing the data gaps investigation and for communication of project status to the project manager. Mr. Kaparos will also be responsible for technical assistance to assigned staff, as appropriate; assistance with resolution of technical or logistical challenges that may be encountered during the investigation; and assistance with field activities and report writing and review and will participate in discussions with Ecology.

Andrew Nakahara provides laboratory coordination and oversight, assists with field activities, and writes and reviews reports for Hart Crowser.

Jessica Blanchette provides health and safety management and support for Hart Crowser.

Jessica Knickerbocker is the Project Manager for TPU and is responsible for all management for the Project. Ms. Knickerbocker is also responsible for planning, creating, and/or managing all work activities, variances, tracking, reporting, communication, performance evaluations, staffing, and internal coordination, and project/program funding as it pertains to developing the project design/construction.

Keith Underwood is the Project Sponsor for TPU and serves as the primary champion for this project. Mr. Underwood will manage the initial project justification and overall benefits realization. The Project Sponsor has the authority to define scope and approve schedule and work plan and will provide overall guidance to the Project Manager throughout the project. Mr. Underwood is also responsible for reviewing and approving all changes to scope, schedule, costs baselines, and project deliverable and accepting or rejecting as appropriate and upon completion of the project approving final project closeout.

Terry Ryan is the Project Advisor for TPU and serves in a consulting capacity to the Project Sponsor. Mr. Ryan will serve as a liaison between the Project Management Team (Project Sponsor and Project Manager) and TPU’s executive team or senior-level management team when appropriate, providing advice and broader business context for the project. The Project Advisor is responsible for working with Sponsor and Project Manager to define scope and identify project assumptions, risks, dependencies, and constraints. Mr. Ryan will review the Project Management Plan with the Sponsor and offer feedback as well as offer support throughout the project life.

Mike Rhubright is the Project Coordinator for TPU and serves as the Subject Matter Expert for environmental cleanups, on behalf of Tacoma Power’s Environmental Compliance Group. Mr. Rhubright will oversee and facilitate Investigation and Construction Phase and is responsible for assisting the Project Manager in creating quality control and assurance standards. The Project Coordinator is also responsible for on-site field inspection, which may include coordination with ECCs, consultant and construction coordination in the field, and maintaining quality control and assurance logs throughout the project. The Project Coordinator will be responsible for providing project progress feedback to the project team during weekly coordination meeting. Responsible for management of consultant and construction Contracts.

Heather Croston provides Administrative Support for TPU and is responsible for assisting the Project Manager in developing all clerical related documents (specifications, reports, PMP, etc.) in organizationally approved formats. Ms. Croston will also be responsible for scribing duties during all project meetings and maintaining all project communication distribution lists.

6.2 SCHEDULE

The drilling and test pit exploration subcontractors are currently scheduled for conducting the RI investigation for the week of December 9, 2019. A utility check with the public and private locators will be completed before field work commences. It’s assumed that the advancement of the sonic borings, including soil and groundwater sampling, and test pit excavations will be completed within four days. If site conditions require additional days for field work, we will notify TPU immediately. Laboratory analytical data will be available within two weeks following sample submittal, and a draft RI/FS repot will be available within approximately four weeks of receiving laboratory analytical data.

7.0 LIMITATIONS

Work for this project will be performed in accordance with generally accepted professional practices for the nature and conditions of the work completed in the same or similar localities, at the time the work will be performed. It is intended for the exclusive use of Hart Crowser and TPU for specific application to the referenced property. This work plan is not meant to represent a legal opinion. No other warranty, express or implied, is made.

8.0 REFERENCES

AIRO 1993. Site Assessment Report, Former Kosmos Mill Site, Glenoma, WA. Prepared for Tacoma Public Utilities by Airo Environmental Services Inc. March 31, 1993.

API, 2012. Heavy Fuel Oils Category Analysis and Hazard Characterization. Prepared for the US Environmental Protection Agency by The American Petroleum Institute Petroleum HPV Testing Group
DOWL 1993. Site Characterization & Cleanup Action Report, Former Kosmos Townsite, Lewis County, WA. Prepared for Tacoma Public Utilities by DOWL Engineers, June 1993.

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Washington State Department of Ecology (WSDOE). 2007. Model Toxics Control Act Regulation. Chapter 173-340 WAC. 12 October.

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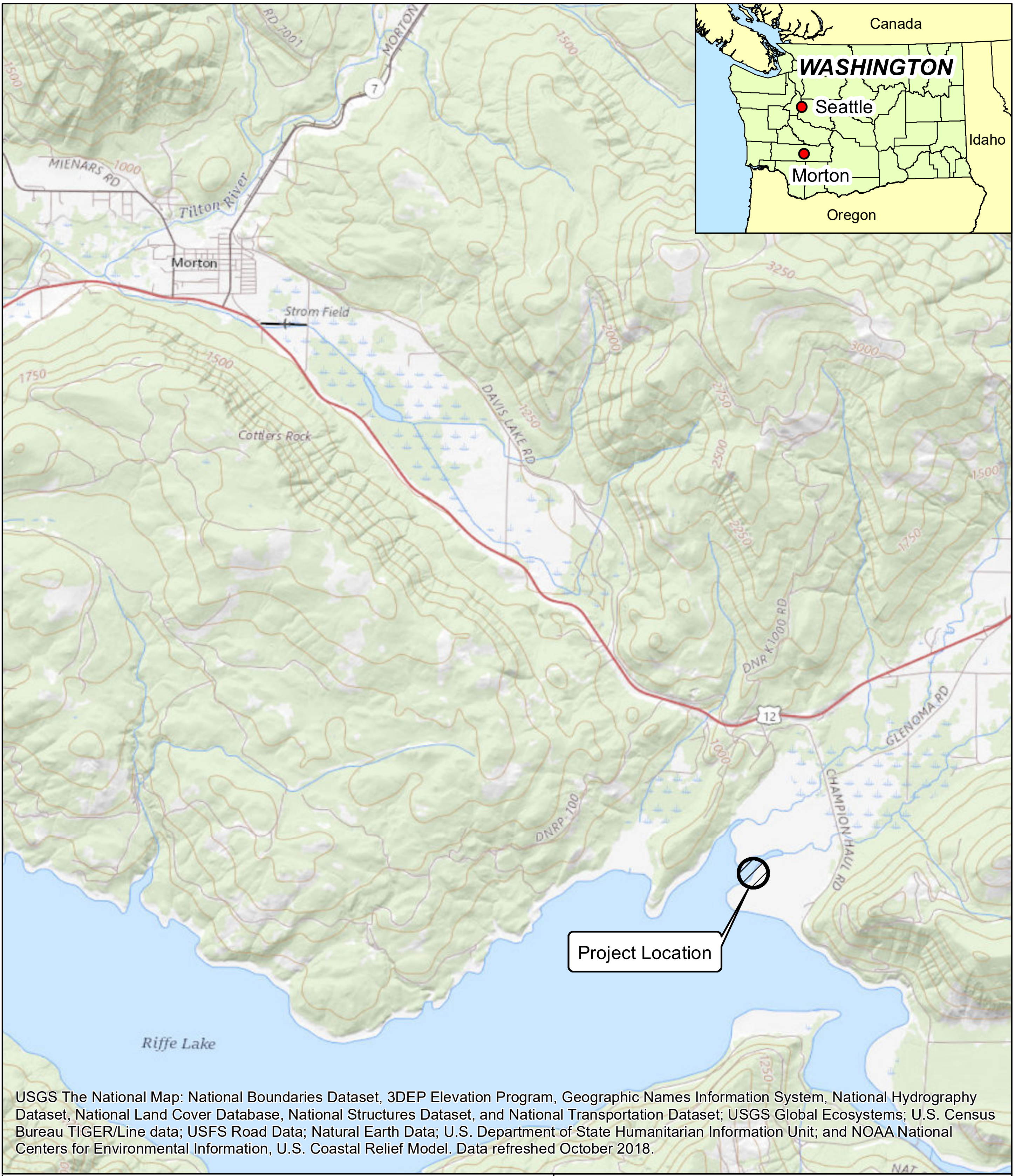

USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed October 2018.

Note: Feature locations are approximate.

Kosmos Mill Oil Cleanup
Morton, Washington

Vicinity Map

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Figure

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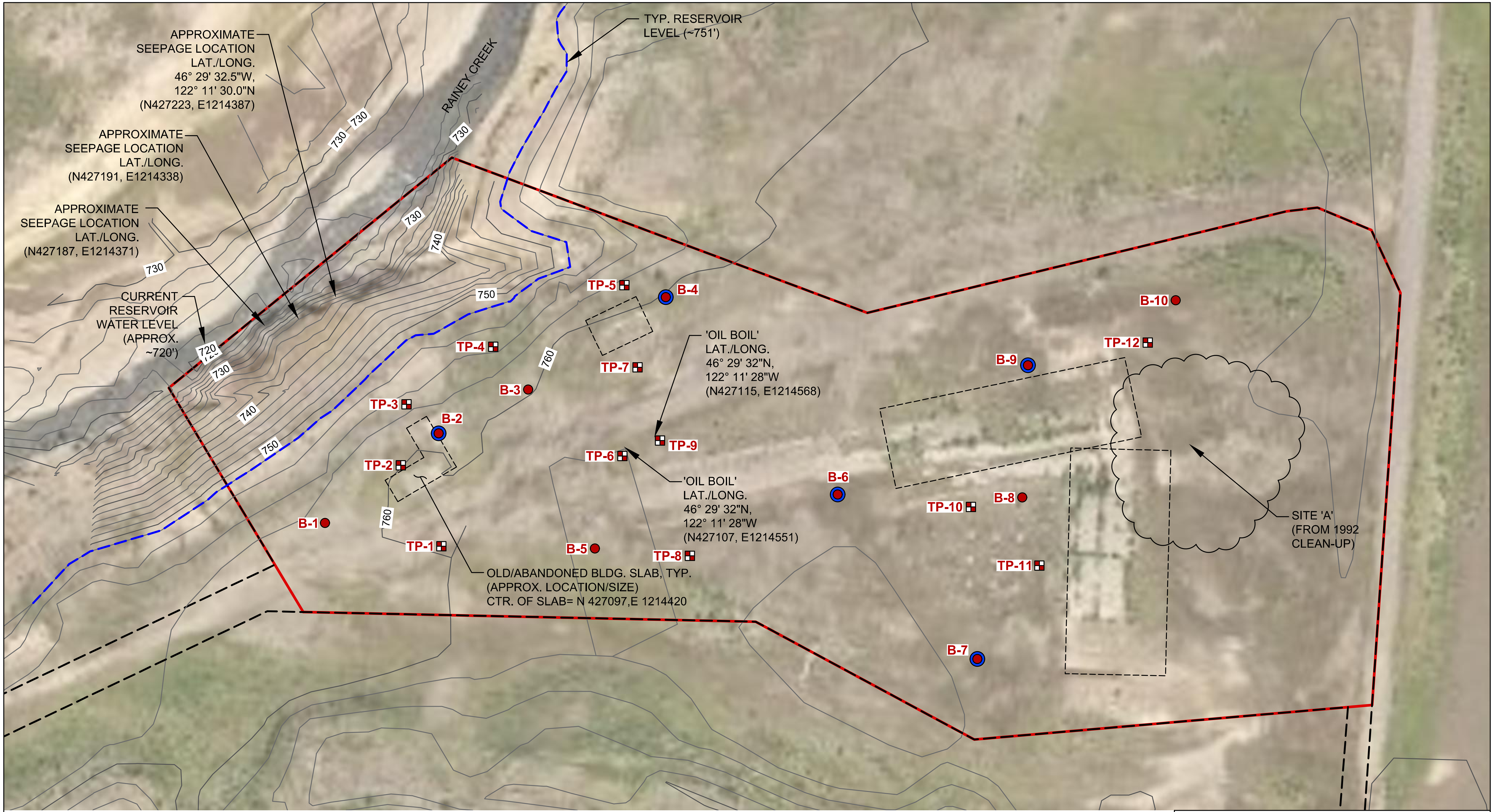

Legend

- ● Proposed Boring
- ◉ Proposed Boring with Grab Groundwater Sample
- ▨ Proposed Test Pit
- ☐ Area of Potential Effect

Notes:

1. Elevation contours and site features/locations provided by the City of Tacoma Public Utilities.
2. Contours derived from aerial 'flyover' done April 1998 when reservoir was at elevation 750.7 (NGVD '88).
3. All proposed work will be conducted within the Area of Potential Effect (APE) boundary.

0 60 120
Scale in Feet

N

Kosmos Mill Oil Cleanup
Morton, Washington

Proposed Exploration Plan

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Figure
2

APPENDIX A

Sampling and Analysis Plan/ Quality Assurance Project Plan

Appendix A - Sampling Analysis Plan/Quality Assurance Project Plan

Kosmos Mill Oil Seep

Kosmos Flats Area

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Kosmos Mill Oil

Kosmos Flats Area

1.0 PROJECT DESCRIPTION

Hart Crowser has prepared this Sampling and Analysis Plan and the Quality Assurance Project Plan (SAP/QAPP) consistent with the requirements of Washington Administrative Code (WAC) 173-340-820 for Tacoma Public Utilities (TPU). This document presents the organization, objectives, planned activities, and specific quality assurance/quality control (QA/QC) procedures associated with the proposed Kosmos Mill Oil Seep site characterization data collection activities to be conducted as part of the Remedial Investigation/Feasibility Study (RI/FS). This data collection effort is being performed as part of the TPU remedial investigation process to determine the source and extent of contamination of the oil seep along the Rainey Creek bank. The goal of the sampling is to obtain reliable data about physical, environmental, and chemical conditions at the site in order to support the goals and objectives of the RI/FS.

The source and extent of the oil seep is not known. Therefore, to evaluate these potential sources and pathways, and to assist in developing the Conceptual Site Model (CSM) as part of the Kosmos Mill Oil Seep RI/FS, this SAP/QAPP focuses on the proposed Site investigation to be conducted at the former Kosmos Mill site.

The objective of the Kosmos Mill Oil Seep data collection effort is to determine the nature and extent of environmental impacts at the Site. This phase of work is discussed in the RI work plan.

This SAP/QAPP provides guidance to field personnel involved in the Kosmos Mill Oil Seep data collection field activities to ensure that data quality is maintained. Any future changes to the Kosmos Mill Oil Seep data collection effort (such as changes in soil or test pit sample locations, sampling frequency, and/or chemical analyses) will be done during the Site investigation and communicated to TPU.

Specific protocols for sampling, sample handling and storage, chain-of-custody, and laboratory and field analyses are described in this SAP/QAPP. Appendix B of the RI Work Plan presents the project-specific Health and Safety Plan (HASP). A copy of the SAP/QAPP and the HASP should be carried in the field when completing the Kosmos Mill Oil Seep data collection activities.

1.1 Project Objectives

The objectives of our proposed activities are to:

- Identify the potential source(s) of the oil release
- Further evaluate the bunker C oil release and determine whether oil has migrated away from the discovered oil seep;

- Characterize the release(s) to the greatest extent possible if and where contamination above MTCA Method A cleanup levels is found; and
- To obtain sufficient and high-quality data to be used in the reporting, feasibility study, and future remedial designs.

1.2 Scope of Work

This SAP/QAPP has been prepared by Hart Crowser on behalf of TPU. Proposed exploration locations are provided in Figure 2 of the RI work plan. The proposed Kosmos Mill Oil Cleanup data collection activities include the following:

- Advance an estimated 10 sonic soil borings to approximately 40 feet below ground surface (bgs).
- Excavate 12 test pits to a depth of up to 20 feet bgs.
- Collect soil samples at 2.5- to 5-foot intervals for soil classification, field screening (sheen, staining, etc.), and possible chemical analysis.
- Collect grab groundwater samples from five of the sonic soil borings using temporary well screens.
- Submit the soil and groundwater samples to an Ecology-accredited laboratory (Friedman and Bruya, Inc. of Seattle, WA) for chemical analyses listed in Section 4.0.
- Review and validate the analytical results for quality assurance.
- Compile laboratory results and compare them with MTCA Method A soil cleanup levels for unrestricted land use and MTCA Method A cleanup levels for groundwater.
- Coordinate with Willamette Cultural Resources Associates, who may conduct additional archaeological assessment to identify whether any significant resources are present.

Sampling locations, procedures, analytical methods, and evaluation of results are discussed in subsequent sections of this SAP/QAPP.

2.0 FIELD SAMPLING PROCEDURES

2.1 Site Access

TPU has granted access for Hart Crowser to conduct environmental investigation activities. Hart Crowser will coordinate activities directly with TPU and will notify the project manager before beginning work at the site.

2.2 Utility Location

Hart Crowser will arrange to have underground utilities located and marked prior to beginning any site characterization activities. Hart Crowser will contact the Washington Utility Notification Center, who will in turn notify the various utilities in the area to mark any underground installations in the vicinity of the Site. We will also subcontract with a private utility locator to mark utilities on the Site. We will review provided Site plans for locations of specific utilities. Exploration locations will be adjusted if necessary, to avoid any underground utilities that are identified.

2.3 Soil Boring Advancement and Test Pit Excavation

Ten borings (B-1 through B-10) will be advanced using sonic drilling and twelve test pits (TP-1 through TP-12) will be excavated. The boring and test pit locations may be modified after work begins based on our field observations and conditions at the Site. If soil boring or test pit locations are modified, new locations will be chosen near the proposed locations or at locations that will better understand and characterize the extent of contamination at the Site. There may be underground obstacles such as concrete slabs or other debris; therefore, multiple soil boring or test pit attempts near each target location may be necessary.

The purpose of the test pits and borings is to help determine the vertical and horizontal extent of contamination. Some test pit locations will be located near potential source locations (e.g. near surface boils and former building foundations) to potentially determine the source(s) of the oil seep.

We anticipate that most of the proposed borings and test pits will be installed to depths of up to 40 feet bgs and up to 20 feet bgs, respectively. However, if field screening indicates that contamination may be present at depth in any of the borings and/or if we do not encounter groundwater in borings, we may continue advancing the borings until we have delineated the vertical extent of contamination, until we encounter groundwater, or until we hit refusal, up to a maximum depth of 50 feet bgs. The maximum depth of test pits will be limited by the maximum reach of the excavator. Each boring location will be located by GPS. Screening and sampling procedures during boring advancement are discussed below.

2.3.1 Soil Screening

Soil obtained from explorations will be collected every 2.5- to 5-foot intervals and be field-screened for environmental impacts using physical observation, performing sheen tests, and measuring headspace vapor using a photoionization detector (PID). The effectiveness of field screening methods varies with temperature, moisture content, organic content, soil type, and age of the constituents. Soil screening tests may not be completed if limited soil volume is recovered. These techniques are discussed below.

Observation. For soil with relatively higher petroleum concentrations there will likely be observable indicators of environmental impacts. Soil may be stained or discolored so that it is visibly noticeable compared to typical soil colors. Sheens may also cause the soil to have a shiny or glossy appearance. Odors may also be present ranging from very faint to strong and from sweet smelling to pungent. Odors are usually detected inadvertently during field activities and are usually noticeably different than typical odors in air.

Sheen Tests. A sheen test is a visual test to assess if a sheen is produced on water by the soil. A small volume of soil is placed in a pan partially filled with water and the water surface is observed for signs of sheen. Sheens are classified as described below.

Sheen Classification

Classification	Description
No sheen (NS)	No visible sheen on water surface.
Slight sheen (SS)	Light colorless film, spotty to globular; spread is irregular, not rapid, areas of no sheen remain, film dissipates rapidly.
Moderate sheen (MS)	Light to heavy film, may have some color or iridescence, globular to stringy, spread is irregular to flowing; few remaining areas of no sheen on water surface.
Heavy sheen (HS)	Heavy colorful film with iridescence; stringy, spread is rapid; sheen flows off the sample; most of the water surface may be covered with sheen.

PID Headspace Measurements. Headspace vapor screening is used to detect volatile organic vapors associated with VOCs. The procedure includes placing a soil sample in a plastic bag and shaking the bag to expose the soil to the air trapped in the bag. The PID probe is then inserted in the bag so that the instrument can measure the concentration of organic vapors in the headspace. The highest vapor reading is recorded for each sample. The PID measures concentrations in ppm (parts per million) and is calibrated to isobutylene. The PID can typically quantify organic vapor concentrations in the range of 0 to 1,000 ppm.

2.3.2 Soil Sampling

The sampling locations from within the boring may be modified in the field (based on field screening) if needed to delineate the vertical extent of impacts in soil (i.e., to bound the contamination by collecting one sample above observed impacts, one from within the impacted zone, and one from beneath the suspected impacted zone).

Soil samples will be labeled according to the boring number and the order the sample was collected (e.g., B1-S1). The samples will be screened in the field using a PID and via visual methods for indications of potential contamination (e.g., sheen, staining). Based on field screening results and sample locations, at least one soil sample from each exploration location will be submitted for chemical analysis. If site conditions and screening results indicate obvious impacts, we will likely request additional samples to be analyzed to further delineate noted impacts vertically within a boring and laterally across an area.

Soil samples will be transferred to labeled, pre-cleaned glassware provided by the sample receiving laboratory. Each soil sample will be transferred using a stainless-steel sampling spoon or disposal sampling equipment. All sample jars will be filled with no headspace prior to capping jars, as much as possible with the soil recovery. Soil samples for volatile analysis will be collected using Environmental Protection Agency (EPA) Method 5035 procedures, by placing a 5-gram soil plug in a laboratory-supplied, methanol-preserved, 40-millileter volatile organic analysis (VOA) bottle.

2.3.3 Groundwater Sampling

Grab groundwater samples will be collected from select borings using temporary well screens set in the boreholes. It is assumed that groundwater samples will be collected from 5 temporary wells if sufficient groundwater is encountered in the sonic borings (locations shown on Figure 2 of RI work plan).

Five-foot-long temporary well screens will be used, and the screen intervals will be selected in the field to span the water table surface. Groundwater will be purged (at least one casing volume) before sample collection, using new polyethylene tubing and a peristaltic pump. Purging will continue to reduce turbidity as much as practicable before water samples are collected.

The temporary wells will be sampled using low-flow groundwater sampling techniques. Purging and sampling will be conducted at a depth representing the middle of the screened interval. The laboratory-supplied sample bottles will be filled directly from the polyethylene tubing at relatively low flow rates. Groundwater samples will be labeled according to the boring number (e.g. HC-B1-GW).

Prior to any groundwater sample collection, field staff will measure and record the depth to water using an electronic water-level probe (an oil-water interface probe may be used if free product is observed in the boring). Measurements of field water quality parameters, including dissolved oxygen; pH; redox potential; specific conductance; temperature; and turbidity, will also be collected.

To prevent cross-contamination of the wells, disposal polyethylene tubing will be used for each groundwater sample, and the water-level probe will be decontaminated between wells.

2.3.4 Decontamination Procedures

Reusable field sampling equipment will be decontaminated by washing with Alconox detergent (or equivalent), rinsing with tap water, and then completing a second rinsing with distilled or deionized water.

Staff will wear disposable nitrile gloves during all sampling, decontamination, and sample handling activities. To prevent cross contamination of samples, staff will discard used gloves after completing a sample and put on a fresh pair of gloves before starting work on the next sample.

2.3.5 Boring Decommissioning

When a boring is no longer needed, it will be decommissioned with bentonite chips or with bentonite grout in accordance with the WAC for Minimum Standards for Construction and Maintenance of Wells (WAC 173-160).

2.3.6 Investigative-Derived Waste

The planned explorations and sampling will generate investigative-derived waste (IDW), such as soil cuttings, purged groundwater, and decontamination fluids. The IDW will be collected in labeled containers (drums approved by WSDOT) and kept on site in a safe, discreet location, pending laboratory results of the samples. On behalf of TPU, arrangement for removal and disposal of the IDW can be coordinated by Hart Crowser after we receive the final analytical results.

All disposable sampling materials and personal protective equipment (such as paper towels and gloves) will be collected in heavy-duty garbage bags and placed in a refuse container for disposal as solid waste.

3.0 SAMPLE HANDLING PROCEDURES

3.1 Sample Preservation and Holding Times

Samples will be preserved according to the requirements of the specific analytical methods to be employed, and all samples will be extracted and analyzed within method-specified holding times. Required sample containers, preservatives, and holding times for soil and groundwater testing are summarized in Tables A-1 and A-2, respectively.

3.2 Chain of Custody and Shipping Procedures

3.2.1 Chain of Custody Procedures

Chain of custody forms will be used to document the collection, custody, and transfer of samples from their initial collection location to the laboratory. Each sample will be entered on the custody form immediately after it is collected.

Sample custody procedures will be followed to provide a record that can accompany a sample as it passes from collection through analysis. A sample is considered to be in custody if it meets at least one of the following conditions:

- It is in someone’s physical possession or view;
- It is secured to prevent tampering (i.e., custody seals); and/or
- It is locked or secured in an area restricted to authorized personnel.

A chain of custody form will be completed in the field as samples are packaged. At a minimum, the information on the custody form will include the sample number, date and time of sample collection, sampler, analysis, and number of containers. A copy of the custody form will be placed in the cooler with its respective samples before the container is sealed for delivery to the laboratory. Another copy will be retained and placed in the project files after review by the project manager. Custody seals will be placed on each cooler or package containing samples so the package cannot be opened without breaking the seals.

3.2.2 Sample Shipping/Delivery Procedures

After sample containers have been filled, they will be packed on ice in coolers. The coolers will be transferred to an Ecology-accredited laboratory (Friedman & Bruya Environmental Labs) for chemical analysis. Chain of custody procedures will commence in the field and will track delivery of the sample to the analytical laboratory. Specific procedures are:

- Individual sample containers will be packed to prevent breakage;
- Custody forms will be enclosed in a plastic bag and taped to the inside lid of the cooler;
- Signed and dated custody seals will be placed on all coolers before shipping;
- Samples will be hand-delivered to the laboratory by Hart Crowser personnel or courier;
- When sample possession is transferred to the laboratory, the custody form will be signed by the persons transferring custody of the coolers; and
- Upon receipt of samples at the laboratory, the shipping container custody seal will be broken and the sample-receiving custodian will compare samples with information on the chain of custody form and record the condition of the samples received.

4.0 LABORATORY ANALYSES

Selected soil and groundwater samples will be analyzed for one or more of the following analyses:

- Diesel- and oil-range petroleum hydrocarbons by Ecology Method NWTPH-Dx;
- Gasoline-range petroleum hydrocarbons by Ecology Method NWTPH-Gx;
- Polycyclic aromatic hydrocarbons (PAHs) by EPA Method 8270E SIM;
- Polychlorinated biphenyls (PCBs) by EPA Method 8082;
- Volatile organic compounds (VOCs) by EPA Method 625/8270;
- Total and/or dissolved metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) EPA Methods 6010B or 6020; and
- Total Suspended Solids (TSS) by SM 2540D.

Screening levels and reporting limits for soil and groundwater are presented in Tables A-3 and A-4, respectively.

5.0 QUALITY ASSURANCE AND QUALITY CONTROL

The laboratory reports will be reviewed by a Hart Crowser technical specialist to ensure conformance with project standards, provide additional data qualifications as appropriate, and verify that the data are acceptable for the purposes of the project. This includes reviewing holding times, reporting limits, method blanks, surrogate recoveries, laboratory duplicate relative percent differences (RPDs), calibration criteria (as provided), spike blank/spike blank duplicate (SB/SBD) recoveries, and matrix spike/matrix spike duplicate (MS/MSD) recoveries. Tables A-5 through A-11 summarize the quality control criteria for each analyte.

5.1 Data Quality Indicators

The overall quality assurance objectives for field sampling, field measurements, and laboratory analysis are to produce data of known and appropriate quality. The procedures and quality control checks specified herein will be used so that known and acceptable levels of accuracy and precision are maintained for each data set. This section defines the objectives for accuracy and precision for measurement data. These goals are primarily expressed in terms of acceptance criteria for the quality control checks performed.

5.1.1 Precision

Precision is the degree of reproducibility or agreement between independent or repeated measurements. Analytical variability will be expressed as the RPD between laboratory replicates and between MS and MSD analyses. RPD will be used to measure precision for this investigation and is defined as follows:

$$RPD = \frac{(D_1 - D_2)}{(D_1 + D_2)/2} \times 100$$

Where

D_1 = sample value
D_2 = duplicate sample value

5.1.2 Accuracy

Accuracy is the agreement between a measured value and its true or accepted value. While it is not possible to determine absolute accuracy for environmental samples, analysis of standards and spiked samples provides an indirect assessment of accuracy.

Laboratory accuracy will be assessed as the percent recovery of MSs, MSDs, surrogate spiked compounds (for organic analyses), and laboratory control samples. Accuracy will be defined as the percentage recovery compared with the true or accepted value and is defined as follows:

$$\%\ Recovery = \frac{(SSR - SR)}{SA} \times 100$$

Where

SSR = spiked sample result
SR = sample results (not applicable for surrogate recovery)
SA = amount of spike added

5.1.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. The sampling program will be designed carefully to see that sample locations are selected properly, sufficient numbers of samples are collected to accurately reflect conditions at the site, and samples are representative of sample locations. A sufficient sample volume will be collected at each sampling point to minimize bias or errors associated with sample particle size and heterogeneity.

5.1.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. So that results are comparable, samples will be analyzed using standard EPA methods and protocols as described in Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods (EPA 1986). Data will also be reviewed to verify that precision and accuracy criteria have been achieved and, if not, that data have been appropriately qualified.

Field personnel will collect samples in a consistent manner at all sampling locations so that all data collected as part of this study are comparable. Comparability is attained by careful adherence to standardized sampling and analytical procedures, based on rigorous documentation of sample locations (including depth, time, and date).

5.1.5 Completeness

Completeness is the percentage of measurements made that are judged to be valid. Completeness will be calculated separately for each analytical group (e.g., TPHs and VOCs). For results to be considered complete, all quality control check analyses required to verify precision and accuracy must have been performed. Data qualified as estimated during the validation process will be considered complete. Results that are rejected during the validation review or samples for which no analytical results were obtained will be considered non-valid measurements. Completeness will be calculated for each analysis using the following equation:

$$Completeness = \frac{valid\ data\ points\ obtained}{total\ data\ points\ planned} \times 100$$

The target goal for completeness is a minimum of 95 percent. Completeness will be monitored on an on-going basis so that archived sample extracts can be reanalyzed, if required, without remobilization.

5.2 Data Quality Assurance Review

Hart Crowser will independently review the quality of the chemical analytical results provided by the laboratory. The data quality report will assess the adequacy of the reported detection limits in achieving the project screening levels; the precision, accuracy, representativeness, and completeness of the data; and the usability of the analytical data for project objectives. Exceedances of analytical control limits will be summarized and evaluated.

A data evaluation review will be performed on an all results using quality control summary sheet results provided by the laboratory for each report. Data evaluation reviews are based on the quality control requirements previously described and follow the format of the EPA National Functional Guidelines for Organic Superfund Methods Data Review (EPA 2017), modified to include specific criteria of individual analytical methods. The laboratory will be contacted to obtain raw data (instrument tuning, calibrations, instrument printouts, bench sheets, and laboratory worksheets) if any problems or discrepancies are discovered during the routine evaluation.

The data evaluation review will verify:

- That sample numbers and analyses match the chain of custody request;
- Sample preservation and holding times;
- That instrument tuning, calibration, and performance criteria were achieved;
- That laboratory blanks were analyzed at the proper frequency and that no analytes were present in the blanks;
- That laboratory duplicates, MSs, surrogate compounds, and laboratory control samples were run at the proper frequency and that control limits were met; and
- That required detection limits were achieved.

Data qualifier flags, beyond any applied by the laboratory, will be added to sample results that fall outside the quality control acceptance criteria. Typical data qualifiers are:

U	The compound was analyzed for but was not detected above the reporting limit. The associated numerical value is the sample reporting limit.
J	The associated numerical value is an estimated quantity because quality control criteria were slightly exceeded.
UJ	The compound was analyzed for, but not detected. The associated numerical value is an estimated reporting limit because quality control criteria were not met.
T	The associated numerical value is an estimated quantity because reported concentrations were less than the practical quantitation limit (lowest calibration standard).
R	Data are not usable because of significant exceedance of quality control criteria. The analyte may or may not be present; resampling and/or reanalysis is necessary for verification.

6.0 DATA ANALYSIS AND REPORTING

6.1 Laboratory Reports

The laboratory data reports will consist of summary data packages that will include:

- Case narrative identifying the laboratory analytical batch number, matrix and number of samples included, analyses performed and analytical methods used, and description of any problems or exceedance of quality control criteria and corrective action taken. The laboratory manager or a designee must sign the narrative.

- Copy of chain of custody forms for all samples included in the analytical batch.
- Tabulated sample analytical results with units, data qualifiers, percent solids, sample weight or volume, dilution factor, laboratory batch and sample number, Hart Crowser sample number, and dates sampled, received, extracted, and analyzed all clearly specified.
- Summary of calibration results.
- Blank summary results indicating samples associated with each blank.
- MS/MSD result summaries with calculated percent recovery and relative percent differences.
- Laboratory control sample results, when applicable, with calculated percent recovery.
- Electronically formatted data deliverable results in Ecology EIM format.

6.2 Data Evaluation and Analysis

After the planned fieldwork, sample analysis, and data quality review, results will be compared with MTCA Method A soil cleanup levels for unrestricted land uses and MTCA Method A cleanup levels for ground water screening levels. We will present our findings from our field observations and analytical results and our recommendations in a summary report (see Section 6.3). Figures and cross sections will be provided with areas of contamination and elevations.

6.3 Hart Crowser Reports

Hart Crowser will prepare the RI/FS report, which will summarize the sampling procedures and laboratory testing results and evaluate potential cleanup options and cost estimates. The report will include a map with sampling locations, tabulated analytical testing data compared with MTCA cleanup levels, sample depth, chemical data quality review, and laboratory analytical reports. The report will include statements on any limitations on the data use that are the result of adverse QC exceedances, as identified in Section 5.2, Data Quality Assurance Review. A final report will be completed after incorporating comments from the client.

7.0 REFERENCES

ASTM 2009. ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). American Society for Testing Materials. ASTM International, West Conshohocken, PA.

Ecology 1997. NWTPH-Gx and NWTPH-Dx Methods, in Analytical Methods for Petroleum Hydrocarbons, ECY 97-602. Washington State Department of Ecology. June 1997.

EPA 1986. Test Methods for Evaluating Solid Waste; Physical/Chemical Methods, SW-846, 3rd Update. Environmental Protection Agency.

EPA 1992. Specifications and Guidance for Contaminant-Free Sample Containers. Environmental Protection Agency. OSWER Directive 92.0-05A.

EPA 2008. US EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review. Environmental Protection Agency. EPA-540-R-08-01, June 2008.

Standard Methods 1989. Standard Methods for the Examination of Water and Wastewater. 17th Edition, American Water Works Association.

APPENDIX B
Health and Safety Plan

Health and Safety Plan

Kosmos Mill Oil Cleanup

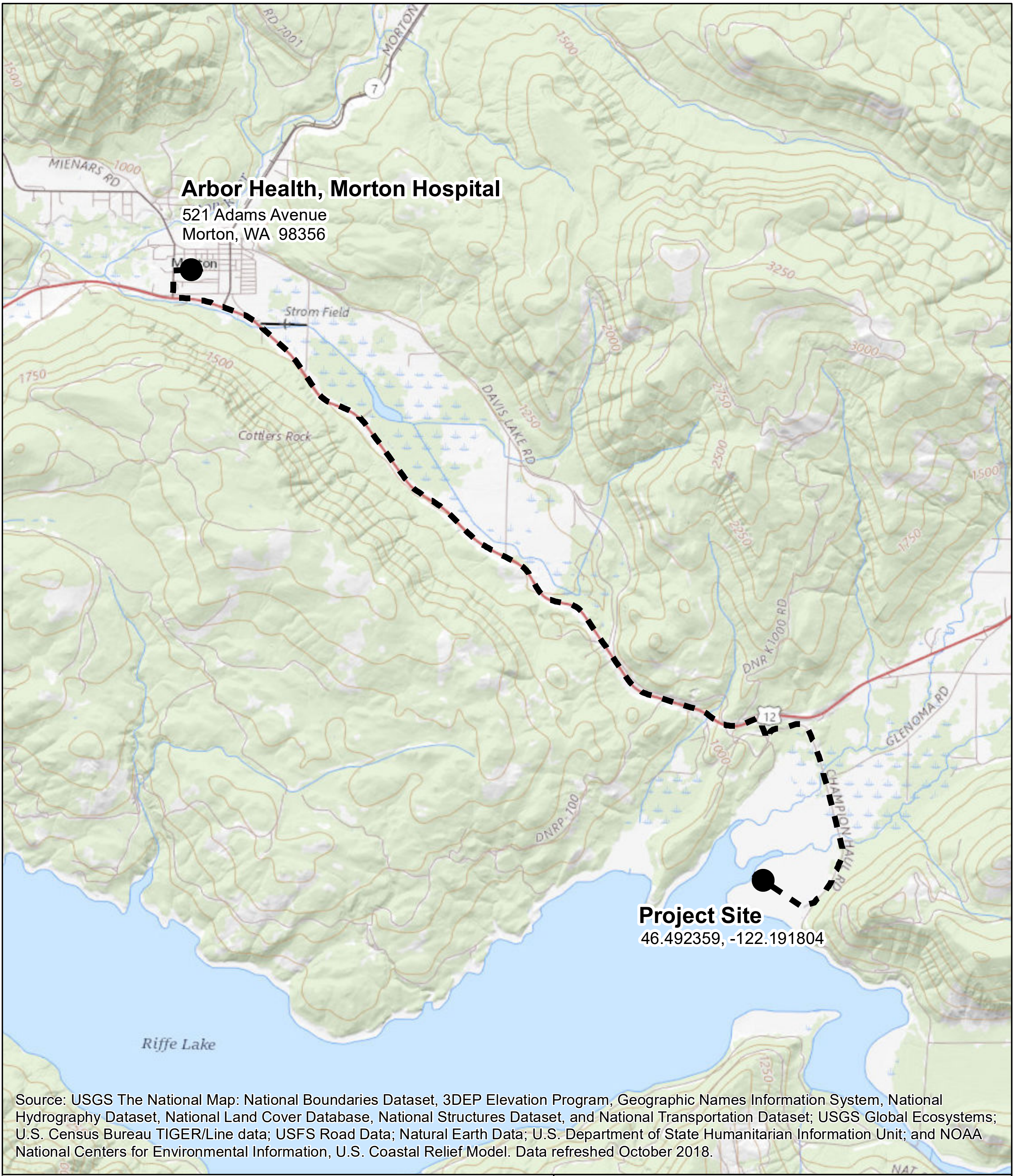
Location coordinates: 46.492841N, -122.191316W

Glenoma, Washington

Date Prepared: November 22, 2019

EMERGENCY INFORMATION

SITE LOCATION	Kosmos Mill Site Approximately one mile south along Champion Haul Road from the intersection of Glenoma Rd and Champion Haul Road Location coordinates: 46.492841N, -122.191316W Glenoma, Washington
NEAREST HOSPITALS	Arbor Health, Morton Hospital 521 Adams Avenue Morton, WA 98356 360-496-5112 The route to the hospital is shown on Figure 1.
CONTACTS	**Hart Crowser** Seattle Office……………………………………………………(206) 324-9530 ►Project Manager, Angie Goodwin……………………….(206) 954-2549 (C) ►Corporate Health and Safety Director, Jeff Wagner….(206) 369-4772 (C) **Client** ►Tacoma Power Utilities, Jessica Knickerbocker…………(253) 389-8044 **State agency local office** **To report environmental problems or spills**………………(360) 407-6300 Poison Control Center ……………………………………(800) 222-1222
EMERGENCY RESPONDERS **Police, Fire, Ambulance**	**911**
IN EVENT OF EMERGENCY CONTACT 911 FOR HELP AS SOON AS POSSIBLE	Give the following information: ➔ **Where You Are** - address, cross streets, or landmarks ☎ **Phone Number** you are calling from ?? **What Happened** - type of injury, accident # **How many persons** need help ?? **What is being done** for the victim(s) !! **You hang up last** – let emergency dispatcher hang up first



Arbor Health, Morton Hospital
521 Adams Avenue
Morton, WA 98356

Project Site
46.492359, -122.191804

Source: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed October 2018.

0 0.5 1 2
Miles

Note: Feature locations are approximate.

N

Kosmos Mill Oil Cleanup
Morton, Washington

Route to Hospital

19499-00
11/19

HARTCROWSER

Figure
1

Document Path: \\seafs\Projects\Notebooks\1949900_Kosmos_Mill_Oil_Cleanup\GIS\MGIS\1949900_AA_RouteToHosp.mxd Date: 11/20/2019 User Name: melissaschweitzer

SITE HEALTH AND SAFETY PLAN SUMMARY

Location: Kosmos Mill Site, approximately one mile south along Champion Haul Road from the intersection of Glenoma Rd and Champion Haul Rd, Glenoma, WA, location coordinates: 46.492841N, -122.191316W

Proposed dates of activities: One week during the month of December 2019.

Type of facility: Former mill site.

Land use of area surrounding facility: Near a campground and hang-gliding landing area. Located at the mouth of Rainey Creek and near Riffe Lake.

Potential site contaminants: Total petroleum hydrocarbons as diesel (TPH-D), gasoline (TPH-G), and heavy oil (TPH-O); benzene, toluene, ethylbenzene, and xylenes (BTEX); lead; polycyclic aromatic hydrocarbons (PAHs); and polychlorinated biphenyls (PCBs).

Routes of entry: Skin contact with soil and groundwater, inhalation of volatiles, and incidental ingestion of soil and groundwater.

Other specific safety hazards: Operating motor vehicles, doing heavy lifting, cold stress, noise exposure, working around heavy equipment, biological hazards (insects, blood-borne pathogens [BBPs]), or slips, trips, and falls.

Protective measures: Safety glasses or goggles (if splash hazard exists), Class II high visibility safety vest, rubber work gloves, nitrile gloves, long pants and shirt with minimum 4-inch sleeve, rain gear, foot protection (e.g., steel-toed boots or shoes with slip-resistant soles). A half-facepiece respirator will be available if air monitoring indicates levels warranting respiratory protection.

Air monitoring equipment: MultiRAE or MiniRAE photoionization detector (PID) with a 10.6 electron volt (eV) lamp. Dust will be monitored visually and engineering controls (wetting soil) will be implemented as necessary.

1.0 INTRODUCTION

1.1 Purpose and Regulatory Compliance

This site-specific Health and Safety Plan (HASP) provides information and procedures for protecting Hart Crowser personnel who handle or contact hazardous substances or may be exposed to physical hazards while collecting soil and groundwater samples at the Kosmos Mill Site located in Glenoma, Washington. The HASP is to be used by Hart Crowser personnel and is written for the specific site conditions, purposes, dates, and personnel specified herein; it will be amended if conditions change.

This HASP is to be used in conjunction with Hart Crowser's Corporate Accident Prevention Program (APP), located on the Hart Crowser Intranet. Together the APP and this HASP constitute the health and safety plan for this site.

A field copy of this HASP is to be used by Hart Crowser personnel and must be available on site throughout the duration of the project. If site conditions, field activities, personnel, dates, or other conditions change over time, this HASP will be updated to address these changes as they occur. Hart Crowser personnel may make minor changes to the field copy by hand in ink (with date and initials). The signed HASP will be retained with the project files when the project is completed.

1.2 Distribution and Approval

This HASP will be made available to all Hart Crowser personnel working at the project site. Hart Crowser workers will read, sign, and return the form titled "Record of Health and Safety Communication" provided in Appendix A of this HASP to certify their agreement to comply with the minimum requirements of this HASP. The Hart Crowser project manager will route the signed Appendix A form to the project files upon completion of field activities covered under the HASP.

This HASP can be provided to subcontractors for informational purposes only and will be told clearly by the Field Health and Safety Manager that that this HASP represents minimum safety procedures for Hart Crowser workers and that subcontractors are responsible for their own safety while on the site. Nothing herein will be construed as granting rights to Hart Crowser subcontractors or any others working on this site to use or legally rely on this HASP.

This HASP has been approved by the Hart Crowser Corporate Health and Safety Director.

1.3 Chain of Command

The Hart Crowser chain of command for health and safety on this project includes the following individuals:

Corporate Health and Safety Director: Jeff Wagner

The Hart Crowser Corporate Health and Safety Director has overall responsibility for preparation and modification of this HASP. If health and safety issues arise during site operations, the director will attempt to resolve them with the appropriate members of the project team.

Project Manager: Angie Goodwin

The Project Manager has overall responsibility for the successful outcome of the project. In consultation with the corporate health and safety director, the project manager makes final decisions about implementing this site-specific HASP. The project manager may delegate this responsibility and the accompanying authority to another project worker as needed.

Project Health and Safety Manager: Andrew Kaparos

The Project Health and Safety Manager has overall responsibility for health and safety on this project and will verify compliance with applicable requirements. This individual will communicate all relevant health and safety issues to Hart Crowser's workers.

Field Health and Safety Manager: Andrew Nakahara

The Field Health and Safety Manager is responsible for implementing this HASP in the field and for maintaining it at the project site. This individual conducts safety briefings, observes workers to verify that they are following HASP procedures, and assures that proper personal protective equipment (PPE) is available and used correctly and that employees have knowledge of the local emergency response system. The field health and safety manager will see that the field HASP is updated as needed to address changes in field conditions or procedures.

1.4 Work Activities

In April of 2019, Bunker C oil was discovered seeping out of the Rainy Creek bank in the Kosmos Flats area (the Site) and reported to the Washington State Department of Ecology (Ecology). Tacoma Public Utilities (TPU) immediately began investigating the seep and implementing measures to mitigate risks to human and environmental health. Hart Crowser's work covered under this HASP includes collecting of soil and groundwater from the former mill site. Samples will be collected by test pit excavations and sonic drilling.

The sampling will be completed in one week during the month of December 2019.

1.5 Site Description

The Site is located in the Rainey Valley next to Riffe Lake. The Site is bounded by Rainey Creek to west and north, Champion Haul Road to the east, and Riffe Lake to the south. The Site topography near the oil seep gradually slopes to the northwest towards Rainy Creek. The Riffe Lake reservoir is currently a part of the power generating system operated by TPU. During the winter months the water levels in the reservoir drop. Spring rainfall and snow melt can flood the Site. The oil seep is located on the eastern side of the Rainy Creek bank, near the former Kosmos Mill site. A sheen can be seen on Rainy Creek's water surface. A boom was installed in Rainy Creek to prevent oil from flowing towards Riffe Lake.

The Site was a part of the Kosmos town lumber mill which was abandoned and demolished prior to 1968. There is little readily available information regarding the lumber mill and its operations.

The general public can enter the Site by foot, and the surrounding land and water is used for recreational activities.

2.0 HAZARD EVALUATION AND CONTROL MEASURES

2.1 Hazardous Substances

In April 2019, an oil seep was discovered in the Kosmos Flats area and reported to the Department of Ecology. This seep was confirmed by Ecology to be Bunker C oil on April 29th, 2019. In addition, other potential hazardous substances associated with former mill sites include total petroleum hydrocarbons as diesel (TPH-D), gasoline (TPH-G), and heavy oil (TPH-O); benzene, toluene, ethylbenzene, and xylenes (BTEX); lead; polycyclic aromatic hydrocarbons (PAHs); and polychlorinated biphenyls (PCBs).

The potential health hazards of these hazardous substances are discussed in individual fact sheets provided in Attachment A to this HASP. The fact sheets describe effects that might occur if acute (short-term) and/or chronic (occurring over a long period – more than 1 year) exposures were to happen. Inclusion of this information does not mean that these effects will occur during the work activities conducted by Hart Crowser.

In general, the hazardous substances that may be encountered during sediment sampling at the Kosmos Mill Site are not expected to be present at concentrations or in a form that could produce significant adverse health effects. The types of work activities to be conducted and the use of personal protective equipment (PPE) will limit potential exposure.

2.2 Potential Exposure Routes

Exposure to the hazardous substances listed above could occur by accidental inhalation of, direct contact with, or ingestion of potentially contaminated soil and groundwater. To prevent contact with potential contaminants, the Hart Crowser sampling team will wear the personal protective equipment (PPE) specified in Section 3.0 while sampling and while decontaminating equipment.

Inhalation

Workers could be exposed by inhaling dust when soil is moved or through volatilization of chemicals from soil. Dust will be monitored visually, and dust-control measures such as soil wetting will be implemented as needed. Air monitoring and control measures specified in this plan will minimize the possibility for inhalation of volatile organic compounds (VOCs).

Direct Contact

Workers could be exposed if contaminated soil, dust, or groundwater contacts the skin, eyes, or clothing. Wearing protective clothing and safety glasses and performing decontamination activities specified in this plan will minimize the potential for skin and eye contact with hazardous substances.

Ingestion

Workers could be exposed if they eat, drink, or perform other hand-to-mouth activities while overseeing construction or collecting soil samples. Personal hygiene measures will be implemented to prevent inadvertent ingestion of contaminants; for example, workers will remove their gloves and wash their hands and faces before eating, drinking, or using tobacco.

2.3 Air Monitoring

For activities in areas where VOCs are known or suspected to be present, air quality will be monitored using a MultiRAE, MiniRAE, or QRAEII photoionization detector (PID) to determine whether VOCs are present and to check the adequacy of PPE (specifically, respiratory protection). The monitoring results may trigger actions, as summarized in Table 1 and described in more detail below under "Action Levels."

Table 1 – Air Monitoring Action Levels

Monitoring Device	Sensor	Result	Action Required	Notes
MultiRAE or MiniRAE	VOC	<5 Units above Background	Continue Monitoring	a
		5 to 10 Units above Background	Use Half-facepiece Respirator or utilize institutional controls to reduce vapor emissions	a, b, c
		>10 Units above Background	Stop Work; Contact Project Health and Safety Manager	a, b

Notes:

a. Use appropriate lamp and calibrate unit.

b. Air-purifying respirators must be used only when use criteria are met and when appropriate cartridges are available.

c. Half-facepiece respirators generally acceptable up to 10 times the PEL.

Air quality will be monitored at the discretion of the field health and safety manager by an individual trained to use the equipment. The project manager is responsible for ascertaining that each designated operator is properly trained in the use of the monitoring equipment. **The results of all air monitoring will be recorded on the project "Field Health and Safety Report" form provided as Appendix B to this HASP**. The results of air monitoring will be used to determine the need to upgrade personal protective equipment (PPE). The "Field Health and Safety Report" forms will be filed with the project records.

The specific piece of monitoring equipment item(s) to be used on this project will be indicated by Hart Crowser unit number on the project "Field Equipment & Supplies" form, which is included in this plan by reference. The equipment technician will calibrate, maintain, and repair each air monitoring equipment item, or arrange for these activities, which will be conducted in accordance with and at the frequency specified by the manufacturer or more frequently, as required by use conditions. The equipment technician will maintain calibration/repair records in the equipment log books.

The following sections describe the equipment and procedures that will be used to monitor VOCs.

MultiRAE or MiniRAE Photoionization Detector

Volatile Organic Compounds. A MultiRAE or MiniRAE photoionization detector (PID) will be used at locations where VOCs may be present during site activities. **This detector is non-specific**, meaning that it does not identify the chemicals present. In addition, since it is calibrated using only a single reference chemical, **the PID provides only an estimate of the actual vapor concentration present**. If chemical-specific information is necessary, other types of sampling equipment must also be used.

Monitoring Procedures. At the discretion of the field health and safety manager, air quality will be monitored using a MultiRAE or MiniRAE PID or equivalent with 10.6 eV lamp to measure organic vapor concentrations during site work activities. The 10.6 eV lamp will be specified for general hydrocarbon survey measurements for chemicals having an ionization potential of up to 10.6 eV, such as benzene (9.24 eV).

The field health and safety manager or other designated project individual is responsible for verifying that the equipment is calibrated and working properly before on-site use. For the MultiRAE or MiniRAE, this will include zeroing the instrument before work begins. Records of these activities will be maintained in the “Field Health and Safety Report” form. If there are any problems with the equipment, the item will be removed from use until repair or replacement can be coordinated with the equipment technician.

Action Levels. PID monitoring will be conducted before work begins at each individual work area where volatile chemicals may be present. Results may trigger actions, as summarized in Table 1 and described below:

- If PID measurements are **less than 5 units** above ambient background levels in the worker's breathing zones, work can proceed without respiratory protection, with monitoring repeated at 15- to 30-minute intervals, or more frequently if odors or signs of irritation are noted.

- If PID measurements are **between 5 and 10 units** above ambient background levels in the worker's breathing zones for 5 consecutive minutes, exposed workers will use air purifying respirators as specified in Table 2, with monitoring repeated at least every 15 minutes, or more frequently if any odors or signs of irritation are noted.

- If PID measurements **exceed 10 units** above ambient background levels in the worker's breathing zones, work will cease and employees will evacuate the work area pending reevaluation of the situation by the project manager and corporate health and safety director. Action will be taken, including plan modification if required, to address any situations where such results are observed.

Calibration and Maintenance. The MultiRAE or MiniRAE PID will be calibrated and maintained according to the manufacturer instructions. If there are problems with the equipment, a completed “Notice of Returned Equipment” form or other notification indicating the equipment condition will accompany the PID returned to the equipment room. The equipment technician will perform maintenance/repair as required.

2.4 Physical Hazards

Potential physical hazards associated with the project include operating motor vehicles, doing heavy lifting, cold stress, noise exposure, working around heavy equipment, biological hazards (insects, blood-borne pathogens [BBPs]), or slips, trips, and falls.

Operating Motor Vehicles

Hart Crowser personnel who operate motor vehicles are legally licensed to do so, will wear seat belts at all times when driving, and will obey all rules of the road while engaged in company business.

Hart Crowser employees will comply with all federal, state, and local regulations on use of cellular devices while driving. Only hands-free cellular devices may be used during vehicle operation. Under no circumstances is text messaging or any use of a keyboard allowed while operating a vehicle.

Heavy Lifting

Field work on this project will require some amount of heavy lifting, for instance carrying coolers containing samples and carrying equipment. Overexertion injuries to the back, shoulders, elbows, hands, or wrists can occur when a load is lifted or otherwise handled. Hands and wrists can be injured from grasping during lifting. Muscles in the forearm that are used for grasping attach to the elbow, so this joint can be injured when lifting. The shoulder can be injured by lifting any load and is especially at risk of injury from lifts done while reaching above the shoulder or away from the body. Frequent lifting and awkward lifting (i.e., above the shoulders, below the knees, at arms’ length) can also result in injuries.

The best procedures for lifting vary depending on conditions and the size and shape of the object being lifted. A general rule for avoiding injuries is to assess the object and surrounding area before lifting, and never attempt to lift an object that is poorly packaged or too heavy. Before lifting, workers should make sure their path is dry and clear of obstacles that could cause a fall.

To lift heavy objects:

- Take a deep breath and relax your muscles.
- Approach the object, and in a slow, controlled movement, bend your knees (keeping your back straight) until you are squatting.
- Grip the object securely with both hands and, when ready, push up and extend your knees until reaching a standing position, with the object at chest level. Do not lift above your shoulders or below your knees.
- Do not twist your back or bend sideways.

- Walk slowly to the destination and put down the heavy object using the same slow, controlled movements, keeping your back relatively straight and bending your knees.
- Do not lift or lower with arms extended.
- Take a break between lifting each object if necessary.
- Never attempt to move any object that seems too heavy to manage alone. Get help from a co-worker as needed.

Workers who need to lift objects should be in good physical shape. Workers not accustomed to lifting or vigorous exercise should not be assigned difficult lifting or lowering tasks.

Cold Stress

Workers who are exposed to extreme cold or work outdoors in cold and wet environments may be at risk of cold stress, which can result when the core body temperature gets too low. The most common consequences of cold stress are hypothermia, frost bite, and trench foot; the latter two are not normally risks on Hart Crowser projects. Factors in cold stress include wetness, wind chill, tiredness, improper clothing, health conditions, and poor physical conditioning.

Near-freezing temperatures is a factor in cold stress. Project workers will dress appropriately for the weather conditions and pay attention to the signs and symptoms of hypothermia. When temperatures drop below normal and wind speed increases, heat can leave the body more rapidly. These weather-related conditions may lead to serious health problems.

Hypothermia

Causes. Hypothermia can result when the body loses heat faster than it can replace it, and temperature drops below 95°F. Wind chill and wetness can play a significant role in lowering core body temperature. It is important to understand that hypothermia can occur even when temperatures are not extremely cold, especially when water, wind, and/or pre-existing health conditions are involved.

Signs. Warning signs of hypothermia include shivering (only initially), confusion, loss of coordination, slurred speech, fumbling, inability to decide, disorientation, apathy, drowsiness, inability to stand or walk, dilated pupils, slowed pulse and breathing, and loss of consciousness. Confusion is a key symptom. With medium or advanced hypothermia, shivering is absent, and the person may not realize they have hypothermia. They may also be unwilling to call attention to themselves or seek help.

Treatment. Hypothermia victims should be immediately but not too rapidly re-warmed.

Rewarming involves:

- Moving the victim into a sheltered area.
- Removing any wet clothing.

- Wrapping the victim loosely with blankets or sleeping bag.
- Applying heat packs or warm containers to armpits, groin, head, neck, and chest.
- If core body temperature falls below 90°F and heated shelter is not available, using skin-to-skin contact with another individual.
- Providing warm beverages if the person is conscious.
- Getting medical help as soon as possible.

Rescue breaths and CPR for victims who are not breathing or who don’t have a pulse are not covered in this HASP.

Noise

Heavy equipment may produce noise levels that exceed 85 decibels A scale (dBA) for personnel working in or around the job site. At this level or above, hearing protection must be worn. A general guideline is if people 3 to 4 feet apart cannot converse without raising voices, the noise levels are too high and hearing protection should be worn. Ear muffs or ear plugs with a noise reduction rating (NRR) of 29 or higher (the highest NRR is 33) will be used when noise levels are too high as determined by the above guideline or by sound level measurements.

Working Around Heavy Equipment

Various heavy equipment (e.g., excavators, drill rigs) may be used at the job site. To work safely around heavy equipment, Hart Crowser on-foot workers will:

- Wear Class II high visibility vests;
- Stay out of the equipment’s swing radius;
- Never position themselves in front of or behind a moving piece of equipment, or between two moving pieces of equipment;
- Maintain eye contact with the operator (never assume the operators sees an on-foot worker);
- Be aware of the back-up alarm signal associated with the equipment; use caution if wearing hearing protection; and
- Not operate heavy equipment unless the worker has the appropriate training and/or licenses.

Heavy equipment is typically powered by diesel engines which emit diesel exhaust, a mixture of gases and particulates. Short-term exposure to diesel exhaust can irritate the eyes, nose, and throat; and cause headaches and nausea. If workers experience short-term effects, they will move away from the diesel exhaust and notify the Project Health and Safety Manager or the Corporate Health and Safety

Director. Exposure to diesel exhaust fumes may lead to other health problems such as lung diseases, heart diseases, asthma, lung damage and immune system problems. These problems typically occur in people with high rates of exposure and long-term exposure (e.g., heavy equipment operators, truck drivers). Existing asthma may be exacerbated by diesel exhaust.

Biological Hazards

Biological hazards include vector-borne diseases, insects, rodents and other wild or stray animals, snakes, and poisonous plants. Vector-borne diseases may be spread to workers by insects such as mosquitoes and ticks. When a mosquito or tick bites a worker, it may transfer a disease-causing agent, such as a parasite, bacteria, or virus. Examples of mosquito-borne diseases are West Nile virus and encephalitis. Lyme disease and Rocky Mountain spotted fever are tick-borne diseases. People are exposed to biological hazards through contact with insects, soil, water, bird or bat droppings, rodent droppings, or poisonous plants.

Insects

Wearing long pants, socks, and long-sleeved shirts provides protection from insects. Using insect repellents that contain DEET or picaridin also provides protection from insects. Insect bites and stings can be treated with over-the-counter products that relieve pain and prevent infection.

Stinging insects include bees, wasps, hornets, and fire ants. Personnel can avoid attracting stinging insects by wearing light-colored clothing and avoiding perfumes or colognes. If such an insect approaches, do not wave wildly and swat blindly; instead, use a gentle pushing or brushing motion to deter them.

Bee stings can produce life-threatening allergic reactions. Symptoms include pain, swelling of the throat, redness or discoloration of the wound, itching, hives, decreased consciousness, and labored or noisy breathing. Personnel who are allergic to insect stings should carry an anaphylactic shock kit prescribed by their physician.

Blood-Borne Pathogens

Workers responding to a first-aid incident could be exposed to blood-borne pathogens (BBPs), which are infectious microorganisms in blood and other body fluids that can cause disease in humans. Examples of these pathogens include hepatitis B virus, hepatitis C virus, and HIV. Workers exposed to BBPs are at risk for serious or life-threatening illnesses.

Universal precautions will be followed if BBP exposure is a concern. Universal precautions involve treating all human blood and other potentially infectious materials as a BBP and protecting oneself from exposure. The easiest way to protect oneself from blood and body fluids is to have the injured person treat their own wound if they are conscious and capable of doing so. If injured people are unable to take care of themselves, or they need help, workers should use disposable gloves and eye protection if there is a splash hazard.

If disposable gloves are not available, a plastic bag (trash, shopping, or sandwich) can be used to create a barrier. If performing CPR, always use a pocket mask equipped with a one-way valve. After removing PPE, wash hands or other affected body parts. Place PPE in a plastic bag, seal the bag, and contact the corporate health and safety director for further instructions.

If you are exposed to BBPs or other potentially infectious materials (i.e. BBPs contact your eyes, mouth, nose, open wounds/sores, abrasions, sunburned areas, or acne), follow these steps:

- Flush the area of the body that was exposed with warm water, and then wash with soap and water. Vigorously scrub all areas. It is the abrasive action of scrubbing that removes the contamination from the skin.
- If you have an open cut, squeeze it gently to make it bleed, then wash with soap and water.
- Notify your project manager or the corporate health and safety director to document the incident. Identify the source of the exposure.
- Get medical counseling (i.e., get tested for BBPs, get vaccinated if needed).

Slips, Trips, and Falls

Hart Crowser workers will be careful to prevent slips on wet walking surfaces and will look for and avoid tripping hazards such as loose rock or debris. Wear steel-toed safety boots with slip-resistant soles.

Be aware of your surroundings. Keep pathways and work areas free of debris and supplies to prevent unsafe walking and working conditions. Changes in elevation such as ruts or holes present a trip hazard and should be marked if possible. Avoid leaving tools on the ground.

Plan what you would do if you start to slip or fall. During a fall, do not try to catch yourself; try to avoid landing on your hands, elbows, or knees. Landing on the side of your body is much safer. If you are walking on a slope and know you are going to slide, lower your center of gravity by sitting down and sliding on your feet and/or bottom. If sliding while standing up, keep your weight over your feet and bend your knees; do not lean backward or forward.

Hazards requiring fall protection are not expected at this site. A written Fall Protection Work Plan is required where fall hazards of 10 feet or more exist. Fall prevention or fall protection measures is required for any walking surface of 4 feet or higher, and when working within the affected area (the distance away from the edge of an excavation equal to the depth of the excavation up to a maximum distance of fifteen feet) of any excavation more than 10 feet deep. If there is a fall hazard of 4 feet or more on a hazardous slope (i.e., a slope where normal footing cannot be maintained without the use of devices because of the pitch of the surface, weather conditions, or surface material), a personal fall restraint system or positioning device system is required. Work will not be performed on slopes steeper than 75 percent or near vertical dropoffs without fall protection equipment.

2.5 Hazard Analysis and Applicable Safety Procedures by Task

Table 2 lists the tasks and associated hazards that may be anticipated during the work activities described in this HASP and associated control measures.

Table 2 – Hazard Analysis by Task

Work Task	Potential Hazards	Protective Measures
Observing and logging soil from test pits and drilled borings	Working around heavy equipment; slips, trips and falls; heavy lifting; noise; and skin contact with contaminated media.	Level D or Level C PPE (see Section 3.0), hard hat, high-visibility safety vest or jacket, caution around moving equipment, safe lifting practices, and hearing protection.
Collecting soil and groundwater samples	Skin contact with contaminated media; working near heavy equipment; slips, trips and falls; and heavy lifting.	Level D or Level C PPE (see Section 3.0), caution around moving equipment and traffic, hearing protection, and air monitoring (as needed).

3.0 PERSONAL PROTECTIVE EQUIPMENT

When fieldwork is performed in contaminated areas, the primary objective is to minimize worker exposure using engineering controls such as ventilating, working up-wind or away from contaminated materials, or wetting soil to reduce dust. If engineering controls are not feasible or may not provide adequate control, and before they are fully implemented, workers will wear specified personal protective equipment (PPE) to minimize potential exposure to hazardous substances.

Contact with hazardous substances at harmful levels is not expected for this project; therefore, PPE is based on the lowest Occupational Safety and Health Administration (OSHA) requirements, Level D. Conditions requiring Level A, B, or C protection are not anticipated for this project. If they do occur, work will stop and the HASP will be amended as required before work is resumed.

Table 3 summarizes the minimum PPE requirements for Hart Crowser workers based on the potential routes of exposure and the potential hazardous substances.

Table 3 – Specific Personal Protection Level Requirements for this Site

Potential Route of Contact: Type of Contaminant	Required Protection Level	Safety Glasses	Hard Hat[b]	Steel-toed Safety Boots or shoes	Tyvek	Poly Tyvek	Nitrile Gloves	Respirator	
								Half-Face piece	Full-Face piece
None anticipated	Level D (a)	X	X	X					
Minor skin contact possible	Level D (a)	X	X	X	g		X		
Skin contamination possible: organics	Level C (c)	X	X	X		g	X		
Inhalation possible: organics	Level C (c)	X	X	X	g		X	d, e	f

Notes:

a. Level D protection required when atmosphere contains no known hazard and work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

b. Hard hat required where risk of striking overhead objects exists.

c. Level C protection required when atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any exposed skin; this assumes that the types of air contaminants have been identified, concentrations have been measured or modeled/estimated, an appropriate respirator cartridge is available, and all air-purifying respirator criteria are met.

d. Appropriate respirator cartridges include organic vapor (MSA GMA or equivalent), combination (MSA GMC-H or equivalent), and others as required for the particular contaminants.

e. Half-facepiece respirator required when PID concentrations range from 5 to 10.

f. Full-facepiece respirators will not be used unless field representative has been properly fit-tested for a full-facepiece respirator.

g. Tyvek or protective clothing should be worn if body contact with impacted materials is likely.

3.1 Level D Activities

Level D protection will be used when the atmosphere contains no known hazards and Hart Crowser workers will not perform activities where skin contact with free-phase product or contaminated materials is likely to occur. These workers will wear regular work clothes (long pants, shirt with minimum 4-inch sleeve), eye protection (safety glasses or goggles), hand protection (nitrile or latex gloves or neoprene-coated work gloves), and foot protection (steel-toed boots or shoes).

3.2 Modified Level D Activities

Modified Level D protection will be used when the atmosphere contains no known hazards and there is a potential that Hart Crowser workers may have skin contact with hazardous substances. These workers will wear regular work clothes (long pants, shirt with minimum 4-inch sleeve), eye protection (safety glasses or goggles), hand protection (nitrile or latex gloves or neoprene-coated work gloves), and foot protection (steel-toed, boots or shoes), and will supplement this equipment with chemical resistant outer clothing (e.g. Tyvek or rain gear) and chemical resistant gloves. Workers will make sure the protective clothing and gloves are suitable for the types of chemicals that may be encountered on site.

3.3 Level C Activities

Workers performing site activities where skin contact with free product or contaminated materials is likely will wear chemical-resistant gloves (nitrile, neoprene, or other appropriate outer gloves, and surgical inner gloves) and polyethylene-coated Tyvek® or other chemical-resistant suits or rain gear. Workers will make sure the protective clothing and gloves are suitable for the types of chemicals that may be encountered on site. Workers will use face shields or goggles as necessary to avoid splashes in the eyes or face.

When performing activities in which inhalation of chemical vapors and dusts is a concern, workers will wear half-facepiece air-purifying respirators as specified in Table 3. If respirators are used, cartridges should be changed on a daily basis, at minimum. They should be changed more frequently if chemical vapors are detected inside the respirator or other symptoms of breakthrough are noted (respiratory irritation, dizziness, or breathing difficulty).

4.0 SAFETY SUPPLIES AND EQUIPMENT LIST

The following safety supplies and equipment must be available on site:

- Fire extinguisher – 3 to 4-pound ABC,
- First aid kit in a sturdy weatherproof carrying case,
- Bottled sterile hand-held eyewash solution,
- Mobile telephone,
- Class II high visibility safety vest or jacket,
- Goretex (or similar) rainsuit,
- Head protection – hard hat,
- Hearing protection,
- Half-facepiece respirator with combination cartridges (as needed),
- Foot protection – steel-toed boots with slip-resistant soles,
- Hand protection – nitrile outer gloves/nitrile inner gloves or neoprene-coated work gloves, and
- Eye protection – safety glasses or safety goggles if a splash hazard is present.

All non-disposable safety gear and PPE must be cleaned after use and stored securely to avoid damage. Avoid storing gear in direct sunlight or exposed to weather conditions. Safety equipment and PPE should be checked before use and damaged or worn-out gear should be disposed of and replaced.

5.0 SITE CONTROL

Field work for this project consists primarily of low-impact sampling activities that will not result in the migration of contaminants or increased exposure to human health or the environment. Therefore, formal exclusion zones, contaminant reduction zones, and support zones are not necessary for this field work.

Although a formal contaminant reduction zone is not necessary, project workers will use precautions during sampling activities. The amount of equipment and number of personnel allowed in sampling areas will be minimized and the amount of samples collected should not exceed what is needed for laboratory analysis.

6.0 DECONTAMINATION

Decontamination for this project is limited to decontaminating sampling equipment.

Hart Crowser workers will practice good hygiene by washing their hands and faces prior to taking rest breaks, drinking liquids, and so forth. They will also wash their hands and faces fully before eating, using tobacco, or as soon as possible upon leaving a work area.

7.0 SITE SECURITY

Security at the Kosmos Mill Site will be the responsibility of the field health and safety manager. Any security problems will be reported to the appropriate authorities and to the client.

8.0 SPILL CONTAINMENT

Sources of bulk chemical subject to spillage are not expected for this project. Accordingly, a spill containment plan is not required for this project.

9.0 EMERGENCY RESPONSE PLAN

This Emergency Response Plan outlines the steps necessary for appropriate response to emergency situations that could reasonably occur during Hart Crowser's work at Kosmos Mill Site. The following paragraphs summarize the key emergency responses for this project.

9.1 Plan Content and Review

The principal hazards addressed by this plan are fire, medical emergencies, and situations such as inadequate PPE for the hazards present. However, to help anticipate other potential emergency situations, field personnel will exercise caution and look for signs of potentially hazardous situations, including:

- General physical hazards (slippery or uneven surfaces, inclement weather, working around heavy equipment);
- Poisonous plants or dangerous animals;
- Underground pipelines or cables; and
- Live electrical wires or equipment.

These and other potential conditions should be anticipated and steps should be taken to prevent problems before they occur.

This emergency response plan will be reviewed and rehearsed, as necessary, during the on-site health and safety briefing so all personnel will know what their duties are if an emergency occurs.

9.2 Plan Implementation

The field health and safety manager will evaluate the situation and act as the lead if an emergency occurs. That individual will determine the need to implement the emergency response, in concert with other resource personnel including client representatives, the project manager, and the corporate health and safety director. Other on-site field personnel will assist the field health and safety manager as needed during an emergency.

If the plan is implemented, the field health and safety manager or designee is responsible for alerting all personnel at the affected area by use of a signal device (such as a hand-held air horn) or visual or shouted instructions, as appropriate.

The field health and safety manager will identify a safe assembly area for workers to gather if it is necessary to evacuate the area and will communicate this location to workers during the on-site health and safety briefing. The “buddy” system will be employed during evacuation to facilitate safe evacuation. The field health and safety manager is responsible for roll call at the assembly area to account for all personnel. As only one Hart Crowser worker will be on-site, a buddy system will be established with other contractors or subcontractors.

9.3 Emergency Response Contacts

Emergency contact information is provided in this HASP (see Page 1). A copy of this HASP will be maintained at the project site. Emergency information includes:

- Emergency telephone numbers,

- Route to nearest hospital (Figure 1), and

- Site description (Section 1.4).

A significant environmental release of contaminants is not likely to occur from work activities subject to this HASP. If it does, the field health and safety manager will contact the project manager or corporate health and safety director to make any required notifications.

If an emergency situation occurs requiring implementation of the emergency response plan (fire, serious injury, or inadequate personal protection equipment for the hazards present, for instance), Hart Crowser staff will cease all work immediately, pending approval from the field health and safety manager to restart work. The general emergency actions described below will be followed.

9.4 Fires

Hart Crowser personnel may attempt to control only very small fires. If the fire expands, or an explosion appears likely, Hart Crowser field workers will evacuate the area immediately. If a fire occurs that cannot be controlled with a 3 to 4-pound ABC fire extinguisher, immediate intervention by the local fire department or other appropriate agency is imperative. Use these steps:

- Immediately call **911**,
- Evacuate to a safe area away from the danger to a previously agreed upon upwind location, and
- Inform the project manager or field health and safety manager of the situation.

9.5 Medical Emergencies

Hart Crowser staff will call **911** immediately if a medical emergency (such as a serious injury or an unconscious worker) occurs. If workers are unsure about the severity of an accident or exposure, they will take a conservative approach and seek medical attention. The field health and safety manager will notify the project manager of the outcome of the medical incident as soon as possible.

No Hart Crowser employees are trained to perform rescue duties or medical duties beyond basic CPR and first aid. Hart Crowser employees certified in CPR and first aid may respond to work-related incidents requiring first aid services. First aid will be treatment for such things as minor cuts and bruises as needed. When rendering first aid, Hart Crowser workers will take necessary precautions to avoid exposure to BBPs. Section 2.4, Physical Hazards, provides information on BBPs and precautions for avoiding exposure.

9.6 Uncontrolled Contaminant Release

Work activities for this project do not present the potential for an uncontrolled contaminant release as defined by

Washington

- Chapter 296-24, Washington Administrative Code (WAC), General Safety and Health Standards.
- Chapter 296-62, WAC, General Occupational Health Standards.
- Chapter 296-155, WAC, Safety Standards for Construction Work.
- Chapter 296-800, WAC, Core Rules. Core Rules are the basic safety and health rules needed by most employers in Washington State.

Federal OSHA

- 29 Code of Federal Regulations (CFR) 1910, General Occupational Safety and Health Standards.
- 29 CFR 1926, Safety and Health Regulations for Construction
- 29 CFR 1904, Recording and Reporting Occupational Injuries and Illnesses.

Hart Crowser staff are not trained as emergency responders as defined by federal and state regulations; therefore, they are not qualified to respond to hazardous material emergencies.

9.7 Potentially High Chemical Exposure Situations

Work activities for this project do not present the potential for high chemical exposure situations.

10.0 NOTIFICATION AND REPORTING

The project manager will be informed immediately if an emergency, accident, or injury occurs at the project location. The project manager will notify the client immediately. The field health and safety manager will notify the corporate health and safety director as soon as possible after the situation has been stabilized. The project manager or corporate health and safety director will notify the appropriate client contacts and regulatory agencies, if applicable. If an individual is injured or suffers a work-related illness, the field health and safety manager or designee will complete an injury/accident report and submit it to human resources or the corporate health and safety director within 24 hours. A blank report is provided as Appendix C.

The project manager, the field health and safety manager, and the corporate health and safety director will evaluate emergency response following the incident. The results of the evaluation will be used in follow-up training exercises to improve the emergency response plan.

11.0 MEDICAL SURVEILLANCE

Hart Crowser employees working on this project participate in a medical surveillance program as described in Section 11 of Hart Crowser’s APP.

12.0 SAFETY TRAINING REQUIREMENTS

Hart Crowser employees who work at sites where there is potential for exposure to hazardous substances, health hazards, or safety hazards will have completed 40 hours of hazardous waste operations and emergency response (HAZWOPER) training and 3 days of supervised field experience. In addition, employees will have completed an 8-hour annual refresher training within the past 12 months or will possess equivalent documented training by experience. Site supervisors will have completed 8 hours of HAZWOPER supervisor training. The project manager will ensure that all employees working on this site have completed required HAZWOPER training. The Hart Crowser safety records coordinator maintains employee health and safety training records.

Employees performing some tasks will require additional safety training on performing the task safely (without injury or property damage) and in compliance with safety regulations. Examples of these tasks include entering confined spaces, wearing a respirator, operating equipment or machinery, working at heights, handling or using hazardous substances, and working in excessive outdoor heat. Safety training requirements are specified in Section 7.2 of the Hart Crowser APP. Hart Crowser personnel will complete hazard-specific safety training as needed based on the tasks to be performed.

Before each work day starts, the field health and safety manager will review applicable health and safety issues with Hart Crowser employees. At these briefings the work to be accomplished will be reviewed and there will be an opportunity for questions to be asked. The "Field Health and Safety Report" form (Appendix B) will be completed daily by the Hart Crowser field health and safety manager or designated individual.

13.0 REPORTING, REPORTS, AND DOCUMENTATION

All incidents (accidents, injuries, near-misses) that occur during field work on this project will be reported to the project manager immediately. The project manager will notify the client and the corporate health and safety director.

The field health and safety manager is responsible for maintaining records demonstrating that the provisions of this HASP are implemented throughout the course of this project.

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Table A-1 – Sample Containers, Preservation, and Holding Times for Soil

Analysis	Preservation	Holding Time[a]	Container
Gasoline-range petroleum hydrocarbons (NWTPH-Gx)	Cool to 4 °C	48 hours to freeze/14 days	3 pre-weighed 40 mL VOA vials
Volatile organic compounds (EPA 8260C)	Cool to 4 °C	48 hours to freeze/14 days	3 pre-weighed 40 mL VOA vials
Diesel- and oil-range petroleum hydrocarbons	Cool to 4 °C	14 days to extraction; 40 days to analysis	1 wide-mouth glass jar, 4 or 8-ounce[b]
(NWTPH-Dx)			
Total metals (As, Ba, Cd, Cr, Pb, Hg, Se, Ag)	Cool to 4 °C	6 months; 28 days for mercury	
(EPA Methods 6000/7000 series)			
Total solids	Cool to 4 °C		
PAHs (EPA 8270 SIM)	Cool to 6 °C	14 days to extraction; 40 days to analysis	1 wide-mouth glass jar, 8-ounce[f]
PCBs (EPA 8082A)	Cool to 6 °C	None	1 wide-mouth glass jar, 8-ounce[f]

Notes:

a. Holding times are from date of sample collection.

b. Diesel- and oil-range hydrocarbons, metals, and total solids can be combined into one 8-ounce glass jar.

Table A-2 – Sample Containers, Preservation, and Holding Times for Groundwater

Analysis	Preservation	Holding Time[a]	Container
Gasoline-range hydrocarbons (NWTPH-Gx)	HCl to pH < 2, cool to 4 °C	14 days	3 x 40 mL glass VOA vials
Volatile organic compounds (EPA 8260C)	HCl to pH < 2, cool to 4 °C	14 days	3 x 40 mL glass VOA vials
Diesel- and oil-range petroleum hydrocarbons	Cool to 4 °C	7 days to extract, 40 to analyze	500 mL amber glass bottle
(NWTPH-Dx)			
Total metals (As, Ba, Cd, Cr, Pb, Hg, Se, Ag)	HNO_3 to pH < 2	6 months; 28 days for mercury	250 mL poly bottle
(EPA Methods 200/7000 series)			
Dissolved metals (As, Ba, Cd, Cr, Pb, Hg, Se, Ag) – field filtered	HNO_3 to pH < 2	6 months; 28 days for mercury	250 mL poly bottle
(EPA Methods 200/7000 series)			
Total suspended solids (SM 2540D)	None	7 days	500 mL poly bottle
PCBs (EPA 8082A)	Cool to 6 °C	None	1L amber glass jar

Notes:

a. Holding times are from date of sample collection.

Table A-3 - Cleanup Levels, Method Detection Limits, and Practical Quantitation Limits for Soil

Analyte	MTCA Method A Cleanup Level Unrestricted Land Uses	MDL	RL
TPH (mg/kg)			
NWTPH-gasoline	100[a]/30[b]	0.36	5.0
NWTPH-diesel	2000[c]	0.82	50
NWTPH-oil	2000[c]	4.9	250
Total Metals by Method 200.8/6020B (mg/kg)			
Arsenic	20	0.1	1.0
Barium		0.096	1.0
Cadmium	2	0.045	1.0
Chromium	2000 (Cr III) /19 (Cr VI)	0.25	1.0
Lead	250	0.045	1.0
Selenium		0.081	1.0
Silver		0.043	1.0
Mercury	2	0.066	1.0
Mercury by Method 1631E (mg/kg)			
Mercury	2	0.000268	0.1
PAHs by EPA 8270 SIM (mg/kg)			
1-Methylnaphthalene		0.000082	0.01
2-Methylnaphthalene		0.000094	0.01
Naphthalene	5	0.00012	0.01
Acenaphthylene		0.0002	0.01
Acenaphthene		0.00011	0.01
Fluorene		0.00011	0.01
Phenanthrene		0.00025	0.01
Anthracene		0.000077	0.01
Fluoranthene		0.00015	0.01
Pyrene		0.00028	0.01
Benzo(a)anthracene		0.00018	0.01
Chrysene		0.00013	0.01
Benzo(b)fluoranthene		0.00012	0.01
Benzo(k)fluoranthene		0.000071	0.01
Benzo(a)pyrene	0.1	0.00011	0.01
Indeno(1,2,3-cd)pyrene		0.00034	0.01
Dibenzo(ah)anthracene		0.00028	0.01
Benzo(ghi)perylene		0.00038	0.01
PCBs by EPA 8082A			
Aroclor 1221		0.0008	0.02
Aroclor 1232		0.0008	0.02
Aroclor 1242 (Aroclor 1016)		0.0008	0.02
Aroclor 1248		0.00069	0.02
Aroclor 1254		0.00069	0.02
Aroclor 1260		0.00069	0.02
Aroclor 1262		0.00069	0.02
Aroclor 1268		0.00069	0.02

Table A-3 - Cleanup Levels, Method Detection Limits, and Practical Quantitation Limits for Soil

Analyte	MTCA Method A Cleanup Level Unrestricted Land Uses	MDL	RL
Volatiles by Method 8260C (µg/kg)			
1,1,1,2-Tetrachloroethane		0.19	5.0
1,1,1-Trichloroethane	2000	0.25	5.0
1,1,2,2-Tetrachloroethane		0.13	5.0
1,1,2-Trichloroethane		0.16	5.0
1,1-Dichloroethane		0.24	5.0
1,1-Dichloroethene		0.27	5.0
1,1-Dichloropropene		0.15	5.0
1,2,3-Trichlorobenzene		0.21	25.0
1,2,3-Trichloropropane		0.17	5.0
1,2,4-Trichlorobenzene		0.33	25.0
1,2,4-Trimethylbenzene		0.11	5.0
1,2-Dibromo-3-chloropropane		0.58	5.0
1,2-Dibromoethane (EDB)		0.25	5.0
1,2-Dichlorobenzene		0.20	5.0
1,2-Dichloroethane (EDC)		0.25	5.0
1,2-Dichloropropane		0.20	5.0
1,3,5-Trimethylbenzene		0.10	5.0
1,3-Dichlorobenzene		0.15	5.0
1,3-Dichloropropane		0.18	5.0
1,4-Dichlorobenzene		0.28	5.0
2,2-Dichloropropane		0.26	1.0
2-Butanone (MEK)		1.70	50.0
2-Chlorotoluene		0.09	5.0
2-Hexanone		1.30	50.0
2-Propanol		N/A	5000.0
4-Chlorotoluene		0.15	5.0
4-Methyl-2-pentanone		0.66	50.0
Acetone		32.00	50.0
Benzene	30	0.15	5.0
Bromobenzene		0.11	5.0
Bromodichloromethane		0.06	5.0
Bromoform		0.31	5.0
Bromomethane		1.80	50.0
Carbon Tetrachloride		0.14	5.0
Chlorobenzene		0.16	5.0
Chloroethane		0.37	50.0
Chloroform		0.16	5.0
Chloromethane		0.28	50.0
cis-1,2-Dichloroethene		0.22	5.0
cis-1,3-Dichloropropene		0.14	5.0
Dibromochloromethane		0.22	5.0
Dibromomethane		0.24	5.0
Dichlorodifluoromethane		16.00	50.0
Diisopropyl ether (DIPE)		0.23	5.0
Ethanol		N/A	5000.0
Ethyl t-butyl ether (ETBE)		0.25	5.0
Ethylbenzene	6000	0.13	5.0

Table A-3 - Cleanup Levels, Method Detection Limits, and Practical Quantitation Limits for Soil

Analyte	MTCA Method A Cleanup Level Unrestricted Land Uses	MDL	RL
Hexachlorobutadiene		0.15	25.0
Hexane		22.00	25.0
Isopropylbenzene		0.10	5.0
m,p-Xylene	9000	0.25	10.0
Methyl t-butyl ether (MTBE)	100	0.21	5.0
Methylene chloride	20	45.00	50.0
Naphthalene		0.25	5.0
n-Propylbenzene		0.10	5.0
o-Xylene	9000	0.23	5.0
p-Isopropyltoluene		0.07	5.0
sec-Butylbenzene		0.09	5.0
Styrene		0.09	5.0
t-Amyl methyl ether (TAME)		0.23	5.0
t-Butyl alcohol (TBA)		40.00	5.0
tert-Butylbenzene		0.06	5.0
Tetrachloroethene	50	0.17	5.0
Toluene	7000	0.10	5.0
trans-1,2-Dichloroethene		0.24	5.0
trans-1,3-Dichloropropene		0.12	5.0
Trichloroethene	30	0.20	5.0
Trichlorofluoromethane		0.25	50.0
Vinyl chloride		0.29	5.0

a. No benzene detected in any samples and BTEX < 1% of total TPH-Gx.

b. Benzene detected or BTEX > 1% of total TPH-Gx.

c. Sum of diesel- and heavy-oil-range TPH cannot exceed 2000 mg/kg criterion.

Table A-4 - Cleanup Levels, Method Detection Limits, and Practical Quantitation Limits for Groundwater

Analyte	MTCA Method A Cleanup Level (µg/L) Groundwater	MDL	RL
TPH			
NWTPH-gasoline	1000[a]/800[b]	10	100
NWTPH-diesel	500	5.4	50
NWTPH-oil	500	52	250
Total Metals by Method 200.8/6020B			
Arsenic	5	0.049	1.0
Barium		N/A	1.0
Cadmium	5	0.049	1.0
Chromium	50	0.0740	1.0
Lead	15	0.0740	1.0
Selenium		0.120	1.0
Silver		0.0420	1.0
Mercury	2	N/A	1.0
Total Mercury by Method 1631E			
Mercury	2	0.00076	0.01
PAHs by EPA 8270D			
1-Methylnaphthalene		0.003	0.2
2-Methylnaphthalene		0.0034	0.2
Acenaphthene		0.0037	0.04
Acenaphthylene		0.0033	0.04
Anthracene		0.0023	0.04
Benz(a)anthracene		0.007	0.04
Benzo(a)pyrene	0.1	0.0028	0.04
Benzo(b)fluoranthene		0.0021	0.04
Benzo(g,h,i)perylene		0.0057	0.04
Benzo(k)fluoranthene		0.0035	0.04
Chrysene		0.0024	0.04
Dibenzo(a,h)anthracene		0.0051	0.06
Fluoranthene		0.0029	0.04
Fluorene		0.0044	0.04
Indeno(1,2,3-cd)pyrene		0.0049	0.04
Naphthalene	160	0.005	0.2
Phenanthrene		0.0062	0.04
Pyrene		0.0054	0.04

Table A-4 - Cleanup Levels, Method Detection Limits, and Practical Quantitation Limits for Groundwater

Analyte	MTCA Method A Cleanup Level (µg/L) Groundwater	MDL	RL
PCBs by EPA 8082A			
Aroclor 1221		0.011	0.1
Aroclor 1232		0.011	0.1
Aroclor 1016		0.011	0.1
Aroclor 1242		0.011	0.1
Aroclor 1248		0.0089	0.1
Aroclor 1254		0.0089	0.1
Aroclor 1260		0.0089	0.1
Aroclor 1262		0.0089	0.1
Aroclor 1268		0.0089	0.1
Dissolved Metals by Method 200.8/6020B			
Arsenic	5	0.049	1.0
Barium		N/A	1.0
Cadmium	5	0.049	1.0
Chromium	50	0.0740	1.0
Lead	15	0.0740	1.0
Selenium		0.120	1.0
Silver		0.0420	1.0
Mercury	2	N/A	1.0
Dissolved Mercury by Method 1631E			
Mercury	2	0.00076	0.10
Volatiles by Method 8260C			
1,1,1,2-Tetrachloroethane		0.038	1
1,1,1-Trichloroethane	200	0.028	1
1,1,2,2-Tetrachloroethane		0.049	1
1,1,2-Trichloroethane		0.043	1
1,1-Dichloroethane		0.047	1
1,1-Dichloroethene		0.08	1
1,1-Dichloropropene		0.023	1
1,2,3-Trichlorobenzene		0.034	1
1,2,3-Trichloropropane		0.04	1
1,2,4-Trichlorobenzene		0.037	1
1,2,4-Trimethylbenzene		0.017	1
1,2-Dibromo-3-chloropropane		0.1	10
1,2-Dibromoethane (EDB)		0.043	1
1,2-Dichlorobenzene		0.017	1
1,2-Dichloroethane (EDC)	5	0.051	1
1,2-Dichloropropane		0.047	1
1,3,5-Trimethylbenzene		0.021	1
1,3-Dichlorobenzene		0.029	1
1,3-Dichloropropane		0.046	1
1,4-Dichlorobenzene		0.038	1
2,2-Dichloropropane		0.044	1
2-Butanone (MEK)		0.26	10
2-Chlorotoluene		0.031	1

Table A-4 - Cleanup Levels, Method Detection Limits, and Practical Quantitation Limits for Groundwater

Analyte	MTCA Method A Cleanup Level (µg/L) Groundwater	MDL	RL
2-Hexanone		0.078	10
2-Propanol		N/A	1000
4-Chlorotoluene		0.028	1
4-Methyl-2-pentanone		0.24	10
Acetone		2.2	10
Benzene	5	0.02	0.35
Bromobenzene		0.044	1
Bromodichloromethane		0.037	1
Bromoform		0.057	1
Bromomethane		0.13	1
Carbon Tetrachloride		0.03	1
Chlorobenzene		0.027	1
Chloroethane		0.066	1
Chloroform		0.048	1
Chloromethane		0.038	10
cis-1,2-Dichloroethene		0.058	1
cis-1,3-Dichloropropene		0.041	1
Dibromochloromethane		0.03	1
Dibromomethane		0.057	1
Dichlorodifluoromethane		0.038	1
Diisopropyl ether (DIPE)		0.02	1
Ethanol		N/A	1000
Ethyl t-butyl ether (ETBE)		0.038	1
Ethylbenzene	700	0.032	1
Hexachlorobutadiene		0.05	1
Hexane		0.039	1
Isopropylbenzene		0.024	1
m,p-Xylene	1000	0.074	2
Methyl t-butyl ether (MTBE)	20	0.046	1
Methylene chloride	5	1.9	5
Naphthalene	160	0.038	1
n-Propylbenzene		0.033	1
o-Xylene	1000	0.038	1
p-Isopropyltoluene		0.025	1
sec-Butylbenzene		0.023	1
Styrene		0.028	1
t-Amyl methyl ether (TAME)		0.028	1
t-Butyl alcohol (TBA)		0.47	1
tert-Butylbenzene		0.014	1
Tetrachloroethene	5	0.088	1
Toluene	1000	0.033	1
trans-1,2-Dichloroethene		0.041	1
trans-1,3-Dichloropropene		0.049	1
Trichloroethene	5	0.084	1
Trichlorofluoromethane		0.051	1
Vinyl chloride	0.2	0.063	0.2

a. No benzene detected.
b. Benzene detected.

Table A-5 – Laboratory Quality Control Procedures, Criteria, and Corrective Actions for Gasoline Analysis

Laboratory Quality Control: NWTPH-Gx (GC/FID)			
Quality Control Check	**Frequency**	**Acceptance Criteria**	**Corrective Action**
Method blank	1 per batch of every 20 or fewer samples	All analytes < reporting limit	Re-extract and re-analyze associated samples unless concentrations are > 5 x blank level
Initial calibration	5-point external calibration before sample analysis	< 20% difference from true value, correlation coefficient ≥ 0.99	Recalibrate instrument
Continuing calibration	Beginning and end of instrument run	NWTPH-Gx ≤ 20% difference from initial calibration.	Recalibrate instrument and re-analyze affected samples
Surrogates	Every lab and field sample	Laboratory control chart limits	Evaluate data for usability
Laboratory duplicate	1 per batch of 20 or fewer samples if no MS/MD	RPD <20%	Evaluate data for usability
Laboratory control sample	1 per batch of 20 or fewer samples	Laboratory control chart limits	Evaluate data for usability
Laboratory control sample duplicate; if no MS/MD or sample duplicate	1 per batch of 20 or fewer samples	Laboratory control chart limits	Evaluate data for usability
Matrix spike sample	1 per batch of 20 or fewer samples if sufficient sample	Laboratory control chart limits	Evaluate data for usability

Table A-6 – Laboratory Quality Control Procedures, Criteria, and Corrective Actions for Diesel and Motor Oil Analysis

Laboratory Quality Control: NWTPH-Dx (GC/FID)			
Quality Control Check	**Frequency**	**Acceptance Criteria**	**Corrective Action**
Method blank	1 per batch of every 20 or fewer samples	All analytes < reporting limit	Re-extract and re-analyze associated samples unless concentrations are > 5 x blank level
Initial calibration	5-point external calibration prior to sample analysis	< 20% difference from true value, correlation coefficient > 0.99	Recalibrate instrument
Continuing calibration	Beginning, end, and every 10 samples with mid-range standard	% difference < 20% of initial calibration	Recalibrate instrument and re-analyze affected samples
Surrogates	Every lab and field sample	Laboratory control chart limits	Evaluate data for usability
Laboratory duplicate	1 per batch of 20 or fewer samples if no MS/MD	RPD <20%	Evaluate data for usability
Laboratory control sample	1 per batch of 20 or fewer samples	Laboratory control chart limits	Evaluate data for usability

Table A-7 – Laboratory Quality Control Procedures, Criteria, and Corrective Actions for Metals Analysis

Laboratory Quality Control: Total and Dissolved Metals – EPA 200/6000/7000 Series			
Quality Control Check	**Frequency**	**Acceptance Criteria**	**Corrective Action**
Initial calibration verification	Daily or each time instrument is set up	90 to 110% of initial calibration	Recalibrate instrument
Initial calibration blank	After each instrument calibration	All analytes < reporting limit	Correct source of contamination
Continuing calibration verification	Every 10 analytical samples and at the beginning and end of each run	90 to 110% of initial calibration	Correct instrument calibration and re-analyze affected samples
Continuing calibration blank	After each continuing calibration verification	All analytes < reporting limit	Correct source of contamination
Method blank	1 per batch of 20 or fewer samples	All analytes < reporting limit	Re-extract and re-analyze associated samples unless concentrations are > 3 times the blank level
Matrix spike	1 per batch of 20 or fewer samples if sufficient sample	75 to 125% recovery	Evaluate data for usability
Matrix spike duplicate	1 per batch of 20 or fewer samples if sufficient sample	75 to 125% recovery	Evaluate data for usability
Laboratory duplicate	1 per batch of 20 or fewer samples if no MS/MD	< 20% RPD	Evaluate data for usability
Laboratory control sample	1 per batch of 20 or fewer samples	80 to 120% recovery	Evaluate data for usability
Laboratory control sample duplicate	1 per batch of 20 or fewer samples if no MS/MD	80 to 120% recovery	Evaluate data for usability

Note:
RPD = relative percent difference

Table A-8 – Laboratory Quality Control Procedures, Criteria, and Corrective Actions for Polycyclic Aromatic Hydrocarbons (PAHs)

Laboratory Quality Control: Polycyclic Aromatic Hydrocarbons (PAHs) – EPA 8270-SIM			
Quality Control Check	**Frequency**	**Acceptance Criteria**	**Corrective Action**
Instrument tuning	DFTPP; Before initial calibration and every 12 hours	See EPA Method 8270	Retune and recalibrate instrument; reanalyze affected samples
Initial calibration	See EPA Method 8270	≤ 20% relative percent difference	Laboratory to recalibrate and re-analyze affected samples
Continuing calibration verification	Every 12 hours	See EPA Method 8270	Recalibrate instrument and reanalyze affected samples
		≤ 20% percent difference	
Method blank	1 per batch of 20 or fewer samples	All analytes < reporting limit	Re-extract and reanalyze associated samples unless sample concentrations are >5x blank level or are undetected
Internal Standards	Every sample and calibration standard mix	Areas with -50% to +100% of initial calibration	Reanalyze affected samples
Laboratory duplicate	1 per batch of 20 or fewer samples if no MS/MD	RPD <20%	Evaluate data for usability
Laboratory control sample	1 per batch of 20 or fewer samples	Laboratory control chart limits	Evaluate data for usability
Laboratory control sample duplicate; if no MS/MD or sample duplicate	1 per batch of 20 or fewer samples	Laboratory control chart limits	Evaluate data for usability
Matrix spike sample	1 per batch of 20 or fewer samples if sufficient sample	Laboratory control chart limits	Evaluate data for usability
Matrix spike duplicate	1 per batch of 20 or fewer samples if sufficient sample	Laboratory control chart limits	Evaluate data for usability
Surrogates	Added to every lab and field sample	Laboratory control chart limits	Evaluate data for useability

Note:
RPD = relative percent difference

Table 9 – Laboratory Quality Control Procedures, Criteria, and Corrective Actions for Polychlrinated Biphenyls

Laboratory Quality Control: Polychlorinated Biphenyls (PCBs) – EPA 8082A			
Quality Control Check	**Frequency**	**Acceptance Criteria**	**Corrective Action**
Initial calibration	5-point external calibration prior to analysis of samples	≤ 25% relative standard deviation	Recalibrate instrument.
Continuing calibration verification	Every 10 samples with mid-range standard	% Difference ≤ 20% of initial calibration	Recalibrate instrument and reanalyze affected samples
Method blank	1 per batch of 20 or fewer samples	All analytes < reporting limit	Re-extract and reanalyze associated samples unless sample concentrations are >5x blank level or are undetected
Laboratory duplicate	1 per batch of 20 or fewer samples if no MS/MD	RPD <20%	Evaluate data for usability
Laboratory control sample	1 per batch of 20 or fewer samples	Laboratory control chart limits	Evaluate data for usability
Laboratory control sample duplicate; if no MS/MD or sample duplicate	1 per batch of 20 or fewer samples	Laboratory control chart limits	Evaluate data for usability
Matrix spike sample	1 per batch of 20 or fewer samples if sufficient sample	Laboratory control chart limits	Evaluate data for usability
Matrix spike duplicate	1 per batch of 20 or fewer samples if sufficient sample	Laboratory control chart limits	Evaluate data for usability
Surrogates	Added to every lab and field sample	Laboratory control chart limits	Evaluate data for useability

Note:
RPD = relative percent difference

Table A-10 – Laboratory Quality Control Procedures, Criteria, and Corrective Actions for Volatile Organic Compound Analysis

Laboratory Quality Control: VOCs – EPA 8260			
Quality Control Check	**Frequency**	**Acceptance Criteria**	**Corrective Action**
Instrument tuning	Before initial calibration and every 12 hours	See EPA Method 8260	Retune and recalibrate instrument
Initial calibration	See EPA Method 8260	< 20% relative percent difference	Laboratory to recalibrate and re-analyze affected samples
Continuing calibration verification	Every 12 hours	See EPA Method 8260 < 20% percent difference	Laboratory to recalibrate if correlation coefficient or response factor does not meet method requirements
Method blank	1 per batch of 20 or fewer samples	All analytes < reporting limit	Laboratory to eliminate or greatly reduce laboratory contamination due to glassware or reagents or analytical system; re-analyze affected samples
Laboratory duplicate	1 per batch of 20 or fewer samples if no MS/MD	RPD <20%	Evaluate data for usability
Laboratory control sample	1 per batch of 20 or fewer samples	Laboratory control chart limits	Evaluate data for usability
Laboratory control sample duplicate; if no MS/MD or sample duplicate	1 per batch of 20 or fewer samples	Laboratory control chart limits	Evaluate data for usability
Matrix spike sample	1 per batch of 20 or fewer samples if sufficient sample	Laboratory control chart limits	Evaluate data for usability
Matrix spike duplicate	1 per batch of 20 or fewer samples if sufficient sample	Laboratory control chart limits	Evaluate data for usability
Surrogates	Added to every lab and field sample	Laboratory control chart limits	Evaluate data for useability

Note:
RPD = relative percent difference

Table A-11 – Laboratory Quality Control Procedures, Criteria, and Corrective Actions for Total Suspended Solids Analysis

Laboratory Quality Control: TSS – SM 2540D			
Quality Control Check	**Frequency**	**Acceptance Criteria**	**Corrective Action**
Method blank	1 per batch of every 10 or fewer samples	All analytes < reporting limit	Re-extract and re-analyze associated samples unless concentrations are > 5 x blank level
Laboratory duplicate	1 per 10 or fewer samples	< 20% RPD	Evaluate data for usability

Note:
RPD = relative percent difference

APPENDIX A
Record of Health and Safety Communication

Record of Health and Safety Communication

PROJECT NAME: Kosmos Mill Oil Cleanup

PROJECT NUMBER: 19499-00

SITE CONTAMINANTS: Total petroleum hydrocarbons as diesel (TPH-D), gasoline (TPH-G), and heavy oil (TPH-O); benzene, toluene, ethylbenzene, and xylenes (BTEX); lead; polycyclic aromatic hydrocarbons (PAHs); and polychlorinated biphenyls (PCBs).

PPE REQUIREMENTS (check all that apply):

X	Eye protection	X	Gloves (specify)	Nitrile or neoprene-coated work gloves
X	Foot protection	X	Clothing (specify)	Long pants, shirt with minimum 4-inch sleeve
X	Head protection		Respirator (specify)	Half-face air purifying (as needed)
		X	Other (specify)	Hearing protection

The following personnel have reviewed a copy of the site-specific HASP. By signing below, these personnel indicate they have read the plan, including all referenced information, and that they understand the requirements detailed for this project.

PRINTED NAME	SIGNATURE	PROJECT DUTIES	DATE

Project manager: please route a copy of this form to the job files when completed.

Benzene - ToxFAQs™

CAS # 71-43-2

This fact sheet answers the most frequently asked health questions (FAQs) about benzene. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHTLIGHTS: Benzene is a widely used chemical formed from both natural processes and human activities. Breathing benzene can cause drowsiness, dizziness, and unconsciousness; long-term benzene exposure causes effects on the bone marrow and can cause anemia and leukemia. Benzene has been found in at least 1,000 of the 1,684 National Priority List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is benzene?

Benzene is a colorless liquid with a sweet odor. It evaporates into the air very quickly and dissolves slightly in water. It is highly flammable and is formed from both natural processes and human activities.

Benzene is widely used in the United States; it ranks in the top 20 chemicals for production volume. Some industries use benzene to make other chemicals which are used to make plastics, resins, and nylon and other synthetic fibers. Benzene is also used to make some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides. Natural sources of benzene include emissions from volcanoes and forest fires. Benzene is also a natural part of crude oil, gasoline, and cigarette smoke.

What happens to benzene when it enters the environment?

- Industrial processes are the main source of benzene in the environment.
- Benzene can pass into the air from water and soil.
- It reacts with other chemicals in the air and breaks down within a few days.
- Benzene in the air can attach to rain or snow and be carried back down to the ground.
- It breaks down more slowly in water and soil, and can pass through the soil into underground water.
- Benzene does not build up in plants or animals.

How might I be exposed to benzene?

- Outdoor air contains low levels of benzene from tobacco smoke, automobile service stations, exhaust from motor vehicles, and industrial emissions.
- Vapors (or gases) from products that contain benzene, such as glues, paints, furniture wax, and detergents, can also be a source of exposure.
- Air around hazardous waste sites or gas stations will contain higher levels of benzene.
- Working in industries that make or use benzene.

How can benzene affect my health?

Breathing very high levels of benzene can result in death, while high levels can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. Eating or drinking foods containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, and death.

The major effect of benzene from long-term exposure is on the blood. Benzene causes harmful effects on the bone marrow and can cause a decrease in red blood cells leading to anemia. It can also cause excessive bleeding and can affect the immune system, increasing the chance for infection. Some women who breathed high levels of benzene for many months had irregular menstrual periods and a decrease in the size of their ovaries, but we do not know for certain that benzene caused the effects. It is not known whether benzene will affect fertility in men.

Benzene

CAS # 71-43-2

How likely is benzene to cause cancer?

Long-term exposure to high levels of benzene in the air can cause leukemia, particularly acute myelogenous leukemia, often referred to as AML. This is a cancer of the bloodforming organs. The Department of Health and Human Services (DHHS) has determined that benzene is a known carcinogen. The International Agency for Research on Cancer (IARC) and the EPA have determined that benzene is carcinogenic to humans.

How can benzene affect children?

Children can be affected by benzene exposure in the same ways as adults. It is not known if children are more susceptible to benzene poisoning than adults.

Benzene can pass from the mother's blood to a fetus. Animal studies have shown low birth weights, delayed bone formation, and bone marrow damage when pregnant animals breathed benzene.

How can families reduce the risks of exposure to benzene?

Benzene exposure can be reduced by limiting contact with gasoline and cigarette smoke. Families are encouraged not to smoke in their house, in enclosed environments, or near their children.

Is there a medical test to determine whether I've been exposed to benzene?

Several tests can show if you have been exposed to benzene. There is a test for measuring benzene in the breath; this test must be done shortly after exposure. Benzene can also be measured in the blood; however, since benzene disappears rapidly from the blood, this test is only useful for recent exposures.

In the body, benzene is converted to products called metabolites. Certain metabolites can be measured in the urine. The metabolite S-phenylmercapturic acid in urine is a sensitive indicator of benzene exposure. However, this test must be done shortly after exposure and is not a reliable indicator of how much benzene you have been exposed to, since the metabolites may be present in urine from other sources.

Has the federal government made recommendations to protect human health?

The EPA has set the maximum permissible level of benzene in drinking water at 5 parts benzene per billion parts of water (5 ppb).

The Occupational Safety and Health Administration (OSHA) has set limits of 1 part benzene per million parts of workplace air (1 ppm) for 8 hour shifts and 40 hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR) 2007. Toxicological Profile for Benzene (Update). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Ethylbenzene- ToxFAQs™

CAS # 100-41-4

This fact sheet answers the most frequently asked health questions (FAQs) about ethylbenzene. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Ethylbenzene is a colorless liquid found in a number of products including gasoline and paints. Breathing very high levels can cause dizziness and throat and eye irritation. Breathing lower levels has resulted in hearing effects and kidney damage in animals. Ethylbenzene has been found in at least 829 of 1,699 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is ethylbenzene?

Ethylbenzene is a colorless, flammable liquid that smells like gasoline.

It is naturally found in coal tar and petroleum and is also found in manufactured products such as inks, pesticides, and paints.

Ethylbenzene is used primarily to make another chemical, styrene. Other uses include as a solvent, in fuels, and to make other chemicals.

What happens to ethylbenzene when it enters the environment?

- Ethylbenzene moves easily into the air from water and soil.
- It takes about 3 days for ethylbenzene to be broken down in air into other chemicals.
- In surface water, ethylbenzene breaks down by reacting with other chemicals found naturally in water.
- Ethylbenzene can move through soil into groundwater.
- In soil, it is broken down by bacteria.

How might I be exposed to ethylbenzene?

- If you live in a city or near many factories or heavily traveled highways, you may be exposed to ethylbenzene in air.
- Releases of ethylbenzene into the air occur from burning oil, gas, and coal and from industries using ethylbenzene.
- Ethylbenzene is not often found in drinking water. Higher levels may be found in residential drinking water wells near landfills, waste sites, or leaking underground fuel storage tanks.
- Exposure can occur if you work in an industry where ethylbenzene is used or made.
- Exposure can occur if you use products containing it, such as gasoline, carpet glues, varnishes, and paints.

How can ethylbenzene affect my health?

Exposure to high levels of ethylbenzene in air for short periods can cause eye and throat irritation. Exposure to higher levels can result in dizziness.

Irreversible damage to the inner ear and hearing has been observed in animals exposed to relatively low concentrations of ethylbenzene for several days to weeks.

Exposure to relatively low concentrations of ethylbenzene in air for several months to years causes kidney damage in animals.

How likely is ethylbenzene to cause cancer?

The International Agency for Research on Cancer (IARC) has determined that ethylbenzene is a possible human carcinogen.

Ethylbenzene

CAS # 100-41-4

How does ethylbenzene affect children?

There are no studies evaluating the effects of ethylbenzene exposure on children or immature animals. It is likely that children would have the same health effects as adults. We do not know whether children would be more sensitive than adults to the effects of ethylbenzene.

We do not know if ethylbenzene will cause birth defects in humans. Minor birth defects and low birth weight have occurred in newborn animals whose mothers were exposed to ethylbenzene in air during pregnancy.

How can families reduce the risk of exposure to ethylbenzene?

- Use adequate ventilation to reduce exposure to ethylbenzene vapors from consumer products such as gasoline, pesticides, varnishes and paints, and newly installed carpeting.
- Sometimes older children sniff household chemicals, including ethylbenzene, in an attempt to get high. Talk with your children about the dangers of sniffing chemicals.
- Household chemicals should be stored out of reach of children to prevent accidental poisoning. Always store household chemicals in their original containers; never store them in containers that children would find attractive to eat or drink from, such as old soda bottles. Gasoline should be stored in a gasoline can with a locked cap.

Is there a medical test to show whether I've been exposed to ethylbenzene?

Ethylbenzene is found in the blood, urine, breath, and some body tissues of exposed people. The most common way to test for ethylbenzene is in the urine. This test measures substances formed by the breakdown of ethylbenzene. Because these substances leave the body very quickly, this test needs to be done within a few hours after exposure occurs.

These tests can show you were exposed to ethylbenzene, but cannot predict the kind of health effects that might occur.

Has the federal government made recommendations to protect human health?

The EPA has determined that exposure to ethylbenzene in drinking water at concentrations of 30 mg/L for 1 day or 3 mg/L for 10 days is not expected to cause any adverse effects in a child.

The EPA has determined that lifetime exposure to 0.7 mg/L ethylbenzene is not expected to cause any adverse effects.

The Occupational Health and Safety Administration (OSHA) has limited workers' exposure to an average of 100 ppm for an 8-hour workday, 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2010. Toxicological Profile for Ethylbenzene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

FUEL OILS

CAS # 8008-20-6, 70892-10-3, 68476-30-2, 68476-34-6, 68476-31-3

Agency for Toxic Substances and Disease Registry ToxFAQs **September 1996**

This fact sheet answers the most frequently asked health questions (FAQs) about fuel oils. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Fuel oils are liquid mixtures produced from petroleum, and their use mostly involves burning them as fuels. Drinking or breathing fuel oils may cause nausea or nervous system effects. However, exposure under normal use conditions is not likely to be harmful. Fuel oils have been found in at least 26 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are fuel oils?

(Pronounced fyo͞o′əl oilz)

Fuel oils are a variety of yellowish to light brown liquid mixtures that come from crude petroleum. Some chemicals found in fuel oils may evaporate easily, while others may more easily dissolve in water.

Fuel oils are produced by different petroleum refining processes, depending on their intended uses. Fuel oils may be used as fuel for engines, lamps, heaters, furnaces, and stoves, or as solvents.

Some commonly found fuel oils include kerosene, diesel fuel, jet fuel, range oil, and home heating oil. These fuel oils differ from one another by their hydrocarbon compositions, boiling point ranges, chemical additives, and uses.

What happens to fuel oils when they enter the environment?

☐ Some chemicals found in fuel oils may evaporate into the air from open containers or contaminated soil or water.

☐ Some chemicals found in fuel oils may dissolve in water after spills to surface waters or leaks from underground storage tanks.

☐ Some chemicals found in fuel oils may stick to particles in water, which will eventually cause them to settle to the bottom sediment.

☐ Some of the chemicals found in fuel oils may be broken down slowly in air, water, and soil by sunlight or small organisms.

☐ Some of the chemicals found in fuel oils may build up significantly in plants and animals.

How might I be exposed to fuel oils?

☐ Using a home kerosene heater or stove, or using fuel oils at work.

☐ Breathing air in home or building basements that has been contaminated with fuel oil vapors entering from the soil.

☐ Drinking or swimming in water that has been contaminated with fuel oils from a spill or a leaking underground storage tank.

☐ Touching soil contaminated with fuel oils.

☐ Using fuel oils to wash paint or grease from skin or equipment.

How can fuel oils affect my health?

Little information is available about the health effects that may be caused by fuel oils. People who use kerosene

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, Public Health Service
Agency for Toxic Substances and Disease Registry

stoves for cooking do not seem to have any health problems related to their exposure.

Breathing some fuel oils for short periods may cause nausea, eye irritation, increased blood pressure, headache, lightheadedness, loss of appetite, poor coordination, and difficulty concentrating. Breathing diesel fuel vapors for long periods may cause kidney damage and lower your blood's ability to clot.

Drinking small amounts of kerosene may cause vomiting, diarrhea, coughing, stomach swelling and cramps, drowsiness, restlessness, painful breathing, irritability, and unconsciousness. Drinking large amounts of kerosene may cause convulsions, coma, or death. Skin contact with kerosene for short periods may cause itchy, red, sore, or peeling skin.

How likely are fuel oils to cause cancer?

The International Agency for Research on Cancer (IARC) has determined that some fuel oils (heavy) may possibly cause cancer in humans, but for other fuel oils (light) there is not enough information to make a determination. IARC has also determined that occupational exposures to fuel oils during petroleum refining are probably carcinogenic in humans.

Some studies with mice have suggested that repeated contact with fuel oils may cause liver or skin cancer. However, other mouse studies have found this not to be the case. No studies are available in other animals or in people on the carcinogenic effects of fuel oils.

Is there a medical test to show whether I've been exposed to fuel oils?

There is no medical test that shows if you have been exposed to fuel oils. Tests are available to determine if some of the chemicals commonly found in fuel oils are in your blood. However, the presence of these chemicals in blood may not necessarily mean that you have been exposed to fuel oils.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) and the Air Force Office of Safety and Health (AFOSH) have set a permissible exposure level (PEL) of 400 parts of petroleum distillates per million parts of air (400 ppm) for an 8-hour workday, 40-hour workweek.

The National Institute for Occupational Safety and Health (NIOSH) recommends that average workplace air levels not exceed 350 milligrams of petroleum distillates per cubic meter of air (350 mg/m^3) for a 40-hour workweek.

The Department of Transportation (DOT) lists fuel oils as hazardous materials and, therefore, regulates their transportation.

Glossary

Carcinogenic: Able to cause cancer.

CAS: Chemical Abstracts Service.

Evaporate: To change into a vapor or a gas.

Hydrocarbon: Any compound made up of hydrogen and carbon.

Milligram (mg): One thousandth of a gram.

ppm: Parts per million.

Sediment: Mud and debris that have settled to the bottom of a body of water.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for fuel oils. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone:1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Lead - ToxFAQs™

What is lead?

Lead is a naturally occurring metal found in small amounts in the earth's crust. Lead can be found in all parts of our environment, including air, water and soil. Lead can exist in many different chemical forms.

Lead is used in the production of batteries, ammunition, and metal products (solder and pipes). Because of health concerns, use of lead in paints, ceramic products, caulking, and pipe solder has been dramatically reduced. The use of lead as an additive to automobile gasoline was banned in 1996 in the United States.

What happens to lead in the environment?

- Lead is an element and, therefore, it does not break down.
- When lead is released to the air, it may be transported long distances before it deposits onto the ground.
- Once deposited, lead often adheres to soil particles.
- Lead in soil can be transported into groundwater, but the amount of lead that moves into groundwater will depend on the chemical form of lead and soil type.

How can I be exposed to lead?

- Eating food or drinking water that contains lead. Water pipes in some older homes may contain lead solder which can leach into the water.
- Spending time in areas where lead-based paints have been used and are deteriorating. Deteriorating lead paint can form lead dust which can be ingested.
- Spending time in areas where the soil is contaminated with lead.
- Working in a job where lead is used or participating in certain hobbies in which lead is used, such as making stained glass.
- Using health-care products or folk remedies that contain lead.

Lead can affect almost every organ and system in your body

How can lead affect my health?

The effects of lead are the same whether it enters the body through inhalation or ingestion. Lead can affect almost every organ and system in your body. The nervous system is the main target for lead toxicity in adults and children. Long-term exposure can result in decreased learning, memory, and attention and weakness in fingers, wrists, or ankles. Lead exposure can cause anemia and damage to kidneys. It can also cause increases in blood pressure, particularly in middle-aged and older individuals. Exposure to high lead levels can severely damage the brain and kidneys and can cause death. In pregnant women, exposure to high levels of lead may cause a miscarriage. High-level exposure in men can damage reproductive organs.

Lead

How can lead affect children?

Children are more vulnerable to lead poisoning than adults because their nervous system is still developing. Children can be exposed to lead in their environment and prior to birth from lead in their mother's body. At lower levels of exposure, lead can decrease mental development, with effects on learning, intelligence and behavior. Physical growth may also be decreased. A child who swallows large amounts of lead may develop anemia, severe stomachache, muscle weakness, and brain damage. Exposure to lead during pregnancy can result in premature births. Some effects of lead may persist into adulthood.

Can lead cause cancer?

There have been several agencies and organizations both in the United States and internationally that have reviewed studies and made an assessment about whether lead can cause cancer.

- The Department of Health and Human Services (HHS) has determined that lead and lead compounds are reasonably anticipated to be human carcinogens
- The U.S. Environmental Protection Agency (EPA) has classified lead as a probable human carcinogen.
- The International Agency for Research on Cancer (IARC) has determined that inorganic lead is probably carcinogenic to humans, and that there is insufficient information to determine whether organic lead compounds will cause cancer in humans.

Can I get a medical test to check for lead?

A blood test is available to measure the amount of lead in your blood. Blood tests are commonly used to screen children for lead poisoning. Your doctor can draw blood samples and send them to appropriate laboratories for analysis.

How can I protect my family from lead exposure?

- Avoid exposure to sources of lead.
- Do not allow children to chew or mouth surfaces that may have been painted with lead-based paint.
- If your home contains lead-based paint or you live in an area contaminated with lead, wash children's hands and faces often to remove lead dusts and soil, and regularly clean the house of dust and tracked in soil.

Want more information?

Go to ATSDR's Toxicological Profile for Lead

CDC Lead Poisoning Prevention Program https://www.cdc.gov/nceh/lead/default.htm

Environmental Protection Agency https://www.epa.gov/lead/protect-your-family-exposures-lead

Call **CDC-INFO** at 1-800-232-4636, or submit your question online at https://wwwn.cdc.gov/dcs/ContactUs/Form

Go to ATSDR's Toxic Substances Portal: http://www.atsdr.cdc.gov/substances/index.asp

If you have any more questions or concerns, you can also find & contact your ATSDR Regional Representative at http://www.atsdr.cdc.gov/DRO/dro_org.html

Polycyclic Aromatic Hydrocarbons (PAHs) - ToxFAQs™

This fact sheet answers the most frequently asked health questions (FAQs) about polycyclic aromatic hydrocarbons (PAHs). For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to polycyclic aromatic hydrocarbons usually occurs by breathing air contaminated by wild fires or coal tar, or by eating foods that have been grilled. PAHs have been found in at least 600 of the 1,430 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What are polycyclic aromatic hydrocarbons?

(Pronounced pŏl′ĭ-sī′klĭk ăr′ə-măt′ĭk hī′drə-kar′bənz)

Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot.

Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale yellow-green solids. PAHs are found in coal tar, crude oil, creosote, and roofing tar, but a few are used in medicines or to make dyes, plastics, and pesticides.

What happens to PAHs when they enter the environment?

- PAHs enter the air mostly as releases from volcanoes, forest fires, burning coal, and automobile exhaust.
- PAHs can occur in air attached to dust particles.
- Some PAH particles can readily evaporate into the air from soil or surface waters.
- PAHs can break down by reacting with sunlight and other chemicals in the air, over a period of days to weeks.
- PAHs enter water through discharges from industrial and wastewater treatment plants.
- Most PAHs do not dissolve easily in water. They stick to solid particles and settle to the bottoms of lakes or rivers.
- Microorganisms can break down PAHs in soil or water after a period of weeks to months.
- In soils, PAHs are most likely to stick tightly to particles; certain PAHs move through soil to contaminate underground water.
- PAH contents of plants and animals may be much higher than PAH contents of soil or water in which they live.

How might I be exposed to PAHs?

- Breathing air containing PAHs in the workplace of coking, coal-tar, and asphalt production plants; smokehouses; and municipal trash incineration facilities.
- Breathing air containing PAHs from cigarette smoke, wood smoke, vehicle exhausts, asphalt roads, or agricultural burn smoke.
- Coming in contact with air, water, or soil near hazardous waste sites.
- Eating grilled or charred meats; contaminated cereals, flour, bread, vegetables, fruits, meats; and processed or pickled foods.
- Drinking contaminated water or cow's milk.
- Nursing infants of mothers living near hazardous waste sites may be exposed to PAHs through their mother's milk.

Polycyclic Aromatic Hydrocarbons

How can PAHs affect my health?

Mice that were fed high levels of one PAH during pregnancy had difficulty reproducing and so did their offspring. These offspring also had higher rates of birth defects and lower body weights. It is not known whether these effects occur in people.

Animal studies have also shown that PAHs can cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure. But these effects have not been seen in people.

How likely are PAHs to cause cancer?

The Department of Health and Human Services (DHHS) has determined that some PAHs may reasonably be expected to be carcinogens.

Some people who have breathed or touched mixtures of PAHs and other chemicals for long periods of time have developed cancer. Some PAHs have caused cancer in laboratory animals when they breathed air containing them (lung cancer), ingested them in food (stomach cancer), or had them applied to their skin (skin cancer).

Is there a medical test to show whether I've been exposed to PAHs?

In the body, PAHs are changed into chemicals that can attach to substances within the body. There are special tests that can detect PAHs attached to these substances in body tissues or blood. However, these tests cannot tell whether any health effects will occur or find out the extent or source of your exposure to the PAHs. The tests aren't usually available in your doctor's office because special equipment is needed to conduct them.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.2 milligrams of PAHs per cubic meter of air (0.2 mg/m^3). The OSHA Permissible Exposure Limit (PEL) for mineral oil mist that contains PAHs is 5 mg/m^3 averaged over an 8-hour exposure period.

The National Institute for Occupational Safety and Health (NIOSH) recommends that the average workplace air levels for coal tar products not exceed 0.1 mg/m^3 for a 10-hour workday, within a 40-hour workweek. There are other limits for workplace exposure for things that contain PAHs, such as coal, coal tar, and mineral oil.

Glossary

Carcinogen: A substance that can cause cancer.

Ingest: Take food or drink into your body.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for polycyclic aromatic hydrocarbons. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636.

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

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Polychlorinated Biphenyls - ToxFAQs™

This fact sheet answers the most frequently asked health questions (FAQs) about polychlorinated biphenyls. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Polychlorinated biphenyls (PCBs) are a mixture of individual chemicals which are no longer produced in the United States, but are still found in the environment. Health effects that have been associated with exposure to PCBs include acne-like skin conditions in adults and neurobehavioral and immunological changes in children. PCBs are known to cause cancer in animals. PCBs have been found in at least 500 of the 1,598 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What are polychlorinated biphenyls?

Polychlorinated biphenyls are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known natural sources of PCBs. PCBs are either oily liquids or solids that are colorless to light yellow. Some PCBs can exist as a vapor in air. PCBs have no known smell or taste. Many commercial PCB mixtures are known in the U.S. by the trade name Aroclor.

PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they don't burn easily and are good insulators. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence they build up in the environment and can cause harmful health effects. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and old microscope and hydraulic oils.

What happens to PCBs when they enter the environment?

- PCBs entered the air, water, and soil during their manufacture, use, and disposal; from accidental spills and leaks during their transport; and from leaks or fires in products containing PCBs.
- PCBs can still be released to the environment from hazardous waste sites; illegal or improper disposal of industrial wastes and consumer products; leaks from old electrical transformers containing PCBs; and burning of some wastes in incinerators.
- PCBs do not readily break down in the environment and thus may remain there for very long periods of time. PCBs can travel long distances in the air and be deposited in areas far away from where they were released. In water, a small amount of PCBs may remain dissolved, but most stick to organic particles and bottom sediments. PCBs also bind strongly to soil.
- PCBs are taken up by small organisms and fish in water. They are also taken up by other animals that eat these aquatic animals as food. PCBs accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water.

How might I be exposed to PCBs?

- Using old fluorescent lighting fixtures and electrical devices and appliances, such as television sets and refrigerators, that were made 30 or more years ago. These items may leak small amounts of PCBs into the air when they get hot during operation, and could be a source of skin exposure.
- Eating contaminated food. The main dietary sources of PCBs are fish (especially sportfish caught in contaminated lakes or rivers), meat, and dairy products.
- Breathing air near hazardous waste sites and drinking contaminated well water.
- In the workplace during repair and maintenance of PCB transformers; accidents, fires or spills involving transformers, fluorescent lights, and other old electrical devices; and disposal of PCB materials.

How can PCBs affect my health?

The most commonly observed health effects in people exposed to large amounts of PCBs are skin conditions such as acne and rashes. Studies in exposed workers have shown changes in blood and urine that may indicate liver damage. PCB exposures in the general population are not likely to result in skin and liver effects. Most of the studies of health effects of PCBs in the general population examined children of mothers who were exposed to PCBs.

Animals that ate food containing large amounts of PCBs for short periods of time had mild liver damage and some died. Animals that ate smaller amounts of PCBs in food over several weeks or months developed various kinds of health effects, including anemia; acne-like skin conditions; and liver, stomach, and thyroid gland injuries. Other effects of PCBs in animals include changes in the immune system, behavioral alterations, and impaired reproduction. PCBs are not known to cause birth defects.

How likely are PCBs to cause cancer?

Few studies of workers indicate that PCBs were associated with certain kinds of cancer in humans, such as cancer of the liver and biliary tract. Rats that ate food containing high levels of PCBs for two years developed liver cancer. The Department of Health and Human Services (DHHS) has concluded that PCBs may reasonably be anticipated to be carcinogens. PCBs have been classified as probably carcinogenic, and carcinogenic to humans (group 1) by the Environmental Protection Agency (EPA) and International Agency for Research on Cancer (IARC), respectively.

How can PCBs affect children?

Women who were exposed to relatively high levels of PCBs in the workplace or ate large amounts of fish contaminated with PCBs had babies that weighed slightly less than babies from women who did not have these exposures. Babies born to women who ate PCB-contaminated fish also showed abnormal responses in tests of infant behavior. Some of these behaviors, such as problems with motor skills and a decrease in short-term memory, lasted for several years. Other studies suggest that the immune system was affected in children born to and nursed by mothers exposed to increased levels of PCBs. There are no reports of structural birth defects caused by exposure to PCBs or of health effects of PCBs in older children. The most likely way infants will be exposed to PCBs is from breast milk. Transplacental transfers of PCBs were also reported In most cases, the benefits of breast-feeding outweigh any risks from exposure to PCBs in mother's milk.

How can families reduce the risks of exposure to PCBs?

- You and your children may be exposed to PCBs by eating fish or wildlife caught from contaminated locations. Certain states, Native American tribes, and U.S. territories have issued advisories to warn people about PCB-contaminated fish and fish-eating wildlife. You can reduce your family's exposure to PCBs by obeying these advisories.
- Children should be told not play with old appliances, electrical equipment, or transformers, since they may contain PCBs.
- Children should be discouraged from playing in the dirt near hazardous waste sites and in areas where there was a transformer fire. Children should also be discouraged from eating dirt and putting dirty hands, toys or other objects in their mouths, and should wash hands frequently.
- If you are exposed to PCBs in the workplace it is possible to carry them home on your clothes, body, or tools. If this is the case, you should shower and change clothing before leaving work, and your work clothes should be kept separate from other clothes and laundered separately.

Is there a medical test to show whether I've been exposed to PCBs?

Tests exist to measure levels of PCBs in your blood, body fat, and breast milk, but these are not routinely conducted. Most people normally have low levels of PCBs in their body because nearly everyone has been environmentally exposed to PCBs. The tests can show if your PCB levels are elevated, which would indicate past exposure to above-normal levels of PCBs, but cannot determine when or how long you were exposed or whether you will develop health effects.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 0.0005 milligrams of PCBs per liter of drinking water (0.0005 mg/L). Discharges, spills or accidental releases of 1 pound or more of PCBs into the environment must be reported to the EPA. The Food and Drug Administration (FDA) requires that infant foods, eggs, milk and other dairy products, fish and shellfish, poultry and red meat contain no more than 0.2-3 parts of PCBs per million parts (0.2-3 ppm) of food. Many states have established fish and wildlife consumption advisories for PCBs.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological profile for polychlorinated biphenyls (PCBs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636.

ToxFAQs^{TM} Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Toluene - ToxFAQs™

CAS # 108-88-3

This fact sheet answers the most frequently asked health related questions (FAQs) regarding exposure to toluene. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important that you understand this information because this substance may harm you, or your family. The health effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to toluene occurs from breathing contaminated workplace air, automobile exhaust, or by using products such as paints, paint thinners, fingernail polish, lacquers, and adhesives. Toluene affects the nervous system. Toluene has been found in at least 1,012 of the 1,699 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is toluene?

Toluene is a clear, colorless liquid with a distinctive smell. It is a good solvent (a substance that can dissolve other substances). Toluene occurs naturally in crude oil and in the tolú tree. It is produced in the process of making gasoline and other fuels from crude oil and in making coke from coal.

Toluene is used in making paints, paint thinners, fingernail polish, lacquers, adhesives, and rubber and in some printing and leather tanning processes. Toluene is also used in the manufacture of other chemicals, nylon, and plastics. It is also added to gasoline along with benzene and xylene to improve octane ratings.

What happens to toluene when it enters the environment?

- Toluene enters the environment when you use materials that contain it. It can also enter surface water and ground water from spills of solvents and petroleum products as well as leaking underground storage tanks at gasoline stations and other facilities.
- When toluene-containing products are placed in landfills or waste disposal sites, toluene can enter the soil or water near the waste site.
- Toluene in subsurface water can be degraded by anaerobic microorganisms.
- Toluene in surface water or soil will readily evaporate to the air or be degraded by bacteria.
- Toluene does not usually stay in the environment long.

How might I be exposed to toluene?

- Breathing contaminated workplace air or automobile exhaust.
- Individuals who work with gasoline, paint, lacquer, or dyes have greater exposures to toluene, as do individuals who smoke or intentionally inhale products containing toluene for its euphoric effects or to get high.
- Living near uncontrolled hazardous waste sites containing toluene products.
- Toluene is not frequently detected in drinking water or food.

How can toluene affect my health?

Toluene may affect the nervous system. Low to moderate levels can cause tiredness, confusion, weakness, drunken-type actions, memory loss, nausea, and loss of appetite. These symptoms usually disappear when exposure stops.

Long-term daily inhalation exposure to toluene in the workplace may cause some hearing and color vision loss. Repeatedly breathing toluene from glue or paint thinners may permanently damage the brain.

The effects of toluene in animals are similar to those seen in humans.

How likely is toluene to cause cancer?

Studies in workers and animals exposed to toluene generally indicate that toluene is not carcinogenic

Toluene

CAS # 108-88-3

The International Agency for Research on Cancer (IARC) determined that toluene is not classifiable as to its carcinogenicity in humans. The EPA determined there is inadequate information to assess the carcinogenic potential of toluene. The National Toxicology Program (NTP) has not considered the carcinogenic potential of toluene.

How can toluene affect children?

The effects of toluene on children have not been studied very much, but toluene seems to produce the same types of effects in children as it does in adults.

Some older children and adolescents who have repeatedly breathed large amounts of toluene to get high have developed loss of muscle control, loss of memory, poor balance, and decreased mental abilities. Some of these changes may last for a long time after toluene has left the body.

Some mothers who breathed large amounts of toluene during pregnancy to get high have had children with birth defects, including retardation of mental abilities and growth.

How can families reduce the risk of exposure to toluene?

- Families can reduce their risk of exposure to toluene by using consumer products containing the chemical (such as paints, glues, inks, and stain removers) in well-ventilated areas and reading the labels of the products.

- When not in use, toluene-containing products should be tightly covered to prevent evaporation into the air.

- Household chemicals should be stored out of the reach of young children to prevent accidental poisonings.

- Always store household chemicals in their original labeled containers. Never store household chemicals in containers that children would find attractive to eat or drink from, such as old soda bottles.

- Use bottled water if you have concerns about the presence of toluene in your tap water.

- Prevent children from eating or playing in the dirt if you live near a waste site that has been contaminated with toluene.

- Talk with children about the dangers of sniffing chemicals.

Is there a medical test to show whether I've been exposed to toluene?

Toluene and its breakdown products (metabolites) can be measured in blood and urine. However, the detection of toluene or its metabolites cannot predict the kind of health effects that might develop from that exposure. Because toluene and its metabolites leave the body fairly rapidly, the tests need to be conducted within days after exposure. The tests are not routinely available at the doctor's office because they require special equipment.

Has the federal government made recommendations to protect human health?

The EPA has recommended a drinking water limit of 1 mg/L for toluene.

The Occupational Safety and Health Administration (OSHA) has set a legal limit for workers of 200 ppm for toluene in air averaged over an 8 hour workday.

The National Institute for Occupational Safety and Health (NIOSH) has set a recommended limit of 100 ppm for toluene in air averaged over a 10-hour workday.

References

This ToxFAQs™ information is taken from the 2015 Toxicological Profile for Toluene (Draft for Public Comment) produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636.

ToxFAQs™ on the web: www.atsdr.cdc.gov/toxFAQs

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

TOTAL PETROLEUM HYDROCARBONS (TPH)

Agency for Toxic Substances and Disease Registry ToxFAQs **August 1999**

This fact sheet answers the most frequently asked health questions (FAQs) about total petroleum hydrocarbons (TPH). For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: TPH is a mixture of many different compounds. Everyone is exposed to TPH from many sources, including gasoline pumps, spilled oil on pavement, and chemicals used at home or work. Some TPH compounds can affect your nervous system, causing headaches and dizziness. TPH has been found in at least 23 of the 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are total petroleum hydrocarbons?

(Pronounced tōt′l pə-trō′lē-əm hī′drə-kär′bənz)

Total petroleum hydrocarbons (TPH) is a term used to describe a large family of several hundred chemical compounds that originally come from crude oil. Crude oil is used to make petroleum products, which can contaminate the environment. Because there are so many different chemicals in crude oil and in other petroleum products, it is not practical to measure each one separately. However, it is useful to measure the total amount of TPH at a site.

TPH is a mixture of chemicals, but they are all made mainly from hydrogen and carbon, called hydrocarbons. Scientists divide TPH into groups of petroleum hydrocarbons that act alike in soil or water. These groups are called petroleum hydrocarbon fractions. Each fraction contains many individual chemicals.

Some chemicals that may be found in TPH are hexane, jet fuels, mineral oils, benzene, toluene, xylenes, naphthalene, and fluorene, as well as other petroleum products and gasoline components. However, it is likely that samples of TPH will contain only some, or a mixture, of these chemicals.

What happens to TPH when it enters the environment?

- ☐ TPH may enter the environment through accidents, from industrial releases, or as byproducts from commercial or private uses.
- ☐ TPH may be released directly into water through spills or leaks.
- ☐ Some TPH fractions will float on the water and form surface films.
- ☐ Other TPH fractions will sink to the bottom sediments.
- ☐ Bacteria and microorganisms in the water may break down some of the TPH fractions.
- ☐ Some TPH fractions will move into the soil where they may stay for a long time.

How might I be exposed to TPH?

- ☐ Everyone is exposed to TPH from many sources.
- ☐ Breathing air at gasoline stations, using chemicals at home or work, or using certain pesticides.
- ☐ Drinking water contaminated with TPH.
- ☐ Working in occupations that use petroleum products.
- ☐ Living in an area near a spill or leak of petroleum products.
- ☐ Touching soil contaminated with TPH.

How can TPH affect my health?

Some of the TPH compounds can affect your central nervous system. One compound can cause headaches and dizziness at high levels in the air. Another compound can cause a nerve disorder called "peripheral neuropathy," consisting of numbness in the feet and legs. Other TPH compounds can cause effects on the blood, immune system, lungs, skin, and eyes.

Animal studies have shown effects on the lungs, central nervous system, liver, and kidney from exposure to TPH compounds. Some TPH compounds have also been shown to affect reproduction and the developing fetus in animals.

How likely is TPH to cause cancer?

The International Agency for Research on Cancer (IARC) has determined that one TPH compound (benzene) is carcinogenic to humans. IARC has determined that other TPH compounds (benzo[a]pyrene and gasoline) are probably and possibly carcinogenic to humans. Most of the other TPH compounds are considered not to be classifiable by IARC.

Is there a medical test to show whether I've been exposed to TPH?

There is no medical test that shows if you have been exposed to TPH. However, there are methods to determine if you have been exposed to some TPH compounds. Exposure to kerosene can be determined by its smell on the breath or clothing. Benzene can be measured in exhaled air and a breakdown product of benzene can be measured in urine. Other TPH compounds can be measured in blood, urine, breath, and some body tissues.

Has the federal government made recommendations to protect human health?

There are no regulations or advisories specific to TPH. The following are recommendations for some of the TPH fractions and compounds:

The EPA requires that spills or accidental releases into the environment of 10 pounds or more of benzene be reported to the EPA.

The Occupational Safety and Health Administration has set an exposure limit of 500 parts of petroleum distillates per million parts of air (500 ppm) for an 8-hour workday, 40-hour workweek.

Glossary

Carcinogenicity: Ability to cause cancer.

CAS: Chemical Abstracts Service.

Immune system: Body organs and cells that fight disease.

Pesticides: Chemicals used to kill pests.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for total petroleum hydrocarbons (TPH). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

XYLENE

CAS # 1330-20-7

Division of Toxicology and Environmental Medicine ToxFAQs™ **August 2007**

This fact sheet answers the most frequently asked health questions (FAQs) about xylene. For more information, call the ATSDR Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to xylene occurs in the workplace and when you use paint, gasoline, paint thinners and other products that contain it. People who breathe high levels may have dizziness, confusion, and a change in their sense of balance. Xylene has been found in at least 840 of the 1,684 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is xylene?

There are three forms of xylene in which the methyl groups vary on the benzene ring: *meta*-xylene, *ortho*-xylene, and *para*-xylene (*m*-, *o*-, and *p*-xylene). These different forms are referred to as isomers.

Xylene is a colorless, sweet-smelling liquid that catches on fire easily. It occurs naturally in petroleum and coal tar. Chemical industries produce xylene from petroleum. It is one of the top 30 chemicals produced in the United States in terms of volume.

Xylene is used as a solvent and in the printing, rubber, and leather industries. It is also used as a cleaning agent, a thinner for paint, and in paints and varnishes. It is found in small amounts in airplane fuel and gasoline.

What happens to xylene when it enters the environment?

❑ Xylene evaporates quickly from the soil and surface water into the air.
❑ In the air, it is broken down by sunlight into other less harmful chemicals in a couple of days.
❑ It is broken down by microorganisms in soil and water.
❑ Only a small amount of it builds up in fish, shellfish, plants, and other animals living in xylene-contaminated water.

How might I be exposed to xylene?

❑ Using a variety of consumer products including gasoline, paint varnish, shellac, rust preventatives, and cigarette smoke. Xylene can be absorbed through the respiratory tract and through the skin.
❑ Ingesting xylene-contaminated food or water, although these levels are likely to be very low.
❑ Working in a job that involves the use of xylene such as painters, paint industry workers, biomedical laboratory workers, automobile garage workers, metal workers, and furniture refinishers.

How can xylene affect my health?

No health effects have been noted at the background levels that people are exposed to on a daily basis.

High levels of exposure for short or long periods can cause headaches, lack of muscle coordination, dizziness, confusion, and changes in one's sense of balance. Exposure of people to high levels of xylene for short periods can also cause irritation of the skin, eyes, nose, and throat; difficulty in breathing; problems with the lungs; delayed reaction time; memory difficulties; stomach discomfort; and possibly changes in the liver and kidneys. It can cause unconsciousness and even death at very high levels.

How likely is xylene to cause cancer?

Both the International Agency for Research on Cancer (IARC) and the EPA have found that there is insufficient information to determine whether or not xylene is carcinogenic.

How can xylene affect children?

The effects of xylene have not been studied in children, but it is likely that they would be similar to those seen in exposed adults. Although there is no direct evidence, children may be more sensitive to acute inhalation exposure than adults because their narrower airways would be more sensitive to swelling effects.

Studies of unborn animals indicate that high concentrations of xylene may cause increased numbers of deaths, and delayed growth and development. In many instances, these same concentrations also cause damage to the mothers. We do not know if xylene harms the unborn child if the mother is exposed to low levels of xylene during pregnancy

How can families reduce the risks of exposure to xylene?

☐ Exposure to xylene as solvents (in paints or gasoline) can be reduced if the products are used with adequate ventilation and if they are stored in tightly closed containers out of the reach of small children.
☐ Sometimes older children sniff household chemicals in attempt to get high. Talk with your children about the dangers of sniffing xylene.
☐ If products containing xylene are spilled on the skin, then the excess should be wiped off and the area cleaned with soap and water.

Is there a medical test to determine whether I've been exposed to xylene?

Laboratory tests can detect xylene or its breakdown products in exhaled air, blood, or urine. There is a high degree of agreement between the levels of exposure to xylene and the levels of xylene breakdown products in the urine. However, a urine sample must be provided very soon after exposure ends because xylene quickly leaves the body. These tests are not routinely available at your doctor's office because they require special equipment.

Has the federal government made recommendations to protect human health?

The EPA set a limit of 10 parts xylene per million parts drinking water (10 ppm).

The Occupational Safety and Health Administration (OSHA) has set limits of 100 parts xylene per million parts of workplace air (100 ppm) for 8 hour shifts and 40 hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for Xylene (Update). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Environmental Medicine, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-800-232-4636, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

APPENDIX B

Field Health & Safety Report

Kosmos Mill Site Glenoma, Washington	
Field Health & Safety Report 19499-00 November 2019	
HARTCROWSER	Appendix **B**

Job No. __________

Date __________

S M T W Th F S

Arrival time: __________

Departure time: __________

Job __________

Location __________

Client __________

Field representative __________ Project manager __________

Field H&S manager __________ Project H&S manager __________

Names of personnel on site __________

Site activities __________

Potential hazards __________

Hazard control used __________

Protective measures taken __________

Comments or observations __________

Sketch position of equipment relative to exploration (attach separate diagram if needed); indicate monitoring point(s) and prevailing wind direction.

Exploration No. ______________________

Air Monitoring Log

Meter Number 1, Type ____________ Calibrated ____________ Checked ____________

Meter Number 2, Type ____________ Calibrated ____________ Checked ____________

Background Reading: Meter 1 ______________________ Meter 2 ______________________

Time	Meter 1	Meter 2	Comments

APPENDIX C
Hart Crowser Incident/Accident Investigation Report

Hart Crowser Incident/Accident Investigation Report*

Hart Crowser Office: ______________________ Incident/Accident Site Location: ______________________ Address: ______________________ State: County:	Project number: ______________________ Date/time of occurrence: ___AM ___PM

Name(s) of Hart Crowser personnel involved in the incident/accident:

Name(s) and Affiliation of any other personnel involved in the incident/accident:

What happened? Describe cause and nature of incident, injury or illness.

Was the incident/accident caused by actions of another individual: __Yes __No If yes, provide name, address, phone and details:

Describe any unsafe action, equipment, conditions that contributed to the incident/accident:

Was first aid given? __**Yes** __**No** __ **Unknown**	Was person referred to medical evaluation/treatment? ___**Yes** ___**No** ___ **Unknown** If yes, indicate date, where and to whom:

Did the employee(s) receive medical treatment beyond first aid __Yes __No __ Unknown If yes, describe medical treatment given:

Will lost time be involved? __**Yes** __**No** __**N/A**	Will restricted work days be involved? __**Yes** __**No** __**N/A**

If yes to either lost time or restricted work, complete the following:

______________ Last normal work date

______________ Date of return to normal work

______________ Number of days lost time involved or expected

______________ Number of days restricted work involved or expected

What actions will be taken to prevent recurrence? Give responsibilities and expected completion dates for each action.

Witnesses (Provide name, company, address, and phone number):

Reported By: Date:	Reviewed by: Corporate health and safety director: Date: Employee(s) manager or supervisor: Date: Human resources: Date:
Will the work-related injury/illness results in a Workers' Compensation claim? __Yes __No ____N/A	If yes, provide claim number and date claim filed:

*The supervisor of the employee(s) involved in the incident/accident must ensure that this form is filled out within 24 hours of the incident/or accident and forwarded to Corporate Health and Safety Director. Attach additional sheets if necessary. If the incident is a recordable work-related injury or illness, OSHA Form 301 must be completed in addition to this form.