United States Coast Guard

FINAL QUALITY ASSURANCE PROJECT PLAN AND SAMPLING AND ANALYSIS PLAN

Burrows Island Light Station
Skagit County, Washington

Contract No. HSCG50-14-D-PSL007
Task Order No. 70Z08818FPXA01700

March 15, 2019
Revision 1

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Burrows Island Light Station
Skagit County, Washington

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CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

95-UCL	95-percent upper confidence interval
Arcadis	Arcadis U.S., Inc.
AST	aboveground storage tank
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminant of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
cy	cubic yards
DQI	data quality indicator
DQO	data quality objective
DRO	diesel-range organics
DU	decision unit
Ecology	Washington State Department of Ecology
EDD	electronic data deliverable
FFS	focused feasibility study
GPS	global positioning system
GRO	gasoline range organics
HASP	Health and Safety Plan
HO	heavy oil
IDW	investigation-derived waste
ISM	incremental sampling methodology
ITRC	Interstate Technology & Regulatory Counsel
mg/kg	milligrams per kilogram
mm	millimeters
MS	matrix spike
MSD	matrix spike duplicate
MTCA	Model Toxics Control Act
NWSS	Northwest Schooner Society
PARCC	precision, accuracy, representativeness, comparability, and completeness

PCB	polychlorinated biphenyl
PPE	personal protective equipment
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RD	remedial design
RI	remedial investigation
SAP	Sampling and Analysis Plan
Site	Burrows Island Light Station, located in Skagit County, Washington
SU	sampling unit
TGI	Technical Guidance Instruction
UFP	Uniform Federal Policy
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency
UST	underground storage tank
XRF	x-ray fluorescence

1 INTRODUCTION

On behalf of the United States Coast Guard (USCG), Arcadis U.S., Inc. (Arcadis) prepared this Quality Assurance Project Plan (QAPP) and Sampling and Analysis Plan (SAP) in partial fulfillment of the requirements of Contract HSCG50-14-D-PSL007, Task Order 70Z08818FPXA01700. This QAPP and SAP was prepared in support of the remedial investigation (RI), focused feasibility study (FFS), and remedial design (RD) at the Burrows Island Light Station, located in Skagit County, Washington (Site). This QAPP and SAP describes the organization, data quality objectives (DQOs), analytical procedures, field sampling procedures and rationale, and quality assurance (QA) and quality control (QC) procedures upon which the RI will be based.

The purpose of the RI is to delineate lead, polychlorinated biphenyls (PCBs), and petroleum constituents at the Site and to evaluate the current conditions of painted structures for lead-based paint. Potential remedial alternatives to address contaminants of concern (COCs) identified in the RI will be evaluated in the FFS and a remedial action will be selected. The RD will provide additional information to implement the selected remedial action. The RI/FFS and RD will be conducted in accordance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements.

Technical oversight responsibilities for the Site, including the tasks described in this QAPP and SAP, will be provided by the USCG Civil Engineering Unit, located in Oakland, California. The USCG will consult with the Washington State Department of Ecology (Ecology) and United States Environmental Protection Agency (USEPA).

This QAPP and SAP is consistent with the Intergovernmental Data Quality Task Force, Uniform Federal Policy (UFP) for QAPPs and USEPA guidance for SAPs. It includes the basic elements of a QAPP and Field Sampling Plan. The UFP QAPP worksheets are included as Appendix A.

The responsible agency is the USCG. As part of the RI/FFS process under CERCLA, the USCG will develop applicable or relevant and appropriate requirements and make to be considered determinations in consultation with Ecology, the USEPA, and other agencies prior to finalizing the RI/FFS report. The USCG will also seek public comment on the RI/FFS and RD in accordance with CERCLA requirements.

The work activities described in this QAPP and SAP will be performed by Arcadis under Contract No. HSCG50-14-D-PSL007 and Task Order No. 70Z08818FPXA01700 with the USCG. Worksheet No. 5 (Project Organizational Chart) and Worksheet No. 6 (Communication Pathways) are provided in Appendix A and contain additional information regarding the project organization.

2 BACKGROUND

This section provides the following Site background information: a site description, operational history, previous investigations and regulatory interactions, topography and geology, and current and future land use.

2.1 Site Description

The Site is located on the western tip of Burrows Island approximately ı mile southeast of Anacortes, Washington on Rosario Strait. The Site is located within the northwest quarter of Section 32, Township 35, Range 01. The global positioning system (GPS) latitude and longitude coordinates for the Site are 48Ü 28ô40òN and -122Ü42ô48òW (utilizing the North American Datum of 1983). The Site is remote and can only be accessed by boat or helicopter. A map showing the location of the Borrows Island Light Station is presented on Figure 1.

The Site is located on USCG-owned property identified as Parcel Number P32494 in Skagit County records (Skagit County 2018). The USCG property comprises 8.2 acres of which approximately 2 acres are cleared and the remainder is heavily forested. The Skagit County designated land use for Parcel P32494 is (740) Recreational Activities. Parcels adjacent to the USCG property are owned by Washington State Parks and Recreation and have similar land use designations as the USCG property. The adjacent parcels are undeveloped and are heavily forested. Several parcels of land on Burrows Island are owned by private individuals: parcels P32502, P32500, P32503, P32452, P99308, and P99309. The privately owned parcels are located on the opposite (eastern) side of Burrows Island compared to the USCG property and will not be affected by work at the Site.

Operation of the light signal is automated and there are no full-time residents or dedicated workers at the Site. Historical site features included residential and operational structures used by USCG personnel before the light signal was automated in 1972. Structures that remain at the Site are listed below and are identified numerically based on historical USCG drawings:

- Lighthouse and fog signal building (101)
- Helicopter pad (located between former structures 102 and 104)
- Duplex (103)
- Boathouse (105)
- Pumphouse and spring cistern, nonoperational (106)
- Salt water flushing pumphouse, nonoperational (108).

Additional historical structures have been removed or demolished and include the following:

- Oil and paint storage building (102)
- Officer-in-Charge quarters and associated fuel oil tank(s) (104)
- Firehouse pump building (107)

- Water tanks (109, 110, 111)
- 10,000-gallon fuel oil aboveground storage tank (AST [112]).

Remnants of historical structures include concrete footings or support structures. The locations of current and historical site features are shown on Figure 2. Historical drawings of the Site provided by the USCG are included in Appendix B.

2.2 Operational History

The Site is currently an active USCG light station and was first developed for that purpose in 1906. The light signal was automated in 1972 and no dedicated USCG personnel have occupied the Site after that time. Based on historical site maps, multiple petroleum tanks were present to supply fuel for heating and site operations (USCG 1958, 1960a), which included the following:

- 10,000-gallon fuel oil AST located southeast of the duplex.
- Two 675-gallon fuel oil ASTs located east of the duplex and connected to the furnaces and gas ranges in the building via underground piping.
- 675 -gallon fuel oil AST, located on the southeast corner of the lighthouse and fog signal building.
- 200-gallon fuel oil underground storage tank (UST), located on the east side of the former Officer-in-Charge quarters.
- Gasoline storage tank located west of the oil and paint storage building.

The fuel oil tanks were connected via underground piping to a ship to shore connection located east of the boathouse. Additional underground piping connected the tanks to the buildings and the main fuel oil line. No connections between the gasoline storage tank and any underground piping or other fueling infrastructure are apparent based on historical information. Historical drawings reference repair work completed on the 10,000-gallon fuel oil AST in 1960 (USCG 1960b). The 10,000-gallon fuel oil AST was removed from the Site, but the concrete support structure remains. The smaller fuel oil tanks and gasoline storage tank were also removed. The fuel oil tank associated with the Officer-in-Charge quarters was a 200 or 300-gallon UST that was removed as part of a remedial action in 1999 (AGI Technologies 1999).

Between 1970 and 1980, power was brought to the island from a submerged power line. A power transformer was located southeast of the lighthouse and fog signal building (USCG 1980a, 1980b). Oil in the transformer is known to have contained PCBs. A spill of approximately 5 to 50 gallons of transformer oil occurred on February 22, 1980 (USCG 1980b). Approximately 140 cubic yards (cy) of soil were removed from around the transformer and transformer pad (USCG 1980b). The submerged power line is no longer active, and the transformer and electrical equipment have been removed. Two additional tanks (690 gallons and 540 gallons) are shown southeast of the lighthouse and fog signal building on drawings from 1980 (USCG 1980b) and appear to be connected to fuel oil lines. No other information is available on these tanks and they do not appear on earlier site drawings.

The Site is not inhabited, although the Site is open to visitors by boat. In 2010, the Northwest Schooner Society (NWSS) assumed custodianship of the Burrows Island Light Station, which is listed on the National Register of Historic Places.

2.3 Previous Investigations/Regulatory Involvement

Multiple investigations and remedial actions have been conducted at the Site. A timeline of these activities and associated documents is presented below:

- *1980*. Removal of 140 cy of PCB-impacted soil from a transformer oil release (see USCG drawing showing extent of remedial investigation and soil confirmation sampling in Appendix B-5).
- *2000*. Removal of a 200- or 300-gallon diesel UST. Corrosion was observed on the bottom of the steel UST and 2 cy of petroleum-contaminated soil were removed from the excavation. One sidewall and one excavation bottom sample were collected and analyzed for diesel-range organics (DRO) and heavy oil (HO). DRO was not detected and HO concentrations were 190 and 240 milligrams per kilogram (mg/kg) from the sidewall and bottom sample, respectively (see the AGI Technologies report dated June 18, 1999 in Appendix B-6).
- *2005*. Removal of 75 tons of lead-contaminated soil at the duplex and encapsulation of painted structures (see the Kellco Services, Inc. report dated October 12, 2005 in Appendix B-7).
- *2009*. A Phase II environmental investigation was performed by ERRG, Inc. to assess lead in soil near the duplex, lighthouse and fog signal building, and boathouse. Elevated levels of lead were identified at all of these locations (see the ERRG report dated August 17, 2009 in Appendix B-8).
- *2015*. A soil stabilization study was conducted by Arcadis to assess reducing leachability of lead impacts in soil using phosphate-based reagents. Soil samples were collected based on x-ray fluorescence (XRF) screening and mixed with reagents to determine the relative impacts on lead leachability. The study concluded that soil amendments were not an effective method to reduce lead leachability for site soil (see the Arcadis memorandum dated November 26, 2018 in Appendix B-10).

Available documentation from previous activities at the Site are included in Appendices B-1 through B-10.

In addition, from November 13 through 16, 2018, Arcadis performed a preliminary sampling event to assess shallow soil for lead using a field XRF instrument and to obtain site information to inform this QAPP and SAP. The sampling event included the following activities:

- Performed a visual assessment and obtained site photographs
- Collected 419 soil samples for XRF field screening for lead
- Collected and analyzed 32 co-located samples for laboratory analysis of lead using USEPA Method 6010 to determine the correlation between raw XRF data and laboratory results
- Collected and analyzed three shallow soil samples for PCBs using USEPA Method 8082
- Analysis of three samples for toxicity characteristic leaching procedure (TCLP) metals for waste characterization purposes.

Activities and results of the November 2018 preliminary assessment were summarized in a Field Sampling Memorandum dated November 26, 2018, which is included as Appendix C.

2.4 Topographic and Geologic Information

Burrows Island is part of the archipelago that includes the San Juan Islands located in the northern Puget Sound between the Strait of Juan de Fuca and the Strait of Georgia. The San Juan Islands include Late Cretaceous thrust faults known as the San Juan thrust system. The San Juan thrust system is divided into five terranes, with Burrows Island located on the Decatur Terrane (Brandon 1988). The Decatur Terrane is composed of two stratigraphically related sections: the Fidalgo Igneous Complex and the Lummi Formation. Formations at Burrows Island primarily belong to the Fidalgo Igneous Complex, which is a middle-late volcanic Jurassic formation mostly associated with minor conglomerates of sandstone and mudstone, Jurassic pillow lava, and brecciated gabro and diabase (Brandon 1988).

The Site has many bedrock outcroppings that consist of oceanic crusts (terranes) and igneous rock (ERRG 2009). Soil is present at greater thickness moving east from the shoreline. Shallow soil samples collected in November 2018 primarily consisted of sandy soil near the buildings. Soil tended to be well-graded and with some organic content from surface vegetation based on visual observations.

The elevation at the tree line is approximately 78 feet above mean seal level with a decrease to 45 feet at the cliff edge prior to dropping down to the water surrounding the island. The topography of the Site generally slopes to the Rosario Strait. No major surface channels or overland runoff features were identified during the sampling event in November 2018 (which included light precipitation during the sampling). Most of the shoreline consists of rocky bluffs.

2.5 Current and Future Land Use

The Site is currently an unmanned light station that is owned and operated by the USCG. An automated and unmanned fog signal is in the lighthouse and fog signal building and is currently operating. The USCG conducts periodic maintenance activities at the Site (e.g., semiannual visits to inspect and maintain the facility). The NWSS conducts periodic restoration and maintenance work as custodians of the light station and associated buildings. The NWSS intends to restore and maintain historical structures associated with the Site following transfer of the property from the USCG. Long-term uses after USCG divestiture may include expanded visitation and overnight accommodations for guests.

3 CONCEPTUAL SITE MODEL

This section provides information regarding the current Site Conceptual Site Model, including a discussion on the COCs and potential source areas, affected media, contaminant fate and transport mechanisms, and potential exposure pathways and receptors.

3.1 Contaminants of Concern and Potential Source Areas

Historical documentation and previous remedial activities at the Site indicate that contaminants associated with lead and PCBs are known to be present in shallow soil and petroleum products may be present based on historic uses. Lead impacts, likely related to weathered and flaking paint, have been observed during previous investigations near most of the historical and existing structures, including the lighthouse and fog signal building, oil and paint storage building, duplex, Officer-in-Charge quarters, boathouse, 10,000-gallon fuel oil AST, and water tanks (ERRG 2009; Arcadis 2018). Petroleum-impacted soil was identified during previous excavation and removal of the UST associated with the Officer-in-Charge quarters. Petroleum-impacted soil during this UST removal was removed and COC concentrations in soil confirmation samples were less than Model Toxics Control Act (MTCA) Method A cleanup levels (AGI Technologies 1999).

Additional fuel and gasoline tanks located near the lighthouse and fog signal building, oil and paint storage building, firehouse pump building, and 10,000-gallon fuel oil AST along with piping between the tanks and the ship to shore loading connection are potential source areas for petroleum constituents. The transformer located adjacent to the lighthouse and fog signal building is known to have contained PCBs and a spill was documented in 1980 (USCG 1980a, 1980b). Residual PCB impacts have been confirmed in this area based on preliminary samples collected during the November 2018 field event (Appendix C; Arcadis 2018). The following constituents will be evaluated as part of the RI to determine the presence and extent of COCs at the Site:

- Lead near existing and historical structures
- Diesel range organics (DRO) from former tank(s) and pipelines
- Heavy oil (HO) from historical fuel oil tank(s) and associated piping
- Gasoline range organics (GRO) from the historical gasoline tank
- Mineral oils from former transformer oil release
- PCBs from the former transformer oil release
- Fuel additives and other compounds associated with gasoline, diesel, HO, and/or mineral oil pursuant to MTCA Table 830-1.

The fuel additivities and other compounds associated with GRO, DRO, HO, and mineral oils that will be evaluated during the RI are identified in Table 830-1, Required Testing for Petroleum Releases (Washington Administrative Code 173-340-900). The footnotes in Table 830-1 provide additional details on what additional testing should be conducted if petroleum hydrocarbons are identified at the Site. These additional analytes include benzene if GRO or DRO are detected above MTCA Method A cleanup levels and cPAHs if DRO is detected above MTCA Method A cleanup levels.

Previous investigations have documented the presence of elevated levels of lead in shallow soil in areas of former and existing structures (most notably near the lighthouse and fog signal building, and the duplex, but also elsewhere) and elevated levels of PCBs near the transformer previously located south of the lighthouse and fog signal building. The presence of elevated concentrations of petroleum hydrocarbons from the historical use of gasoline, diesel, and fuel oil products at the Site have not yet been confirmed but will be investigated as part of the RI. The former or existing structures at the Site and potential sources of COCs associated with these areas are presented in Table 1. The locations of historical features are shown on Figure 2.

3.2 Media Affected

Data indicate that lead from chipping and flaking of lead-based paint impacted shallow soil near the lighthouse and fog signal building, boathouse, and duplex, and other areas where painted structures were previously located. In general, concentrations of lead diminish significantly with distance from former or existing painted structures (Appendix C; Arcadis 2018). Additionally, surficial release(s) of PCB-containing transformer oil impacted shallow soil near the transformer (USCG 1980a, 1980b). Petroleum hydrocarbons from former fuel tanks could also have impacted shallow soil. Due to the limited depth to bedrock throughout much of the Site, releases would likely be limited to surface and near surface soils.

The impacted media is limited to shallow soil in the upland portion of the USCG property. There is no surface water at the Site except for the Puget Sound, which surrounds the island. Groundwater is not encountered due to shallow bedrock and is not used for beneficial purposes at the Site. Bedrock outcroppings are visible adjacent to the shoreline along the west and north sides of the Site and was encountered at shallow depths (i.e. less than 2 feet) in the areas near the Lighthouse and Fog Signal Building. The ground surface slopes upwards towards the east and bedrock was not encountered in shallow borings.

The coast line of the island comprises steep cliffs and a rocky coast line. Two small sandy beaches were noted during the initial investigation and are located northeast of the site. The observed beaches are not located adjacent to historical structures and are not in areas where surface water runoff from source areas is possible. Given that transport of contaminants by surface runoff is highly unlikely at these locations and that these areas are not expected to be influenced by flaking or chipping paint from historical structures, it is unlikely that elevated lead concentrations are present in sediments at these locations.

3.3 Contaminant Fate and Transport

Lead in soil is relatively immobile and persistent. Consistent with low mobility, the available data suggest that the greatest lead concentrations are present in shallow soil located near former and existing structures where the lead was presumably deposited from chipping and deterioration of lead-based paint. The fixation of lead in soil limits the transfer of lead to aquatic systems. Transport of lead may occur from wind or by erosion of soil particles (Ecology 2013).

Heavy-end petroleum contaminants from fuel oil, diesel, or PCB-containing transformer oil are expected to adhere to soil particles and also have low mobility in soil. Unlike lead, which is persistent, the mass of petroleum hydrocarbons is expected to diminish through time from biodegradation and volatilization. PCBs are not volatile and do not readily biodegrade, and therefore are expected to persist longer than the petroleum hydrocarbons, if present. Primary transport mechanisms for hydrocarbons and PCBs include erosion of shallow impacted soil by wind or water.

3.4 Potential Receptors and Pathways

Potential human receptors to COCs at the Site include site workers and visitors, which are currently limited by low occupancy due to the difficultly accessing the site. Potential exposure pathways to humans include direct contact with contaminated soil and inhalation of contaminated dust particles, especially during windy days. Groundwater, if any, is not present in amounts that could be beneficially used due to shallow bedrock. The spring that was historically used as a water source is located in a drainage area that is separated from the main portion of the Site where contaminant migration is highly unlikely. There are no surface water bodies present at the Site, other than Puget Sound which is saline and not suitable for potable uses. Areas of sediment near the Site are very limited due to the rocky nature of the coastline and none are in areas where transport of contaminants by surface runoff could have occurred. Based on these considerations there is no significant exposure pathway from groundwater, surface water, and sediment. The terrestrial ecological evaluation conducted by Ecology for the Site in 2013 identified the following potential terrestrial ecological receptors in the upland portion of the Site (Ecology 2013):

- Soil-associated invertebrates
- Vascular plants
- Ground-feeding birds (robin)
- Ground-feeding small mammal predators (shrew)
- Herbivorous small mammals (vole).

Exposure to Site contaminants to these potential ecological receptors is possible but is considered limited due to generally shallow bedrock that limits habitat for earthworms and burrowing animals and the relatively small amounts of habitable areas at the Site compared to other undeveloped areas on Burrows Island.

4 PROJECT DATA QUALITY OBJECTIVES

USEPA's seven-step DQO process (USEPA 2006) was used to guide the design rationale for the study. The overarching project objectives and each step in the DQO process is described below.

4.1 Project Objectives and Problem Definition

The overarching goal is for the USCG to transfer ownership and management of the light station to the NWSS pursuant to the National Historic Lighthouse Preservation Act of 2000 and CERCLA Section 120(h) once the Site is cleaned up to a level that is protective of human health and the environment. The NWSS intends to restore the Site to reflect various periods of time, and to rehabilitate the duplex to a condition that would allow guests to stay on site for short periods of time. They envision having a rotating care taker to remain on site for extended periods (not to exceed 6 months).

Historic operations at the light station have resulted in surface and near surface contamination from lead-based paint deterioration (chipping, flaking). Additionally, in 1980, there was a confirmed release of PCBs from an oil transformer in the vicinity of the lighthouse and fog signal building. The PCB-release area was partially excavated and contaminated soils were transferred off-site for disposal. Limited sampling of near surficial stained soils in November 2018 indicate that residual impacts of PCB-affected soil above 1 milligram per kilogram (mg/kg) are still present in shallow soils (Appendix D; Arcadis 2018).

The historic use of petroleum products (gasoline, diesel, and fuel oil) at the Site could also have potentially resulted in environmental impacts. AGI Technologies documented the removal of a 200 or 300-gallon fuel oil UST in May 1999. Approximately 2 cubic yards of petroleum impacted soil was excavated at the time of the UST removal, and soil confirmation samples were collected to confirm that remaining soil at bottom and sidewalls of excavation were below MTCA Method A cleanup levels. The presence or absence of petroleum constituents at locations of former tanks and pipelines is currently considered a data gap.

The objectives of SAP are to determine the following elements:

- Extent (lateral and vertical) of lead concentrations in soil surrounding all current buildings and demolished buildings and painted structures previously located on the Site.
- Existence (if any) of contamination associated with the removed fuel oil/diesel 10,000-gallon AST and piping.
- If PCB concentrations exceeding 1 mg/kg in soil remain from the transformer oil spill in 1980, and the extent (lateral and vertical) of such impacts.
- Evaluate all existing buildings and other painted structures to determine what exterior surfaces may require further encapsulation or further remedial action. These findings will be included in the RD.
- Any other potential contamination discovered during the RI.

4.2 Data Quality Objectives

The USEPAâs seven-step DQO process (USEPA 2006) was used to guide the design rationale for the study. Each step is described below.

4.2.1 Step 1: State the Problem

As discussed above, historical operations at the light station have impacted surface and near surface soils with lead, PCBs and possibly other petroleum-related COCs from the historical use of petroleum products (fuel oil, diesel, and gasoline). Cleanup of these COCs in soil to levels that are protective of human health and the environment is necessary prior to USCG divesting of the property.

4.2.1.1 Team Members and Roles

Team members and their roles are described in Worksheets No. 4 and No. 7 (Appendix A).

4.2.1.2 Schedule

A preliminary schedule is presented in Table 2. The project schedule may vary due to agency review times, weather, and other factors.

4.2.2 Step 2: Identify the Goals of the Study

The primary goal of this study is to generate data of acceptable quality on concentrations of COCs at the Site to complete the delineation of COCs in soil and to inform the FFS and subsequent RD.

In November 2018, Arcadis conducted a field reconnaissance visit to the Site that included photo documentation, preliminary screening of lead concentrations in surface and near surface soils using an XRF instrument, limited analytical testing to obtain correlations between XRF field screening data and laboratory results for lead, and limited sampling for PCBs in an area of visually stained soil in the former transformer oil release area. The DQOs that were achieved for the initial site visit and soil screening assessment were as follows:

- Where are the locations of the existing and former site features?
- Is there any visual evidence of contamination in these areas?
- What area(s) of the Site are not accessible (or have limited access) for sampling due to constraints such as shallow bedrock, steep slopes, heavy vegetation, or other reasons?
- What is the spatial distribution of lead in surface (0 to 6 inches) based on XRF screening data?
- What is the correlation between lead concentrations as measured using the field XRF instrument and analytical samples using USEPA Method 6010 at select locations?
- Based on XRF screening results and visual observations, what is an appropriate delineation of decision units (DUs) and sampling units (SUs) for subsequent sampling using incremental sampling methodology (ISM)?

The RI discussed in this QAPP and SAP will consist of comprehensive sampling and analytical testing to address the following DQOs:

- Are petroleum hydrocarbons (gasoline, diesel, mineral oil, or HO) COCs at this Site in addition to lead and PCBs?
- What are the lateral and vertical extents of COCs in soil?
- What areas of the Site, if any, exceed the Washington State Dangerous Waste criteria for lead?
- What areas of the Site, if any, exceed 250 mg/kg total lead concentrations in soil?
- What areas of the Site, if any, exceed 1 mg/kg of PCBs in soil?
- What areas of the Site, if any, exceed MTCA Method A soil cleanup levels for gasoline (100 mg/kg), diesel (2,000 mg/kg), mineral oil (4,000 mg/kg), or HO (2,000 mg/kg)?
- Are any of the COCs present at levels that would trigger disposal as a Resource Conservation and Recovery Act hazardous waste, Washington State Dangerous Waste, or Toxic Substances Control Act regulated waste?

4.2.3 Step 3: Identify Information Inputs

The third step of the DQO process requires consideration of the following:

- Types and potential sources of information (e.g., site characteristics or variables) that should be measured to provide estimates or resolve decisions
- Information to provide a basis for specifying performance or acceptance criteria
- Information on the performance of appropriate sampling and analysis methods.

Information needed to answer the above questions include:

- Historical maps and reports (Appendix B)
- Photographs and field notes describing site features and conditions at the time of the site inspection.
- Concentrations of COCs in soil.

4.2.4 Step 4: Define Boundaries of the Site

The Site is located entirely within USCG-owned property on Burrows Island and includes all areas where hazardous substances (e.g., lead, petroleum, PCBs) were released from operation of the Burrows Island Light Station and have been located.

4.2.5 Step 5: Define the Analytical Approach

The sampling scheme will include both ISM and discrete sampling methods. ISM will be performed for lead throughout the Site, except for a small area near the pumphouse and spring cistern where discrete sampling methods will be performed for lead. Discrete sampling methods will be used to assess petroleum hydrocarbons and PCBs.

Select soil samples will be analysed by a Washington State certified laboratory for the following constituents:

- Lead by USEPA Method 6010 and EPA Method 1311
- PCBs by USEPA Method 8082
- Petroleum hydrocarbons, GRO by NWTPH-Gx
- Petroleum hydrocarbons, DRO by NWTPH-Dx
- Petroleum hydrocarbons, HO by NWTPH-Dx
- Petroleum hydrocarbons, mineral oils by NWTPH-Dx
- Benzene by USEPA Method 8260 (only if GRO or DRO are detected at concentrations greater than MTCA Method A cleanup levels)
- cPAHs by USEPA Method 8270 SIM (only if DRO is detected at concentrations greater than MTCA A cleanup levels)
- Volatile petroleum hydrocarbons by NWTPH-VPH (only if GRO is detected at concentrations greater than MTCA Method A cleanup levels)
- Extractable petroleum hydrocarbons by NWTPH-EPH (only if DRO, HO, or mineral oils are detected at concentrations greater than MTCA A cleanup levels).

Soil analytical data will be compared to MTCA Method A cleanup levels, which will be used as screening levels until final cleanup levels are established. If there is no MTCA Method A cleanup level, then soil analytical data will be compared to MTCA Method B screening levels.

4.2.6 Step 6: Specify the Performance Criteria

The goal of Step 6 is to define performance or acceptance criteria to minimize the possibility of making erroneous conclusions or failing to keep uncertainty in estimates to within acceptable levels (USEPA 2006). For this study, performance and acceptance criteria will apply to generating appropriate and acceptable data for establishing if COCs in soil exceed applicable MTCA Method A or, if there is no published MTCA Method A cleanup level, MTCA Method B cleanup levels.

Table 3 provides soil screening levels (MTCA Method A). Final cleanup levels will be determined later in the RI/FFS process. Reporting limits for analytical testing will be less than the screening levels identified in Table 3.

4.2.6.1 Sampling Completeness

The areas to be sampled were selected based on evaluation of existing drawings and reports, and a site inspection and a comprehensive XRF screening event performed by Arcadis in November 2018. Available maps and reports are included in Appendix B. A copy of the Field Sampling Memorandum documenting results of the November 2018 site inspection and XRF screening event is included as Appendix C.

4.2.6.1.1 Incremental Composite Sampling Scheme

Sampling and chemical analysis for lead will be accomplished using ISM in general accordance with Interstate Technology & Regulatory Counsel (ITRC) guidance (ITRC 2012). Sampling and analysis for PCBs, petroleum hydrocarbons, and lead in select areas with limited access will be performed using discrete sampling methods.

Worksheet #18 in Appendix A provides a summary of the ISM sampling scheme, including the number of borings, number of increments, and number of composite samples that will implemented during the RI. As indicated in this Worksheet, the Site is divided into 18 DUs and 61 SUs. Primary incremental composite samples, which are comprised of 30 equal-volume incremental composite samples, will be collected from 18 DUs at two depth intervals. ISM composite samples will be collected from 0 to 0.5-foot below ground surface (bgs) and 0.5 to 1.0-foot bgs. Select increments from the 0.5 to 1.0-foot bgs interval (minimum of 20%) will be analyzed in the field using XRF. If screening results indicate that average lead concentrations are above 200 mg/kg, soil samples will be collected from the next 0.5-foot interval (i.e. 1.0 to 1.5-feet bgs). If XRF results from the deeper sample continue to indicate elevated lead concentrations, deeper increments will be collected until XRF results indicate average lead concentrations below 200 mg/kg or until refusal is encountered.

Replicate ISM composite samples (duplicate and triplicate) will consist of 30 increments each and will be collected from discrete points separate from the primary locations from the 0 to 0.5 feet bgs depth interval in 4 DUs. As indicated in Worksheet #18, the ISM sampling program will include up to 780 soil borings, 1,320 increment samples, and 166 composite samples.

In addition to the primary and replicate ISM composite samples, composite samples will be collected from each SU using the same procedures as the ISM composite samples. The SU composite samples will be collected from the same soil increments as the primary ISM samples and will be submitted to the laboratory for analysis pending the results of the ISM composite samples. SU composite samples will be submitted to the lab on hold and will be analyzed if the primary ISM sample results indicate lead concentrations between 200 and 400 mg/kg.

Primary ISM composite samples will also be analyzed for leachable lead by TCLP if the composite total lead result is greater than 100 mg/kg..

Additional information regarding the sampling rationale and sample locations is provided in Section 5.1.

4.2.6.1.2 Discrete Sampling for Polychlorinated Biphenyls and Petroleum Hydrocarbons

Discrete soil samples will be collected for laboratory analysis for PCBs and petroleum hydrocarbons in the areas of the former PCB-oil transformer and areas where petroleum tanks and pipelines were previously located. Discrete soil sampling in the PCB-oil transformer area was selected over ISM because that area is not well defined, a reliable screening process has not been implemented, the previous excavation work has likely limited the extent of PCB impacts, and potential lateral and vertical heterogeneity. The area of the pumphouse and spring cistern (106) will also be evaluated by collecting discrete soil samples instead of ISM because there is very limited soil in the vicinity of the building and the surrounding area is steep and difficult to access and sample safely. Additional information on the discrete sampling locations and rationale is included in Section 5.2.

4.2.6.2 Data Quality

Sampling and analysis of soil will be conducted using standard USEPA or state-approved methods. QC measures will include:

- *Field triplicate samples*. Triplicate ISM samples will be collected from 4 DUs (10 percent of the DUs). Due to the large number of increment samples, it is not considered practicable to collect triplicate replicates at all DUs and SUs. The DUs selected for field triplicates will include 3 composite samples consisting of 30 increments per composite sample. The 95-percent upper confidence interval (95-UCL) will be calculated for each triplicate DU using the Student's t or Chebyshev method following the procedures in the ITRC guidance (ITRC 2012). The Student's t method will be used if the coefficient of variation is low (e.g., less than 1). If the coefficient of variance is high (greater than or equal to 1), then the Chebyshev method will be used to calculate the 95-UCL. The calculated 95-UCL will be compared to the lead cleanup level of 250 mg/kg.
- *Field duplicates*. Field duplicates measure sampling precision and will be collected at a minimum of 10 percent of the discrete sample locations.
- *Matrix spike (MS), and matrix spike duplicates (MSDs)*. MS and MSD samples are analyzed to measure interference from the sample matrix on the recovery of the target analytes. MS and MSDs will be performed in the laboratory at a frequency of one sample per batch or one sample per 20 samples, whichever is more frequent.
- *Field rinsate blanks*. Equipment rinsate samples will be collected daily from decontaminated reusable equipment (e.g., hand trowel, hand auger) to identify possible contamination from the sampling environment or equipment. These blanks will be collected by pouring laboratory-provided distilled water over (or through) decontaminated sampling equipment and into a jar.

4.2.7 Step 7: Develop the Plan for Obtaining Data

The last step in the DQO process is to develop a design for collecting the proposed samples in a manner that will meet the specified performance criteria. The rationale for selecting the sample locations and sampling procedures is discussed in Section 5 and field sampling procedures are described in Section 7.

4.3 Data Quality Indicators

The QA objective is to generate analytical data of known and appropriate quality that are acceptable and useful for decision making (e.g., determining lateral and vertical extent of contamination greater than unrestricted land use criteria). Data quality indicators (DQIs), comprising statistics and data descriptors, are used to help achieve this objective. The principal DQIs are precision, accuracy, representativeness, comparability, and completeness (PARCC) and bias and sensitivity, as described in Table 4.

4.4 Data Review and Validation

Arcadis staff not involved with the data collection will review field documents and perform a level II data review of all the analytical data reports. The data review will be in accordance with the Superfund Contract Laboratory Program National Functional Guidelines for Data Review (USEPA 2017a and

USEPA 2017b) and the QA/QC criteria specified in this QAPP and SAP. Data will be reviewed and, if appropriate, flagged with data qualifiers. Based on laboratory data validation/review, a qualified Arcadis scientist will determine if the QA criteria have been met and will establish and document data usability (Appendix A, QAPP Worksheet 15).

4.5 Data Management

Arcadis will maintain a consistent project file system for project documents. The contract laboratory will electronically submit the laboratory report in PDF format and as an electronic data deliverable (EDD). The EDD will be in a format recognized by Ecology’s current Environmental Information Management System.

4.6 Assessment Oversight

Direct oversight of the field investigation will be provided by an experienced Arcadis Field Team Leader, who will be in daily contact with the Arcadis Project Manager. Daily field reports will be submitted by the Arcadis Field Team Leader to the Arcadis Project Manager for review. The Arcadis Project Manager will provide the daily field report to the USCG Project Manager in a timely manner (typically the next day) and will alert the USCG Project Manager to any identified issues during the field investigation (if necessary).

5 SAMPLE LOCATIONS AND RATIONALE

The proposed sampling approach is designed to characterize the lateral and vertical extents of COCs in soil associated with historical activities at the Site. As discussed in Section 3.1, the confirmed COCs in soil are lead and PCBs. Petroleum hydrocarbons have also been historically stored and used onsite and may also be present in soil. Soil samples will be collected using ISM within DUs to determine the lateral and vertical extents of lead in soil. Discrete samples will be collected in areas of known storage or use of petroleum- and PCB-containing materials, as well as in the area of the Pumphouse and spring cistern.

5.1 Incremental Composite Sampling (Inorganics)

Incremental sampling methodology is the preferred sampling approach for evaluating lead concentrations in soil at the Site because it provides a more accurate and precise method for establishing the true mean concentration of lead within the DU compared to discrete sampling methods (ITRC 2012).

5.1.1 Primary and Replicate ISM Composite Samples

Primary ISM composite samples will be generated from 30 discrete incremental samples (30 borings) that are distributed within the DU and composited in the field to form a single composite soil sample for analysis. A grid of 30 approximately equal-sized cells has been established for each DU and the proposed increment sampling location has been placed at the center of each grid cell. A minimum of two depth intervals will be evaluated to provide vertical delineation within each DU. For all DUs, increment samples will be collected from 0 to 0.5-foot bgs and from 0.5 to 1.0 feet bgs, unless bedrock or refusal is encountered at a shallower depth.

A subset of incremental samples from the 0.5 to 1.0 feet bgs interval will be analyzed with XRF in the field to determine if deeper samples will be collected. A minimum of 20 percent of the discrete incremental samples from the bottom-most interval in each DU will be analyzed using XRF. Samples analyzed by XRF will be spatially distributed over the DU. If the average lead concentration exceeds 200 mg/kg, additional increment samples will be collected from the next 0.5-foot interval below the preceding sample (i.e. 1.0 to 1.5 feet bgs if the XRF results from the 0.5 to 1.0 feet bgs interval are above 200 mg/kg).

Duplicate and triplicate ISM composite samples will be collected from 0 to 0.5-foot bgs interval in the following four DUs (10 percent of the total number of ISM composite samples) to evaluate data reproducibility and consistency:

- DU 02 (boathouse, 105)
- DU-06 (oil and paint storage building, 102)
- DU-08 (lighthouse and fog signal building, 101)
- DU-13 (duplex, 103).

A total of 90 discrete incremental samples will be collected in areas designated for triplicates (includes 30 primary, 30 duplicates, and 30 triplicates). Duplicate and triplicate samples will be collected from separate borings located within the same incremental sampling cell as the primary sample location.

Each of the DUs has been divided into two to four SUs. Composite samples will be collected for each SU from the primary ISM soil increments using the same methodology as the ISM composite samples (i.e. homogenization and collection of an equal volume of soil from each increment). The SU composite will be shipped to the laboratory and placed on hold pending the results of the DU composite sample. The SU composite samples will be analyzed by the laboratory using the same processing and analytical methods as the DU composite sample if lead concentrations from the DU composite sample are between 200 and 400 mg/kg. The SU laboratory results will be used to further refine the extent of lead-impacted soil within a DU if the DU sample results are marginally greater than or less than the lead soil screening level of 250 mg/kg.

5.1.2 Sample Quantities, Increment Locations, and Rationale

Based on the results of the November 2018 preliminary investigation and other historical information, 18 DUs and 61 SUs have been identified for additional sampling. Samples will be collected from two depth intervals (0 to 0.5-foot bgs and 0.5 to 1.0-foot bgs or deeper depending on XRF field screening).

The number of soil borings, increment samples, and composite samples to be completed during the RI are summarized below:

- Soil borings: 780 (540 primary borings and 240 duplicate/triplicate borings), assuming all locations are accessible and can be readily sampled.
- Increment samples: 1,320 (1,080 primary increments, 240 duplicate/triplicate increments)
- Composite samples: 166 (36 primary ISM samples, eight duplicates/triplicates ISM samples, and 122 SU composite samples).

Actual sampling locations may vary from the locations selected due to site conditions such as bedrock outcropping or obstructions. Deviations from the prescribed sampling locations will be documented in the field logbook. Seventeen of the 18 areas have preselected increment locations. Increment sampling locations in DU-18 (Officer-in-Charge quarters, 104) will be selected by the Arcadis Field Team Leader after coordination with the Arcadis Project Manager at the time of sampling due to limited accessibility in this area that would make preselection of sample locations in this DU infeasible. Less than 30 increments may be collected from DU 18 is access is limited.

Table 5 identifies GPS coordinates for the increment sample soil boring locations. Proposed DUs and SUs are shown on Figure 3. Increment sampling locations within each DU and SU are shown on Figures 4 through 10.

5.1.3 Sample Rationale

The boundaries of the DUs were selected to encompass areas that exhibited similar conditions with regard to initial XRF soil screening, distance from structures, and historical use. Table 6 provides the incremental sampling rationale for each DU and the average XRF lead concentration in each DU based on the November 2018 sampling event. XRF lead screening results within each DU boundary are shown on Figures 11 through 19. Each DU is further described below.

5.1.3.1 Decision Units 1 and 2 ï Boathouse (105)

The locations of DUs 1 and 2 are shown on Figure 4. DU 1 encompasses the area directly adjacent to the east, south, and west sides of the boathouse. The areas directly adjacent to the boathouse have been excavated to repair siding, creating a trench around portions of the structure, based on observations during the preliminary assessment. Initial XRF results indicate generally low lead concentrations with sporadic locations with moderate impacts.

DU 2 covers the remaining accessible areas within 40 feet of the boathouse to the east, west, and south (not within DU 1). Preliminary XRF analysis indicated that concentrations are generally low in this area.

5.1.3.2 Decision Unit 3 ï Northwest Open Area

The location of DU 3 is shown on Figure 4. The areas outside of the boathouse (105) and oil and paint storage building (102) that were not surveyed as part of the initial mobilization are included in DU 3. There are no buildings or sources that are anticipated to have contributed COCs to surface soil within this area.

5.1.3.3 Decision Units 4, 5, and 18 ï Officer-in-Charge Quarters (104)

The locations of DU 4, DU 5 and DU 18 are shown on Figure 5. DUs 4 and 5 include the areas outside of the Officer-in-Charge quarters on the north, east, and south sides. DU 4 is closer to the Officer-in-Charge quarters and DU 5 is farther away.

Access to the DU 18 within the footprint of the Officer-in-Charge quarters and to the west is generally limited due to brush and the apparent remnants of the foundation of the structure. The ground surface also slopes significantly toward the helicopter pad. Initial XRF screening results within DU 4 exhibited sporadic areas of moderate to high lead concentrations.

DU 5 includes the accessible areas within approximately 40 feet of the Officer-in-Charge quarters to the north, east, and south that are not included in DU 4. Initial XRF concentrations were generally low.

DU 18 includes a limited accessible area near the Officer-in-Charge quarters. The area has a moderately steep slope to the west, trees, heavy vegetation, and possibly other obstructions from the footings of the Officer-in-Charge quarters. Sampling locations will be determined by the Field Team Leader at the time of the sampling event because it is not feasible to preselect locations at this time. Sample locations will be recorded in the field using GPS. The number of increment samples will be determined in the field and may vary from the target of 30 increment samples.

5.1.3.4 Decision Units 6 and 7 ï Oil and Paint Storage Building (102)

The locations of DU 6 and DU 7 are shown on Figure 6. DU 6 includes the area where the oil and paint storage building and associated structures were located. The boundaries of the DU were defined to encompass the initial XRF sample locations in this area that exhibited moderate to high lead concentrations. The ground surface underneath the helicopter pad to the east is not currently accessible due to the heavy metal articulated plates that comprise the pad surface. Additional sampling may be evaluated during this event or at a point prior to remedial implementation in the future if the helicopter pad is removed and the area becomes accessible.

DU 7 includes the areas to the north and west of DU 6 where initial XRF samples contained low concentrations of lead.

5.1.3.5 Decision Units 8 and 9 ï Lighthouse and Fog Signal Building (101)

The locations of DU 8 and DU 9 are shown on Figure 7. DU 8 contains areas of moderate to high lead impacts surrounding the lighthouse and fog signal building observed during initial XRF sampling. The DU boundary extends to the edge of the accessible area to the west.

DU 9 includes areas to the south, east, and north of the lighthouse and fog signal building. Initial XRF results from samples within DU 9 were generally low. The location of the former transformer is on the southeast side of the DU.

5.1.3.6 Decision Unit 10 ï Southern Open Area

The location of DU 10 is shown on Figure 7. DU 10 includes the open lawn between the duplex and the lighthouse and fog signal building. Current structures in this area include a sidewalk and a fire alarm bell. The area is bounded by the helicopter pad to the north and forested areas to the south. Initial XRF results from the eastern portion of the DU indicated low lead impacts.

5.1.3.7 Decision Units 11, 12, and 13 ï Duplex (103)

The locations of DU 11, DU 12, and DU 13 are shown on Figure 8. DU 11 includes the areas immediately adjacent to the duplex within approximately 10 feet of the building. The area includes sidewalks that extend around the perimeter of the duplex and two tanks on the east side of the building. XRF sampling results indicate sporadic areas of moderate to high lead concentrations.

DU 12 includes areas within approximately 10 to 30 feet of the duplex. The area is generally open lawn. A fence is present on the east side of the duplex. XRF results indicate areas of moderate to high impacts on all sides of the structure.

DU 13 encompasses areas to the south, east, and north of the duplex that are generally greater than 20 feet from the building. The areas to the south and east of the DU are forested and border DU 5 to the north. XRF results indicate generally low lead concentrations within DU 13.

5.1.3.8 Decision Unit 14 ï 10,000-Gallon Fuel Oil Aboveground Storage Tank (112)

The location of DU 14 is shown on Figure 9. The area within DU 14 includes the footprint of the 10,000-gallon fuel oil AST. Concrete supports are present in the area, which is generally overgrown with brush and ivy. XRF results indicate moderate to high impacts in the areas between and adjacent to the concrete supports.

5.1.3.9 Decision Unit 15 ï Firehouse Pump Building (107)

The location of DU 15 is shown on Figure 9. DU 15 includes the area surrounding the firehouse pump building and the remaining concrete foundation. The surrounding area is generally forested and covered in brush and shrubs. A fence associated with the duplex is present to the west and a makeshift latrine is present to the south of the DU. XRF samples indicate low to moderate lead concentrations.

5.1.3.10 Decision Units 16 and 17 ï Water Tanks

The locations of DU 16 and 17 are shown on Figure 10. DU 16 includes two water tanks identified based on field observations and historical documentation located east of the duplex. The surrounding area is forested, and the tanks and platforms have collapsed. XRF lead concentrations were low in samples collected during the November XRF screening event.

DU 17 includes three additional water tanks that are located farther east. The area is also forested, and the tanks are no longer present, although wood and concrete footings and some piping are present. XRF results indicated sporadic locations of moderate to high lead concentrations.

5.2 Discrete Soil Samples

Information regarding the discrete soil sampling plan is presented in Table 7. Discrete sample GPS locations are identified in Table 8 and shown on Figure 20. Soil samples collected for analysis of petroleum constituents will be collected from discrete locations that were selected based on historical use and visual observations during the November 2018 field event. Discrete sampling was selected to evaluate petroleum impacts based on the Guidance for Site Checks and Site Assessments for Underground Storage Tanks (Ecology 1991). Although petroleum products were generally stored in ASTs, underground piping is present between the tanks and the ship to shore fuel oil connection.

A minimum of six discrete samples (three locations and two depths) will be collected from the locations of each of the known former tanks discussed in Section 2.2. Samples will be collected from the ends and the middle of the former location of the tank, if possible. For locations where the tanks were known to be aboveground, samples will be collected from 0 to 0.5-foot bgs. The 200-gallon fuel oil UST near the Officer-In-Charge quarters was removed in 1999 and extended to 5 feet bgs. Soil samples will be collected near this tank at 5 feet bgs or the maximum depth practical based on field conditions. Soil samples will be collected from underneath or adjacent to underground fuel piping at a frequency of one sample per 50 feet of piping in accordance with Ecology guidance (Ecology 1991). The samples will be collected from the soil immediately underneath the piping, if present. Samples will be collected for the contingent analyses listed in Table 7 and submitted on hold pending the results of GRO and DRO/HO analysis. At least one sample from each of the former tank areas and samples that are collected along the pipeline will be submitted for benzene analysis on hold pending initial DRO and GRO results. Samples for cPAHs will be collected from all locations proposed for DRO and will be submitted to the lab on hold pending the DRO results. A minimum of one sample will be collected for VPH from the area of the former gasoline tank and at least one sample will be collected for EPH from each of the former diesel or heating oil tanks and submitted to the lab on hold pending results of DRO and GRO.

Discrete soil samples will also be collected to evaluate the area around the transformer oil spill near the lighthouse and fog signal building (USCG 1980a, 1980b). Proposed soil sample locations were selected within and adjacent to the extents of the transformer oil spill and subsequent excavation. Samples will be collected from 0 to 0.5-foot bgs and 2.0 to 2.5-feet bgs (or the depth of refusal if that is encountered at a shallower depth).

6 SAMPLE ANALYSIS

This section summaries the laboratory test procedures that will be used and the laboratory processing of incremental composite samples.

6.1 Analysis

The approximate number and locations of samples to be collected are discussed in Section 4.2. Soil samples will be analyzed by an Ecology-certified laboratory using USEPA or state-approved methods for the constituents listed in Section 4.2.5. Soil analytical data will be compared to MTCA Method A cleanup levels. If there is no MTCA Method A cleanup level, the soil analytical data will be compared to MTCA Method B cleanup levels.

ISM composite samples will be analyzed for TCLP lead based if the total lead result is above 100 mg/kg to compare to dangerous waste criteria. Samples that may be analyzed will be determined following completion of total lead analysis in all ISM composite samples. Analysis for additional petroleum constituents, including benzene, cPAHs, EPH and VPH will be determined based on initial sampling results for DRO and GRO.

6.2 Laboratory Processing of Incremental Sampling Methodology Samples

Laboratory processing of ISM samples will include:

- Air drying samples at ambient temperature.
- Disaggregating soil by gently milling by hand or using hand tools (e.g., pestle) to break up soil agglomerates, while taking care not to break apart hard particles that may have metals (lead) locked inside.
- Sieving using a number 10 soil sieve (2-millimeter screen size).
- Collecting a 10-gram subsample using 2-D Japanese slabcake subsampling method (ITRC 2012).
- Digestion and analysis of the sample per USEPA approved methods.

ISM sample replicates and SU composite samples, if selected for analysis, will be processed using the same methodology. Particle size reduction and systematic subsampling are intended to provide improved precision compared to methods that do not provide particle size reduction and systematic sampling (ITRC 2012).

7 FIELD METHODS AND PROCEDURES

This section discusses soil sampling procedures for incremental composite sampling and discrete soil sampling.

7.1 Soil Sampling

7.1.1 ISM Composite Sampling

ISM will be performed pursuant to guidance from the ITRC (2012). Individual increments will be collected using manual methods in accordance with the Technical Guidance Instruction (TGI) for Soil Drilling and Sampling Collection (Appendix D) and placed in individually labeled plastic bags. Increments will be homogenized in the plastic bag by hand mixing and a single volumetric scoop will be collected and placed in a laboratory-provided container. Soil samples will be representative of the overall soil matrix at each sample location and will be generally free of organic material and gravel unless that material represents the primary soil type at the sample location. Unique soil conditions (such as paint chips, staining, or other debris) will be documented in field notes.

The total ISM composite sample should be at least 1 kilogram of soil. The ISM composite sample will be stored on ice pending shipment to the laboratory. Composite samples from each SU will be collected from the remaining sample volume using the same methods as the primary ISM composite sample (i.e., single volumetric scoop from each increment within the SU) and will be submitted pending analysis based on results of the ISM samples.

Reusable sampling equipment will be decontaminated in accordance with the TGI for Groundwater and Soil Sampling Equipment Decontamination (Appendix D) between DUs (including at different depth intervals within the same area). Sampling tools used to collect increment samples within a DU will include minimum decontamination (gross removal of soil by dry methods). Deviations or adjustments to sample locations will be documented in the field by collecting updated GPS coordinates or by measuring at least 2 distances from known structures.

7.1.2 X-Ray Fluorescence Field Screening

Field screening of select soil samples will be conducted using a portable XRF analyzer. The XRF field screening will be performed to inform the vertical delineation of lead and will supplement existing XRF field screening data collected in November 2018. A minimum of 20 percent of the non-surface increment samples (i.e. deeper than 0.5 feet bgs) will be screened for lead using the XRF instrument. If the average XRF lead concentration of the screened samples is above 200 (mg/kg) for lead, then deeper soil sample will be collected for laboratory analysis. The 200 mg/kg criteria is considered a conservative screening action level based on a presumed cleanup level for lead of 250 mg/kg.

XRF analysis will be conducted on increment soil samples collected in plastic bags. Any large pieces of soil within the plastic bag will be broken into smaller pieces or removed, and the soil will be blended by hand to homogenize. Each selected increment sample will be screened with the XRF for a minimum of 60 seconds. Samples will be analyzed in accordance with the Technical Guidance Instructions (TGI) for Screening Soil for Metals with X-Ray Fluorescence Analyzer (Appendix D).

7.1.3 Discrete Samples

Samples will be collected using manual methods from surface intervals using a decontaminated hand auger or trowel in accordance with the TGI for Soil Drilling and Sampling Collection (Appendix D). Soil will be placed into laboratory-provided containers, placed on ice, and shipped or transferred to the laboratory for analysis. Reusable sampling equipment will be decontaminated between sampling locations in accordance with the TGI for Groundwater and Soil Sampling Equipment Decontamination (Appendix D). Discrete soil sampling locations are shown on Figure 20.

7.2 Paint Chip Evaluation

A visual inspection will be conducted on all painted buildings and structures that are present at the Site. The survey will consist of documenting areas of paint weathering and chipping that could lead to further source material through photos and field sketches. The area of each building or structure that may require additional treatment or encapsulation will be estimated based on field measurements and observations of paint condition.

7.3 Field Equipment

Equipment to support field sampling will be calibrated and maintained according to the manufacturer's recommendation prior to and during use. Prior to field sampling, equipment will be inspected to confirm it is operational and able to function as intended. If any equipment malfunctions or needs service, it will be replaced or serviced as quickly as practical. Field equipment that will be required for field sampling includes, but is limited to, the following items:

- Hand augers, shovels, and hand trowels
- GPS unit
- Tablet personal computer (connected to GPS unit)
- Laboratory supplied coolers and sampling containers
- Digital cameras
- Cell phones (no satellite phone is necessary due to confirmed cell phone coverage)
- XRF instrument
- Personal protective equipment (PPE [nitrile gloves, steel toe boots, safety glasses, high visibility vests, personal floatation devices, hard hats])
- First aid kit and emergency eyewash
- Fire extinguisher

- Decontamination supplies (spray bottles, potable water, buckets with lids, scrub brushes, nonphosphate detergent)
- Garbage bags, zip-type plastic bags
- Tape measure/wheel
- Field note books and pens (indelible ink).

8 SAMPLE IDENTIFICATION AND HANDLING

This section discusses sample identification and handling procedures.

8.1 Sample Identification

Each ISM composite sample and discrete sample will be assigned a unique identification (ID) number based on the DU or SU and depth of the samples. Increment sample designations and location information are identified in Table 5 (increment sample designations are distinct from ISM sample designations)**.** Thirty increment samples will be composited in the field, labeled, and shipped to the laboratory under chain of custody protocol.

Composite samples and discrete sample IDs will consist of the following codes to identify the type, location, depth, and replicate number:

The first part of the sample ID will represent whether the sample type is ISM composite or discrete:

- Incremental Sampling Methodology = ISM
- Discrete soil boring sample = SB
- Rinsate samples = RS
- Investigation derived waste sample = IDW

The second part of the sample ID will provide area information:

- Composite samples will be identified by DU and SU numbers.
- Discrete samples will be identified by nearby building identifier (e.g., 101, 102), if applicable.

The third part of the sample ID will provide information on the depth (bottom) of the sample(s) in feet below ground surface (e.g. 0.5, 1, 1.5).

The fourth and final part of the sample ID will provide information on the replicate sample identifier:

- A = primary ISM sample
- B = duplicate ISM sample
- C = triplicate ISM sample
- DUP = duplicate (for discrete soil samples).

Several examples of sample ID numbers include:

- ISM-02-0.5-A = Composite sample collected from Area 2, at a depth of 0.5 foot bgs, primary replicate.
- ISM-03-01-1.0 = Composite sample collected from Area 3, Subarea 1, at a depth 1 foot bgs.
- SB-101-05-2.5 = discrete sample, lighthouse and fog signal building, sample number 5 in this area, sample depth 2.5 feet bgs.

8.2 Sample Handling

Samples will be placed in laboratory-supplied containers and will be handled according to the chain of custody protocol described in the TGI for Chain of Custody, Handling, Packing, and Shipping (Appendix D). The laboratory will provide new and certified precleaned sample containers appropriate to the list of analytes. Soil samples requiring temperature control preservation and will be shipped on ice. Sample coolers will be properly labeled and shipped according to U.S. Department of Transportation requirements.

9 INVESTIGATION-DERIVED WASTE

Investigation-derived waste (IDW) that may be generated during the field sampling includes excess soil, decontamination water, and disposable PPE. IDW generated during field sampling will be handled in accordance with the TGI for Investigation-Derived Waste Handling and Storage (Appendix D). Any IDW with evidence of gross contamination (i.e., petroleum staining) will be containerized separately. Materials will be characterized for off-site disposal if a waste profile is not already available. Materials that are nonhazardous will be disposed of as solid waste. Any excess phosphate-free detergent-bearing decontamination water or any sample remaining after processing will be deposited near the collection area.

10 FIELD DOCUMENTATION

This section summarizes field document procedures that will be used during the RI.

10.1 Field Logbook

Daily field activities will be documented in a bound field logbook in accordance with the Quality Procedure for Field Activities Documentation (Appendix D). Entries will be made in waterproof ink. If an incorrect entry is made, the information will be crossed out with a single line and initialed next to the incorrect entry by the person making the entry. Recorded information may include, but is not limited to, the following:

- Site name and location
- Date and time of arrival and departure
- Name and signature of person maintaining the log
- Names of all persons at the Site
- Purpose of visit
- Level of PPE used
- Field instrument identification and calibration information
- Location of sampling points
- Results of field measurements made
- Number of samples collected
- Methods of sample collection and any factors that may affect quality
- All sample identification numbers
- Description of samples, including (as applicable) the depth at which the sample was collected, field duplicate or replicate samples collected, and/or other quality control samples collected
- Weather conditions on the day of sampling and any field observations
- Deviations or changes to the procedures and sampling locations established in this QAPP and SAP and discussion with and direction from the Arcadis Project Manager.

10.2 Chain of Custody

Chain of custody procedures will be followed to document sample possession from the time of sample to sample analysis. The Chain of custody form will contain the unique identification number for all samples, data and time of sample collection, description, sample type, preservation (if any), and analyses required. The chain of custody form will remain with the samples at all times. Chain of custody procedures are described in ArcadisôStandard Operating Procedure (SOP) for Sample Chain of Custody in Appendix D.

11 QUALITY CONTROL

DQOs were developed using the USEPAôs DQO process (USEPA 2006) to describe data and data quality needs. Data quality indicators such as PARCC parameters and analytical sensitivity will be used to assess conformance of data with QC criteria (USEPA 2002).

11.1 Incremental Composite Sampling Field Replicates

Duplicate and triplicate ISM composite samples will be collected to assess the heterogeneity within a DU. Replicate ISM increments will be collected for 10 percent of the total number of ISM samples (four DUs). The replicate increments will be collected from locations that are distinct from the primary increment locations. Replicate ISM samples will be processed by the laboratory using the same methods as the primary ISM sample.

11.2 Field Duplicates (Discrete Samples)

Field duplicates will be used to assess variability attributable to collection, handling, shipment, storage, and/or laboratory handling and analysis. Field duplicates will be collected from a minimum of 10 percent of the discrete sample locations. Field duplicates samples will be co-located with the primary sample and will be processed by the laboratory using the same methods as the primary sample. The field duplicates will be submitted to the laboratory ñblindò (i.e., not identified as a QC sample, but labeled with a different site identification than the regular sample.

11.3 Matrix Spike and Matrix Spike Duplicates (Discrete Samples)

MS and MSDs will be used to assess the accuracy of the analytical method. MS, and MSD samples will be selected by the laboratory and analyzed at a frequency of one sample per 20 samples or one per batch, whichever is more frequent, per laboratory SOPs. Adequate sample volume will be obtained for MS and MSD analysis.

11.4 Equipment Rinsate Blanks

Equipment rinsate blanks are used to identify potential contamination from the sampling environment, sampling equipment, or sample shipment. After equipment decontamination is complete, an equipment rinsate sample will be collected by running distilled water over the cleaned sampling equipment. The sample will be collected in clean laboratory-supplied containers. Equipment blanks will be collected at a frequency of once per day of field activities where reusable sampling equipment is used.

11.5 Laboratory Quality Control Samples

Method blank and laboratory control samples will be analyzed at a frequency of one per 20 samples or per batch, or as identified by the method guidance for the media samples, whichever is greater.

12 FIELD VARIANCES

Table 9 identifies the various types of changes that may occur during the field program and required actions and documentation for the change event. Project specific deviations from the directions outlined in the TGIs and SOPs (Appendix D) include:

- Increments that will be analyzed by XRF in the field will not be dried or sieved prior to analysis. Soil will be directly collected into plastic bags and homogenized prior to XRF analysis, but no other processing will be completed.
- Discrete confirmatory samples will not be collected to evaluate the accuracy of the XRF results.
- Soil descriptions will consist of abbreviated classification of the principal component (i.e. sand, clay, gravel) and general color. Descriptions will be completed for discrete soil samples and ISM composite samples, but not for all increments. Unique soil conditions (i.e. paint chips, staining, etc.) will be noted where observed.
- Soil screening for volatile petroleum constituents using a photo-ionization detector (PID) will be completed on select discrete samples and will be completed using the headspace in the plastic bag that samples are collected in. Samples will not be heated prior to measurements.
- Visual assessment of non-aqueous phase liquid (NAPL) will be completed on discrete samples. No other field testing or screening for NAPL will be conducted.

Other deviations encountered in the field will be recorded in notes as appropriate. TGIs and SOPs relevant to the field work are included in Appendix D.

13 HEALTH AND SAFETY

Field sampling will be conducted in accordance with the requirements of the Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response standard pursuant to Code of Federal Regulations 1910.120 and applicable Washington State Department of Labor and Industry Standards. The work will be conducted in accordance with a site-specific Health and Safety Plan (HASP) that describes site specific hazards and mitigation measures to reduce risks to workers. A copy of the HASP is included as Appendix E.

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TABLES

Table 1
Constituents of Concern and Potential Source Areas
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

Area ID	Area Description	Potential Sources	Potential COCs
101	Lighthouse and fog signal building	Painted structures Fuel oil tank Transformer	Lead DRO, HO, Mineral Oils PCBs Benzene (if DRO is present) cPAHs (if DRO is present)
102	Former oil and paint storage building	Painted structures Oils Gasoline AST	Lead GRO, DRO, HO Benzene (if GRO or DRO are present) cPAHs (if DRO is present)
103	Duplex	Painted structures	Lead
104	Former Officer-in-Charge quarters	Painted structures Fuel oil tank	Lead DRO, HO Benzene (if DRO is present) cPAHs (if DRO is present)
105	Boathouse	Painted structures	Lead
106	Pump house and spring cistern	Painted Structures	Lead
107	Firehouse pump building	Painted structures Fuel oil/diesel tank(s)	Lead DRO, HO Benzene (if DRO is present) cPAHs (if DRO is present)
108	Salt water flushing pumphouse	Painted structures	Lead
--	Former Water tanks	Painted structures	Lead
112	Former 10,000-gallon fuel oil AST and pipeline	Painted structures AST and pipeline	Lead DRO, HO Benzene (if DRO is present) cPAHs (if DRO is present)

Note:
See Figure 20 for locations of these areas.

Acronyms and Abbreviations:
-- = Not Designated
AST = aboveground storage tank
COC = constituent of concern
cPAH = carcinogenic polycyclic aromatic hydrocarbon
DRO = diesel range organics
GRO = gasoline range organics
HO = heavy oil
PCB = polychlorinated biphenyl

Table 2
Preliminary Schedule
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

Activity	Description	Date
1	Prepare Quality Assurance Project Plan and Sampling and Analysis Plan	Feb-19
2	Conduct remedial investigation fieldwork	March or April 2019
3	Prepare Remedial Investigation/Focused Feasibility Study Report (Draft, Second Draft, and Final)	Sep-19
4	Remedial design	Jan-20
5	Public review/final cost estimates	Apr-20

Table 3
Preliminary Soil Screening Levels
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

Constituent	Preliminary Soil Cleanup Level (mg/kg)	Source
Lead	250	MTCA Method A
GRO	100/30[1]	MTCA Method A
DRO	2,000	MTCA Method A
HO	2,000	MTCA Method A
Mineral oils	4,000	MTCA Method A
PCBs	1	MTCA Method A
Benzene	0.03	MTCA Method A
cPAHs	0.1	MTCA Method A

Note:

1. The MTCA Method A screening level for GRO is based on the presence of benzene. The Method A cleanup level is 30 mg/kg when benzene is present and 100 mg/kg when benzene is absent.

Acronyms and Abbreviations:

cPAH = carcinogenic polycyclic aromatic hydrocarbon
DRO = diesel range organics
GRO = gasoline range organics
HO = heavy oils
mg/kg = milligrams per kilogram
MTCA = Model Toxics Control Act
PCB = polychlorinated biphenyl

Table 4
Data Quality Indicators
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DQI	Definition	Methodologies	Corrective Actions
Precision	Precision measures the agreement among a set of replicate measurements. Field precision is assessed through the collection and analysis of field duplicates (discrete) and field triplicates (incremental sampling methodology). Analytical precision is estimated by duplicate/replicate analyses, usually on laboratory control samples, spiked samples, and/or field duplicates. Precision will be reported as relative percent difference.	Use same laboratory and equipment, if possible. Use consistent and approved laboratory methodology. Acquire replicate field samples (see Section 5).	If duplicate data do not meet the objective: - Evaluate apparent cause (e.g., sample heterogeneity) - Request reanalysis or remeasurement - Qualify the data before use.
Accuracy	Accuracy is the closeness of a measured result to an accepted reference value. It is usually measured as a percent recovery. Quality control analyses to be used to measure accuracy include standard recoveries, laboratory control samples, spiked samples, and surrogates.	Analyze matrix spike, matrix spike duplicates, laboratory control samples, and surrogates	If recovery does not meet objective: - Qualify the data before use - Request reanalysis or remeasurement.
Representativeness	Sample representativeness is the degree to which data accurately and precisely represent the environmental condition.	Follow approved plans and document changes or deviations.	If results are not representative of the system: - Identify cause - Flag for further review - Review for usability - Take corrective action.
Comparability	Comparability represents the degree of confidence with which one dataset can be compared to another.	Use identical or similar sample collection and handling methods, sample preparation, and analytical methods.	If data are not comparable to other datasets (e.g., preliminary XRF results from November 2018 sampling event): - Identify discrepancies and discuss with the United States Coast Guard.

Table 4
Data Quality Indicators
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DQI	Definition	Methodologies	Corrective Actions
Completeness	Completeness is a measure of the amount of valid data collected compared to the amount planned. Field completeness is a measure of the number of samples collected versus planned. Laboratory completeness is a measure of the number of valid measurements compared to the number planned.	Follow approved plan and document any changes or discrepancies.	If the data does not meet the completeness objective: - Identify appropriate changes; - Resample or collect additional samples; - Revise plan.
Bias	Bias is a distortion of a measurement that causes error in one direction (consistent low or high).	Perform matrix and matrix spike duplicates.	If data are biased: - Qualify/reject data - Assess usability - Identify problem; if possible, correct and reanalyze sample.
Sensitivity	Sensitivity refers to an instrumentôs or methodôs minimum concentration that can be reliably measured.	Ensure practical quantitative limits, method detection limits, and/or reporting limits (RLs) are appropriate. RLs should at least be less than applicable Model Toxics Control Act Method A or B cleanup levels.	If detection limits do not meet objective: - Qualify/reject data - Assess usability - Identify problem; if possible, correct and reanalyze sample.

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
01	-122.71332938400	48.47856540190	1	DU-01-1A	Primary
01	-122.71329226100	48.47857202980	2	DU-01-2A	Primary
01	-122.71328906100	48.47855884690	3	DU-01-3A	Primary
01	-122.71332609300	48.47854706290	4	DU-01-4A	Primary
01	-122.71328744500	48.47854747530	5	DU-01-5A	Primary
01	-122.71328533000	48.47853541000	6	DU-01-6A	Primary
01	-122.71332421700	48.47852623870	7	DU-01-7A	Primary
01	-122.71328322700	48.47852217390	8	DU-01-8A	Primary
01	-122.71332194400	48.47850739530	9	DU-01-9A	Primary
01	-122.71328171400	48.47851088260	10	DU-01-10A	Primary
01	-122.71328068200	48.47849825820	11	DU-01-11A	Primary
01	-122.71331847400	48.47848807170	12	DU-01-12A	Primary
01	-122.71327921300	48.47848615470	13	DU-01-13A	Primary
01	-122.71331217200	48.47846996650	14	DU-01-14A	Primary
01	-122.71327534600	48.47847231310	15	DU-01-15A	Primary
01	-122.71324309300	48.47847608000	16	DU-01-16A	Primary
01	-122.71321363200	48.47847754680	17	DU-01-17A	Primary
01	-122.71318682300	48.47847825390	18	DU-01-18A	Primary
01	-122.71315992400	48.47848190690	19	DU-01-19A	Primary
01	-122.71313952400	48.47848323310	20	DU-01-20A	Primary
01	-122.71317483600	48.47850181090	21	DU-01-21A	Primary
01	-122.71314489400	48.47850632160	22	DU-01-22A	Primary
01	-122.71317718800	48.47851776490	23	DU-01-23A	Primary
01	-122.71314707000	48.47852761000	24	DU-01-24A	Primary
01	-122.71317799100	48.47853465990	25	DU-01-25A	Primary
01	-122.71314891400	48.47854818810	26	DU-01-26A	Primary
01	-122.71318190500	48.47855128980	27	DU-01-27A	Primary
01	-122.71315343600	48.47856481430	28	DU-01-28A	Primary
01	-122.71319123600	48.47857085140	29	DU-01-29A	Primary
01	-122.71315514400	48.47857924460	30	DU-01-30A	Primary
02	-122.71341751700	48.47859634620	1	DU-02-1A	Primary
02	-122.71340405400	48.47857998800	1	DU-02-1C	Replicate C
02	-122.71343419600	48.47861235120	1	DU-02-1B	Replicate B
02	-122.71337234400	48.47859816320	2	DU-02-2A	Primary
02	-122.71338408800	48.47858115560	2	DU-02-2B	Replicate B
02	-122.71336370300	48.47861431060	2	DU-02-2C	Replicate C
02	-122.71332449100	48.47859452840	3	DU-02-3A	Primary

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
02	-122.71330039600	48.47858333870	3	DU-02-3C	Replicate C
02	-122.71332895300	48.47861297590	3	DU-02-3B	Replicate B
02	-122.71341026000	48.47855482130	4	DU-02-4A	Primary
02	-122.71342245500	48.47853712940	4	DU-02-4B	Replicate B
02	-122.71342726200	48.47857027750	4	DU-02-4C	Replicate C
02	-122.71336598300	48.47855765470	5	DU-02-5A	Primary
02	-122.71337800900	48.47853974400	5	DU-02-5C	Replicate C
02	-122.71335363500	48.47857405480	5	DU-02-5B	Replicate B
02	-122.71340285400	48.47851268270	6	DU-02-6A	Primary
02	-122.71341493800	48.47849414350	6	DU-02-6C	Replicate C
02	-122.71339122600	48.47853112630	6	DU-02-6B	Replicate B
02	-122.71335967800	48.47851561580	7	DU-02-7A	Primary
02	-122.71336878700	48.47849785360	7	DU-02-7B	Replicate B
02	-122.71334919100	48.47853321210	7	DU-02-7C	Replicate C
02	-122.71339528900	48.47846982200	8	DU-02-8A	Primary
02	-122.71340792900	48.47845272970	8	DU-02-8B	Replicate B
02	-122.71338510600	48.47848729470	8	DU-02-8C	Replicate C
02	-122.71335214500	48.47847211090	9	DU-02-9A	Primary
02	-122.71336332500	48.47845398150	9	DU-02-9C	Replicate C
02	-122.71334076000	48.47849017080	9	DU-02-9B	Replicate B
02	-122.71338782000	48.47842714120	10	DU-02-10A	Primary
02	-122.71339991000	48.47841216970	10	DU-02-10B	Replicate B
02	-122.71337503300	48.47844512450	10	DU-02-10C	Replicate C
02	-122.71334427300	48.47843001880	11	DU-02-11A	Primary
02	-122.71335587200	48.47841288520	11	DU-02-11B	Replicate B
02	-122.71333151400	48.47844783150	11	DU-02-11C	Replicate C
02	-122.71337340900	48.47839077750	12	DU-02-12A	Primary
02	-122.71339300600	48.47837972970	12	DU-02-12B	Replicate B
02	-122.71335198100	48.47840449850	12	DU-02-12C	Replicate C
02	-122.71331575300	48.47839379810	13	DU-02-13A	Primary
02	-122.71333267700	48.47838125230	13	DU-02-13B	Replicate B
02	-122.71329791500	48.47840671020	13	DU-02-13C	Replicate C
02	-122.71330440000	48.47843602590	14	DU-02-14A	Primary
02	-122.71331109800	48.47841578270	14	DU-02-14B	Replicate B
02	-122.71329579200	48.47845807860	14	DU-02-14C	Replicate C
02	-122.71326953500	48.47840485520	15	DU-02-15A	Primary
02	-122.71327652600	48.47838541970	15	DU-02-15B	Replicate B

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
02	-122.71326165700	48.47842963280	15	DU-02-15C	Replicate C
02	-122.71325799200	48.47844884810	16	DU-02-16A	Primary
02	-122.71327942700	48.47843567750	16	DU-02-16C	Replicate C
02	-122.71323523700	48.47846096050	16	DU-02-16B	Replicate B
02	-122.71323651800	48.47840782540	17	DU-02-17A	Primary
02	-122.71324398300	48.47838525270	17	DU-02-17C	Replicate C
02	-122.71323251000	48.47843116530	17	DU-02-17B	Replicate B
02	-122.71320097700	48.47844897540	18	DU-02-18A	Primary
02	-122.71318053600	48.47843797750	18	DU-02-18B	Replicate B
02	-122.71322120700	48.47846129030	18	DU-02-18C	Replicate C
02	-122.71319896200	48.47841136650	19	DU-02-19A	Primary
02	-122.71321050800	48.47838757720	19	DU-02-19B	Replicate B
02	-122.71317881100	48.47842631190	19	DU-02-19C	Replicate C
02	-122.71315383100	48.47839589310	20	DU-02-20A	Primary
02	-122.71318637300	48.47838652190	20	DU-02-20C	Replicate C
02	-122.71311970800	48.47840370070	20	DU-02-20B	Replicate B
02	-122.71314018700	48.47842330310	21	DU-02-21A	Primary
02	-122.71312017300	48.47841326420	21	DU-02-21C	Replicate C
02	-122.71316400600	48.47843227810	21	DU-02-21B	Replicate B
02	-122.71314406700	48.47845205450	22	DU-02-22A	Primary
02	-122.71311322100	48.47844237750	22	DU-02-22C	Replicate C
02	-122.71316756900	48.47846260220	22	DU-02-22B	Replicate B
02	-122.71308830800	48.47840745930	23	DU-02-23A	Primary
02	-122.71307628600	48.47839231020	23	DU-02-23C	Replicate C
02	-122.71310483000	48.47842076100	23	DU-02-23B	Replicate B
02	-122.71307652200	48.47844214360	24	DU-02-24A	Primary
02	-122.71306013200	48.47843023970	24	DU-02-24C	Replicate C
02	-122.71309946200	48.47845231530	24	DU-02-24B	Replicate B
02	-122.71308462800	48.47846762590	25	DU-02-25A	Primary
02	-122.71311770200	48.47846015700	25	DU-02-25B	Replicate B
02	-122.71304005600	48.47847056620	25	DU-02-25C	Replicate C
02	-122.71310100200	48.47849520670	26	DU-02-26A	Primary
02	-122.71311855900	48.47848347220	26	DU-02-26B	Replicate B
02	-122.71308004500	48.47850825050	26	DU-02-26C	Replicate C
02	-122.71304715800	48.47849595260	27	DU-02-27A	Primary
02	-122.71306290400	48.47847895080	27	DU-02-27B	Replicate B
02	-122.71302195900	48.47851019400	27	DU-02-27C	Replicate C

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
02	-122.71304569700	48.47852878900	28	DU-02-28A	Primary
02	-122.71301495000	48.47852855800	28	DU-02-28B	Replicate B
02	-122.71307022100	48.47854107710	28	DU-02-28C	Replicate C
02	-122.71310433700	48.47852760770	29	DU-02-29A	Primary
02	-122.71308084000	48.47851623770	29	DU-02-29C	Replicate C
02	-122.71312628000	48.47853814300	29	DU-02-29B	Replicate B
02	-122.71310598000	48.47855775440	30	DU-02-30A	Primary
02	-122.71306757000	48.47855078700	30	DU-02-30C	Replicate C
02	-122.71313175200	48.47857603160	30	DU-02-30B	Replicate B
03	-122.71348966400	48.47860050260	1	DU-03-1A	Primary
03	-122.71351776900	48.47856091070	2	DU-03-2A	Primary
03	-122.71346018000	48.47856213170	3	DU-03-3A	Primary
03	-122.71354487300	48.47851960330	4	DU-03-4A	Primary
03	-122.71347083200	48.47852410230	5	DU-03-5A	Primary
03	-122.71345225700	48.47848858430	6	DU-03-6A	Primary
03	-122.71351385900	48.47848379370	7	DU-03-7A	Primary
03	-122.71357506900	48.47847894650	8	DU-03-8A	Primary
03	-122.71363139600	48.47845762270	9	DU-03-9A	Primary
03	-122.71363379600	48.47842181530	10	DU-03-10A	Primary
03	-122.71356820700	48.47843802670	11	DU-03-11A	Primary
03	-122.71350663800	48.47844282380	12	DU-03-12A	Primary
03	-122.71344493700	48.47844760410	13	DU-03-13A	Primary
03	-122.71357468700	48.47840101280	14	DU-03-14A	Primary
03	-122.71349929800	48.47840192140	15	DU-03-15A	Primary
03	-122.71343790400	48.47840672670	16	DU-03-16A	Primary
03	-122.71355898300	48.47837106520	17	DU-03-17A	Primary
03	-122.71349175100	48.47836078870	18	DU-03-18A	Primary
03	-122.71343041700	48.47836572810	19	DU-03-19A	Primary
03	-122.71342323100	48.47832482530	20	DU-03-20A	Primary
03	-122.71348456500	48.47831997880	21	DU-03-21A	Primary
03	-122.71355811000	48.47833205350	22	DU-03-22A	Primary
03	-122.71360550200	48.47828962220	23	DU-03-23A	Primary
03	-122.71354956300	48.47829730340	24	DU-03-24A	Primary
03	-122.71348680300	48.47828584990	25	DU-03-25A	Primary
03	-122.71341916000	48.47827607380	26	DU-03-26A	Primary
03	-122.71335633100	48.47826868450	27	DU-03-27A	Primary
03	-122.71335701000	48.47830216820	28	DU-03-28A	Primary

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
03	-122.71335327900	48.47833330280	29	DU-03-29A	Primary
03	-122.71335401900	48.47836173340	30	DU-03-30A	Primary
04	-122.71324425600	48.47829388460	1	DU-04-1A	Primary
04	-122.71324266100	48.47826075920	2	DU-04-2A	Primary
04	-122.71322967400	48.47823705500	3	DU-04-3A	Primary
04	-122.71318549300	48.47824111130	4	DU-04-4A	Primary
04	-122.71319795600	48.47826605160	5	DU-04-5A	Primary
04	-122.71320784100	48.47829486480	6	DU-04-6A	Primary
04	-122.71317235500	48.47829555410	7	DU-04-7A	Primary
04	-122.71313510900	48.47829669390	8	DU-04-8A	Primary
04	-122.71310051500	48.47829817480	9	DU-04-9A	Primary
04	-122.71309548900	48.47826744820	10	DU-04-10A	Primary
04	-122.71305977900	48.47830186350	11	DU-04-11A	Primary
04	-122.71303675500	48.47827945030	12	DU-04-12A	Primary
04	-122.71301648700	48.47830311080	13	DU-04-13A	Primary
04	-122.71297338100	48.47830437840	14	DU-04-14A	Primary
04	-122.71293197900	48.47830403660	15	DU-04-15A	Primary
04	-122.71292932800	48.47827316740	16	DU-04-16A	Primary
04	-122.71297680200	48.47827832410	17	DU-04-17A	Primary
04	-122.71296705400	48.47825171210	18	DU-04-18A	Primary
04	-122.71292684200	48.47824355300	19	DU-04-19A	Primary
04	-122.71293317900	48.47821845640	20	DU-04-20A	Primary
04	-122.71293718400	48.47819709680	21	DU-04-21A	Primary
04	-122.71290744000	48.47816556700	22	DU-04-22A	Primary
04	-122.71294627300	48.47817353500	23	DU-04-23A	Primary
04	-122.71293731000	48.47814859660	24	DU-04-24A	Primary
04	-122.71298005300	48.47814829360	25	DU-04-25A	Primary
04	-122.71300901400	48.47817130630	26	DU-04-26A	Primary
04	-122.71302333300	48.47814801640	27	DU-04-27A	Primary
04	-122.71305941200	48.47815387740	28	DU-04-28A	Primary
04	-122.71309253400	48.47814959680	29	DU-04-29A	Primary
04	-122.71313398500	48.47814649020	30	DU-04-30A	Primary
05	-122.71329168000	48.47825855930	1	DU-05-1A	Primary
05	-122.71329129900	48.47829018060	2	DU-05-2A	Primary
05	-122.71327289600	48.47831958660	3	DU-05-3A	Primary
05	-122.71327050200	48.47834257740	4	DU-05-4A	Primary
05	-122.71326953700	48.47836678070	5	DU-05-5A	Primary

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
05	-122.71320271100	48.47836515480	6	DU-05-6A	Primary
05	-122.71320060800	48.47832996490	7	DU-05-7A	Primary
05	-122.71314762500	48.47836716540	8	DU-05-8A	Primary
05	-122.71314577000	48.47833154120	9	DU-05-9A	Primary
05	-122.71309308000	48.47836912970	10	DU-05-10A	Primary
05	-122.71309112600	48.47833313970	11	DU-05-11A	Primary
05	-122.71303896900	48.47837048410	12	DU-05-12A	Primary
05	-122.71303686800	48.47833471510	13	DU-05-13A	Primary
05	-122.71298380200	48.47837007930	14	DU-05-14A	Primary
05	-122.71298214800	48.47833549080	15	DU-05-15A	Primary
05	-122.71293201400	48.47834139370	16	DU-05-16A	Primary
05	-122.71288312400	48.47831583560	17	DU-05-17A	Primary
05	-122.71287261300	48.47828855560	18	DU-05-18A	Primary
05	-122.71287091400	48.47826240200	19	DU-05-19A	Primary
05	-122.71286927500	48.47823516510	20	DU-05-20A	Primary
05	-122.71286770600	48.47820692150	21	DU-05-21A	Primary
05	-122.71286600600	48.47817793070	22	DU-05-22A	Primary
05	-122.71286432400	48.47814749580	23	DU-05-23A	Primary
05	-122.71286315000	48.47811532760	24	DU-05-24A	Primary
05	-122.71291977500	48.47811602490	25	DU-05-25A	Primary
05	-122.71297165700	48.47811536670	26	DU-05-26A	Primary
05	-122.71302364700	48.47811467670	27	DU-05-27A	Primary
05	-122.71307487200	48.47811408910	28	DU-05-28A	Primary
05	-122.71312518700	48.47811344530	29	DU-05-29A	Primary
05	-122.71317829200	48.47810799480	30	DU-05-30A	Primary
06	-122.71361908800	48.47819267920	1	DU-06-1B	Replicate B
06	-122.71359555000	48.47820931920	1	DU-06-1C	Replicate C
06	-122.71360323800	48.47819768420	1	DU-06-1A	Primary
06	-122.71355997600	48.47819616940	2	DU-06-2C	Replicate C
06	-122.71358069700	48.47821080770	2	DU-06-2B	Replicate B
06	-122.71357066800	48.47820405590	2	DU-06-2A	Primary
06	-122.71353727300	48.47820389820	3	DU-06-3A	Primary
06	-122.71352640500	48.47821211710	3	DU-06-3C	Replicate C
06	-122.71354874800	48.47819700700	3	DU-06-3B	Replicate B
06	-122.71350247100	48.47820462770	4	DU-06-4A	Primary
06	-122.71351418400	48.47821180650	4	DU-06-4B	Replicate B
06	-122.71349213100	48.47819731750	4	DU-06-4C	Replicate C

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Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
06	-122.71348058600	48.47821310550	5	DU-06-5C	Replicate C
06	-122.71346852800	48.47820599580	5	DU-06-5A	Primary
06	-122.71345903900	48.47819807440	5	DU-06-5B	Replicate B
06	-122.71347245100	48.47818328560	6	DU-06-6A	Primary
06	-122.71348666300	48.47819039450	6	DU-06-6B	Replicate B
06	-122.71346417800	48.47817418830	6	DU-06-6C	Replicate C
06	-122.71353356200	48.47819001190	7	DU-06-7B	Replicate B
06	-122.71351392700	48.47818371730	7	DU-06-7A	Primary
06	-122.71349442200	48.47818017550	7	DU-06-7C	Replicate C
06	-122.71354264900	48.47817932460	8	DU-06-8C	Replicate C
06	-122.71358389700	48.47818926010	8	DU-06-8B	Replicate B
06	-122.71356103200	48.47818330380	8	DU-06-8A	Primary
06	-122.71354033200	48.47816480250	9	DU-06-9C	Replicate C
06	-122.71349657200	48.47817372160	9	DU-06-9B	Replicate B
06	-122.71351805800	48.47816954840	9	DU-06-9A	Primary
06	-122.71347655200	48.47815962140	10	DU-06-10A	Primary
06	-122.71346122800	48.47816845630	10	DU-06-10B	Replicate B
06	-122.71349032300	48.47815098670	10	DU-06-10C	Replicate C
06	-122.71346745100	48.47814492100	11	DU-06-11C	Replicate C
06	-122.71348926900	48.47812424750	11	DU-06-11B	Replicate B
06	-122.71347876900	48.47813492130	11	DU-06-11A	Primary
06	-122.71348986100	48.47811025720	12	DU-06-12A	Primary
06	-122.71350802300	48.47810433460	12	DU-06-12B	Replicate B
06	-122.71347220100	48.47811932160	12	DU-06-12C	Replicate C
06	-122.71350653700	48.47808631640	13	DU-06-13C	Replicate C
06	-122.71347582800	48.47809856850	13	DU-06-13B	Replicate B
06	-122.71349206800	48.47809387730	13	DU-06-13A	Primary
06	-122.71351907600	48.47808540700	14	DU-06-14B	Replicate B
06	-122.71354870900	48.47809726670	14	DU-06-14C	Replicate C
06	-122.71353193700	48.47809246960	14	DU-06-14A	Primary
06	-122.71353394000	48.47811011570	15	DU-06-15A	Primary
06	-122.71351986800	48.47811339030	15	DU-06-15C	Replicate C
06	-122.71354671000	48.47810403050	15	DU-06-15B	Replicate B
06	-122.71354677600	48.47813554880	16	DU-06-16A	Primary
06	-122.71353800500	48.47814511760	16	DU-06-16B	Replicate B
06	-122.71356025500	48.47812655170	16	DU-06-16C	Replicate C
06	-122.71356111300	48.47817289220	17	DU-06-17B	Replicate B

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
06	-122.71354010400	48.47815145150	17	DU-06-17C	Replicate C
06	-122.71354985300	48.47815770690	17	DU-06-17A	Primary
06	-122.71359618500	48.47817273190	18	DU-06-18A	Primary
06	-122.71360560600	48.47818440970	18	DU-06-18B	Replicate B
06	-122.71357350500	48.47816887190	18	DU-06-18C	Replicate C
06	-122.71357050200	48.47815021200	19	DU-06-19B	Replicate B
06	-122.71358522300	48.47815647270	19	DU-06-19A	Primary
06	-122.71360278700	48.47816171280	19	DU-06-19C	Replicate C
06	-122.71359279400	48.47812695270	20	DU-06-20B	Replicate B
06	-122.71358059900	48.47813628050	20	DU-06-20A	Primary
06	-122.71357081800	48.47814401410	20	DU-06-20C	Replicate C
06	-122.71361616500	48.47818441600	21	DU-06-21C	Replicate C
06	-122.71362957900	48.47817748890	21	DU-06-21A	Primary
06	-122.71365432600	48.47817148530	21	DU-06-21B	Replicate B
06	-122.71366096700	48.47815598650	22	DU-06-22A	Primary
06	-122.71366611400	48.47816370540	22	DU-06-22C	Replicate C
06	-122.71365078400	48.47814777930	22	DU-06-22B	Replicate B
06	-122.71364159700	48.47816575030	23	DU-06-23B	Replicate B
06	-122.71361337900	48.47815278360	23	DU-06-23C	Replicate C
06	-122.71362675900	48.47815924570	23	DU-06-23A	Primary
06	-122.71365138300	48.47813699820	24	DU-06-24A	Primary
06	-122.71367651100	48.47813756720	24	DU-06-24B	Replicate B
06	-122.71363614900	48.47814505710	24	DU-06-24C	Replicate C
06	-122.71362544700	48.47813159040	25	DU-06-25C	Replicate C
06	-122.71361366700	48.47813642440	25	DU-06-25A	Primary
06	-122.71360223100	48.47814416100	25	DU-06-25B	Replicate B
06	-122.71363075300	48.47810339570	26	DU-06-26B	Replicate B
06	-122.71365947900	48.47812493870	26	DU-06-26C	Replicate C
06	-122.71363848900	48.47811881110	26	DU-06-26A	Primary
06	-122.71360738600	48.47811279970	27	DU-06-27A	Primary
06	-122.71361904600	48.47810415860	27	DU-06-27B	Replicate B
06	-122.71359817800	48.47812090220	27	DU-06-27C	Replicate C
06	-122.71357377600	48.47811446930	28	DU-06-28A	Primary
06	-122.71358591700	48.47810690180	28	DU-06-28C	Replicate C
06	-122.71355931800	48.47812017530	28	DU-06-28B	Replicate B
06	-122.71357795800	48.47810170680	29	DU-06-29B	Replicate B
06	-122.71355724100	48.47808399580	29	DU-06-29C	Replicate C

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
06	-122.71356876500	48.47809383260	29	DU-06-29A	Primary
06	-122.71358815500	48.47808307930	30	DU-06-30B	Replicate B
06	-122.71362206600	48.47809706820	30	DU-06-30C	Replicate C
06	-122.71359940800	48.47809163530	30	DU-06-30A	Primary
07	-122.71362639900	48.47825825820	1	DU-07-1A	Primary
07	-122.71359302400	48.47825895770	2	DU-07-2A	Primary
07	-122.71355912300	48.47825971500	3	DU-07-3A	Primary
07	-122.71352536100	48.47826043390	4	DU-07-4A	Primary
07	-122.71349248400	48.47826113840	5	DU-07-5A	Primary
07	-122.71345955100	48.47826210370	6	DU-07-6A	Primary
07	-122.71346082100	48.47823838050	7	DU-07-7A	Primary
07	-122.71348529400	48.47822171360	8	DU-07-8A	Primary
07	-122.71349147800	48.47823915780	9	DU-07-9A	Primary
07	-122.71352434100	48.47823846370	10	DU-07-10A	Primary
07	-122.71354497300	48.47822098480	11	DU-07-11A	Primary
07	-122.71355806400	48.47823775640	12	DU-07-12A	Primary
07	-122.71359237200	48.47823767160	13	DU-07-13A	Primary
07	-122.71362616900	48.47823701820	14	DU-07-14A	Primary
07	-122.71360081600	48.47821803770	15	DU-07-15A	Primary
07	-122.71363198500	48.47820887240	16	DU-07-16A	Primary
07	-122.71365945300	48.47822715990	17	DU-07-17A	Primary
07	-122.71369490700	48.47822877220	18	DU-07-18A	Primary
07	-122.71369843400	48.47821101380	19	DU-07-19A	Primary
07	-122.71365854900	48.47820507780	20	DU-07-20A	Primary
07	-122.71366238500	48.47818196520	21	DU-07-21A	Primary
07	-122.71369105900	48.47819229820	22	DU-07-22A	Primary
07	-122.71371898700	48.47818462910	23	DU-07-23A	Primary
07	-122.71369444500	48.47817040280	24	DU-07-24A	Primary
07	-122.71370800700	48.47815455700	25	DU-07-25A	Primary
07	-122.71370482300	48.47813884360	26	DU-07-26A	Primary
07	-122.71369109600	48.47812397050	27	DU-07-27A	Primary
07	-122.71368879000	48.47810166700	28	DU-07-28A	Primary
07	-122.71365892700	48.47810550300	29	DU-07-29A	Primary
07	-122.71364822900	48.47809046280	30	DU-07-30A	Primary
08	-122.71367183900	48.47806744590	1	DU-08-1A	Primary
08	-122.71365435400	48.47805603350	1	DU-08-1C	Replicate C
08	-122.71369373300	48.47808078890	1	DU-08-1B	Replicate B

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
08	-122.71362820800	48.47806507170	2	DU-08-2A	Primary
08	-122.71361526200	48.47805128530	2	DU-08-2C	Replicate C
08	-122.71364035300	48.47808071470	2	DU-08-2B	Replicate B
08	-122.71367164600	48.47803688880	3	DU-08-3A	Primary
08	-122.71369116900	48.47802507880	3	DU-08-3B	Replicate B
08	-122.71365572400	48.47804758390	3	DU-08-3C	Replicate C
08	-122.71362363900	48.47803164910	4	DU-08-4A	Primary
08	-122.71361391500	48.47804108710	4	DU-08-4C	Replicate C
08	-122.71363928800	48.47801995390	4	DU-08-4B	Replicate B
08	-122.71355804900	48.47802566540	5	DU-08-5A	Primary
08	-122.71352844800	48.47803038290	5	DU-08-5B	Replicate B
08	-122.71358660600	48.47801985300	5	DU-08-5C	Replicate C
08	-122.71349862700	48.47801492850	6	DU-08-6A	Primary
08	-122.71349010300	48.47799899520	6	DU-08-6C	Replicate C
08	-122.71351212500	48.47803059910	6	DU-08-6B	Replicate B
08	-122.71353482300	48.47799766190	7	DU-08-7A	Primary
08	-122.71354802700	48.47801090100	7	DU-08-7B	Replicate B
08	-122.71351610800	48.47798760920	7	DU-08-7C	Replicate C
08	-122.71358572700	48.47800265860	8	DU-08-8A	Primary
08	-122.71360765200	48.47801102430	8	DU-08-8B	Replicate B
08	-122.71356463600	48.47799496150	8	DU-08-8C	Replicate C
08	-122.71364239800	48.47799891230	9	DU-08-9A	Primary
08	-122.71367546700	48.47798988700	9	DU-08-9B	Replicate B
08	-122.71362411200	48.47801021560	9	DU-08-9C	Replicate C
08	-122.71368688400	48.47800537230	10	DU-08-10A	Primary
08	-122.71371433300	48.47799104330	10	DU-08-10C	Replicate C
08	-122.71367155900	48.47801420720	10	DU-08-10B	Replicate B
08	-122.71372264000	48.47796952510	11	DU-08-11A	Primary
08	-122.71370362600	48.47798156100	11	DU-08-11B	Replicate B
08	-122.71374861100	48.47795839880	11	DU-08-11C	Replicate C
08	-122.71366327900	48.47797336600	12	DU-08-12A	Primary
08	-122.71368596800	48.47796463370	12	DU-08-12B	Replicate B
08	-122.71364095600	48.47798148020	12	DU-08-12C	Replicate C
08	-122.71366937400	48.47795076690	13	DU-08-13A	Primary
08	-122.71369919000	48.47795492660	13	DU-08-13C	Replicate C
08	-122.71364251300	48.47794639650	13	DU-08-13B	Replicate B
08	-122.71373047000	48.47793909610	14	DU-08-14A	Primary

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Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
08	-122.71371375000	48.47792836320	14	DU-08-14C	Replicate C
08	-122.71374962100	48.47794929750	14	DU-08-14B	Replicate B
08	-122.71366923800	48.47792972550	15	DU-08-15A	Primary
08	-122.71369640300	48.47792340640	15	DU-08-15B	Replicate B
08	-122.71363881600	48.47793600180	15	DU-08-15C	Replicate C
08	-122.71372916600	48.47790685500	16	DU-08-16A	Primary
08	-122.71374694700	48.47791694020	16	DU-08-16C	Replicate C
08	-122.71371090200	48.47789605800	16	DU-08-16B	Replicate B
08	-122.71366720400	48.47790886580	17	DU-08-17A	Primary
08	-122.71369852000	48.47791425530	17	DU-08-17C	Replicate C
08	-122.71363707200	48.47790351950	17	DU-08-17B	Replicate B
08	-122.71366799200	48.47788837860	18	DU-08-18A	Primary
08	-122.71369507800	48.47788097390	18	DU-08-18C	Replicate C
08	-122.71363859400	48.47789350510	18	DU-08-18B	Replicate B
08	-122.71372606900	48.47787510160	19	DU-08-19A	Primary
08	-122.71374332200	48.47788507950	19	DU-08-19B	Replicate B
08	-122.71370960100	48.47786413650	19	DU-08-19C	Replicate C
08	-122.71372407600	48.47784255450	20	DU-08-20A	Primary
08	-122.71370822400	48.47785386060	20	DU-08-20B	Replicate B
08	-122.71374085000	48.47783104660	20	DU-08-20C	Replicate C
08	-122.71368448200	48.47785305400	21	DU-08-21A	Primary
08	-122.71369266900	48.47783192790	21	DU-08-21C	Replicate C
08	-122.71367569000	48.47787221950	21	DU-08-21B	Replicate B
08	-122.71365183700	48.47785277010	22	DU-08-22A	Primary
08	-122.71364433600	48.47783357530	22	DU-08-22B	Replicate B
08	-122.71365741100	48.47787211010	22	DU-08-22C	Replicate C
08	-122.71360703300	48.47784765140	23	DU-08-23A	Primary
08	-122.71362969000	48.47785599390	23	DU-08-23C	Replicate C
08	-122.71360012700	48.47783638320	23	DU-08-23B	Replicate B
08	-122.71360579300	48.47787746650	24	DU-08-24A	Primary
08	-122.71362791100	48.47786611430	24	DU-08-24B	Replicate B
08	-122.71358959400	48.47788725110	24	DU-08-24C	Replicate C
08	-122.71358700000	48.47790189340	25	DU-08-25A	Primary
08	-122.71362224000	48.47790557030	25	DU-08-25C	Replicate C
08	-122.71355350800	48.47789733430	25	DU-08-25B	Replicate B
08	-122.71356405000	48.47787206020	26	DU-08-26A	Primary
08	-122.71355590200	48.47788743170	26	DU-08-26B	Replicate B

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
08	-122.71357434200	48.47785305350	26	DU-08-26C	Replicate C
08	-122.71351747600	48.47789297630	27	DU-08-27A	Primary
08	-122.71348819400	48.47790072100	27	DU-08-27C	Replicate C
08	-122.71353805000	48.47787495640	27	DU-08-27B	Replicate B
08	-122.71351302000	48.47791811250	28	DU-08-28A	Primary
08	-122.71353867100	48.47790948660	28	DU-08-28B	Replicate B
08	-122.71348812200	48.47792448480	28	DU-08-28C	Replicate C
08	-122.71350667100	48.47794503580	29	DU-08-29A	Primary
08	-122.71352051400	48.47795359700	29	DU-08-29C	Replicate C
08	-122.71348946800	48.47793452870	29	DU-08-29B	Replicate B
08	-122.71351060800	48.47797200050	30	DU-08-30A	Primary
08	-122.71348908000	48.47797883530	30	DU-08-30C	Replicate C
08	-122.71348907400	48.47796361150	30	DU-08-30B	Replicate B
09	-122.71358383300	48.47806904710	1	DU-09-1A	Primary
09	-122.71358316700	48.47804668780	2	DU-09-2A	Primary
09	-122.71353565500	48.47806981320	3	DU-09-3A	Primary
09	-122.71353503700	48.47804673830	4	DU-09-4A	Primary
09	-122.71348953100	48.47807054250	5	DU-09-5A	Primary
09	-122.71344975200	48.47806630790	6	DU-09-6A	Primary
09	-122.71348878600	48.47804667330	7	DU-09-7A	Primary
09	-122.71345435100	48.47803563880	8	DU-09-8A	Primary
09	-122.71345790200	48.47801259000	9	DU-09-9A	Primary
09	-122.71345739000	48.47799064950	10	DU-09-10A	Primary
09	-122.71345691300	48.47796875730	11	DU-09-11A	Primary
09	-122.71345621300	48.47794725490	12	DU-09-12A	Primary
09	-122.71345579100	48.47792575520	13	DU-09-13A	Primary
09	-122.71345589000	48.47790413810	14	DU-09-14A	Primary
09	-122.71345895700	48.47788453900	15	DU-09-15A	Primary
09	-122.71345893600	48.47786620780	16	DU-09-16A	Primary
09	-122.71345858900	48.47784769470	17	DU-09-17A	Primary
09	-122.71345810000	48.47782918720	18	DU-09-18A	Primary
09	-122.71346104200	48.47781049840	19	DU-09-19A	Primary
09	-122.71350122600	48.47786754300	20	DU-09-20A	Primary
09	-122.71350295900	48.47783042760	21	DU-09-21A	Primary
09	-122.71350285500	48.47779738130	22	DU-09-22A	Primary
09	-122.71352875200	48.47785172200	23	DU-09-23A	Primary
09	-122.71354135800	48.47781294780	24	DU-09-24A	Primary

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
09	-122.71355636200	48.47783580450	25	DU-09-25A	Primary
09	-122.71358426700	48.47781938200	26	DU-09-26A	Primary
09	-122.71361673800	48.47781441330	27	DU-09-27A	Primary
09	-122.71365228100	48.47781360190	28	DU-09-28A	Primary
09	-122.71368915500	48.47781267240	29	DU-09-29A	Primary
09	-122.71372717500	48.47781187170	30	DU-09-30A	Primary
10	-122.71341414900	48.47806466840	1	DU-10-1A	Primary
10	-122.71337463300	48.47806290150	2	DU-10-2A	Primary
10	-122.71333406700	48.47806101750	3	DU-10-3A	Primary
10	-122.71328873400	48.47805660020	4	DU-10-4A	Primary
10	-122.71327942600	48.47800898370	5	DU-10-5A	Primary
10	-122.71331233000	48.47802054000	6	DU-10-6A	Primary
10	-122.71334706400	48.47802031250	7	DU-10-7A	Primary
10	-122.71338127100	48.47802005220	8	DU-10-8A	Primary
10	-122.71341553100	48.47801980340	9	DU-10-9A	Primary
10	-122.71341441400	48.47797271850	10	DU-10-10A	Primary
10	-122.71338026600	48.47797288930	11	DU-10-11A	Primary
10	-122.71334611400	48.47797313210	12	DU-10-12A	Primary
10	-122.71331147500	48.47797334090	13	DU-10-13A	Primary
10	-122.71327876100	48.47795207520	14	DU-10-14A	Primary
10	-122.71331058500	48.47792621060	15	DU-10-15A	Primary
10	-122.71334512700	48.47792601390	16	DU-10-16A	Primary
10	-122.71337922800	48.47792578340	17	DU-10-17A	Primary
10	-122.71341321500	48.47792562340	18	DU-10-18A	Primary
10	-122.71341210700	48.47787863970	19	DU-10-19A	Primary
10	-122.71337822800	48.47787884260	20	DU-10-20A	Primary
10	-122.71334418200	48.47787907290	21	DU-10-21A	Primary
10	-122.71330973500	48.47787926860	22	DU-10-22A	Primary
10	-122.71327808000	48.47789491690	23	DU-10-23A	Primary
10	-122.71327736200	48.47783796650	24	DU-10-24A	Primary
10	-122.71330886500	48.47783249870	25	DU-10-25A	Primary
10	-122.71334321300	48.47783218050	26	DU-10-26A	Primary
10	-122.71337720500	48.47783182900	27	DU-10-27A	Primary
10	-122.71341126400	48.47783145980	28	DU-10-28A	Primary
10	-122.71332230800	48.47780245930	29	DU-10-29A	Primary
10	-122.71328720600	48.47777779820	30	DU-10-30A	Primary
11	-122.71315621200	48.47804222320	1	DU-11-1A	Primary

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
11	-122.71316532900	48.47801961930	2	DU-11-2A	Primary
11	-122.71316616500	48.47799445790	3	DU-11-3A	Primary
11	-122.71316446300	48.47796707810	4	DU-11-4A	Primary
11	-122.71316607000	48.47794003920	5	DU-11-5A	Primary
11	-122.71316450100	48.47791329850	6	DU-11-6A	Primary
11	-122.71316420800	48.47788565500	7	DU-11-7A	Primary
11	-122.71315831600	48.47786108380	8	DU-11-8A	Primary
11	-122.71311732800	48.47786393110	9	DU-11-9A	Primary
11	-122.71307867000	48.47786410110	10	DU-11-10A	Primary
11	-122.71304101900	48.47786546150	11	DU-11-11A	Primary
11	-122.71300702900	48.47786819760	12	DU-11-12A	Primary
11	-122.71297882500	48.47786890860	13	DU-11-13A	Primary
11	-122.71295367400	48.47787033360	14	DU-11-14A	Primary
11	-122.71291780400	48.47786286870	15	DU-11-15A	Primary
11	-122.71291880300	48.47788978740	16	DU-11-16A	Primary
11	-122.71291936300	48.47791712250	17	DU-11-17A	Primary
11	-122.71292004200	48.47794522600	18	DU-11-18A	Primary
11	-122.71296004000	48.47794245460	19	DU-11-19A	Primary
11	-122.71299826900	48.47794307650	20	DU-11-20A	Primary
11	-122.71299805000	48.47797031980	21	DU-11-21A	Primary
11	-122.71296146100	48.47797142770	22	DU-11-22A	Primary
11	-122.71291922900	48.47797334980	23	DU-11-23A	Primary
11	-122.71291942000	48.47800067080	24	DU-11-24A	Primary
11	-122.71291822600	48.47802727370	25	DU-11-25A	Primary
11	-122.71294271100	48.47804188700	26	DU-11-26A	Primary
11	-122.71298330800	48.47804151070	27	DU-11-27A	Primary
11	-122.71302166500	48.47804119050	28	DU-11-28A	Primary
11	-122.71306618500	48.47804152880	29	DU-11-29A	Primary
11	-122.71310861800	48.47804111410	30	DU-11-30A	Primary
12	-122.71323900400	48.47805872240	1	DU-12-1A	Primary
12	-122.71318543100	48.47806111530	2	DU-12-2A	Primary
12	-122.71311609700	48.47806408590	3	DU-12-3A	Primary
12	-122.71304310300	48.47806479880	4	DU-12-4A	Primary
12	-122.71296956700	48.47806537630	5	DU-12-5A	Primary
12	-122.71289573900	48.47806565350	6	DU-12-6A	Primary
12	-122.71287936800	48.47803811380	7	DU-12-7A	Primary
12	-122.71287743600	48.47799887620	8	DU-12-8A	Primary

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
12	-122.71287835000	48.47796036490	9	DU-12-9A	Primary
12	-122.71287763700	48.47792213550	10	DU-12-10A	Primary
12	-122.71287683400	48.47788359010	11	DU-12-11A	Primary
12	-122.71287589900	48.47784712010	12	DU-12-12A	Primary
12	-122.71289095600	48.47782535810	13	DU-12-13A	Primary
12	-122.71294034100	48.47783025320	14	DU-12-14A	Primary
12	-122.71298385200	48.47783028240	15	DU-12-15A	Primary
12	-122.71302790500	48.47783030500	16	DU-12-16A	Primary
12	-122.71307191300	48.47783028930	17	DU-12-17A	Primary
12	-122.71311486600	48.47783032480	18	DU-12-18A	Primary
12	-122.71315732000	48.47783024180	19	DU-12-19A	Primary
12	-122.71320028500	48.47783046460	20	DU-12-20A	Primary
12	-122.71324230600	48.47783040310	21	DU-12-21A	Primary
12	-122.71322409000	48.47786002600	22	DU-12-22A	Primary
12	-122.71322457200	48.47788165510	23	DU-12-23A	Primary
12	-122.71322472200	48.47790347080	24	DU-12-24A	Primary
12	-122.71322492000	48.47792524850	25	DU-12-25A	Primary
12	-122.71322543500	48.47794710480	26	DU-12-26A	Primary
12	-122.71322566100	48.47796857520	27	DU-12-27A	Primary
12	-122.71322562300	48.47798964390	28	DU-12-28A	Primary
12	-122.71322624200	48.47801066070	29	DU-12-29A	Primary
12	-122.71322653800	48.47803206240	30	DU-12-30A	Primary
13	-122.71318565200	48.47808327830	1	DU-13-1A	Primary
13	-122.71322534700	48.47808080310	1	DU-13-1B	Replicate B
13	-122.71313571300	48.47808952540	1	DU-13-1C	Replicate C
13	-122.71307277800	48.47808502560	2	DU-13-2A	Primary
13	-122.71302648800	48.47807923810	2	DU-13-2C	Replicate C
13	-122.71311624700	48.47808745810	2	DU-13-2B	Replicate B
13	-122.71296880100	48.47808631700	3	DU-13-3A	Primary
13	-122.71300834000	48.47808215790	3	DU-13-3B	Replicate B
13	-122.71292469300	48.47809343550	3	DU-13-3C	Replicate C
13	-122.71287167500	48.47808759910	4	DU-13-4A	Primary
13	-122.71290878700	48.47808214730	4	DU-13-4B	Replicate B
13	-122.71282827500	48.47809596640	4	DU-13-4C	Replicate C
13	-122.71280976700	48.47807972800	5	DU-13-5A	Primary
13	-122.71284981700	48.47807004600	5	DU-13-5C	Replicate C
13	-122.71278755400	48.47809171180	5	DU-13-5B	Replicate B

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
13	-122.71281732800	48.47805334020	6	DU-13-6A	Primary
13	-122.71284469700	48.47804792330	6	DU-13-6B	Replicate B
13	-122.71278407000	48.47805808740	6	DU-13-6C	Replicate C
13	-122.71281662700	48.47802884320	7	DU-13-7A	Primary
13	-122.71278755000	48.47802497990	7	DU-13-7B	Replicate B
13	-122.71285215000	48.47803478840	7	DU-13-7C	Replicate C
13	-122.71281603200	48.47800349300	8	DU-13-8A	Primary
13	-122.71284608700	48.47799690240	8	DU-13-8B	Replicate B
13	-122.71278084800	48.47800989350	8	DU-13-8C	Replicate C
13	-122.71281464500	48.47797899190	9	DU-13-9A	Primary
13	-122.71278406600	48.47797458060	9	DU-13-9B	Replicate B
13	-122.71284958300	48.47798465410	9	DU-13-9C	Replicate C
13	-122.71281410300	48.47795529030	10	DU-13-10A	Primary
13	-122.71284351800	48.47794920090	10	DU-13-10B	Replicate B
13	-122.71278056200	48.47796261690	10	DU-13-10C	Replicate C
13	-122.71281279500	48.47793247090	11	DU-13-11A	Primary
13	-122.71277909100	48.47792800320	11	DU-13-11B	Replicate B
13	-122.71284931500	48.47793785960	11	DU-13-11C	Replicate C
13	-122.71281212600	48.47791195620	12	DU-13-12A	Primary
13	-122.71284522600	48.47790685530	12	DU-13-12B	Replicate B
13	-122.71277603200	48.47791830400	12	DU-13-12C	Replicate C
13	-122.71281161900	48.47789150790	13	DU-13-13A	Primary
13	-122.71277837300	48.47788623960	13	DU-13-13B	Replicate B
13	-122.71284706600	48.47789640440	13	DU-13-13C	Replicate C
13	-122.71281050700	48.47786937610	14	DU-13-14A	Primary
13	-122.71284440800	48.47786238060	14	DU-13-14B	Replicate B
13	-122.71277668400	48.47787680160	14	DU-13-14C	Replicate C
13	-122.71280982500	48.47784689540	15	DU-13-15A	Primary
13	-122.71277675900	48.47784232040	15	DU-13-15B	Replicate B
13	-122.71284833700	48.47785199730	15	DU-13-15C	Replicate C
13	-122.71280889500	48.47782406000	16	DU-13-16A	Primary
13	-122.71284193900	48.47781739020	16	DU-13-16B	Replicate B
13	-122.71277355000	48.47783101860	16	DU-13-16C	Replicate C
13	-122.71279878800	48.47779743550	17	DU-13-17A	Primary
13	-122.71282776200	48.47778575170	17	DU-13-17C	Replicate C
13	-122.71277303800	48.47780765850	17	DU-13-17B	Replicate B
13	-122.71279716400	48.47776752960	18	DU-13-18A	Primary

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
13	-122.71277015000	48.47775822210	18	DU-13-18C	Replicate C
13	-122.71282162900	48.47777540220	18	DU-13-18B	Replicate B
13	-122.71285014600	48.47778222750	19	DU-13-19A	Primary
13	-122.71285609800	48.47775856630	19	DU-13-19B	Replicate B
13	-122.71283947300	48.47780823720	19	DU-13-19C	Replicate C
13	-122.71288589400	48.47778250410	20	DU-13-20A	Primary
13	-122.71287755200	48.47775840760	20	DU-13-20C	Replicate C
13	-122.71289287800	48.47780462700	20	DU-13-20B	Replicate B
13	-122.71292154200	48.47778245030	21	DU-13-21A	Primary
13	-122.71291161300	48.47775929220	21	DU-13-21B	Replicate B
13	-122.71291201200	48.47780754150	21	DU-13-21C	Replicate C
13	-122.71295771000	48.47778249960	22	DU-13-22A	Primary
13	-122.71296965400	48.47775691170	22	DU-13-22C	Replicate C
13	-122.71294837300	48.47780481070	22	DU-13-22B	Replicate B
13	-122.71299392000	48.47778230800	23	DU-13-23A	Primary
13	-122.71300062300	48.47776110170	23	DU-13-23B	Replicate B
13	-122.71298310000	48.47780686930	23	DU-13-23C	Replicate C
13	-122.71302950600	48.47778272260	24	DU-13-24A	Primary
13	-122.71301835000	48.47775901550	24	DU-13-24C	Replicate C
13	-122.71303732400	48.47780499360	24	DU-13-24B	Replicate B
13	-122.71306510500	48.47778258420	25	DU-13-25A	Primary
13	-122.71305317800	48.47775893230	25	DU-13-25C	Replicate C
13	-122.71307241100	48.47780496620	25	DU-13-25B	Replicate B
13	-122.71310102200	48.47778258740	26	DU-13-26A	Primary
13	-122.71309281600	48.47776068930	26	DU-13-26B	Replicate B
13	-122.71311010100	48.47780721870	26	DU-13-26C	Replicate C
13	-122.71313677500	48.47778275190	27	DU-13-27A	Primary
13	-122.71312571600	48.47775823640	27	DU-13-27C	Replicate C
13	-122.71314421600	48.47780488490	27	DU-13-27B	Replicate B
13	-122.71317247900	48.47778272730	28	DU-13-28A	Primary
13	-122.71316545600	48.47776113690	28	DU-13-28B	Replicate B
13	-122.71318410800	48.47780698150	28	DU-13-28C	Replicate C
13	-122.71320825600	48.47778277080	29	DU-13-29A	Primary
13	-122.71321932200	48.47775816330	29	DU-13-29C	Replicate C
13	-122.71319963100	48.47780289960	29	DU-13-29B	Replicate B
13	-122.71324427200	48.47778283600	30	DU-13-30A	Primary
13	-122.71325277600	48.47776134600	30	DU-13-30B	Replicate B

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
13	-122.71323276800	48.47780812090	30	DU-13-30C	Replicate C
14	-122.71278530500	48.47769820560	1	DU-14-1A	Primary
14	-122.71276469600	48.47769884850	2	DU-14-2A	Primary
14	-122.71274408800	48.47769949140	3	DU-14-3A	Primary
14	-122.71272347900	48.47770013430	4	DU-14-4A	Primary
14	-122.71270287000	48.47770077720	5	DU-14-5A	Primary
14	-122.71278391400	48.47767849940	6	DU-14-6A	Primary
14	-122.71276330600	48.47767914230	7	DU-14-7A	Primary
14	-122.71274269700	48.47767978520	8	DU-14-8A	Primary
14	-122.71272208800	48.47768042810	9	DU-14-9A	Primary
14	-122.71270147900	48.47768107100	10	DU-14-10A	Primary
14	-122.71278252400	48.47765879330	11	DU-14-11A	Primary
14	-122.71276191500	48.47765943620	12	DU-14-12A	Primary
14	-122.71274130600	48.47766007910	13	DU-14-13A	Primary
14	-122.71272069800	48.47766072200	14	DU-14-14A	Primary
14	-122.71270008900	48.47766136490	15	DU-14-15A	Primary
14	-122.71278113300	48.47763908710	16	DU-14-16A	Primary
14	-122.71276052400	48.47763973000	17	DU-14-17A	Primary
14	-122.71273991600	48.47764037290	18	DU-14-18A	Primary
14	-122.71271930700	48.47764101580	19	DU-14-19A	Primary
14	-122.71269869800	48.47764165870	20	DU-14-20A	Primary
14	-122.71277974200	48.47761938090	21	DU-14-21A	Primary
14	-122.71275913400	48.47762002380	22	DU-14-22A	Primary
14	-122.71273852500	48.47762066670	23	DU-14-23A	Primary
14	-122.71271791600	48.47762130960	24	DU-14-24A	Primary
14	-122.71269730800	48.47762195250	25	DU-14-25A	Primary
14	-122.71277835200	48.47759967470	26	DU-14-26A	Primary
14	-122.71275774300	48.47760031760	27	DU-14-27A	Primary
14	-122.71273713400	48.47760096050	28	DU-14-28A	Primary
14	-122.71271652600	48.47760160340	29	DU-14-29A	Primary
14	-122.71269591700	48.47760224630	30	DU-14-30A	Primary
15	-122.71274809100	48.47805480460	1	DU-15-1A	Primary
15	-122.71271846100	48.47805508610	2	DU-15-2A	Primary
15	-122.71268883100	48.47805536760	3	DU-15-3A	Primary
15	-122.71265920100	48.47805564900	4	DU-15-4A	Primary
15	-122.71262957100	48.47805593050	5	DU-15-5A	Primary
15	-122.71274772600	48.47803781700	6	DU-15-6A	Primary

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
15	-122.71271809600	48.47803809850	7	DU-15-7A	Primary
15	-122.71268846600	48.47803838000	8	DU-15-8A	Primary
15	-122.71265883600	48.47803866150	9	DU-15-9A	Primary
15	-122.71262920600	48.47803894300	10	DU-15-10A	Primary
15	-122.71274736100	48.47802082950	11	DU-15-11A	Primary
15	-122.71271773100	48.47802111100	12	DU-15-12A	Primary
15	-122.71268810100	48.47802139250	13	DU-15-13A	Primary
15	-122.71265847100	48.47802167390	14	DU-15-14A	Primary
15	-122.71262884100	48.47802195540	15	DU-15-15A	Primary
15	-122.71274699600	48.47800384190	16	DU-15-16A	Primary
15	-122.71271736600	48.47800412340	17	DU-15-17A	Primary
15	-122.71268773600	48.47800440490	18	DU-15-18A	Primary
15	-122.71265810600	48.47800468640	19	DU-15-19A	Primary
15	-122.71262847600	48.47800496790	20	DU-15-20A	Primary
15	-122.71274663100	48.47798685440	21	DU-15-21A	Primary
15	-122.71271700100	48.47798713590	22	DU-15-22A	Primary
15	-122.71268737100	48.47798741740	23	DU-15-23A	Primary
15	-122.71265774100	48.47798769890	24	DU-15-24A	Primary
15	-122.71262811100	48.47798798030	25	DU-15-25A	Primary
15	-122.71274626600	48.47796986680	26	DU-15-26A	Primary
15	-122.71271663600	48.47797014830	27	DU-15-27A	Primary
15	-122.71268700600	48.47797042980	28	DU-15-28A	Primary
15	-122.71265737600	48.47797071130	29	DU-15-29A	Primary
15	-122.71262774600	48.47797099280	30	DU-15-30A	Primary
16	-122.71228267900	48.47793758960	1	DU-16-1A	Primary
16	-122.71225907900	48.47793832580	2	DU-16-2A	Primary
16	-122.71223547800	48.47793906190	3	DU-16-3A	Primary
16	-122.71221187800	48.47793979810	4	DU-16-4A	Primary
16	-122.71218827700	48.47794053420	5	DU-16-5A	Primary
16	-122.71228144500	48.47792009350	6	DU-16-6A	Primary
16	-122.71225784400	48.47792082970	7	DU-16-7A	Primary
16	-122.71223424400	48.47792156580	8	DU-16-8A	Primary
16	-122.71221064300	48.47792230200	9	DU-16-9A	Primary
16	-122.71218704300	48.47792303810	10	DU-16-10A	Primary
16	-122.71228021000	48.47790259740	11	DU-16-11A	Primary
16	-122.71225661000	48.47790333360	12	DU-16-12A	Primary
16	-122.71223300900	48.47790406970	13	DU-16-13A	Primary

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
16	-122.71220940900	48.47790480580	14	DU-16-14A	Primary
16	-122.71218580800	48.47790554200	15	DU-16-15A	Primary
16	-122.71227897500	48.47788510130	16	DU-16-16A	Primary
16	-122.71225537500	48.47788583740	17	DU-16-17A	Primary
16	-122.71223177500	48.47788657360	18	DU-16-18A	Primary
16	-122.71220817400	48.47788730970	19	DU-16-19A	Primary
16	-122.71218457400	48.47788804590	20	DU-16-20A	Primary
16	-122.71227774100	48.47786760520	21	DU-16-21A	Primary
16	-122.71225414000	48.47786834130	22	DU-16-22A	Primary
16	-122.71223054000	48.47786907750	23	DU-16-23A	Primary
16	-122.71220694000	48.47786981360	24	DU-16-24A	Primary
16	-122.71218333900	48.47787054970	25	DU-16-25A	Primary
16	-122.71227650600	48.47785010900	26	DU-16-26A	Primary
16	-122.71225290600	48.47785084520	27	DU-16-27A	Primary
16	-122.71222930500	48.47785158130	28	DU-16-28A	Primary
16	-122.71220570500	48.47785231750	29	DU-16-29A	Primary
16	-122.71218210500	48.47785305360	30	DU-16-30A	Primary
17	-122.71193742900	48.47799934750	1	DU-17-1A	Primary
17	-122.71190541500	48.47800327980	2	DU-17-2A	Primary
17	-122.71187343800	48.47800719530	3	DU-17-3A	Primary
17	-122.71184154000	48.47801109690	4	DU-17-4A	Primary
17	-122.71180951700	48.47801503610	5	DU-17-5A	Primary
17	-122.71177779000	48.47801891130	6	DU-17-6A	Primary
17	-122.71193107300	48.47797668670	7	DU-17-7A	Primary
17	-122.71189907100	48.47798062300	8	DU-17-8A	Primary
17	-122.71186714700	48.47798453680	9	DU-17-9A	Primary
17	-122.71183521100	48.47798844820	10	DU-17-10A	Primary
17	-122.71180320600	48.47799239040	11	DU-17-11A	Primary
17	-122.71177151100	48.47799626690	12	DU-17-12A	Primary
17	-122.71192465800	48.47795388970	13	DU-17-13A	Primary
17	-122.71189268600	48.47795789470	14	DU-17-14A	Primary
17	-122.71186083500	48.47796187180	15	DU-17-15A	Primary
17	-122.71182887900	48.47796585830	16	DU-17-16A	Primary
17	-122.71179690900	48.47796986830	17	DU-17-17A	Primary
17	-122.71176526400	48.47797381050	18	DU-17-18A	Primary
17	-122.71191825400	48.47793116810	19	DU-17-19A	Primary
17	-122.71188629300	48.47793517760	20	DU-17-20A	Primary

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
17	-122.71185449800	48.47793915340	21	DU-17-21A	Primary
17	-122.71182250200	48.47794315030	22	DU-17-22A	Primary
17	-122.71179055100	48.47794716430	23	DU-17-23A	Primary
17	-122.71175893700	48.47795110770	24	DU-17-24A	Primary
17	-122.71191192000	48.47790863940	25	DU-17-25A	Primary
17	-122.71187995900	48.47791261250	26	DU-17-26A	Primary
17	-122.71184820700	48.47791654730	27	DU-17-27A	Primary
17	-122.71181616200	48.47792051480	28	DU-17-28A	Primary
17	-122.71178421800	48.47792449120	29	DU-17-29A	Primary
17	-122.71175262500	48.47792839710	30	DU-17-30A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-1A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-2A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-3A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-4A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-5A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-6A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-7A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-8A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-9A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-10A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-11A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-12A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-13A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-14A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-15A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-16A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-17A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-18A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-19A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-20A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-21A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-22A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-23A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-24A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-25A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-26A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-27A	Primary

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type
18	Unassigned	Unassigned	Unassigned	DU-18-28A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-29A	Primary
18	Unassigned	Unassigned	Unassigned	DU-18-30A	Primary

Table 5
Increment Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU[1]	X Coordinate[2]	Y Coordinate[2]	DU Cell	Sample ID	Sample Type

Notes:

1. Increment sample locations for DU 18 will be determined in the field. Actual number of increments ma

2. GPS Datum = North American Datum of 1983.

Acronyms and Abbreviations:
DU = decision unit
ID = identification

Table 6
Incremental Sampling Plan
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU	Subunits	Depth[1] (feet bgs)	Average Lead Concentration, XRF (ppm)	Analyses	Duplicate/ Triplicate ISM Samples	Number of Incremental Samples[2]	Rationale
1	SU1 - SU4	0.0 - 0.5 0.5 - 1.0	186.9	Lead (USEPA Method 6010)	--	60	Encompasses highest concentration samples at the boathouse, including trench.
2	SU1 - SU3	0.0 - 0.5 0.5 - 1.0	54.2	Lead (USEPA Method 6010)	X	120	Includes all samples 20 to 40 feet from the boathouse. All samples are 0 to 250 ppm.
3	SU1 - SU4	0.0 - 0.5 0.5 - 1.0	N/A	Lead (USEPA Method 6010)	--	60	Covers unsampled area next to the boathouse and north of the helicopter pad.
4	SU1 - SU4	0.0 - 0.5 0.5 - 1.0	403.6	Lead (USEPA Method 6010)	--	60	Encompasses highest concentration samples around Officer-in-Charge quarters, including samples >1,000 ppm.
5	SU1 - SU4	0.0 - 0.5 0.5 - 1.0	93.5	Lead (USEPA Method 6010)	--	60	Includes low concentration samples (0 to 250 ppm) outside DU 4.
6	SU1 - SU4	0.0 - 0.5 0.5 - 1.0	1578.1	Lead (USEPA Method 6010)	X	120	Encompasses the bulk of the high concentration (>1,000 ppm) samples in the center of the oil and paint storage building.
7	SU1 - SU3	0.0 - 0.5 0.5 - 1.0	101.8	Lead (USEPA Method 6010)	--	60	Includes lower concentration samples at the oil and paint storage building outside DU 6, but including some samples >1,000 ppm.
8	SU1 - SU4	0.0 - 0.5 0.5 - 1.0	1796.9	Lead (USEPA Method 6010)	X	120	Encompasses the bulk of the high concentration (>1,000 ppm) samples surrounding the Burrows Island Light Station.
9	SU1 - SU4	0.0 - 0.5 0.5 - 1.0	101.5	Lead (USEPA Method 6010)	--	60	Includes lower concentration samples at the Burrows Island Light Station outside DU 8, but including some samples >1,000 ppm.

Table 6
Incremental Sampling Plan
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

DU	Subunits	Depth[1] (feet bgs)	Average Lead Concentration, XRF (ppm)	Analyses	Duplicate/ Triplicate ISM Samples	Number of Incremental Samples[2]	Rationale
10	SU1 - SU4	0.0 - 0.5 0.5 - 1.0	56.6	Lead (USEPA Method 6010)	--	60	Covers the space between the Burrows Island Light Station and the duplex. All samples in this area were <250 ppm.
11	SU1 - SU4	0.0 - 0.5 0.5 - 1.0	470.3	Lead (USEPA Method 6010)	--	60	Encompasses the bulk of the high concentration (>1,000 ppm) samples surrounding the duplex, within the first 10 feet.
12	SU1 - SU4	0.0 - 0.5 0.5 - 1.0	291.7	Lead (USEPA Method 6010)	--	60	Includes the next 10 feet beyond DU 12.
13	SU1 - SU3	0.0 - 0.5 0.5 - 1.0	143.3	Lead (USEPA Method 6010)	X	120	Covers the rest of the area surrounding DU 13.
14	SU1, SU2	0.0 - 0.5 0.5 - 1.0	480.0	Lead (USEPA Method 6010)	--	60	Covers the area surrounding the 10,000-gallon fuel oil tank.
15	SU1 - SU4	0.0 - 0.5 0.5 - 1.0	127.4	Lead (USEPA Method 6010)	--	60	Surrounds the firehouse pump building.
16	SU1, SU2	0.0 - 0.5 0.5 - 1.0	7.2	Lead (USEPA Method 6010)	--	60	Encompasses the area around the two western water tanks.
17	SU1 - SU4	0.0 - 0.5 0.5 - 1.0	495.0	Lead (USEPA Method 6010)	--	60	Encompasses the area around the two eastern water tanks.
18	N/A	0.0 - 0.5 0.5 - 1.0	N/A	Lead (USEPA Method 6010)	--	60	Encompasses area of limited accessibility in area of Officer-in-Charge quarters. Actual number of increment samples may vary.

Notes:

1. Deeper sampling interval may be revised based on XRF screening in the field.
2. Duplicate and triplicate increments will be collected from the 0.0 - 0.5 foot interval only.

Acronyms and Abbreviations:

< = less than
> = greater than
bgs = below ground surface
DU = decision unit
N/A = not applicable
ppm = parts per million
USEPA = United States Environmental Protection Agency

Table 7
Discrete Sampling Plan
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

Area	Source	Depth[1] (feet bgs)	Primary Analysis	Contingent Analysis[2,3]	Number of Discrete Samples
Area 101 -- Lighthouse and fog signal building	A 675-gallon fuel oil tank at the southeast corner of building.	0.0 - 0.5 2.0 - 2.5	DRO (NWTPH-Dx) HO (NWTPH-Dx)	Benzene (USEPA Method 8260) cPAHs (USEPA Method 8270-SIM) EPH (NWTPH-EPH)	6
Area 101 -- Lighthouse and fog signal building	Location of historical PCB spill and excavation activities.	0.0 - 0.5 2.0 - 2.5	TPH (mineral oil) PCBs (USEPA Method 8082A) DRO (NWTPH-Dx) HO (NWTPH-Dx)	Not applicable	34
Area 101 -- Lighthouse and fog signal building	Two pipelines connecting to Area 101.	0.0 - 0.5 2.0 - 2.5	DRO and HO (NWTPH-Dx)	Benzene (USEPA Method 8260) cPAHs (USEPA 8270-SIM) EPH (NWTPH-EPH)	8
Area 102 -- Oil and paint storage building	Former oil and paint storage and a former gasoline storage tank at the west side of the building.	0.0-0.5 2.0 - 2.5	GRO (NWTPH-Gx) DRO (NWTPH-Dx) HO (NWTPH-Dx)	Benzene (USEPA Method 8260) cPAHs (USEPA Method 8270-SIM) VPH (NWTPH-VPH) EPH (NWTPH-EPH)	6
Area 103 -- Duplex	Three pipelines connecting to the 10,000-gallon AST pipeline.	0.0 - 0.5 2.0 - 2.5	DRO and HO (NWTPH-Dx)	Benzene (USEPA Method 8260) cPAHs (USEPA 8270-SIM) EPH (NWTPH-EPH)	6
Area 104 -- Officer-in-Charge quarters	Former 200-gallon underground fuel oil tank located on the east side of the building.	0.0 - 0.5 4.5 - 5.0	DRO and HO (NWTPH-Dx)	Benzene (USEPA Method 8260) cPAHs (USEPA Method 8270-SIM) EPH (NWTPH-EPH)	6
Area 106 -- Spring cistern building	Lead paint on the cistern building.	0.0-0.5 2.0-2.5	Lead (USEPA Method 6010)	Not applicable	6
Area 107 -- Firehouse pump building	Two former 675-gallon aboveground fuel oil day tanks.	0.0 - 0.5 2.0 - 2.5	DRO and HO (NWTPH-Dx)	Benzene (USEPA Method 8260) cPAHs (USEPA Method 8270-SIM) EPH (NWTPH-EPH)	6
10,000-gallon AST	Former 10,000-gallon fuel oil/diesel oil AST.	0.0 - 0.5 2.0 - 2.5	DRO and HO (NWTPH-Dx)	Benzene (USEPA Method 8260) cPAHs (USEPA Method 8270-SIM) EPH (NWTPH-EPH)	24
10,000-gallon AST pipeline	Fuel pipeline running from shore east of boathouse to the former 10,000-gallon AST.	2.0 - 2.5 (or directly underneath pipeline)	DRO and HO (NWTPH-Dx)	Benzene (USEPA Method 8260) cPAHs (USEPA 8270-SIM) EPH (NWTPH-EPH)	14

Table 7
Discrete Sampling Plan
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

Notes:

1. The maximum depth of soil samples may be adjusted in the field if refusal is encountered at a shallower depth.
2. Soil samples will be analyzed for benzene, cPAHs, and EPH if DRO or HO is detected at a concentration greater than MTCA A screening levels.
3. Soil samples will be analyzed for benzene and VPH if GRO is detected at a concentration greater than MTCA A screening levels.

Acronyms and Abbreviations:

AST = aboveground storage tank
bgs = below ground surface
cPAH = carcinogenic polycyclic organic hydrocarbon
DRO = diesel range organics
EPH = extractable petroleum hydrocarbons
GRO = gasoline range organics
HO = heavy oil range hydrocarbons
PCB = polycyclic aromatic hydrocarbon
TPH = total petroleum hydrocarbons
USEPA = United States Environmental Protection Agency
VPH = volatile petroleum hydrocarbons

Table 8
Discrete Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

Location ID[1]	Source	Sample ID	X Coordinate[2]	Y Coordinate[2]	Analytes
101	Transformer	SB-101A-01	-122.71349243300	48.47780558120	PCB, Mineral Oils
101	Transformer	SB-101A-02	-122.71345593400	48.47782215940	PCB, Mineral Oils
101	Transformer	SB-101A-03	-122.71347872200	48.47783571060	PCB, Mineral Oils
101	Transformer	SB-101A-04	-122.71340660900	48.47783982030	PCB, Mineral Oils
101	Transformer	SB-101A-05	-122.71343265700	48.47779405810	PCB, Mineral Oils
101	Transformer	SB-101A-06	-122.71354126100	48.47782108110	PCB, Mineral Oils
101	Transformer	SB-101A-07	-122.71355565300	48.47780075380	PCB, Mineral Oils
101	Transformer	SB-101A-08	-122.71351511000	48.47778790390	PCB, Mineral Oils
101	Transformer	SB-101A-09	-122.71350797900	48.47781499900	PCB, Mineral Oils
101	Transformer	SB-101A-10	-122.71340685900	48.47780322920	PCB, Mineral Oils
101	Transformer	SB-101A-11	-122.71353676300	48.47777905270	PCB, Mineral Oils
101	Transformer	SB-101A-12	-122.71348315900	48.47777062470	PCB, Mineral Oils
101	Transformer	SB-101A-13	-122.71347667000	48.47783118240	PCB, Mineral Oils
101	Transformer	SB-101A-14	-122.71346835100	48.47781398120	PCB, Mineral Oils
101	Transformer	SB-101A-15	-122.71356610300	48.47777629570	PCB, Mineral Oils
101	Transformer	SB-101A-16	-122.71352602500	48.47775685120	PCB, Mineral Oils
101	Transformer	SB-101A-17	-122.71346708800	48.47779441400	PCB, Mineral Oils
101	Transformer	SB-101A-18	-122.71349394200	48.47779408590	PCB, Mineral Oils
101	Transformer	SB-101A-19	-122.71344253000	48.47783244510	PCB, Mineral Oils
101	Transformer	SB-101A-20	-122.71341040100	48.47782099880	PCB, Mineral Oils
101	Fuel Oil AST	SB-101B-01	-122.71354653200	48.47793143110	DRO, HO, benzene, cPAHs
101	Fuel Oil AST	SB-101B-02	-122.71354207500	48.47791509540	DRO, HO, benzene, cPAHs
101	Fuel Oil AST	SB-101B-03	-122.71351927200	48.47792517710	DRO, HO, benzene, cPAHs
102	Gasoline AST	SB-102-01	-122.71353534100	48.47816626990	GRO, DRO, HO, benzene, cPAHs
102	Gasoline AST	SB-102-02	-122.71356219200	48.47817559990	GRO, DRO, HO, benzene, cPAHs
102	Gasoline AST	SB-102-03	-122.71356376400	48.47815443350	GRO, DRO, HO, benzene, cPAHs
104	Fuel Oil UST	SB-104-01	-122.71298156700	48.47823055810	DRO, HO, benzene, cPAHs
104	Fuel Oil UST	SB-104-02	-122.71300705500	48.47824099790	DRO, HO, benzene, cPAHs
104	Fuel Oil UST	SB-104-03	-122.71300393700	48.47822022720	DRO, HO, benzene, cPAHs
106	Lead Paint	SB-106-01	-122.71226442600	48.47913208810	Lead
106	Lead Paint	SB-106-02	-122.71225198500	48.47909623200	Lead
106	Lead Paint	SB-106-03	-122.71230521900	48.47907809680	Lead
107	Fuel Oil AST	SB-107-01	-122.71273823600	48.47797065740	DRO, HO, benzene, cPAHs
107	Fuel Oil AST	SB-107-02	-122.71270032600	48.47797184000	DRO, HO, benzene, cPAHs
107	Fuel Oil AST	SB-107-03	-122.71272056900	48.47798089290	DRO, HO, benzene, cPAHs
107	Fuel Oil AST	SB-107-04	-122.71273564500	48.47795088260	DRO, HO, benzene, cPAHs
107	Fuel Oil AST	SB-107-05	-122.71269773400	48.47795206530	DRO, HO, benzene, cPAHs

Table 8
Discrete Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

Location ID[1]	Source	Sample ID	X Coordinate[2]	Y Coordinate[2]	Analytes
107	Fuel Oil AST	SB-107-06	-122.71271478200	48.47793615700	DRO, HO, benzene, cPAHs
10,000-Gallon AST	Diesel/Fuel Oil AST	SB-112-01	-122.71272309100	48.47764262800	DRO, HO, benzene, cPAHs
10,000-Gallon AST	Diesel/Fuel Oil AST	SB-112-02	-122.71272555100	48.47768438850	DRO, HO, benzene, cPAHs
10,000-Gallon AST	Diesel/Fuel Oil AST	SB-112-03	-122.71272360200	48.47766267620	DRO, HO, benzene, cPAHs
10,000-Gallon AST	Diesel/Fuel Oil AST	SB-112-04	-122.71272548400	48.47770838330	DRO, HO, benzene, cPAHs
10,000-Gallon AST	Diesel/Fuel Oil AST	SB-112-05	-122.71268847300	48.47764370790	DRO, HO, benzene, cPAHs
10,000-Gallon AST	Diesel/Fuel Oil AST	SB-112-06	-122.71269093400	48.47768546840	DRO, HO, benzene, cPAHs
10,000-Gallon AST	Diesel/Fuel Oil AST	SB-112-07	-122.71268898400	48.47766375610	DRO, HO, benzene, cPAHs
10,000-Gallon AST	Diesel/Fuel Oil AST	SB-112-08	-122.71269086600	48.47770946320	DRO, HO, benzene, cPAHs
10,000-Gallon AST	Diesel/Fuel Oil AST	SB-112-09	-122.71265495500	48.47764398460	DRO, HO, benzene, cPAHs
10,000-Gallon AST	Diesel/Fuel Oil AST	SB-112-10	-122.71265741600	48.47768574510	DRO, HO, benzene, cPAHs
10,000-Gallon AST	Diesel/Fuel Oil AST	SB-112-11	-122.71265546700	48.47766403280	DRO, HO, benzene, cPAHs
10,000-Gallon AST	Diesel/Fuel Oil AST	SB-112-12	-122.71265734800	48.47770973990	DRO, HO, benzene, cPAHs
10,000-Gallon AST Pipeline	Diesel/Fuel Oil Pipeline	SB-112-P-01	-122.71295757800	48.47851721470	DRO, HO, benzene, cPAHs
10,000-Gallon AST Pipeline	Diesel/Fuel Oil Pipeline	SB-112-P-02	-122.71292995400	48.47838327150	DRO, HO, benzene, cPAHs
10,000-Gallon AST Pipeline	Diesel/Fuel Oil Pipeline	SB-112-P-03	-122.71289725700	48.47824857300	DRO, HO, benzene, cPAHs
10,000-Gallon AST Pipeline	Diesel/Fuel Oil Pipeline	SB-112-P-04	-122.71286504200	48.47811352240	DRO, HO, benzene, cPAHs
10,000-Gallon AST Pipeline	Diesel/Fuel Oil Pipeline	SB-112-P-05	-122.71280962200	48.47797922430	DRO, HO, benzene, cPAHs
10,000-Gallon AST Pipeline	Diesel/Fuel Oil Pipeline	SB-112-P-06	-122.71269952500	48.47773051930	DRO, HO, benzene, cPAHs
10,000-Gallon AST Pipeline	Diesel/Fuel Oil Pipeline	SB-112-P-07	-122.71275662300	48.47785093320	DRO, HO, benzene, cPAHs
Building 101 Pipeline A[3]	Fuel Oil Pipeline	SB-101-P-01	-122.71333237300	48.47789246070	DRO, HO, benzene, cPAHs
Building 101 Pipeline A[3]	Fuel Oil Pipeline	SB-101-P-02	-122.71314453500	48.47786531710	DRO, HO, benzene, cPAHs
Building 101 Pipeline A[3]	Fuel Oil Pipeline	SB-101-P-03	-122.71295424800	48.47784185000	DRO, HO, benzene, cPAHs
Building 101 Pipeline B[4]	Fuel Oil Pipeline	SB-101-P-04	-122.71353944600	48.47786203240	DRO, HO, benzene, cPAHs
Building 103 Pipeline A[5]	Fuel Oil Pipeline	SB-103-P-01	-122.71288330300	48.47798597000	DRO, HO, benzene, cPAHs

Table 8
Discrete Sample Locations
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

Location ID[1]	Source	Sample ID	X Coordinate[2]	Y Coordinate[2]	Analytes
Building 103 Pipeline B[6]	Fuel Oil Pipeline	SB-103-P-02	-122.71288165000	48.47796965760	DRO, HO, benzene, cPAHs
Building 103 Pipeline C[7]	Fuel Oil Pipeline	SB-103-P-03	-122.71287841800	48.47794315330	DRO, HO, benzene, cPAHs

Notes:

1. See Figure 20 for locations of these areas.
2. GPS Datum = North American Datum 1983.
3. Building 101 Pipeline A connects to the 10,000-gallon AST pipeline.
4. Building 101 Pipeline B runs south of the Lighthouse and Fog Signal Building.
5. Building 103 Pipeline A is the northernmost pipeline.
6. Building 103 Pipeline B is the middle pipeline.
7. Building 103 Pipeline C is the southernmost pipeline.

Acronyms and Abbreviations:

AST = above ground storage tank
cPAHs = carcinogenic polycyclic aromatic hydrocarbons
DRO = diesel range organics
GRO = gasoline range organics
ID = identification
PCB = polychlorinated biphenyls
UST = underground storage tank

Table 9
Change Control
Quality Assurance Project Plan and Sampling and Analysis Plan
Burrows Island Light Station
Skagit County, Washington

Type of Change	Description	Action	Documentation
Deviation	Minor change that does not affect the technical accuracy of the project or work schedule.	The person recognizing the change will consult with field team leader.	Minor field changes will be documented in field logbook and deviation form. Field team leader to provide details to project team, including the USCG, in daily report.
Change	Change has a considerable effect on performance or cost but still allows for meeting DQOs.	Field team leader to notify Arcadis PM. Arcadis PM to notify the USCG. The USCG will determine if there is a need to revise document and/or notify others.	Changes will be documented in field logbook and change form. This documentation is to be provided in daily report.
Fundamental Change	Change has a significant effect of the project and does not meet DQO requirements.	Notify the USCG immediately. The USCG will determine if change requires a revision to the document and/or notification of the USEPA, Ecology, or others.	Document in field logbook. If change is identified after field work is completed, the Arcadis PM will provide written documentation to the USCG.

Acronyms and Abbreviations:
DQO = data quality objective
Ecology = Washington State Department of Ecology
PM = Project Manager
USCG = United States Coast Guard
USEPA = United States Environmental Protection Agency

FIGURES

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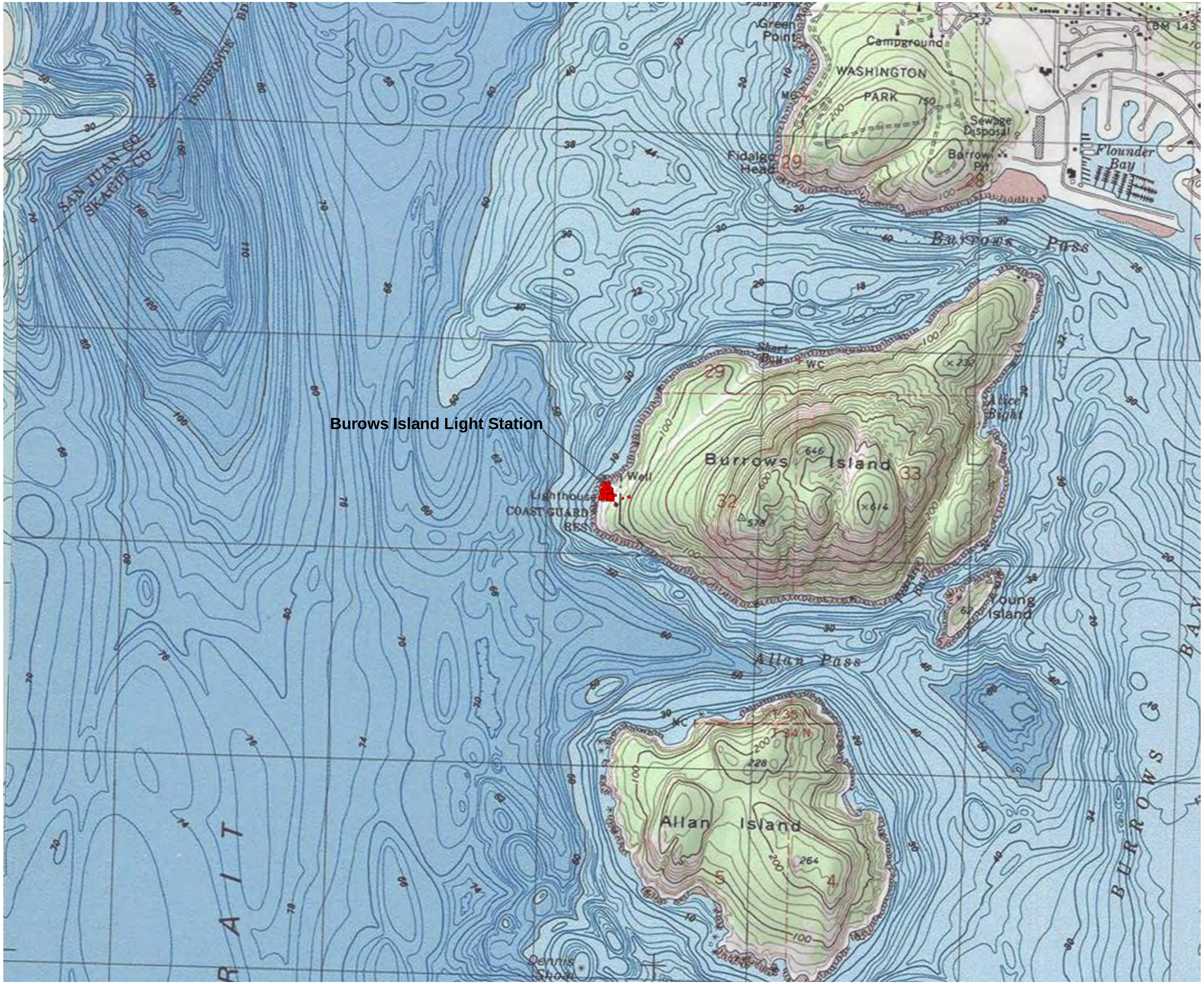

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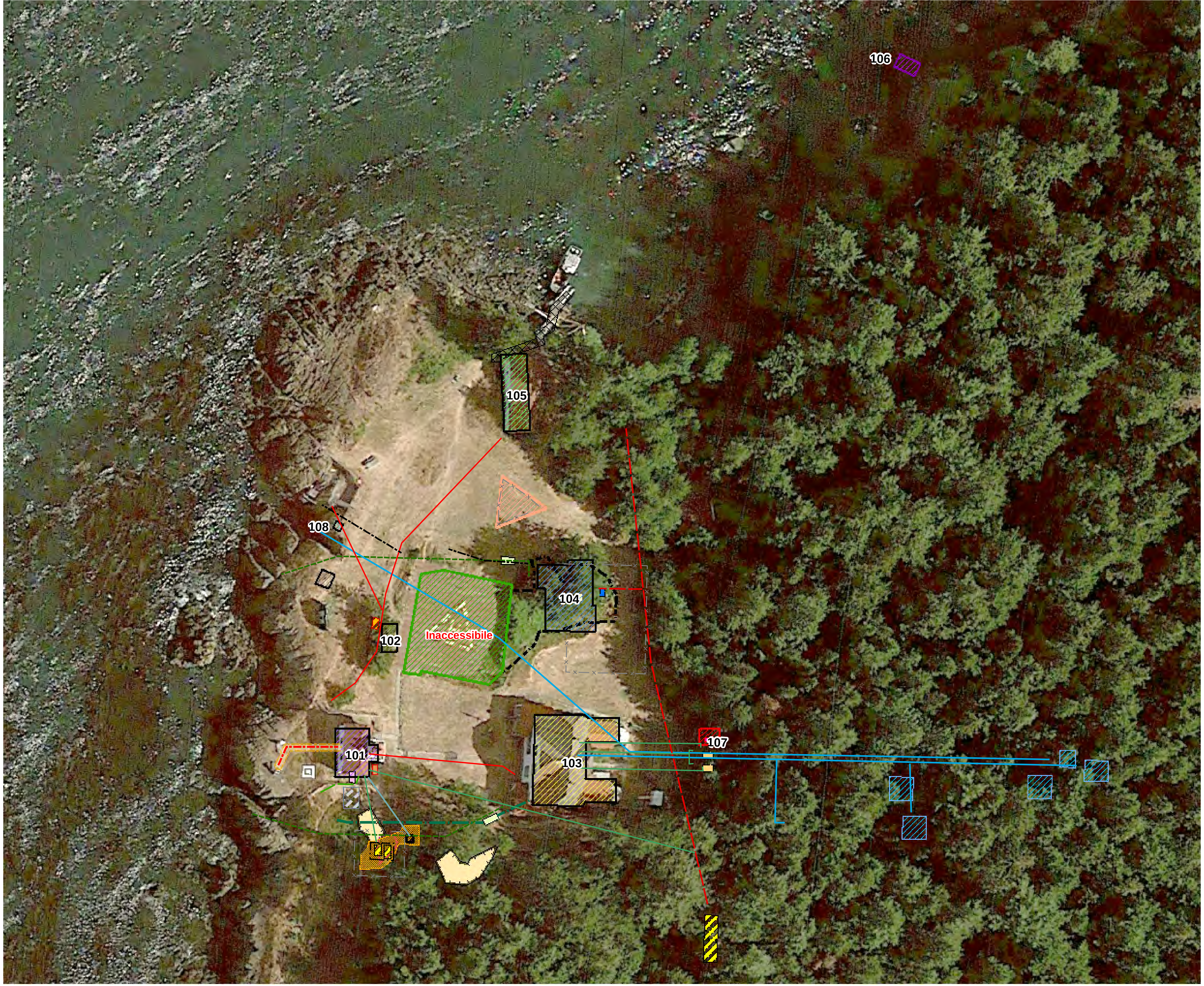
0 1,500 3,000
SCALE IN FEET

BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Site Location Map

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1



LEGEND

Structures

- ▨ Lighthouse
- ▨ Oil and Paint Storage Building
- ▨ Double Dwelling
- ▨ Officer In Charge Quarters
- ▨ Boathouse
- ▨ Pumphouse and Spring Cistern
- ▨ Firehouse Pump Building
- ▨ Salt Water Flushing Pumphouse
- ▭ Area Based on Accessibilty
- ■ 675-Gallon Fuel Oll Tank
- ▨ 540-Gallon Fuel Tank
- ▨ Excavated Tank Area
- ▭ Fuel Oil Tank
- ■ F.O. Tank
- ▨ 690-Gallon Fuel Tank
- ▨ Old Cistern
- ▨ Transformer Pad
- ■ Fire Pump
- ▭ Dark Staining
- ▨ Old Helicopter Pad
- ▨ Helicopter Pad
- ▭ Debris Pile
- ▩ Inaccessible Area
- ▨ Water Tanks/Platforms
- ▨ Elevated 10,000-Gallon Fuel Oil Tank
- ■ Septic Tank
- ▨ Cistern
- ■ 675-Gallon Fuel Oil Tank
- ■ Fuel Oil Tank
- ▨ Gasoline Storage Tank
- ▩ Landing/Dock
- ▭ 3 ft Utility Line Buffer
- - - Active Electric Utility Line
- — Water Line
- — Electric Line
- - - Septic Line
- — 2 in Abandoned Conduit
- —×— Tank Fence
- — Fuel Line
- - - Drain Pipe
- -·- Concrete Containment
- -·- 4 in Sewer
- —×— Fence
- — 3 in Sewer Line
- — Fuel Pipe

Note:

1. Site features based on U.S. Coast Guard historical drawing Fire Protection, Water & Sewer Systems, Burrows Island Light Station, Dwg No. 60.5804, December 1960.

BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Site Plan with Current and Historical Features

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2

CITY: SAN FRANCISCO DIV/GROUP: ENV/IM DB: kgpeters LD: PIC: PM: TM:
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LEGEND

01 Decision Units (DU)

SU-2 DU Subunits

Structures

▨ Lighthouse

▨ Oil and Paint Storage Building

▨ Double Dwelling

▨ Officer In Charge Quarters

▨ Boathouse

▨ Pumphouse and Spring Cistern

▨ Firehouse Pump Building

▨ Salt Water Flushing Pumphouse

▨ Water Tanks/Platforms

▨ Elevated 10,000-Gallon Fuel Oil Tank

▨ Septic Tank

▨ Cistern

▨ 675-Gallon Fuel Oil Tank

▨ Fuel Oil Tank

▨ Gasoline Storage Tank

▨ Landing/Dock

Notes:

GPS - global positioning system
XRF - X-ray fluorescence

1. Sampling locations were recorded in the field using GPS with an approximate horizontal accuracy of 3 feet.
2. XRF lead concentrations are adjusted based on the correlation between laboratory analytical and XRF field screening results. Results were corrected using the following formula: $Y = 1.136X - 0.02354$ Where,
   Y = Log of the corrected XRF concentration
   X = Log of the XRF field measurement concentration
   Logarithms in the equation are in base 10.
3. Site features based on U.S. Coast Guard historical drawing Fire Protection, Water & Sewer Systems, Burrows Island Light Station, Dwg No. 60.5804, December 1960.

0 60 120

SCALE IN FEET

BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Location of Decision Units and Subunits

ARCADIS Design & Consultancy for natural and built assets

FIGURE
3

CITY: SAN FRANCISCO DIV/GROUP: ENV/IM DB: kgpeters LD: PIC: PM: TM:
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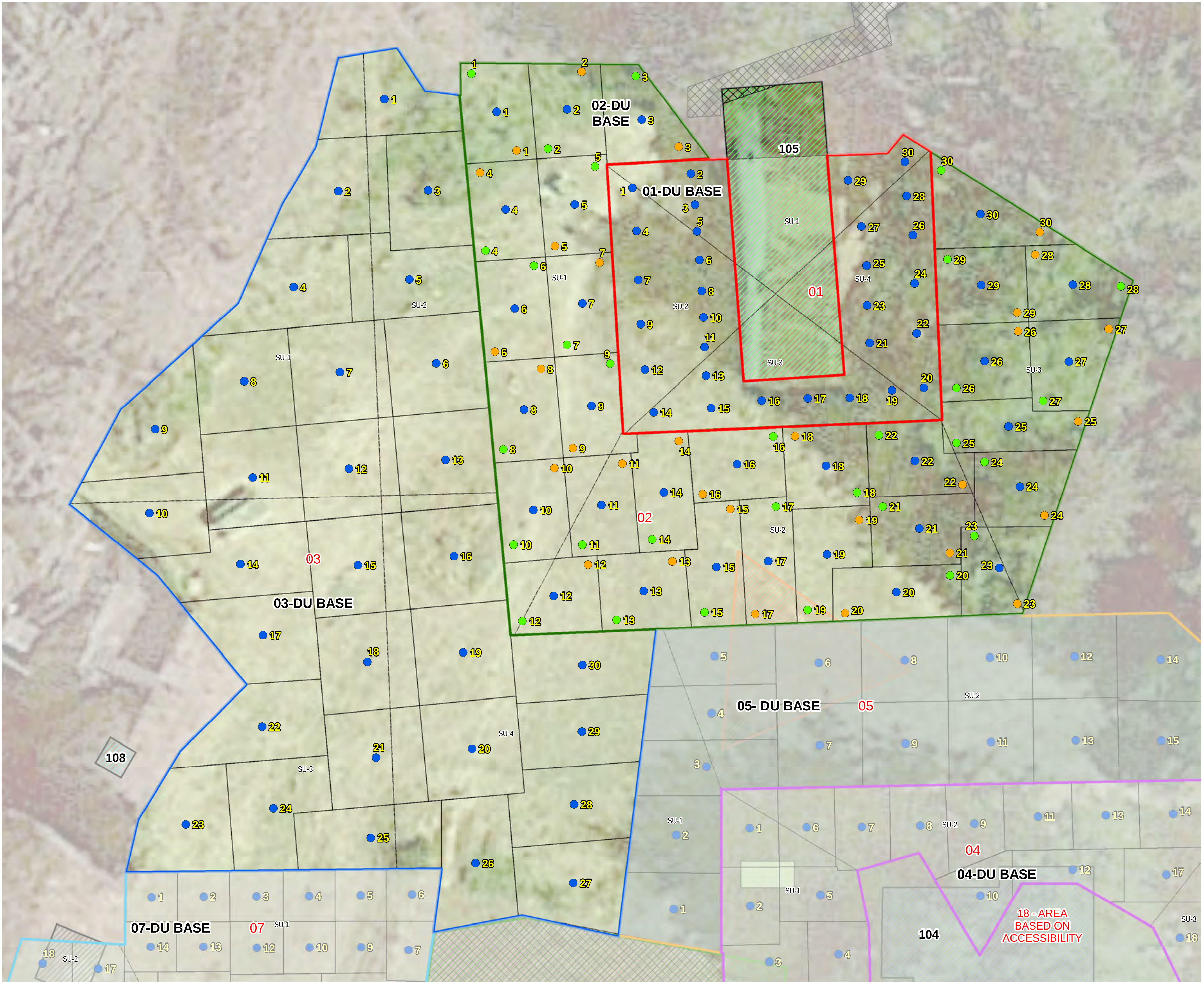

LEGEND

- ● Primary Sample
- ● Replicate B Sample
- ● Replicate C Sample
- ▨ 104, Officer In-Charge Quarters
- ▨ 105, Boathouse
- ▨ 108, Salt Water Flushing Pumphouse
- ▨ Old Helicopter Pad
- ▨ Helicopter Pad
- ▭ Septic Tank
- ▨ Landing/Dock

Decision Unit Sampling Grid

- ▭ Sampling Area Subunits
- ▭ 01-DU BASE 01
- ▭ 02-DU BASE 02
- ▭ 03-DU BASE 03
- ▭ 04-DU BASE 04
- ▭ 05-DU BASE 05
- ▭ 07-DU BASE 07
- 9 DU Subunit Label (SU-X)
- 9 Sampling Area Subunit Label

Note:
ICS = incremental composite sampling

0 15 30
SCALE IN FEET

BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Decision Units 1, 2 and 3 - Boathouse and Northwest Open Area

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4

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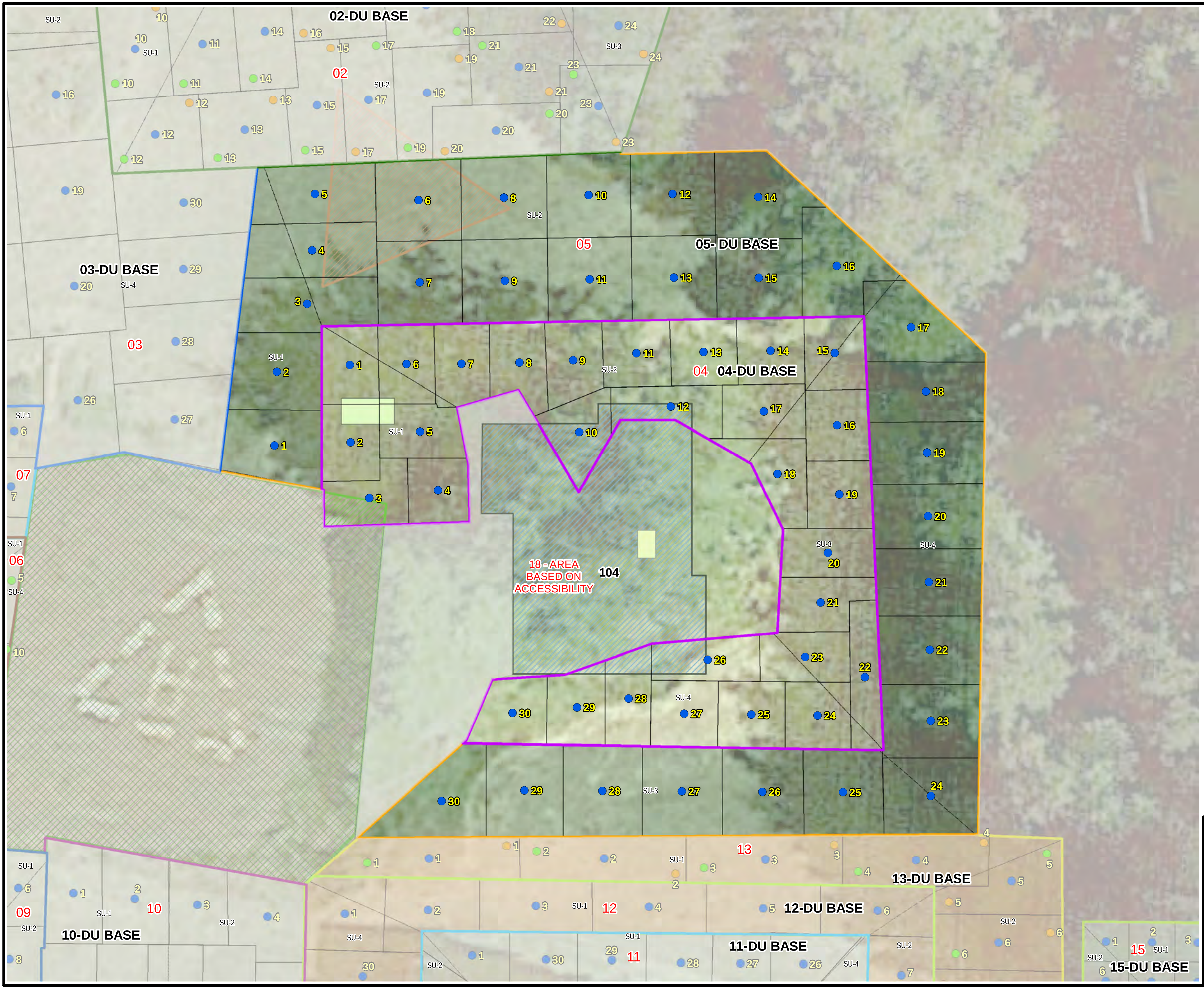

LEGEND

●	Primary Sample
▨	104, Officer In-Charge Quarters
▨	Old Helicopter Pad
▨	Helicopter Pad
🟩	Septic Tank
🟨	Fuel Oil Tank

Decision Unit Sampling Grid

☐	Sampling Area Subunits
☐	02-DU BASE 02
☐	03-DU BASE 03
☐	04-DU BASE 04
☐	05-DU BASE 05
☐	06-DU BASE 06
☐	07-DU BASE 07
☐	09-DU BASE 09
☐	10-DU BASE 10
☐	11-DU BASE 11
☐	12-DU BASE 12
☐	13-DU BASE 13
☐	15-DU BASE 15
9	DU Subunit Label (SU-X)
9	Sampling Area Subunit Label

Note:
ICS = incremental composite sampling

0 15 30
SCALE IN FEET

BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Decision Units 4, 5 and 18 - Officer-In-Charge Quarters

ARCADIS Design & Consultancy for natural and built assets

FIGURE
5

CITY: SAN FRANCISCO DIV/GROUP: ENV/IM DB: jchen LD: PIC: PM: TM:
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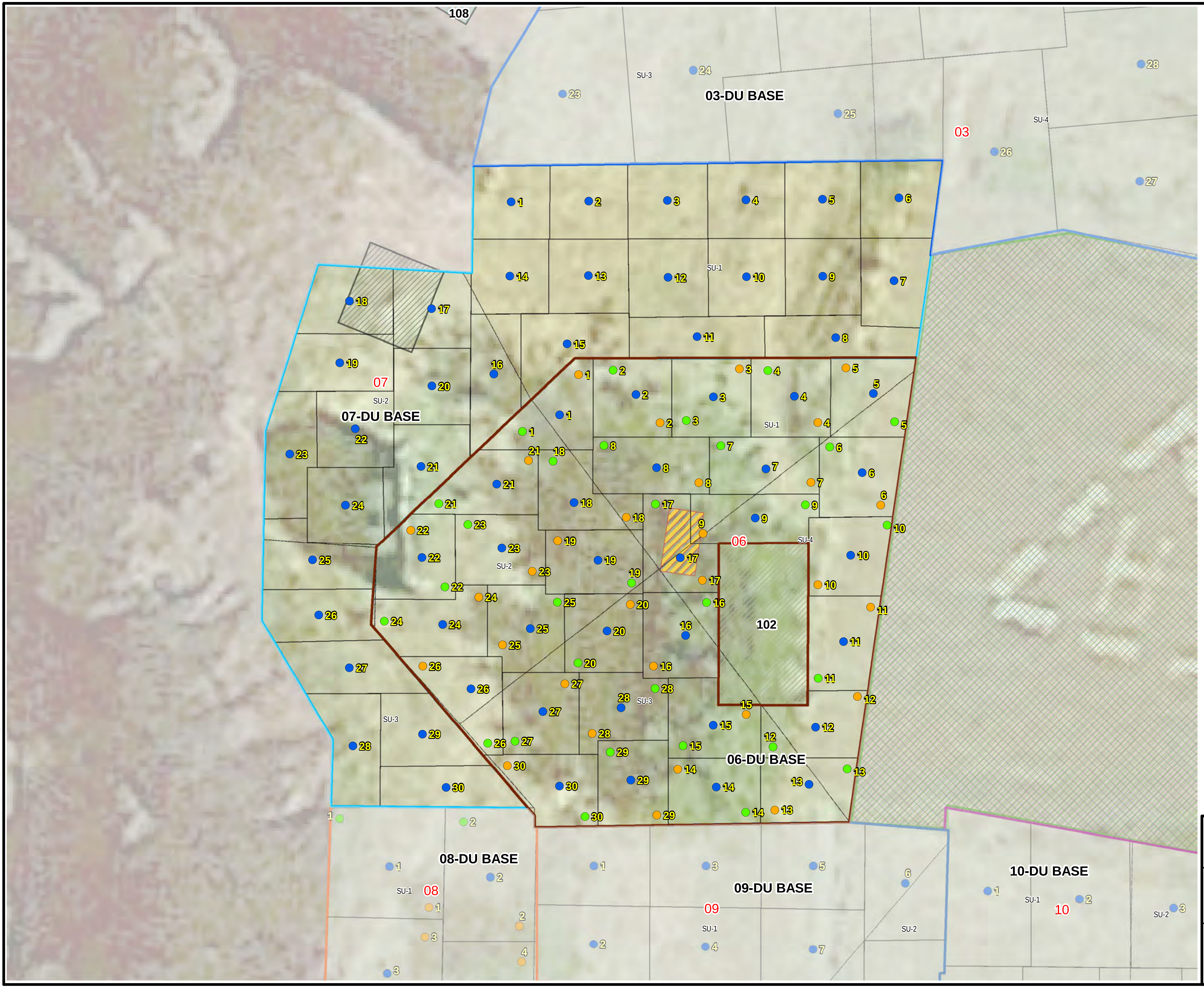


LEGEND

●	Primary Sample
●	Replicate B Sample
●	Replicate C Sample
▨	102, Oil and Paint Storage Building
▨	108, Salt Water Flushing Pumphouse
▨	Helicopter Pad
▨	Gasoline Storage Tank

Decision Unit Sampling Grid

☐	Sampling Area Subunits
☐	03-DU BASE 03
☐	06-DU BASE 06
☐	07-DU BASE 07
☐	08-DU BASE 08
☐	09-DU BASE 09
☐	10-DU BASE 10
9	DU Subunit Label (SU-X)
9	Sampling Area Subunit Label

Note:
ICS = incremental composite sampling

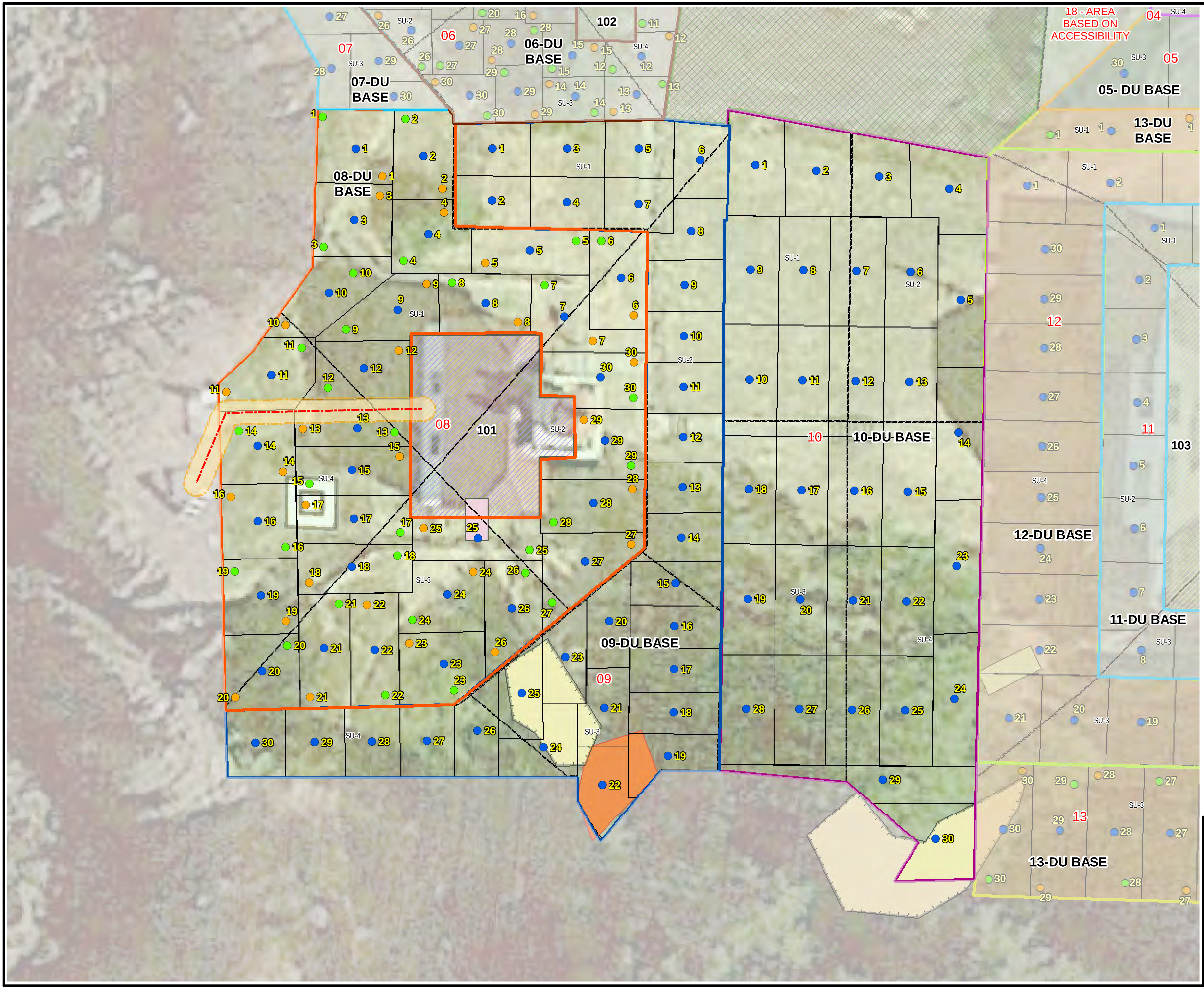
0 10 20
SCALE IN FEET

BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Decision Units 6 and 7 - Oil and Paint Storage Building

ARCADIS Design & Consultancy for natural and built assets

FIGURE
6



LEGEND

- ● Primary Sample
- ● Replicate B Sample
- ● Replicate C Sample
- Active Electric Utility Line
- ▨ 3 ft Utility Line Buffer
- ▨ 101, Lighthouse
- ▨ 102, Oil and Paint Storage Building
- ▨ 103, Duplex
- 🟥 Dark Staining
- ▨ Helicopter Pad
- ▨ Debris Pile
- 🟩 Septic Tank
- ▨ 675-Gallon Fuel Oil Tank

Decision Unit Sampling Grid

- ☐ Sampling Area Subunits
- ☐ 04-DU BASE 04
- ☐ 05-DU BASE 05
- ☐ 06-DU BASE 06
- ☐ 07-DU BASE 07
- ☐ 08-DU BASE 08
- ☐ 09-DU BASE 09
- ☐ 10-DU BASE 10
- ☐ 11-DU BASE 11
- ☐ 12-DU BASE 12
- ☐ 13-DU BASE 13
- 9 DU Subunit Label (SU-X)
- 9 Sampling Area Subunit Label

Note:
ICS = incremental composite sampling

0 10 20
SCALE IN FEET

BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Decision Units 8, 9 and 10 - Lighthouse and Fog Signal Building and Southern Open Area

ARCADIS Design & Consultancy for natural and built assets

FIGURE
7

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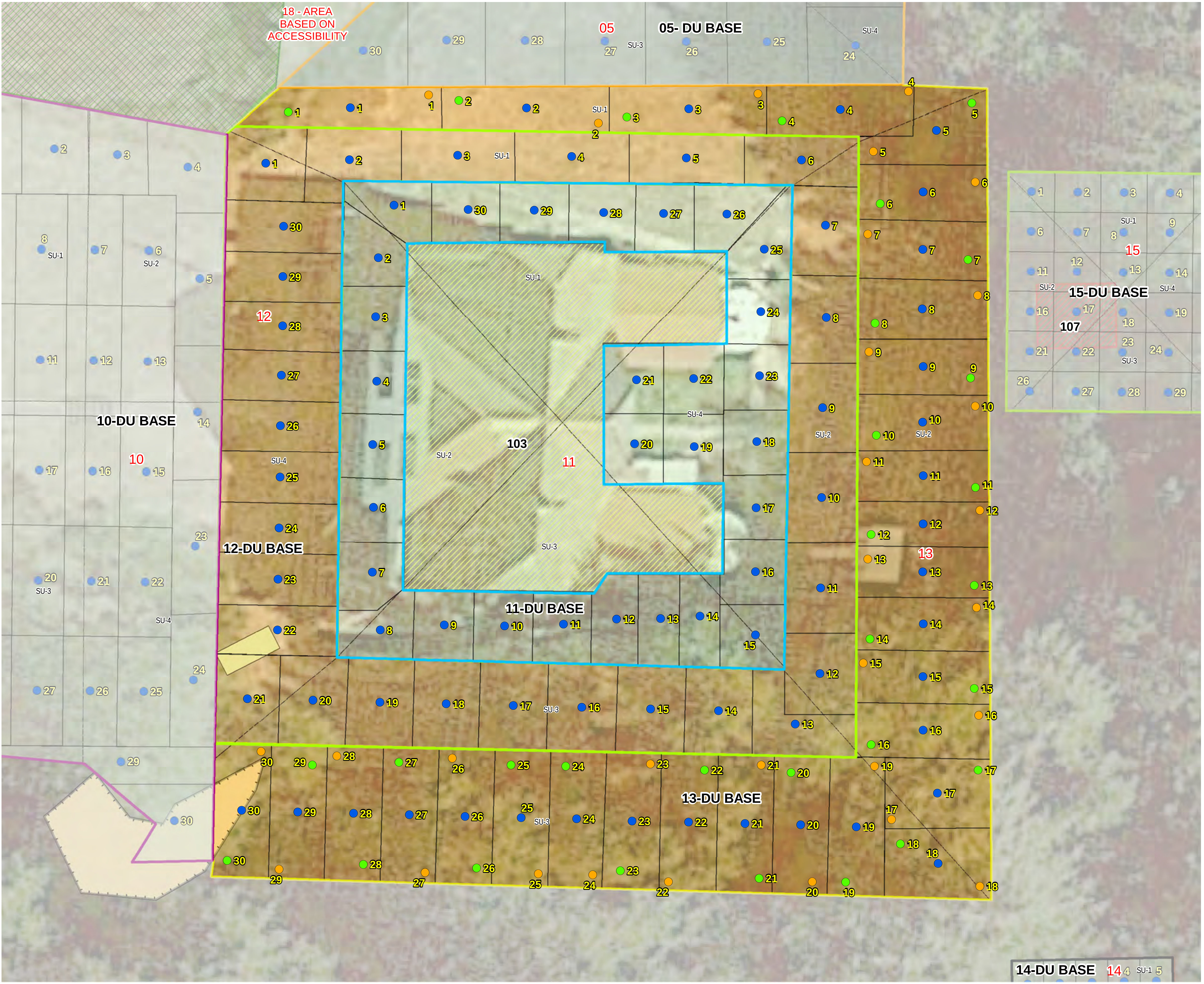

LEGEND

●	Primary Sample
●	Replicate B Sample
●	Replicate C Sample
▨	103, Duplex
▨	107, Firehouse Pump Building
▨	Helicopter Pad
▨	Debris Pile
☐	Septic Tank

Decision Unit Sampling Grid

☐	Sampling Area Subunits
☐	05-DU BASE 05
☐	10-DU BASE 10
☐	11-DU BASE 11
☐	12-DU BASE 12
☐	13-DU BASE 13
☐	14-DU BASE 14
☐	15-DU BASE 15
9	DU Subunit Label (SU-X)
9	Sampling Area Subunit Label

Note:
ICS = incremental composite sampling

0 15 30
SCALE IN FEET

BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Decision Units 11, 12 and 13 - Duplex

ARCADIS Design & Consultancy for natural and built assets

FIGURE
8

CITY: SAN FRANCISCO DIV/GROUP: ENV/IM DB: jchen LD: PIC: PM: TM:
PROJECT: PATH: Z:\GISProjects_ENV\Burrows_Island_Lighthouse_2018\MXD\Burrows Island Lighthouse_Figure4-10_ICSMapset.mxd DATE: 2/10/2019 8:57:43 PM

LEGEND

●	Primary Sample
▨	103, Duplex
🟥	107, Firehouse Pump Building
▨	Elevated 10,000-Gallon Fuel Oil Tank

Decision Unit Sampling Grid

☐	Sampling Area Subunits
☐	11-DU BASE 11
☐	12-DU BASE 12
☐	13-DU BASE 13
☐	14-DU BASE 14
☐	15-DU BASE 15
☐	16-DU BASE 16
9	DU Subunit Label (SU-X)
9	Sampling Area Subunit Label

Note:
ICS = incremental composite sampling

0 17.5 35
SCALE IN FEET

BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Decision Units 14 and 15 - 10,000-Gallon Fuel Oil Aboveground Storage Tank and Firehouse Pumping Building

ARCADIS Design & Consultancy for natural and built assets

FIGURE
9

CITY: SAN FRANCISCO DIV/GROUP: ENV/IM DB: jchen LD: PIC: PM: TM:
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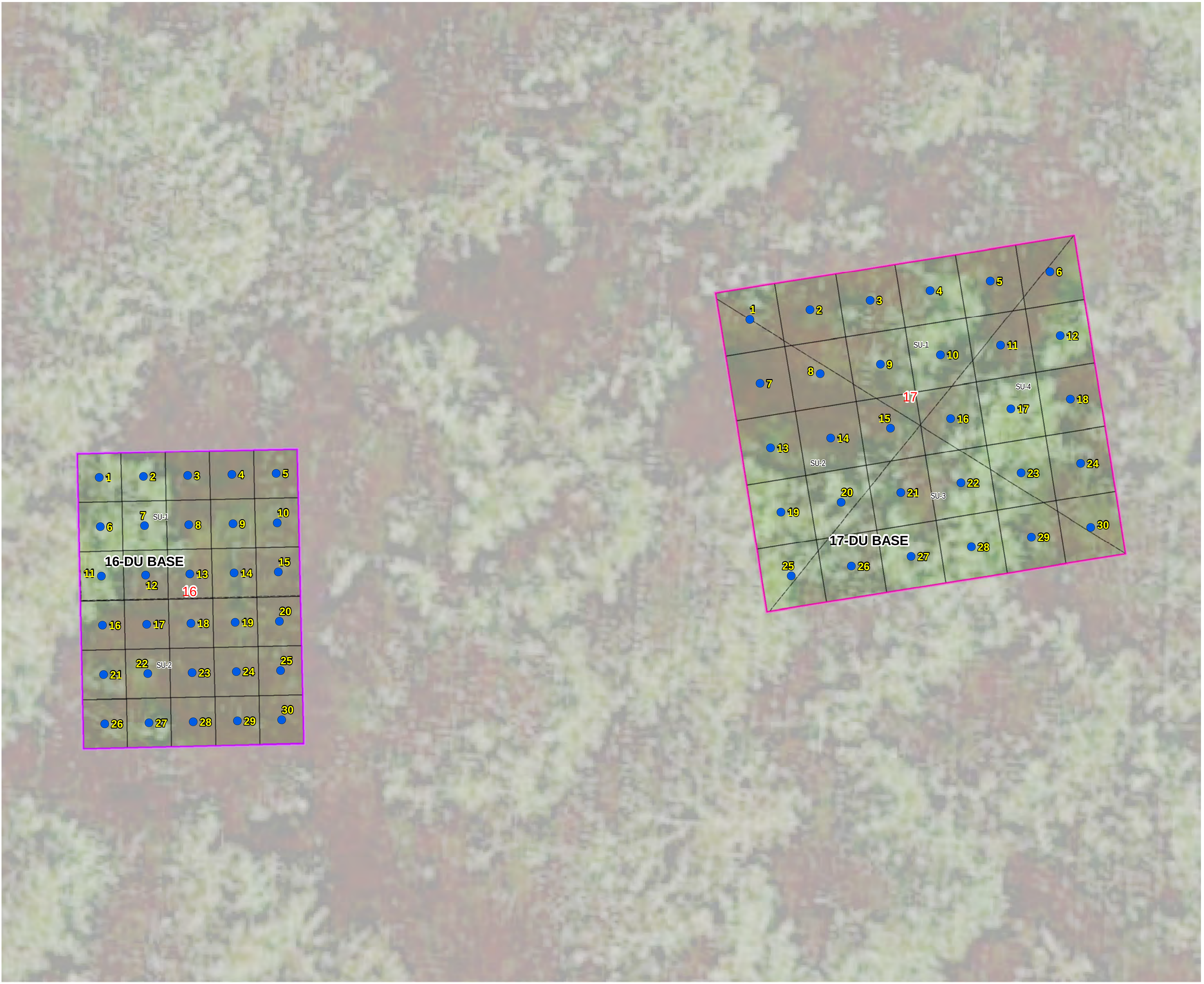

LEGEND

● Primary Sample

Decision Unit Sampling Grid

▭ Sampling Area Subunits

▭ 16-DU BASE 16

▭ 17-DU BASE 17

9 DU Subunit Label (SU-X)

9 Sampling Area Subunit Label

Note:
ICS = incremental composite sampling

0 12.5 25
SCALE IN FEET

BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Decision Units 16 and 17 - Water Tanks

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FIGURE
10

CITY: SAN FRANCISCO DIV/GROUP: ENV/IM DB: jchen LD: PIC: PM: TM:
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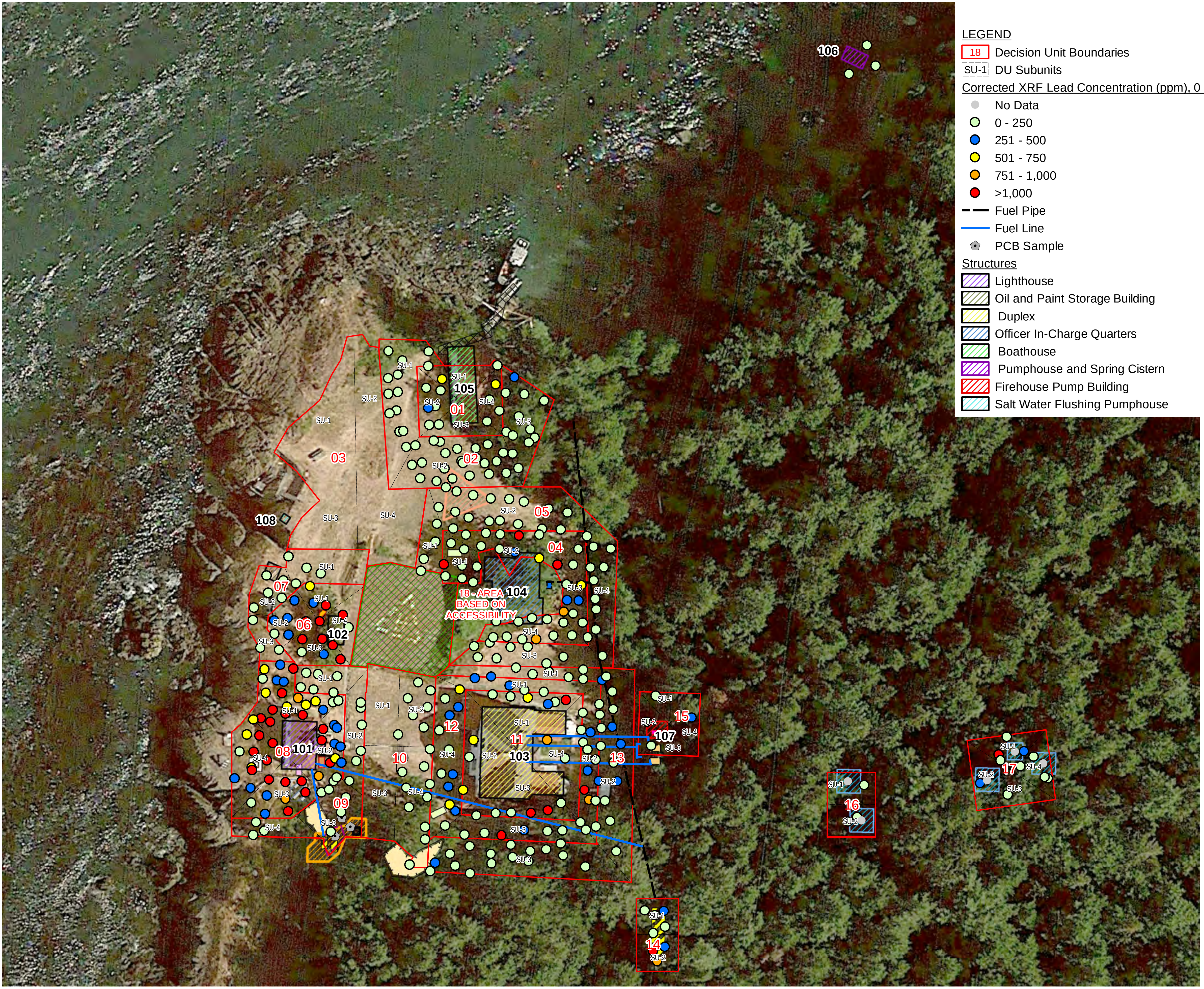

LEGEND

- 🟥 18 Decision Unit Boundaries
- ☐ SU-1 DU Subunits

Corrected XRF Lead Concentration (ppm), 0 to 6 inches bgs

- ● No Data
- ● 0 - 250
- ● 251 - 500
- ● 501 - 750
- ● 751 - 1,000
- ● >1,000
- — Fuel Pipe
- — Fuel Line
- ⬟ PCB Sample

Structures

- ▨ Lighthouse
- ▨ Oil and Paint Storage Building
- ▨ Duplex
- ▨ Officer In-Charge Quarters
- ▨ Boathouse
- ▨ Pumphouse and Spring Cistern
- ▨ Firehouse Pump Building
- ▨ Salt Water Flushing Pumphouse
- ■ 675-Gallon Fuel Oil Tank
- ▨ 540-Gallon Fuel Tank
- ▨ Excavated Tank Area
- ■ Fuel Oil Tank
- ■ F.O. Tank
- ▨ 690-Gallon Fuel Tank
- ▨ Old Cistern
- ▨ Transformer Pad
- ■ Fire Pump
- ☐ Dark Staining
- ▨ Old Helicopter Pad
- ▨ Helicopter Pad
- ☐ Debris Pile
- ▨ Elevated 10,000-Gallon Fuel Oil Tank
- ■ Septic Tank
- ■ 675-Gallon Fuel Oil Tank
- ■ Fuel Oil Tank
- ▨ Gasoline Storage Tank
- ☒ Landing/Dock

Notes:

bgs - below ground surface
GPS - global positioning system
ppm - parts per million
> - Greater than
XRF - X-ray fluorescence
PCB - polychlorinated biphenyls

1. Sampling locations were recorded in the field using GPS with an approximate horizontal accuracy of 3 feet.
2. XRF lead concentrations are adjusted based on the correlation between laboratory analytical and XRF field screening results. Results were corrected using the following formula: $Y = 1.136X - 0.02354$ Where, Y = Log of the corrected XRF concentration X = Log of the XRF field measurement concentration Logarithms in the equation are in base 10.
3. Site features based on U.S. Coast Guard historical drawing Fire Protection, Water & Sewer Systems, Burrows Island Light Station, Dwg No. 60.5804, December 1960.

BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Decision Unit Boundaries with XRF Sample Results November 2018 Sampling Event

ARCADIS Design & Consultancy for natural and built assets

FIGURE
11

CITY: SAN FRANCISCO DIV/GROUP: ENV/IM DB: kgpeters LD: PIC: PM: TM:
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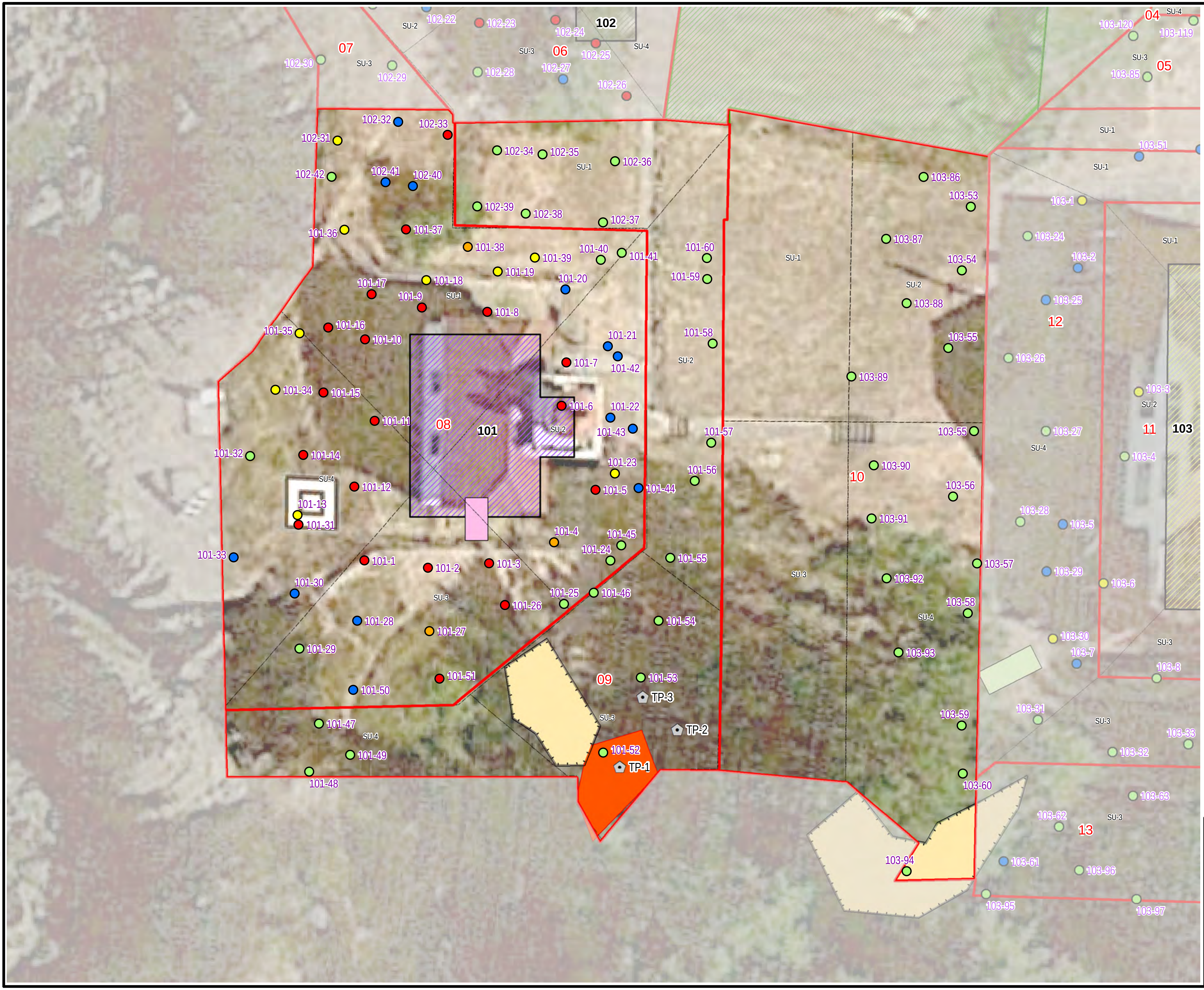


LEGEND

🟥 Decision Unit Boundaries
☐ DU Subunits
▨ 101, Lighthouse
▨ 102, Oil and Paint Storage Building
▨ 103, Duplex
9 DU Subunit Label (SU-X)

XRF Lead Corrected (ppm)

● 0 - 250
● 251 - 500
● 501 - 750
● 751 - 1,000
● >1,000
⬠ Discrete PCB Soil Sample Location
🟧 Dark Staining
▨ Helicopter Pad
▨ Debris Pile
🟩 Septic Tank
🟪 675-Gallon Fuel Oil Tank

Notes:
GPS - global positioning system
ppm - parts per million
\> - Greater Than
XRF - X-ray fluorescence
PCB - polychlorinated biphenyls

1. Sampling locations were recorded in the field using GPS with an approximate horizontal accuracy of 3 feet.
2. XRF lead concentrations are adjusted based on the correlation between laboratory analytical and XRF field screening results. Results were corrected using the following formula: Y = 1.136X - 0.02354 Where,
   Y = Log of the corrected XRF concentration
   X = Log of the XRF field measurement concentration
   Logarithms in the equation are in base 10.
3. Site features based on U.S. Coast Guard historical drawing Fire Protection, Water & Sewer Systems, Burrows Island Light Station, Dwg No. 60.5804, December 1960.

0 15 30
SCALE IN FEET

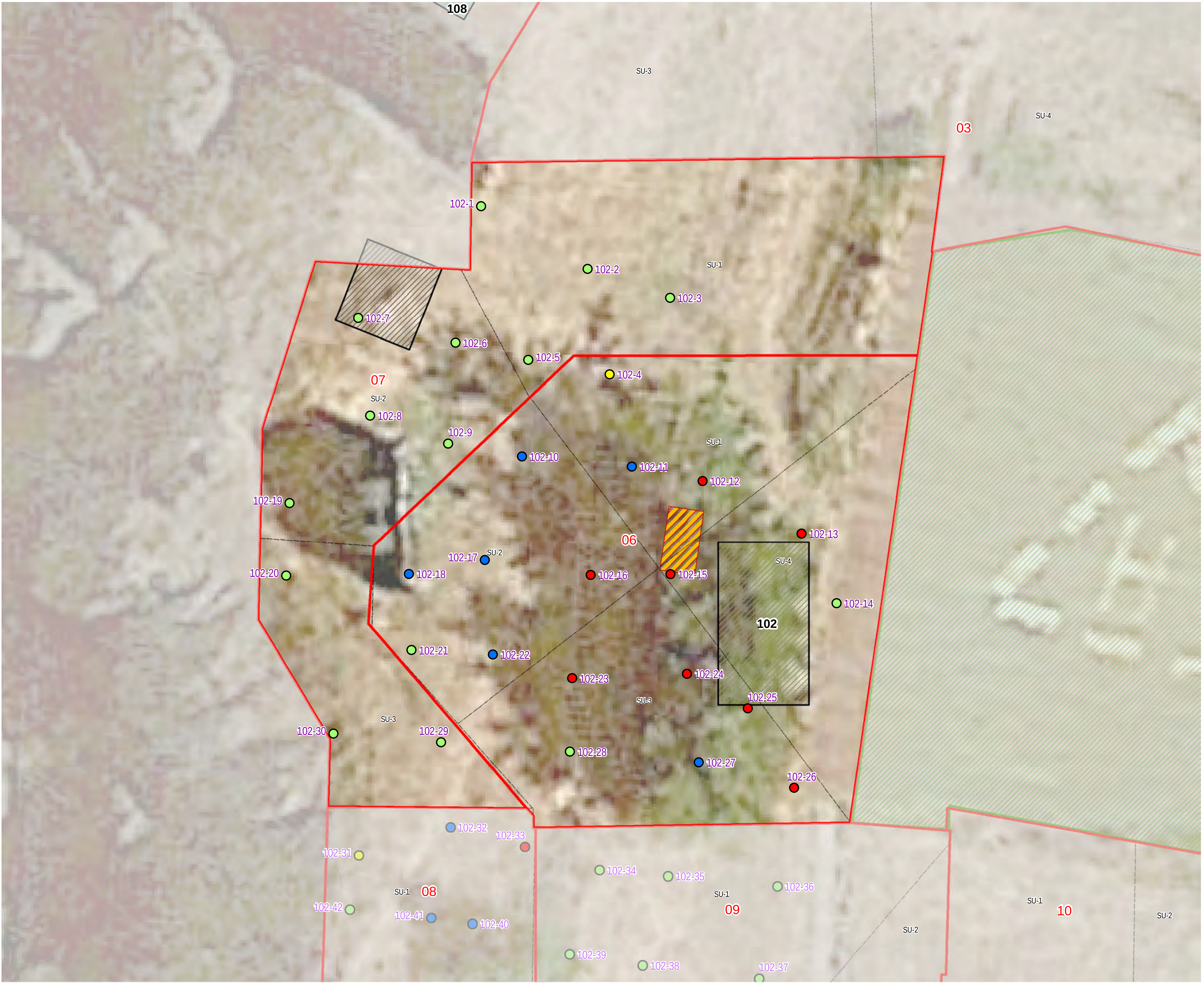
BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Building 101 XRF Sampling Results
November 2018 Sampling Event

ARCADIS Design & Consultancy for natural and built assets

FIGURE
12

CITY: SAN FRANCISCO DIV/GROUP: ENV/IM DB: jchen LD: PIC: PM: TM:
PROJECT: PATH: Z:\GISProjects_ENV\Burrows_Island_Lighthouse_2018\MXD\Burrows Island Lighthouse_Figure12thru19_DiscreteLocationsMapset.mxd DATE: 2/10/2019 8:40:05 PM



LEGEND

- 🟥 Decision Unit Boundaries
- ☐ DU Subunits
- ▨ 102, Oil and Paint Storage Building
- ▨ 108, Salt Water Flushing Pumphouse
- 9 DU Subunit Label (SU-X)

XRF Lead Corrected (ppm)

- ● 0 - 250
- ● 251 - 500
- ● 501 - 750
- ● >1,000
- 🟩 Helicopter Pad
- ▨ Gasoline Storage Tank

Notes:
GPS - global positioning system
ppm - parts per million
> - Greater Than
XRF - X-ray fluorescence

1. Sampling locations were recorded in the field using GPS with an approximate horizontal accuracy of 3 feet.
2. XRF lead concentrations are adjusted based on the correlation between laboratory analytical and XRF field screening results. Results were corrected using the following formula: Y = 1.136X - 0.02354 Where,
   Y = Log of the corrected XRF concentration
   X = Log of the XRF field measurement concentration
   Logarithms in the equation are in base 10.
3. Site features based on U.S. Coast Guard historical drawing Fire Protection, Water & Sewer Systems, Burrows Island Light Station, Dwg No. 60.5804, December 1960.

0 10 20
SCALE IN FEET

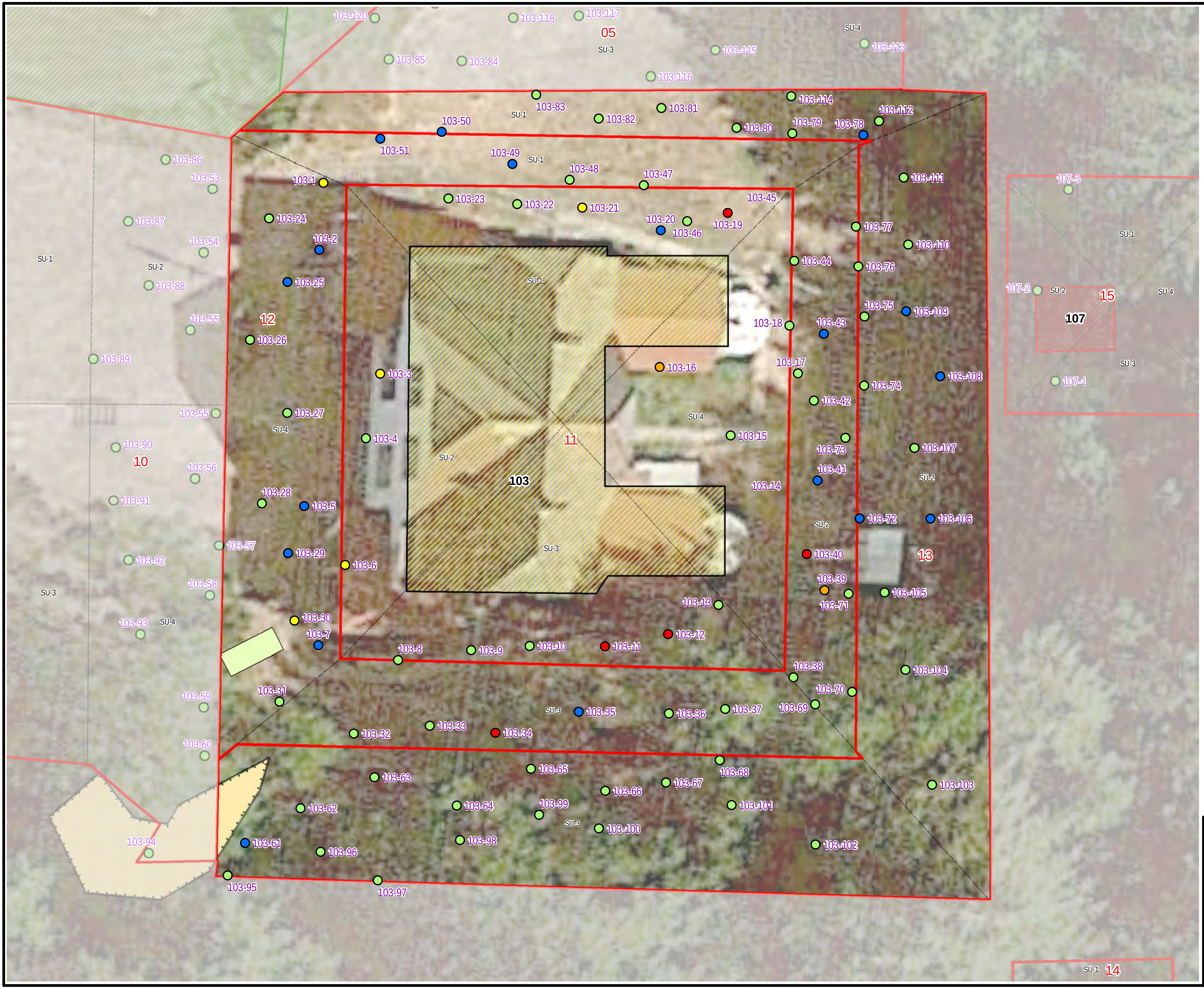
BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Building 102 XRF Sampling Results November 2018 Sampling Event

ARCADIS Design & Consultancy for natural and built assets

FIGURE
13

CITY: SAN FRANCISCO DIV/GROUP: ENV/IM DB: jchen LD: PIC: PM: TM:
PROJECT: PATH: Z:\GISProjects_ENV\Burrows_Island_Lighthouse_2018\MXD\Burrows Island Lighthouse_Figure12thru19_DiscreteLocationsMapset.mxd DATE: 2/10/2019 8:23:58 PM



LEGEND

🟥	Decision Unit Boundaries
☐	DU Subunits
▨	103, Duplex
▨	107, Firehouse Pump Building
9	DU Subunit Label (SU-X)

XRF Lead Corrected (ppm)

●	0 - 250
●	251 - 500
●	501 - 750
●	751 - 1,000
●	>1,000
▨	Helicopter Pad
▨	Debris Pile
🟩	Septic Tank

Notes:
GPS - global positioning system
ppm - parts per million
> - Greater Than
XRF - X-ray fluorescence

1. Sampling locations were recorded in the field using GPS with an approximate horizontal accuracy of 3 feet.
2. XRF lead concentrations are adjusted based on the correlation between laboratory analytical and XRF field screening results. Results were corrected using the following formula: $Y = 1.136X - 0.02354$ Where,
   Y = Log of the corrected XRF concentration
   X = Log of the XRF field measurement concentration
   Logarithms in the equation are in base 10.
3. Site features based on U.S. Coast Guard historical drawing Fire Protection, Water & Sewer Systems, Burrows Island Light Station, Dwg No. 60.5804, December 1960.

0 15 30
SCALE IN FEET

BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Building 103 XRF Sampling Results
November 2018 Sampling Event

ARCADIS Design & Consultancy for natural and built assets

FIGURE
14

CITY: SAN FRANCISCO DIV/GROUP: ENV/IM DB: jchen LD: PIC: PM: TM:
PROJECT: PATH: Z:\GISProjects_ENV\Burrows_Island_Lighthouse_2018\MXD\Burrows Island Lighthouse_Figure12thru19_DiscreteLocationsMapset.mxd DATE: 2/10/2019 8:23:58 PM

LEGEND

🟥 Decision Unit Boundaries

☐ DU Subunits

▨ 104, Officer In-Charge Quarters

9 DU Subunit Label (SU-X)

XRF Lead Corrected (ppm)

● 0 - 250

● 251 - 500

● 501 - 750

● 751 - 1,000

● >1,000

▨ Old Helicopter Pad

▨ Helicopter Pad

🟩 Septic Tank

🟨 Fuel Oil Tank

Notes:
GPS - global positioning system
ppm - parts per million
> - Greater Than
XRF - X-ray fluorescence

1. Sampling locations were recorded in the field using GPS with an approximate horizontal accuracy of 3 feet.
2. XRF lead concentrations are adjusted based on the correlation between laboratory analytical and XRF field screening results. Results were corrected using the following formula: Y = 1.136X - 0.02354 Where, Y = Log of the corrected XRF concentration X = Log of the XRF field measurement concentration Logarithms in the equation are in base 10.
3. Site features based on U.S. Coast Guard historical drawing Fire Protection, Water & Sewer Systems, Burrows Island Light Station, Dwg No. 60.5804, December 1960.

0 15 30

SCALE IN FEET

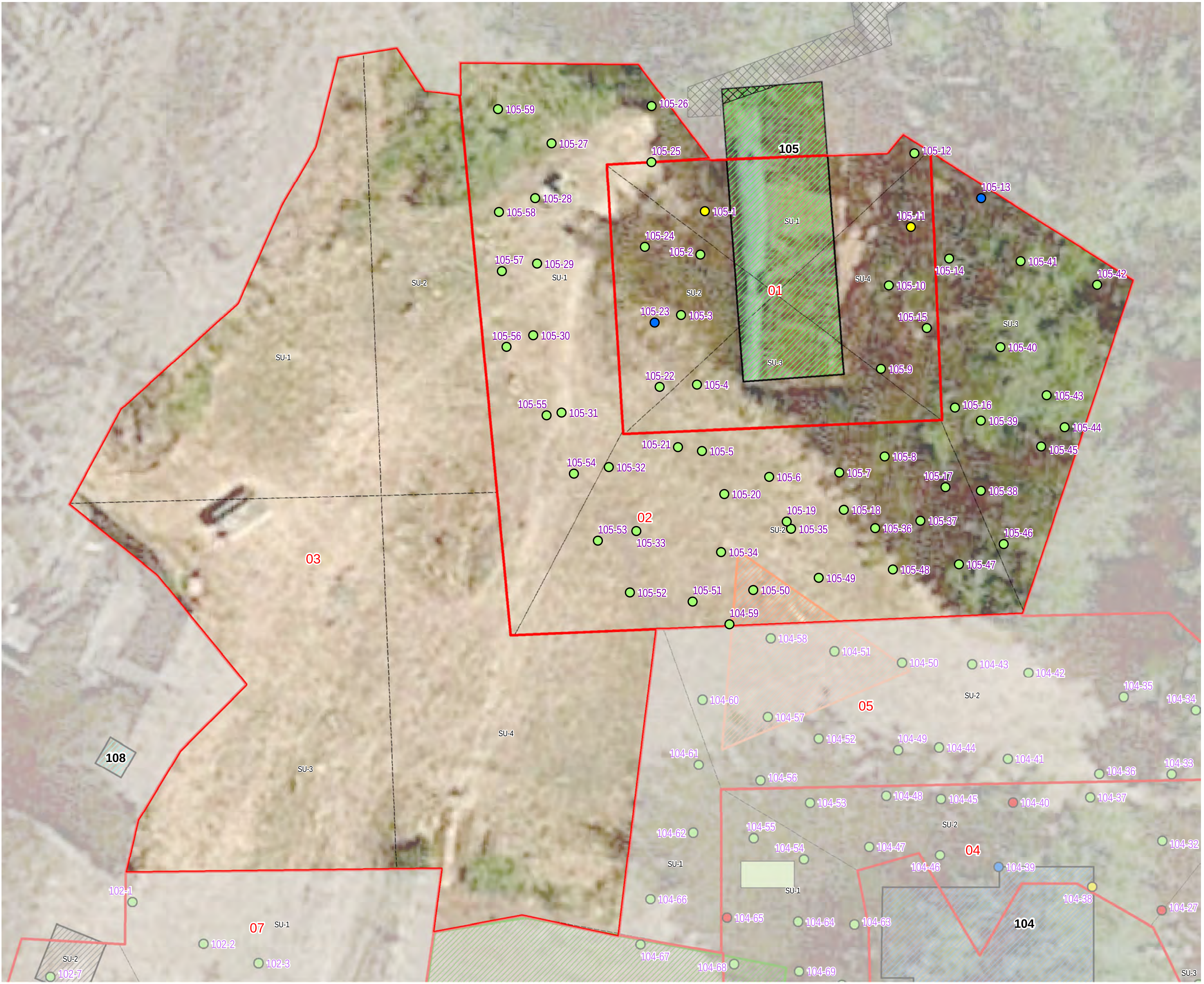
BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Building 104 XRF Sampling Results
November 2018 Sampling Event

ARCADIS Design & Consultancy for natural and built assets

FIGURE
15

CITY: SAN FRANCISCO DIV/GROUP: ENV/IM DB: jchen LD: PIC: PM: TM:
PROJECT: PATH: Z:\GISProjects_ENV\Burrows_Island_Lighthouse_2018\MXD\Burrows Island Lighthouse_Figure12thru19_DiscreteLocationsMapset.mxd DATE: 2/10/2019 8:23:58 PM



LEGEND

▭	Decision Unit Boundaries
▭	DU Subunits
▨	104, Officer In-Charge Quarters
▨	105, Boathouse
▨	108, Salt Water Flushing Pumphouse
9	DU Subunit Label (SU-X)

XRF Lead Corrected (ppm)

●	0 - 250
●	251 - 500
●	501 - 750
▨	Old Helicopter Pad
▨	Helicopter Pad
🟩	Septic Tank
▨	Landing/Dock

Notes:
GPS - global positioning system
ppm - parts per million
> - Greater Than
XRF - X-ray fluorescence

1. Sampling locations were recorded in the field using GPS with an approximate horizontal accuracy of 3 feet.
2. XRF lead concentrations are adjusted based on the correlation between laboratory analytical and XRF field screening results. Results were corrected using the following formula: Y = 1.136X - 0.02354 Where, Y = Log of the corrected XRF concentration X = Log of the XRF field measurement concentration Logarithms in the equation are in base 10.
3. Site features based on U.S. Coast Guard historical drawing Fire Protection, Water & Sewer Systems, Burrows Island Light Station, Dwg No. 60.5804, December 1960.

0 15 30

SCALE IN FEET

BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Building 105 XRF Sampling Results November 2018 Sampling Event

ARCADIS Design & Consultancy for natural and built assets

FIGURE
16

CITY: SAN FRANCISCO DIV/GROUP: ENV/IM DB: jchen LD: PIC: PM: TM:
PROJECT: PATH: Z:\GISProjects_ENV\Burrows_Island_Lighthouse_2018\MXD\Burrows Island Lighthouse_Figure12thru19_DiscreteLocationsMapset.mxd DATE: 2/10/2019 8:23:58 PM

LEGEND

▨ 106, Pumphouse and Spring Cistern

9 DU Subunit Label (SU-X)

XRF Lead Corrected (ppm)

● 0 - 250

Notes:
GPS - global positioning system
ppm - parts per million
> - Greater Than
XRF - X-ray fluorescence

1. Sampling locations were recorded in the field using GPS with an approximate horizontal accuracy of 3 feet.
2. XRF lead concentrations are adjusted based on the correlation between laboratory analytical and XRF field screening results. Results were corrected using the following formula: $Y = 1.136X - 0.02354$ Where,
   Y = Log of the corrected XRF concentration
   X = Log of the XRF field measurement concentration
   Logarithms in the equation are in base 10.
3. Site features based on U.S. Coast Guard historical drawing Fire Protection, Water & Sewer Systems, Burrows Island Light Station, Dwg No. 60.5804, December 1960.

0 5 10

SCALE IN FEET

BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Building 106 XRF Sampling Results November 2018 Sampling Event

ARCADIS Design & Consultancy for natural and built assets

FIGURE
17

CITY: SAN FRANCISCO DIV/GROUP: ENV/IM DB: jchen LD: PIC: PM: TM:
PROJECT: PATH: Z:\GISProjects_ENV\Burrows_Island_Lighthouse_2018\MXD\Burrows Island Lighthouse_Figure12thru19_DiscreteLocationsMapset.mxd DATE: 2/10/2019 8:40:05 PM

LEGEND

🟥 Decision Unit Boundaries

☐ DU Subunits

▨ 103, Duplex

▨ 107, Firehouse Pump Building

9 DU Subunit Label (SU-X)

XRF Lead Corrected (ppm)

● 0 - 250

● 251 - 500

● 751 - 1,000

● >1,000

▨ Tank Platform WT-4A

▨ Tank Platform WT-4B

▨ Elevated 10,000-Gallon Fuel Oil Tank

Notes:
GPS - global positioning system
ppm - parts per million
> - Greater Than
XRF - X-ray fluorescence

1. Sampling locations were recorded in the field using GPS with an approximate horizontal accuracy of 3 feet.
2. XRF lead concentrations are adjusted based on the correlation between laboratory analytical and XRF field screening results. Results were corrected using the following formula: Y = 1.136X - 0.02354 Where, Y = Log of the corrected XRF concentration X = Log of the XRF field measurement concentration Logarithms in the equation are in base 10.
3. Site features based on U.S. Coast Guard historical drawing Fire Protection, Water & Sewer Systems, Burrows Island Light Station, Dwg No. 60.5804, December 1960.

0 17.5 35

SCALE IN FEET

BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

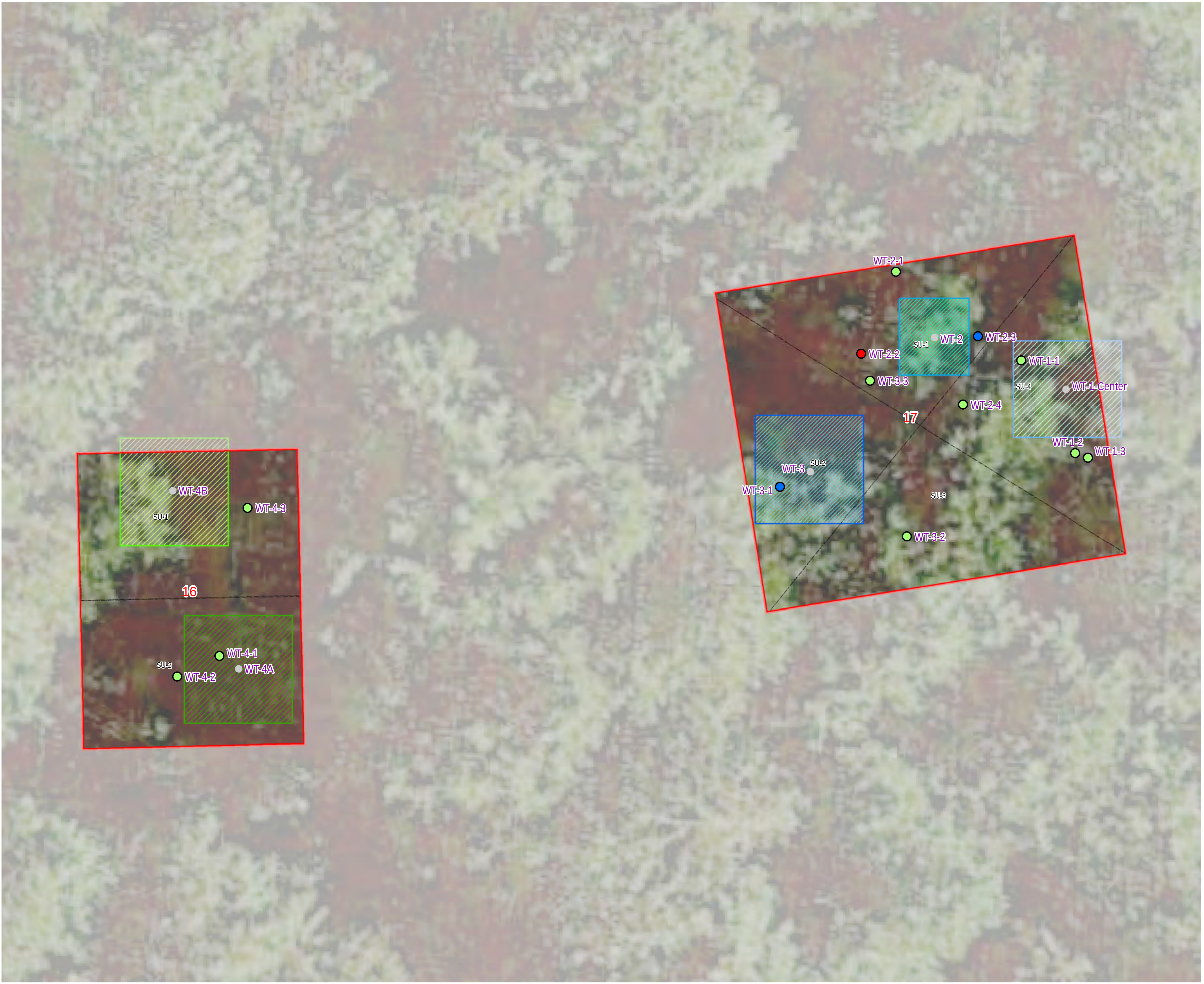
Building 107 and Tank 112 XRF Sampling Results November 2018 Sampling Event

ARCADIS Design & Consultancy for natural and built assets

FIGURE

18

CITY: SAN FRANCISCO DIV/GROUP: ENV/IM DB: jchen LD: PIC: PM: TM:
PROJECT: PATH: Z:\GISProjects_ENV\Burrows_Island_Lighthouse_2018\MXD\Burrows Island Lighthouse_Figure12thru19_DiscreteLocationsMapset.mxd DATE: 2/10/2019 8:23:58 PM



LEGEND

- 🟥 Decision Unit Boundaries
- ⬚ DU Subunits
- 9 DU Subunit Label (SU-X)

XRF Lead Corrected (ppm)

- ● No Data
- ● 0 - 250
- ● 251 - 500
- ● >1,000
- ▨ Water Tank 1
- ▨ Water Tank 2
- ▨ Water Tank 3
- ▨ Tank Platform WT-4A
- ▨ Tank Platform WT-4B

Notes:
GPS - global positioning system
ppm - parts per million
> - Greater Than
XRF - X-ray fluorescence

1. Sampling locations were recorded in the field using GPS with an approximate horizontal accuracy of 3 feet.
2. XRF lead concentrations are adjusted based on the correlation between laboratory analytical and XRF field screening results. Results were corrected using the following formula: Y = 1.136X - 0.02354 Where, Y = Log of the corrected XRF concentration X = Log of the XRF field measurement concentration Logarithms in the equation are in base 10.
3. Site features based on U.S. Coast Guard historical drawing Fire Protection, Water & Sewer Systems, Burrows Island Light Station, Dwg No. 60.5804, December 1960.

0 12.5 25

SCALE IN FEET

BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Water Tank XRF Sampling Results
November 2018 Sampling Event

ARCADIS Design & Consultancy for natural and built assets

FIGURE
19

CITY: SAN FRANCISCO DIV/GROUP: ENV/IM DB: jchen LD: PIC: PM: TM:
PROJECT: PATH: Z:\GISProjects_ENV\Burrows_Island_Lighthouse_2018\MXD\Burrows Island Lighthouse_Figure12thru19_DiscreteLocationsMapset.mxd DATE: 2/10/2019 8:40:05 PM

LEGEND

- ╍ Fuel Pipe
- ─ Fuel Line
- ● GRO*
- ● LEAD
- ● PCB/MINERAL OILS/DRO/HO*
- ● DRO/HO*

Structures

- ▨ Lighthouse
- ▨ Oil and Paint Storage Building
- ▨ Duplex
- ▨ Officer In-Charge Quarters
- ▨ Boathouse
- ▨ Pumphouse and Spring Cistern
- ▨ Firehouse Pump Building
- ▨ Salt Water Flushing Pumphouse
- ■ 675-Gallon Fuel Oil Tank
- ▨ 540-Gallon Fuel Tank
- ▨ Excavated Tank Area
- ■ Fuel Oil Tank
- ■ F.O. Tank
- ▨ 690-Gallon Fuel Tank
- ▨ Old Cistern
- ▨ Transformer Pad
- ■ Fire Pump
- ☐ Dark Staining
- ▨ Old Helicopter Pad
- ▨ Helicopter Pad
- ■ Debris Pile
- ▨ Elevated 10,000-Gallon Fuel Oil Tank
- ■ Septic Tank
- ■ 675-Gallon Fuel Oil Tank
- ■ Fuel Oil Tank
- ▨ Gasoline Storage Tank
- ▨ Landing/Dock

Notes:
DRO - diesel range organics
GRO - gasoline range organics
HO - heavy oils
PCB - polychlorinated biphenyl

1. Sampling locations will be modified as necessary in the field to account for site features.
2. * = Additional analyses may be performed in accordance with MTCA Table 830-1 based on the results of this testing.

0 60 120
SCALE IN FEET

BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Location of Discrete Samples

ARCADIS Design & Consultancy for natural and built assets

FIGURE
20

CITY: SAN FRANCISCO DIV/GROUP: ENV/IM DB: jchen LD: PIC: PM: TM:
PROJECT: PATH: Z:\GISProjects_ENV\Burrows_Island_Lighthouse_2018\MXD\Figure20_ Location of Discrete Samples.mxd DATE: 2/10/2019 9:08:36 PM

APPENDIX A

UFP QAPP Worksheets

Worksheet #1 – Title and Approval Page

Site Name/Project Name:	**Remedial Investigation, Focused Feasibility Study, and Remedial Design at Burrows Island Light Station, Skagit County, Washington**
Site Location:	The Burrows Island Light Station is located on an island in Skagit County, Washington, near the City of Anacortes.
Document Title:	Final Quality Assurance Project Plan & Sampling and Analysis Plan
Lead Organization:	United States Coast Guard, Civil Engineering Unit Oakland
Preparer's Name and Organizational Affiliation:	Josh Gravenmier, Arcadis U.S. Inc. (Arcadis)
Preparer's Contact Information:	2300 Clayton Road, Suite 400, Concord, CA, 94520 / 925-274-1100 / josh.gravenmier@arcadis.com
Preparation Date:	March 15, 2019
Investigative Organization's Project Manager:	
	Signature
	Josh Gravenmier, Arcadis
Investigative Organization's Project Quality Assurance Manager:	Paul T. McCullough
	Signature
	Paul McCullough, Arcadis
Lead Organization's Project Manager:	HALL.JAMES.CHADAM.1250240755 Digitally signed by HALL.JAMES.CHADAM.1250240755 Date: 2019.03.14 12:08:17 -07'00'
	Signature
	James Hall, Project Manager

Worksheet #2 – QAPP Identifying Information

Site Name/Project Name:	**Remedial Investigation, Focused Feasibility Study, and Remedial Design at Burrows Island Light Station, Skagit County, Washington**
Site Location:	The Burrows Island Light Station is located on an island in Skagit County, Washington, near the City of Anacortes.
Site Number/Code:	Not applicable – The Burrows Island Light Station is not a National Priorities List facility
Project Sites:	Burrows Island Light Station
Contractor Name:	Arcadis U. S., Inc. (Arcadis)
Contractor Number/Task Order Number:	HSCG50-14-D-PSL007/ 70Z08818FPXA01700
Contract Title:	Remedial Investigation, Focused Feasibility Study, and Remedial Design at Burrows Island Light Station, Skagit County, Washington
Work Assignment Number:	Not applicable
Identify Guidance Used to Prepare Quality Assurance Project Plan (QAPP):	Uniform Federal Policy for Quality Assurance Project Plans, Manual V1 (2005) DoD Quality Systems Manual, Version 4.2
Identify Regulatory Program:	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
Identify Approval Entity:	United States Coast Guard (USCG)
Indicate Whether the QAPP is a Generic or a Project-Specific QAPP?	Project Specific.
List Dates of Scoping Sessions that were Held:	10/4/18 (project kick off meeting); 11/5/18, 11/19/18, 11/27/18, 12/4/18, 12/10/18, 12/11/18, 12/19/1.8, 1/8/19

Worksheet #2 – QAPP Identifying Information

List Dates and Titles of QAPP Documents Written for Previous Site Work, if Applicable:	AGI Technologies. 1999. Removal of Heating Oil UST at Burrows Island Light Station, Project #13-01325, Contract #DTCG88-99-C-623039, Anacortes, Washington. June 18. Kellco. 2005. Paint Stabilization and Soil Removal, U.S. Coast Guard Lighthouse Station, Burrows Island, Washington. October 12. ERRG. 2009. Final Site Investigation Report, Burrows Island Light Station, Skagit County, Washington. August. Ecology. 2013. Terrestrial Ecological Evaluation, Burrows Island Light Station, Skagit County, Washington. September. Arcadis 2015. Lead Stabilization Treatability Testing Memo Addendum for Burrows Island Light Station. October 15.
List Organizational Partners (Stakeholders) and Connection with Lead Organization:	USCG – Lead Organization Arcadis – Contractor Northwest Schooner Society (NWSS) – Entity that will acquire Light Station after cleanup U.S. Environmental Protection Agency – Regulatory Agency Washington State Department of Ecology – Regulatory Agency
List Data Users:	USEPA, Ecology, NWSS, and Arcadis
Lead Organization's Program Manager:	James Hall, Contracting Officer Representative and Project Manager

Worksheet #2 – QAPP Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s) (per Uniform Federal Policy QAPP 2005)	**Required Information**	**Crosswalk to Related Information and Documents**
Project Management and Objectives		
2.1 Title and Approval Page	- Title and Approval Page	Worksheet #1 – Title and Approval Page
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	- Table of Contents - QAPP Identifying Information	The Table of Contents is provided following the UFP-QAPP cover page Worksheet #2 – QAPP Identifying Information
2.3 Distribution List and Project Personnel Sign-Off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	- Distribution List - Project Personnel Sign-Off Sheet	Worksheet #3 – Distribution List Worksheet #4 – Project Personnel Sign-Off
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	- Project Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications Table - Special Personnel Training Requirements Table	Worksheet #5 – Project Organizational Chart Worksheet #6 – Communication Pathways Worksheet #7 – Personnel Responsibilities and Qualifications Worksheet #8 – Special Personnel Training Requirements
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History and Background	- Project Planning Session Documentation (including data needs tables) - Project Scoping Session Participants Sheet - Problem Definition, Site History, and Background	Worksheet #9 – Project Team Planning Sessions Participants Sheet Site setting and background information for each of the sites is provided in the Sampling and Analysis Plan.

Worksheet #2 – QAPP Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s) (per Uniform Federal Policy QAPP 2005)	Required Information	Crosswalk to Related Information and Documents
2.6 Project Quality Objectives and Measurement Performance Criteria 2.6.1 Development of Project Quality Objectives Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	- Site-Specific Project Quality Objectives - Measurement Performance Criteria Table	Worksheet #10 – Conceptual Site Model Worksheet #11 – Problem Definition/Data Quality Objectives Worksheets #12-1 through #12-39 – Measurement Performance Criteria for project analytes Details concerning the project objectives can be found in the Sampling and Analysis Plan.
2.7 Secondary Data Evaluation	- Sources of Secondary Data and Information - Secondary Data Criteria and Limitations Table	Worksheet #13 – Secondary Data Criteria and Limitations
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	- Summary of Project Tasks - Reference Limits and Evaluation Table - Project Schedule/Timeline Table	Worksheet #14 – Summary of Project Tasks Worksheets #15-1 through #15-9 – Project and Laboratory Detection Limits for sample media Worksheet #16 – Project Schedule/Timeline

Worksheet #2 – QAPP Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s) (per Uniform Federal Policy QAPP 2005)	Required Information	Crosswalk to Related Information and Documents
Measurement/Data Acquisition		
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume and Preservation 3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures 3.1.2.4 Field Equipment Calibration, Maintenance, Testing and Inspection Procedures 3.1.2.5 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	- Sampling Design and Rationale - Sample Location Map - Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table - Analytical Methods/SOP Requirements Table - Field Quality Control (QC) Sample Summary Table - Sampling SOPs - Project Sampling SOP References Table - Field Equipment Calibration, Maintenance, Testing, and Inspection Table	Worksheet #17 – Sampling Design and Rationale Worksheet #18 – Sampling Locations and Methods/Standard Operating Procedure Requirements Worksheet #19 – Analytical SOP Requirements (Sample Containers, Preservation, and Holding Times) Worksheet #20 – Sample Quantities and Control Frequencies Worksheet #21 – Field Sampling Standard Operating Procedure References Worksheet #22 – Field Equipment Calibration, Maintenance, Testing, and Inspection General field sampling SOPs are provided in Appendix A. The laboratory analytical SOPs are provided in Appendix B.

Worksheet #2 – QAPP Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s) (per Uniform Federal Policy QAPP 2005)	Required Information	Crosswalk to Related Information and Documents
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	- Analytical SOPs - Analytical SOP References Table - Analytical Instrument Calibration Table - Analytical Instrument and Equipment Maintenance, Testing and Inspection Table	Worksheet #23 – Analytical Standard Operating Procedure References Worksheet #24 – Analytical Instrument Calibration Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing, and Inspection Laboratory Analytical SOPs are provided in Appendix B.
3.3 Sample Collection Documentation, Handling, Tracking and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	- Sample Collection Documentation Handling, Tracking and Custody SOPs - Sample Container Identification - Sample Handling Flow Diagram - Example Chain-of-Custody (CoC) Form and Seal	Worksheet #26 – Sample Handling System Worksheet #27 – Sample Custody Requirements An example of the CoC form is provided in the SOP for CoC, Handling, Packing, and Shipping. This SOP is contained in Appendix A.
3.4 Quality Control Samples 3.4.1 Sampling Quality Control Samples 3.4.2 Analytical Quality Control Samples	- QC Samples Table - Screening/Confirmatory Analysis Decision Tree	Worksheets #28-1 through #28-39 present QC sample criteria for project analytes.
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	- Project Documents and Records Table - Analytical Services Table - Data Management SOPs	Worksheet #29 – Project Documents and Records Worksheet #30 – Analytical Services The Data Management Plan is presented in Worksheet #14 – Summary of Project Tasks

This worksheet identifies the key information included in the Quality Assurance Project Plan, and lists all the required Quality Assurance Project Plan elements and where it is presented.

Worksheet #2 – QAPP Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s) (per Uniform Federal Policy QAPP 2005)	Required Information	Crosswalk to Related Information and Documents
Assessment/Oversight		
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	- Assessments and Response Actions - Planned Project Assessments Table - Audit Checklists - Assessment Findings and Corrective Action Responses Table	Worksheet #31 – Planned Project Assessments Worksheet #32 – Assessment Findings and Corrective Action Responses
4.2 QA Management Reports	- QA Management Reports Table	Worksheet #33 – Quality Assurance Management Reports
4.3 Final Project Report	- Narrative and timeline of project activities - Data Summary Conclusions and recommendations	Not Applicable (Final Project Report)
Data Review		
5.1 Overview		
5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment 5.2.3.2 Activities	- Verification (Step I) Process Table - Validation (Steps IIa and IIb) Process Table - Validation (Steps IIa and IIb) Summary Table - Usability Assessment	Worksheet #34 – Verification (Step I) Process Worksheet #35 – Validation (Steps IIa and IIb) Process Worksheet #36 – Validation (Steps IIa and IIb) Summary Worksheet #37 – Usability Assessment
5.3 Streamlining Data Review 5.3.1 Data Review Steps to be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining	Not Applicable	Not Applicable

Worksheet #3 – Distribution List

Quality Assurance Project Plan (QAPP) Recipients	Title	Organization	Telephone Number	E-mail Address
James Hall	Contracting Officer Representative and Project Manager	USCG	510-637-5593	James.C.Hall2@uscg.mil
Travis Cohen	Contracting Officer	USCG	510-637-5587	Travis.Cohen@uscg.mil
Karen Ladd	SILC Technical Expert	USCG	510-637-5579	Karen.ladd@uscg.mil
Sandra Caldwell	Land Use Supervisor	Ecology	360-407-7236	SACA461@ecy.wa.gov
Josh Gravenmier	Project Manager	Arcadis	925-296-7858	Josh.Gravenmier@arcadis.com
Paul McCullough	Principal Environmental Engineer / Project Technical Advisor /QA/QC	Arcadis	206-726-4728	Paul.McCullough@arcadis.com
Troy Sclafani	Program Director	Arcadis	248-994-2288	Troy.Sclafani@arcadis.com
Mark Ullery	Environmental Engineer	Arcadis	206-726-4713	Mark.Ullery@arcadis.com
Kyle Haslam	Project Scientist / Field Technical Leader	Arcadis	206-719-6991	Kyle.Haslam@arcadis.com
Alex Pink	Environmental Scientist/Field Technical Leader	Arcadis	906-440-8394	Alexander.Pink@arcadis.com
Ryan Brauchla	AFS Task Manager 2 / Field Team	Arcadis	206-726-4757	Ryan.Brauchla@arcadis.com

Worksheet #3 – Distribution List

Quality Assurance Project Plan (QAPP) Recipients	Title	Organization	Telephone Number	E-mail Address
Julia Vidonish	Environmental Engineer / Field Team	Arcadis	206-413-6523	Julia.Vidonish@arcadis.com
Patrick Collins	Civil Engineer / Field Team	Arcadis	206-726-4755	Patrick.Collins@arcadis.com
Daniel Gilbert	Geologist / Field Team	Arcadis	206-413-6540	Daniel.Gilbert@arcadis.com
David Baumeister	Laboratory Project Manager	Onsite	425-883-3881	DBaumeister@onsite-env.com
Stacey Duran	Laboratory QA Manager	Onsite	425-883-3881	SDuran@onsite-env.com

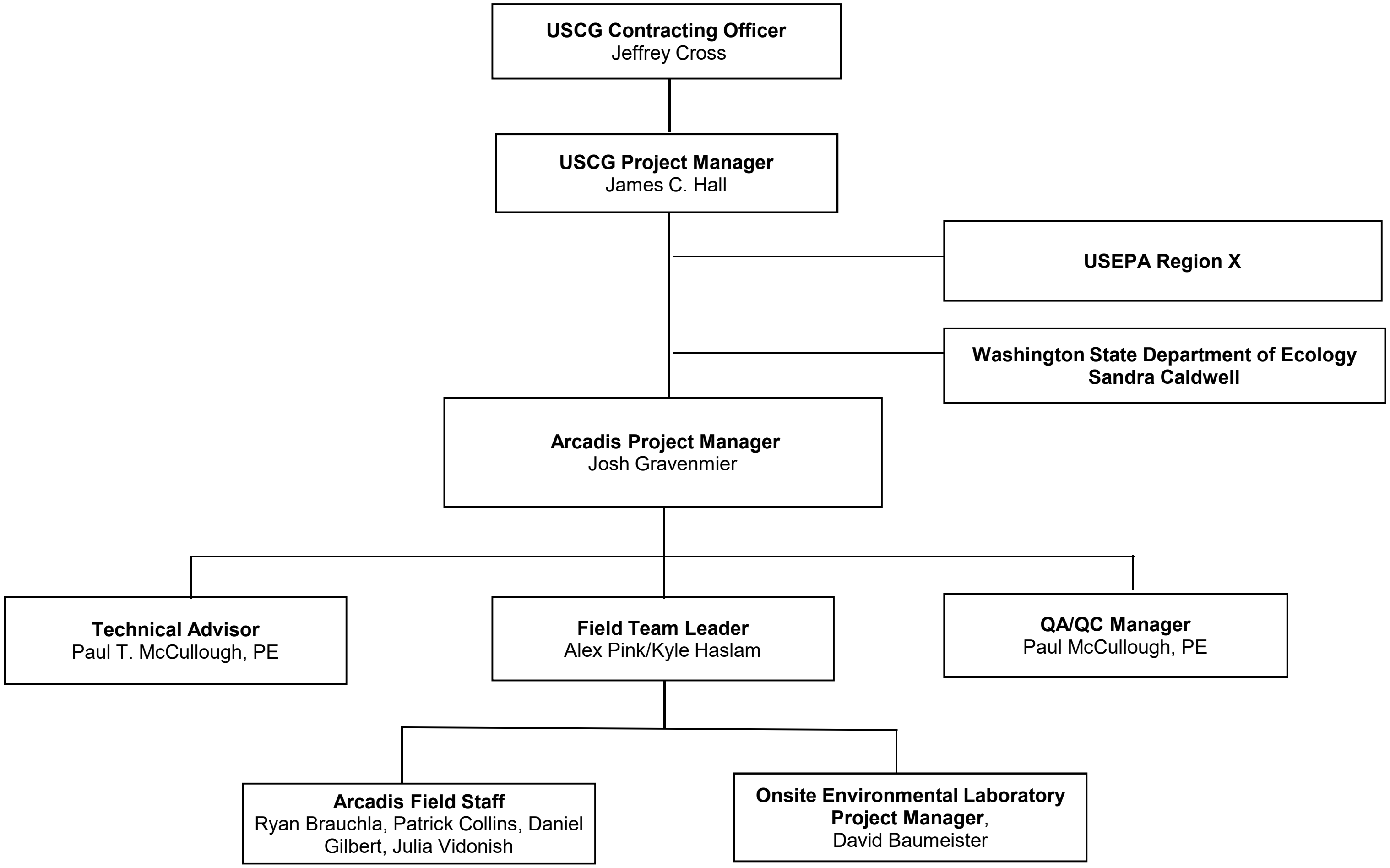
Note:
Copies of the QAPP/SAP will be distributed to the individuals listed above.
SILC – Shore Infrastructure Logistics Center
QA – Quality Assurance
QC – Quality Control

QAPP Worksheet #4 Project Personnel Sign-Off

Organization/Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Arcadis/Josh Gravenmier	Project Manager	909-296-7858		March 13, 2019
Arcadis/Paul McCullough	Principal Environmental Engineer	206-214-7161	Paul T. McCullough	March 13, 2019
Arcadis/Mark Ullery	Office Support	360-292-8990		
Arcadis/Kyle Haslam	Field Team Leader	206-719-6991		March 13, 2019
Arcadis/Alex Pink	Field Team Leader	952-693-5176	alex Pink	March 14, 2019
Arcadis/Ryan Brauchla	Field Support	206-726-4757		March 14, 2019
Arcadis/Emily Zikmund	Field Support	707-260-5171	Emily Zikmund	March 14, 2019
Arcadis/Daniel Gilbert	Field Support	206-413-6540	Daniel Sly Gilbert	March 14, 2019
Arcadis/Julia Vidonish	Field Support	724-317-4630	Julia E. Vidonish	March 13, 2019

Note: Please see Worksheet #3 for personnel who have received a copy of the QAPP/SAP.

QAPP Worksheet #5 Project Organization Chart



QAPP Worksheet #6 Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (e.g., Timing, Pathways)
Point of Contact with EPA, Ecology, and other Agencies or Stakeholders	USCG Project Manager	James Hall	510.637.5544	USCG Project Manager will coordinate with EPA, Ecology, and other agencies, as necessary.
Manage RI/FSS and RD	Arcadis Project Manager	Josh Gravenmier	707-338-4441	Arcadis Project Manager will be notified of field-related questions or problems by phone, e-mail, or fax by close of business the next business day. Arcadis PM will notify USCG (James Hall) of any issues that need to be addressed by USCG
QAPP changes in the field	Arcadis Field Team Leader	Kyle Haslam/Alex Pink	206-719-6991 (Kyle) 906-440-8394 (Alex)	The Arcadis Field Team Leader will be notified the Arcadis Project Manager and Technical Advisor of any changes to the QAPP and reasons for the changes immediately. Any minor changes to the QAPP made in the field will be documented in an email from the Arcadis Project Manager to the USCG Project Manager. Any major changes to the QAPP must be approved by the USCG
Reporting Lab Data Quality Issues	Laboratory Quality Assurance Manager	Onsite: Stacey Duran	Onsite: 425.883.3881	All Quality Assurance/Quality Control issues with project field samples will be reported by the Laboratory Project Manager to the Data Quality Assurance Manager within two business days. Any significant laboratory data quality issues (i.e., potentially rejected data) will be documented in an email from the Arcadis Project Manager to the USCG Project Manager within two business days of identifying the issue during data review and validation. Data Validation Reports and Data Summary Reports will be provided in the RI Report.

QAPP Worksheet #6 Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (e.g., Timing, Pathways)
Field and Analytical Corrective Actions	Technical Advisor	Paul McCullough	206-214-7161	The need for corrective action for field and analytical issues will be determined by the Data Quality Assurance Manager in conjunction with the Arcadis Project Manager, the Field Program Coordinator or the Laboratory Quality Assurance Manager, as appropriate.
Release of Analytical Data	Technical Advisor	Paul McCullough	206-214-7161	No final analytical data can be released until validation is completed and the Data Quality Assurance Manager has approved the release.
QAPP Amendments	Technical Advisor	Paul McCullough	206-214-7161	Any major changes to the QAPP must be approved by the Arcadis Technical Advisor and communicated by the Arcadis Project Manager to the USCG Project Manager in writing before any change can be implemented.

QAPP Worksheet #7 Personnel Responsibilities and Qualifications

Name	Title	Organizational Affiliation	Education and Experience Qualifications
James Hall	Contracting Officer Representative and Project Manager	USCG	Designated as the USCG Project Manager and Contracting Officer Representative.
Travis Cohen	Contracting Officer Representative	USCG	Designated as USCG Contracting Officer.
Sandra Caldwell	Land Use Supervisor	Ecology	Ecology designated contact.
Troy Sclafani	Program Director	Arcadis	B.S., Geology; 15 years experience
Josh Gravenmier	Project Manager	Arcadis	B.S. Soil and Water Science, M.S. Environmental Management, 28 years experience
Paul McCullough	Technical Advisor / QA/QC	Arcadis	B.S. Environmental Engineering, 26 years experience
Mark Ullery	Office Support	Arcadis	B.S. Civil Engineering, M.S. Environmental Engineering, 4 years experience
Kyle Haslam	Field Team Leader	Arcadis	B.S. Environmental Science, 9 years experience
Alex Pink	Field Team Leader	Arcadis	B.S. Environmental Geoscience, 3.5 years experience

QAPP Worksheet #7 Personnel Responsibilities and Qualifications

Name	Title	Organizational Affiliation	Education and Experience Qualifications
Julia Vidonish	Field Team	Arcadis	B.S. Geophysical Sciences, Ph.D. Environmental Engineering, 1 year experience
Ryan Brauchla	Field Team	Arcadis	B.S. Geology, 6 years experience
Patrick Collins	Field Team	Arcadis	B.S. Geological Engineering, 2.5 years experience
Daniel Gilbert	Field Team	Arcadis	B.S. Geology, 1 year experience
Stacey Duran	Laboratory Quality Assurance Manager	Onsite Environmental	B.S. Pre-medicine, 16 years experience
David Baumeister	Laboratory Project Manager	Onsite Environmental	B.A. Biology, 25 years experience

Notes:

The responsibilities of the various team members are summarized below by organization.

USCG

Project Manager
Responsibilities and duties include the following:

- Communicate with Ecology, EPA, and other agencies and stakeholders
- Manage overall scope, schedule, and budget
- Review and approve project deliverables

Contracting Officer Representative

Responsibilities and duties include the following:

- Monitor the progress of the project.
- Evaluate technical document and field work.
- Advise the USCG Project Manager and Contracting Officer on matters relating to the project.

Arcadis

Program Director

Responsibilities and duties include the following:

- Provide programmatic-level technical and administrative guidance to the project team.
- Provide review of project leadership and resources.
- Assist with staff resource allocation and scheduling.
- Provide quality review on documents and deliverables to ensure compliance with contractual agreements.

Project Manager

Responsibilities and duties include the following:

- Communicate with USCG and project team
- Direct Arcadis project team.
- Oversee Arcadis work products.
- Provide Arcadis approval for major project deliverables.

Technical Advisor, QA/QC

Responsibilities and duties include the following:

- Provide technical direction to project team in consultation with Arcadis Project Manager
- Participate in meetings with USCG and agencies in coordination with Arcadis Project Manager and USCG Project Manager
- Review project deliverables
- Coordinate with laboratory to ensure project objectives are being met

Field Team Leader

Responsibilities and duties include the following:

- Coordinate field and laboratory schedules pertaining to relevant site activities.
- Request sample bottles from laboratory.
- Instruct personnel working on relevant site activities.
- Review field instrumentation, maintenance, and calibration to meet quality objectives.
- Review relevant field records and logs.
- Maintain field and laboratory files of notebooks/logs, data reductions and calculations; provide complete copies to the Project Coordinator.
- Develop, establish, and maintain files on relevant site activities.
- Perform data review of field data reductions and reports on relevant site activities.

- Verify that corrective actions are taken for deficiencies cited during audits of relevant site activities.
- Perform overall quality assurance/quality control of the relevant portions of the site activities.

Field Team

Responsibilities and duties include the following:

- Perform field procedures associated with the investigations as set forth in the QAPP/SAP.
- Perform field analyses and collect quality assurance samples.
- Calibrate, operate, and maintain field equipment.
- Reduce field data.
- Maintain sample custody.
- Prepare field records and logs.

Data Quality Assurance Manager

Responsibilities and duties include the following:

- Review laboratory data packages.
- Oversee and interface with the analytical laboratory.
- Coordinate field quality assurance/quality control procedures with Task Managers (including audits of field activities), concentrating on field analytical measurements and practices to meet data quality objectives.
- Review field reports.
- Perform and review audit reports.
- Prepare interim quality assurance/quality control compliance reports.
- Prepare a quality assurance/quality control report in accordance with USEPA guidelines, including an evaluation of field and laboratory data and data usability reports.

Onsite Environmental

General responsibilities and duties of the analytical laboratories include the following:

- Perform sample analyses and associated laboratory quality assurance/quality control procedures.
- Supply sampling containers and shipping cartons.
- Maintain laboratory custody of sample.
- Adhere to all protocols in the QAPP.

Project Manager

Responsibilities and duties include the following:

- Serve as primary communication link between Arcadis and laboratory technical staff.
- Monitor workloads and maintain availability of resources.
- Oversee preparation of analytical reports.
- Supervise in-house chain of custody.

Laboratory Quality Assurance Manager

Responsibilities and duties include the following:

- Conduct audits of all laboratory activities.

Washington State Department of Ecology

Land Use Supervisor

Responsibilities and duties include the following:

- Review and comment on the QAPP.
- Assist USCG Project Manager in developing ARARs and TBCs and ensuring that remedial investigation, focused feasibility study, and remedial design meets State ARARs and TBCs

QAPP Worksheet #8 Special Personnel Training Requirements

Project Function	Specialized Training	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Field Activities	40-hour HAZWOPER	Certified Trained Professionals	Not Applicable	Field operations personnel	Arcadis Field Staff and Subcontractors	Arcadis project offices and Site-Specific Health and Safety Plan
	XRF use and dosimetry monitoring	Equipment vendor	Not Applicable	Field operations personnel	Arcadis Field Staff	Arcadis project offices and Site-Specific Health and Safety Plan
	Lead Safety Awareness	Certified Professionals	Not Applicable	Field operations personnel	Arcadis Field Staff and Subcontractors	Arcadis project offices and Site-Specific Health and Safety Plan
Analytical Chemistry	Laboratory Accreditation	Washington Department of Ecology Laboratory Accreditation	Not Applicable	Not Applicable	OnSite Environmental 14648 NE 95th St. Redmond, WA 98052 425.883.3881	OnSite Environmental 14648 NE 95th St. Redmond, WA 98052 425.883.3881
Additional training/certification requirements are listed in the project health and safety plan.						

Note: Current HAZWOPER training certificates for consultant field staff and subcontractors will be maintained in the Arcadis Seattle, Washington office location for each employee performing work at the Site where 40-hour training is required for the position assignment.

QAPP Worksheet #9 Project Team Planning Sessions Participants' Sheet

Project Name: **Remedial Investigation, Focused Feasibility Study, and Remedial Design at Burrows Island Light Station, Skagit County, Washington**	Site Name: **USCG Burrows Island Light Station**
Projected Date(s) of Sampling: November 2018-April 2019	Site Location:Burrows Island Light Station, Burrows Island, Washington (0.25 from Anacortes, Washington in Skagit County)
Project Manager: James Hall (USCG); Josh Gravenmier (Arcadis)	

Date of Sessions: October 4, 2018 (Kick off Call), October 29, 2018 (Field Team Meeting); November 5, 2018 (touch point call); November 19 (touch point call), November 27, 2018 (touch point call and call with EPA); December 4, 2018 (touch point call); December 10, 2018 (Field Team Meeting); December 11, 2018 (touch point call); December 19, 2019 (touch point call), January 8, 2019 (touch point call)

Scoping Sessions Purpose: Review document preparation requirements and approach associated with the creation of a SAP/QAPP applicable to USCG Burrows Island Light Station. Discuss field sampling plan, including incremental sampling methodology (ISM), discrete sampling, logistics, schedule, and coordination with EPA, Ecology, and NWSS.

Name	Title	Affiliation	Phone	E-mail Address	Project Role
James Hall	Environmental Engineer	USCG	510-637-5544	James.C.Hall2@uscg.com	USCG Project Manager
Josh Gravenmier	Technical Expert, Associate V.P.	Arcadis	925-296-7857	Josh.gravenmier@arcadis.com	Arcadis Project Manager
Paul McCullough, PE	Principal Environmental Engineer	Arcadis	206-214-7161	Paul.mccullough@arcadis.com	Technical advisor, QA-QC

Name	Title	Affiliation	Phone	E-mail Address	Project Role
Mark Ullery	Environmental Engineer	Arcadis	206-726-4713	Mark.ullery@arcadis.com	Office Support
Kyle Haslam	Project Scientist	Arcadis	206-719-6991	Kyle.haslam@arcadis.com	Field Team Leader
Julia Vidonish, Ph.D	Environmental Engineer	Arcadis	206-413-6523	julia.vidonish@arcadis.com	Field Team, Lab coordinator
Meeting Discussions/Comments					
QAPP/SAP shall be combined document and include UFP QAPP Worksheets and narrative text. Sampling methodology will include ISM for lead and discrete sampling for petroleum constituents (e.g., relatively small areas). ISM should be generally consistent with ITRC Guidance. James Hall will coordinate with EPA and Ecology to obtain appropriate agency approvals/notifications and will discuss SOW with agencies as appropropriate. At this time, anticipated cleanup levels are 250 mg/kg for lead, 1 mg/kg for total PCBs, 2,000 mg/kg for total petroleum hydrocarbons (diesel and heavy oil), and 4,000 mg/kg for total petroleum hydrocarbons as mineral oil. Media is soil.					

QAPP Worksheet #10 Problem Definition — Data Quality Objectives

Step 1: State the Problem:

Historic operations at the light station have impacted surface and near surface soil with lead, PCBs and possibly other petroleum related COCs from historic use of petroleum products (fuel oil, diesel, and gasoline). Cleanup of these COCs in soil to levels that are protective of human health and the environment is necessary prior to USCG turning over the light station to the NWSS.

Step 2: Identify the Goal of the Study:

The primary goal of this study is to generate data of acceptable quality on concentrations of COCs at the Site to complete the delineation of COCs in soil and to inform the FFS and subsequent RD. In November 2018, Arcadis conducted a field reconnaissance visit to the Site that included photo documentation, preliminary screening of lead concentrations in surface and near surface soils using an XRF instrument, limited analytical testing to obtain correlations between XRF field screening data and laboratory results for lead, and limited sampling for PCBs in an area of visually stained soils in the former transformer oil release area. The data quality objectives that were achieved for the initial site visit and soil screening assessment were as follows:

- Where are the locations of the existing and former site features?
- Is there any visual evidence of contamination in these areas?
- What area(s) of the Site are not accessible (or have limited access) for sampling due to constraints such as shallow bedrock, steep slopes, heavy vegetation, or other reasons?
- What is the spatial distribution of lead in surface (0 to 6-inches) based on XRF-screening data?
- What is the correlation between lead concentrations as measured using the field XRF instrument and analytical samples using EPA Method 6010 at select locations?
- Based on XRF screening results and visual observations, what is an appropriate delineation of decision units (DUs) and sampling units (SUs) for subsequent sampling using incremental sampling methodology (ISM)?

The RI study discussed in this document will consist of comprehensive sampling and analytical testing to address the following DQO's:

- Are petroleum hydrocarbons (gasoline, diesel, mineral oil, or heavy oil) COCs at this Site in addition to lead and PCBs.
- What is the lateral and vertical extent of COCs in soil?
- What areas of the Site, if any, exceed 250 mg/kg total lead concentrations in soil?

QAPP Worksheet #10 Problem Definition — Data Quality Objectives

- What areas of the Site, if any, exceed 1 mg/kg of PCBs in soil?
- What areas of the Site, if any, exceed MTCA Method A soil cleanup levels for gasoline (100 mg/kg), diesel (2,000 mg/kg), mineral oil (4,000 mg/kg) or heavy oil (2,000 mg/kg)?
- Are any of the COCs present at levels that would trigger disposal as a Resource Conservation and Recovery Act (RCRA) hazardous waste, Washington State Dangerous Waste, or Toxic Substances Control Act (TSCA) regulated waste?
-

Step 3: Identify Information Inputs:

Information needed to answer the above questions include:

- Historic maps and reports (Appendix B)
- Photographs and field notes describing site features and conditions at the time of the site inspection.
- Concentrations of COCs in soil.

Step 4: Define the Boundaries of the Sampling:

The Site is located entirely within USCG-owned property on Burrows Island and includes all areas where hazardous substances (e.g., lead, petroleum, PCBs) were released from operation of the light station and have come to be located.

Step 5: Develop the Analytic Approach:

The sampling scheme will include both ISM and discrete sampling methods. Incremental composite sampling will be performed for lead throughout the Site, except for a small area in the vicinity of the former Spring Cistern and Pumphouse (Area 106 of Figure 2), where discrete sampling methods will be performed for lead. Discrete sampling methods will be used to assess petroleum hydrocarbons and PCBs.

Select soil samples will be analysed by a Washington State certified laboratory for the following constituents:

- Lead – EPA Method 6010
- PCBs – EPA Method 8082

- Petroleum Hydrocarbons, Gasoline – NWTPH-Gx
- Petroleum Hydrocarbons, Diesel – NWTPH-Dx
- Petroleum Hydrocarbons, Heavy Oil – NWTPH-Dx
- Petroleum Hydrocarbons, Mineral Oil – NWTPH-Dx
- Benzene– EPA 8260 (only if gasoline or diesel range petroleum hydrocarbons are detected above MTCA Method A cleanup levels)
- cPAHs – EPA 8270 SIM (only if diesel or heavy oil range hydrocarbons are detected above MTCA A cleanup levels)
- VPH – NWTPH-VPH (only if gasoline-range petroleum hydrocarbons are detected at concentrations above MTCA Method A cleanup levels)
- EPH – NWTPH-EPH (only if diesel, heavy oil, or mineral oil range hydrocarbons are detected at concentrations above MTCA A cleanup levels)

Soil analytical data will be compared to MTCA Method A cleanup levels, which will be used as screening levels until final cleanup levels are established. If there is no MTCA Method A cleanup level, then soil analytical data will be compared to MTCA Method B screening levels.

Step 6: Specify Performance or Acceptance Criteria:

For this study, performance and acceptance criteria will apply to generating appropriate and acceptable data for establishing if COCs in soil exceed applicable MTCA Method A or, if there is no published MTCA Method A cleanup level, MTCA Method B cleanup levels.

Step 7: Develop the Plan for Obtaining Data:

The overall quality assurance objective is to develop and implement procedures for field sampling — chain of custody, laboratory analysis and reporting — that will provide results to support the evaluation of site data consistent with National Contingency Plan (NCP) requirements. Specific procedures for sampling, chain of custody, laboratory instrument calibration, laboratory analysis, data reporting, internal quality control, audits, preventive maintenance of field equipment and corrective action are described in other sections of this SAP/QAPP.

Sampling for lead will be performed in accordance with ITRC guidelines for incremental composite sampling. The ISM sampling will include: 18 DUs, 61 SUs. ISM samples will be collected from each DU and SU at 2 discrete depths (total of 166 composite samples). Field Triplicates will be collected in 4 DUs. Samples will be analyzed for lead after processing at laboratory. The laboratory processing will include: air drying at ambient temperature, “gentle” soil dissagreggation using hand or peste methods, sieving to below 2 millimeters, subsampling using Japanese 2D slab-cake method, and laboratory analysis using EPA Method 6010.

Samples will be analyzed for lead in deeper DUs only if the shallow DU lead concentration is greater or equal to 250 mg/kg. Sampling of SUs will only be performed if lead analytical results for applicable Du is between 200 and 400 mg/kg (moderately above and below the 250 mg/kg screening level). At a minimum, 22 composite samples will be analyzed for lead (assuming no deeper DUs or SUs are analyzed). At high end, a total of 158 composite samples will be analyzed for lead using EPA Method 6010.

Discrete samples will be collected in areas with historic petroleum products and PCBs. The sampling program will include discrete sampling as follows:

- 6 samples for GRO using NWTPH-Gx
- 110 samples for DRO and HO using NWTPH-Dx
- 34 samples for TPH as mineral oil using NWTPH-Dx
- 34 samples for PCBs using EPA Method 8082A
- 6 samples for lead sing EPA Method 6010

Additionally, discrete samples will be analyzed for benzene using EPA Method 8260, cPAHs using EPA Method 8270SIM, and Extractable Petroleum Hydrocarbons using NWTPH-EPH in the event that DRO is detected above MTCA Method A screening levels. In the event the GRO is detected above MTCA Method A screening levels, samples will be analyzed for benzene using EPA Method 8260 and Volatile Petroleum Hydrocarbons using Method NWTPH-VPH. Refer to the SAP/QAPP for additional details on sampling procedures and rationale.

QAPP Worksheet #11 Project Quality Objectives/Systematic Planning Process Statements

Who will use the data?

The data will be used by USCG, Arcadis, and Washington State Department of Ecology.

What will the data be used for?

The data will be used as part of the RI to determine the lateral and vertical extent of COCs in soil at the Site. These data will be used to inform a subsequent focused feasibility study that will evaluate potential remedial action alternatives to address COCs in soil above applicable cleanup levels, and the subsequent remedial design and cost estimate for the selected remedy.

What type of data are needed? (target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques)

The types of data will include:

- Discrete and/or incremental composite soil sampling (ICS) for the following constituents:
    - Lead (EPA 6010)
    - Total Petroleum Hydrocarbons (NWTPH-Gx and NWTPH-Dx)
    - PCBs (EPA 8082))
    - Benzene (EPA 8260), cPAHs (EPA 8270SIM), EPH (NWTPH-EPH), and VPH (NWTPH-VPH) will be analyzed if DRO or GRO is detected above MTCA Method A screening levels per Table 830-1 of MTCA Cleanup Regulation.
- Paint chip samples will be analyzed for lead using EPA Method 7000B

How “good” do the data need to be in order to support the environmental decision

QAPP Worksheet #11 Project Quality Objectives/Systematic Planning Process Statements

Site characterization data needs to facilitate evaluation of the nature and extent of potential soil impacts at the Site and determine if removal action will be necessary. At a minimum, soil analytical results are required to meet MTCA Method A or B cleanup levels (unrestricted land use) for each constituent of potential concern. Waste characterization data are needed to determine if the soils generated during the Site evaluation and/or removal action are characteristically hazardous and to determine the proper means of transportation and disposal. Specific requirements for data quality are identified in Worksheet # 37.
How much data are needed? (number of samples for each analytical group, matrix and concentration)
The number of samples and analyses for each media are summarized in Worksheet #20 and described in the SAP (Arcadis, 2019).
Where, when, and how should the data be collected/generated?
Sampling for lead will be performed using incremental composite sampling methods pursuant to ITRC guidelines, except in the vicinity of Building 106 (Spring Cistern Pumphouse), where lead sampling will be performed using discrete methods due to limited size and accessibility. Discrete samples will be collected for petroleum hydrocarbons and PCBs in areas where petroleum products are known to have been located and in the area of the former PCB transformer oil spill. Standard protocols for sample collection and handling, sample preparation, and analytical methods will be followed. Standard operating procedures for field sampling are referenced in this document and provided in the SAP (Arcadis, 2019).
Who will collect and generate the data?
Arcadis will collect the data. Analytical testing will be performed by On Site Environmental, Inc for all constituents exceed lead-based paint. Lead based samples will be analyzed by NVL Laboratories.

QAPP Worksheet #11 Project Quality Objectives/Systematic Planning Process Statements

How will the data be reported?
Site evaluation data will be reported in a Remedial Investigation/Focused Feasibility Study (RI/FSS) report. The report will include data tables to summarize the analytical results and a map that shows the sample locations. Field notes will be provided to USCG at the completion of each field day. Copies of the field notes will be appended to the RI/FSS report.
How will the data be archived?
All data will be archived by USCG CEU Oakland in their Oakland, California office and in the ADEPT database. Arcadis will store the data at the Arcadis office in Seattle, Washington.

QAPP Worksheet #12-1 – Measurement Performance Criteria (Polychlorinated Biphenyls in Soil)

Matrix	Soil
Analytical Group	Polychlorinated biphenyls
Concentration Level	All

Sampling Procedure[1]	**Analytical Method/ Standard Operating Procedure (SOP)**[2]	**Data Quality Indicators**	**Measurement Performance Criteria**	**Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
F-1, F-2, F-3	SW846 8082A/ L-3	Precision – Overall	Relative percent difference (RPD) <50%	Field duplicate	S&A
		Accuracy/Bias	Percent recovery (%R)	Surrogate	A
		Accuracy/Bias Contamination	< ½ Limit of Quantitation	Blanks (field, equipment, method)	S&A
		Accuracy/Bias	%R	Laboratory control sample (LCS) and laboratory control sample duplicate (LCSD)[3]	A
		Accuracy/Bias and Precision	Retention times, see analytical SOP	Retention time windows	A
		Accuracy/Bias	%R, same as LCS	Matrix spike and matrix spike duplicate (MS/MSD)[3]	A
		Precision	RPD, <30%	MS/MSD or LCS/LCSD [3]	A

Notes:

LCS	Laboratory control sample.
LCSD	Laboratory control sample duplicate
MS	Matrix spike.
MSD	Matrix spike duplicate.
RPD	Relative percent difference.
SOP	Standard operating procedure.
%D	Percent difference.

%R Percent recovery.

[1] Reference number from Worksheet #21.

[2] Reference number from Worksheet #23.

[3] Sufficient sample size for MS and MSD analysis must be client-provided. LCS/LCSD performed when no MS/MSD are supplied.

QAPP Worksheet #12-3 – Measurement Performance Criteria (Carcinogenic Polycyclic Aromatic Hydrocarbons in Soil)

Matrix	Soil
Analytical Group	cPAHs
Concentration Level	All

Sampling Procedure[1]	Analytical Method/Standard Operating Procedure (SOP)[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria[4]	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
F-1, F-2, F-3	SW846 8270-SIM/ L-7	Precision – Overall	Relative percent difference (RPD) < 50%	Field duplicate	S&A
		Accuracy/Bias	Percent recovery (%R), laboratory generated limits See Appendix B	Surrogate	A
		Accuracy/Bias Contamination	< Reporting Limit (RL)	Blanks (field, equipment, method)	S&A
		Accuracy/Bias	%R (70-130)	Initial calibration verification	A
		Accuracy/Bias	%D ± 20%	Continuing calibration verification	A
		Accuracy/Bias	%R, See Appendix B	Laboratory control sample (LCS) and laboratory control sample duplicate (LCSD)[3]	A
		Accuracy/Bias	% Relative abundance, see analytical SOP	Instrument performance check: decafluorotri-phenylphosphine (DFTPP)	A
		Precision	Area response 50-200%	Internal standard	A

QAPP Worksheet #12-3 – Measurement Performance Criteria (Carcinogenic Polycyclic Aromatic Hydrocarbons in Soil)

Matrix	Soil
Analytical Group	cPAHs
Concentration Level	All

Sampling Procedure[1]	Analytical Method/Standard Operating Procedure (SOP)[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria[4]	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
		Accuracy/Bias	%R, See Appendix B	Matrix spike (MS)[3] and Matrix spike duplicate (MSD)	A
		Precision	RPD < 40%	MS/MSD or LCS/LCSD [3]	A

Notes:

LCS	Laboratory control sample.
MS	Matrix spike.
MSD	Matrix spike duplicate.
RL	Reporting limit.
RPD	Relative percent difference.
SOP	Standard operating procedure.
%D	Percent difference.
%R	Percent recovery.

[1] Reference number from Quality Assurance Project Plan Worksheet #21.

[2] Reference number from Quality Assurance Project Plan Worksheet #23.

[3] MS and MSD must be client-provided. LCS/LCSD performed when no MS/MSD are supplied.

[4] Measurement Performance Criteria (MPC) that is “laboratory generated limits” are re-generated annually. The MPCs in the laboratory analytical reports will reflect the most recent MPCs.

QAPP Worksheet #12-5 – Measurement Performance Criteria (TPH Diesel Range Organics [DRO]/Heavy Oil [HO]/Gasoline Range Organics [GRO] in Soil)

Matrix	Soil				
Analytical Group	GRO/DRO/HO				
Concentration Level	All				
Sampling Procedure[1]	**Analytical Method/ Standard Operating Procedure (SOP)**[2]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**[4]	**Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
F-1, F-2, F-3	NWTPH-Gx, NWTPH-Dx L-5 and L-6	Precision – Overall	Relative percent difference (RPD) < 50%	Field duplicate	S&A
		Accuracy/Bias	Percent recovery (%R), laboratory generated limits See Appendix B	Surrogate	A
		Accuracy/Bias Contamination	< Reporting Limit (RL)	Blanks (equipment, method)	S&A
		Accuracy/Bias	%R, See Appendix B	Laboratory control sample (LCS) and laboratory control sample duplicate (LCSD)[3]	A
		Accuracy/Bias and Precision	Retention times, see analytical SOP	Retention time windows	A
		Accuracy/Bias	%R	Matrix spike (MS)[3] and Matrix spike duplicate (MSD)	A
		Precision	RPD –GRO/DRO < 40%	MS/MSD or LCS/LCSD[3]	A

Notes:

LCS	Laboratory control sample.
MS	Matrix spike.
MSD	Matrix spike duplicate.

RL	Reporting limit.
RPD	Relative percent difference.
SOP	Standard operating procedure.
%D	Percent difference.
%R	Percent recovery.

[1] Reference number from Quality Assurance Project Plan Worksheet #21.
[2] Reference number from Quality Assurance Project Plan Worksheet #23.
[3] MS and MSD must be client-provided. LCS/LCSD performed when no MS/MSD are supplied.
[4] Measurement Performance Criteria (MPC) that is “laboratory generated limits” are re-generated annually. The MPCs in the laboratory analytical reports will reflect the most recent MPCs.

QAPP Worksheet #12-7 Measurement Performance Criteria – Fractionated Lead (Total, Coarse, Fine Solids)

Matrix	Solids
Analytical Group	Fractionated Lead; Total, Coarse and Fine
Concentration Level	All

Sampling Procedure[1]	Analytical Method/Standard Operating Procedures[2]	Data Quality Indicators	Measurement Performance Criteria[4]	Quality Control Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
F-1, F-2, F-3, and F-4	SW846 6010D/L-1	Precision — Overall	Relative Percent Difference (RPD) < 50%	Field duplicate	S&A
		Accuracy/Bias Contamination	< RL	Blanks (field, equipment, calibration, prep.)	S&A
		Accuracy/Bias	Percent Recovery (%R) 90-110	Initial and continuing calibration verification	A
		Precision — lab	%R 80 – 120%	Interference check sample (A and AB)	A
		Accuracy/Bias	%R 75-125	MS/MSD	A
		Precision	RPD <20%	Laboratory Duplicate or MS/MSD	A
		Accuracy/Bias	%R, laboratory generated limits See Appendix B	LCS	A

QAPP Worksheet #12-7 Measurement Performance Criteria – Fractionated Lead (Total, Coarse, Fine Solids)

Matrix	Solids
Analytical Group	Fractionated Lead; Total, Coarse and Fine
Concentration Level	All

Sampling Procedure[1]	Analytical Method/Standard Operating Procedures[2]	Data Quality Indicators	Measurement Performance Criteria[4]	Quality Control Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
		Accuracy/Bias	%R 75-125	Post-digestion spike	A
		Precision	%D < 10%	Serial dilution[3]	A

Notes:

LCS	Laboratory control sample.
MS	Matrix spike.
MSD	Matrix spike duplicate.
RL	Reporting limit.
RPD	Relative percent difference.
SOP	Standard operating procedure.
%D	Percent difference.
%R	Percent recovery.

1. Reference number from QAPP Worksheet #21.
2. Reference number from QAPP Worksheet #23.
3. Performed as needed only for analytes with concentration > 50 times the method detection limit.
4. Measurement Performance Criteria (MPC) that is “laboratory generated limits” are re-generated annually. The MPCs in the laboratory analytical reports will reflect the most recent MPCs.

QAPP Worksheet #12-12 Measurement Performance Criteria – Metals (IDW)

Matrix	Aqueous
Analytical Group	IDW Lead
Concentration Level	All

Sampling Procedure[1]	**Analytical Method/Standard Operating Procedures**[2]	**Data Quality Indicators**	**Measurement Performance Criteria**[4]	**Quality Control Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
F-9	SW846 200.8/6010D/8082A/8270/NWTPH/7470A, L-1 -- L-3, L-6-- L-7, L-10	Precision — Overall	Relative Percent Difference (RPD) < 50%	Field duplicate	S&A
		Accuracy/Bias Contamination	< RL	Blanks (field, equipment, calibration, prep.)	S&A
		Accuracy/Bias	Percent Recovery (%R) 90-110	Initial and continuing calibration verification	A
		Precision — lab	%R 80 – 120%	Interference check sample (A and AB)	A
		Accuracy/Bias	%R 75-125	MS/MSD	A
		Precision	RPD < 20%	Laboratory Duplicate or MS/MSD	A
		Accuracy/Bias	%R, laboratory generated limits	LCS	A
		Accuracy/Bias	%R 75-125	Post-digestion spike	A

QAPP Worksheet #12-12 Measurement Performance Criteria – Metals (IDW)

Matrix	Aqueous
Analytical Group	IDW Lead
Concentration Level	All

Sampling Procedure[1]	**Analytical Method/Standard Operating Procedures**[2]	**Data Quality Indicators**	**Measurement Performance Criteria**[4]	**Quality Control Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
		Precision	Percent difference (%D) < 10%	Serial dilution[3]	A

Notes:

LCS	Laboratory control sample.
MS	Matrix spike.
MSD	Matrix spike duplicate.
RL	Reporting limit.
RPD	Relative percent difference.
SOP	Standard operating procedure.
%D	Percent difference.
%R	Percent recovery.

1. Reference number from QAPP Worksheet #21.
2. Reference number from QAPP Worksheet #23.
3. Performed as needed only for analytes with concentration > 50 times the method detection limit.

[4] Measurement Performance Criteria (MPC) that is "laboratory generated limits" are re-generated annually. The MPCs in the laboratory analytical reports will reflect the most recent MPCs.

Worksheet #12-23 – Measurement Performance Criteria (Metals in Soil)

Matrix	Soil
Analytical Group	Metals
Concentration Level	All

Sampling Procedure[1]	**Analytical Method/Standard Operating Procedure**[2]	**Data Quality Indicators**	**Measurement Performance Criteria**	**Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
F-2 and/or F-4	SW846 6010C/7471B/ L-15/L-18	Precision – Overall	Relative percent difference (RPD) <50%	Field duplicate	S&A
		Accuracy/Bias Contamination	< ½ Limit of Quantitation	Blanks (field, equipment, method)	S&A
		Accuracy/Bias	Percent recovery (%R) Inductively Coupled Plasma 90-110% Mercury 80-120%	Initial and continuing calibration verification	A
		Precision – lab	Percent recovery (%R)	Interference check sample (A and AB)	A
		Precision – lab	%R	Reporting limit verification	A
		Accuracy/Bias	%R	Laboratory control sample (LCS) and laboratory control sample duplicate (LCSD)[3]	A
		Accuracy/Bias	%R, same as LCS	Matrix spike and matrix spike duplicate (MS/MSD)[3]	A
		Precision	RPD <30%	MS/MSD or LCS/LCSD[3]	A
		Accuracy/Bias	%R	Post-digestion spike	A
		Precision	Percent difference (%D)	Serial dilution[4]	A

Worksheet #12-23 – Measurement Performance Criteria (Metals in Soil)

Notes:

LCS	Laboratory control sample.
LCSD	Laboratory control sample duplicate
MS	Matrix spike.
MSD	Matrix spike duplicate.
RPD	Relative percent difference.
SOP	Standard operating procedure.
%D	Percent difference.
%R	Percent recovery.

[1] Reference number from Worksheet #21.

[2] Reference number from Worksheet #23.

[3] MS and MSD must be client-provided. LCS/LCSD performed when no MS/MSD are supplied.

[4] Performed as needed only for analytes with concentration > 50 times the method detection limit (MDL).

QAPP Worksheet #13 Secondary Data Criteria and Limitations

Secondary Data	Data Source (Originating Organization, Report Title and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/Collection Dates)	How Data Will Be Used?	Limitations on Data Use
Record Drawing showing historic features, including structures, tanks, and piping.	Exhibit B.1 – 1960 Burrows Island Site Plan, Fire Protection Water snad Sewer Systems Map	USCG. 1960	Map will be used to inform locations of sampling based on historic site features	Site features shown on map are approximate and subject to field verification.
Record Drawing showing historic site features including former 10,000 gallon AST and pipeline	Exhibit B.2 – U.S. Coast Guard, 13th Division Civil Engineering. 1958. Burrows Island Site Plan – Gasoline and Oil Systems. June. Revised March 1961.	USCG. 1961	Map will be used to inform locations of sampling based on historic site features	Site features shown on map are approximate and subject to field verification.
Drawing that shows profile and dimensions of former 10,000 gallon AST and associated support system (saddle)	Exhibit B.3 – U.S. Coast Guard, 13th Division Civil Engineering. 1960. Repairs to Bottoms of Fuel Oil Storage Tank. July.	USCG. 1960.	This drawing documents that the tank was a 10,000 gallon diesel oil tank.	Site features shown on map are approximate and subject to field verification.

QAPP Worksheet #13 Secondary Data Criteria and Limitations

Secondary Data	Data Source (Originating Organization, Report Title and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/Collection Dates)	How Data Will Be Used?	Limitations on Data Use
Drawing showing location of former remedial excavation associated with transformer oil release	Exhibit B.4 – U.S. Coast Guard, 13th Division Civil Engineering. 1980. PCB Decontamination Plan.	USCG. 1980	Map will be used to inform locations of sampling based on historic site features	Site features shown on map are approximate and subject to field verification.
Drawing showing location of former remedial excavation associated with transformer oil release and soil confirmation sampling locations	Exhibit B.5 – U.S. Coast Guard, 13th Division Civil Engineering. 1980. Transformer Oil (PCB) Spill—Soil/Sample Concentration. March	USCG. 1980	Map will be used to inform locations of sampling based on historic site features	No report is available to document 1980 soil removal action. Data depicted on the drawing can not be verified and is for informational purposes only.

QAPP Worksheet #13 Secondary Data Criteria and Limitations

Secondary Data	Data Source (Originating Organization, Report Title and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/Collection Dates)	How Data Will Be Used?	Limitations on Data Use
Report documenting removal of 300 gallon fuel oil UST located approximately 300 feet due north of duplex building	Exhibit B.6 – AGI Technologies. 1999. Removal of Heating Oil UST at Burrows Island Light Station, Project #DTCG88-99-C-623039, Anacortes, Washington. June.	AGI Technologies. 1999	Report will be used to identify sample locations for TPH-Dx (heavy oil).	Report documents that confirmation samples were below cleanup levels following limited soil removal. Additional testing in the area is warranted to confirm that TPH-Dx in this area meets cleanup levels.
Report documenting encapsulation of painted structures at Boathouse, Lighthouse, and Duplex and removal of 300 barrels of lead impacted soils above 1,000 mg/kg from and around the Duplex.	Exhibit B.7 – Kellco Services, Inc. 2005. Paint Stabilization and Soil Removal, U.S. Coast Guard Lighthouse Station, Burrows, Island, Washington. October.	Kellco Services, Inc.2005	Data informs the need for additional investigation from and around the Duplex Building.	Soil removal criteria was 1,000 mg/kg for lead. Additional sampling and chemical analysis for lead is necessary to fully delineate the lateral and vertical extent of lead impacted soil above cleanup level (assumed to be 250 mg/kg).

QAPP Worksheet #13 Secondary Data Criteria and Limitations

Secondary Data	Data Source (Originating Organization, Report Title and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/Collection Dates)	How Data Will Be Used?	Limitations on Data Use
Report documents characterization of lead in the vicinity of Lighthouse, Boathouse, and Duplex.	Exhibit B.8 – ERRG. 2009. Final Site Investigation Report, Burrows Island Light Station, Skagit County, Washington. August.	ERRG	Data informs the need for additional characterization in these areas	Limited sampling was performed (61 samples); screening criteria used was 1,000 mg/kg. Expect cleanup criteria to be 250 mg/kg.
Terrestial Ecological Evaluation for Site conducted by Ecology	Exhibit B.9 – Washington Department of Ecology. 2013. Terrestrial Ecological Evaluation, Burrows Island Light Station, Skagit County, Washington. September.	Ecology	Report provides information on site background and potential ecological receptors.	The table values used to evaluate risk associated with lead exposure are conservative and may overestimate risk. The recommended cleanup remedy (soil stabilization with phosphate amendments) were demonstrated to not be effective for this site and this cleanup technology is not considered effective for this Site.

QAPP Worksheet #13 Secondary Data Criteria and Limitations

Secondary Data	Data Source (Originating Organization, Report Title and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/Collection Dates)	How Data Will Be Used?	Limitations on Data Use
Site-specific lead stabilization treatability study	Exhibit B.10 – Arcadis. 2015. Lead Stabilization Treatability Testing Memo Addendum for Burrows Island Light Station. October	Arcadis	Data will inform subsequent FFS	Data indicate lead stabilization using methods evaluated is not effective. This technology is not considered appropriate for this Site.
Comprehensive lead screening in all accessible areas of site using field XRF.	Appendix C. Arcadis. 2019.Mobilization 1 Sampling Memo, dated November 26, 2018.	Arcadis	Data will be used to identify DUs for lead sampling in subsequent RI using incremental composite sampling methods.	XRF field screening does not meet DQOs for delineation. Analytical sampling will be required to complete characterization.

QAPP Worksheet #14 Summary of Project Tasks

Sampling Tasks

The sampling activities are described in the SAP/QAPP (Arcadis 2019).

Analysis Tasks

Soil samples will be processed, prepared and analyzed by Onsite Environmental:

  - Total Lead by EPA Method 6010.
  - Petroleum hydrocarbons by NWTPH-Gx and NWTPH-Dx
  - Carcinogenic Polycyclic Aromatic Hydroacarbons by EPA Method 8270-SIM
  - Polychlorinated biphenyls by EPA 8082
  - Benzene by EPA 8260

- In addition, select soil samples will also be analyzed by OnSite Environmental for waste characterization (e.g. profiling for potential subsequent soil removal action). Analytical test procedures for waste profiling includes:
  - RCRA 8 metals (EPA 6010, EPA 6020, EPA 7471)
  - TCLP lead by EPA 1311

Quality Control Tasks

The samples will be collected and processed as documented in field Standard Operating Procedures provided in the SAP (Arcadis 2019). The quality control samples are described in Worksheet #28.

Secondary Data

See Worksheet #13.

Data Management Tasks

QAPP Worksheet #14 Summary of Project Tasks

The purpose of data management is to ensure that all of the necessary data are accurate and readily accessible to meet the analytical and reporting objectives of the project. The analytical results from Site evaluation and removal action activities if warranted will be received from the laboratory in an electronic data deliverable format. Due to the limited amount of data, a database will not be created, but electronic data deliverables will be used to populate a spreadsheet for reporting and evaluation purposes.

Documentation and Records

Field sample identification — described in the SAP (Arcadis 2019).

- **Field documentation** — Field personnel will provide comprehensive documentation covering various aspects of field sampling, field analysis, and sample chain of custody. This documentation consists of a record that allows reconstruction of field events and sample handling to aid in the data review and interpretation process. Documents, records, and information relating to the performance of the field work will be retained in the project file.

- **Laboratory project files** — The laboratory will establish a file for pertinent data. The laboratory will retain project files and data packages for a period not less than 5 years. The USCG and/or its designated representative will retain copies of the analytical data reports.

- **Laboratory logbooks** — Workbooks, bench sheets, instrument logbooks, and instrument printouts will be used to trace the history of samples through the analytical process and to document important aspects of the work, including the associated quality controls. As such, logbooks, bench sheets, instrument logs, and instrument printouts will be part of the permanent record of the laboratory. Each page or entry will be dated and initialed by the analyst at the time of entry. Errors in entry will be crossed out in indelible ink with one stroke, corrected without the use of white-out or by obliterating or writing directly over the erroneous entry, and initialed and dated by the individual making the correction. Pages of logbooks that are not used will be completed by lining out unused portions. Information regarding the sample, analytical procedures performed, and results of the testing will be recorded on laboratory forms or personal notebook pages by the analyst. These notes will be dated and will also identify the analyst, instrument used, and instrument conditions. Laboratory notebooks will be periodically reviewed by the laboratory group leaders for accuracy, completeness, and compliance with this QAPP. All entries and calculations will be verified by laboratory technician. If all entries on the pages are correct, the laboratory technician will initial and date the pages.

- **Computer and hard copy storage** — All electronic files and deliverables will be retained by the laboratory for not less than 5 years; hard copy data packages (or electronic copies) will also be retained for not less than 5 years. The USCG and/or its designated representative will retain copies of the analytical data reports.

- **Field data reporting** — Information collected in the field through visual observation, manual measurement, and/or field instrumentation will be recorded in field notebooks or data sheets and/or on forms. Such data will be reviewed by the appropriate Field Program Coordinator for

QAPP Worksheet #14 Summary of Project Tasks

adherence to the SAP (Arcadis 2019) and for consistency. Concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and (as necessary) incorporated into the data evaluation process. If applicable, field data forms and calculations will be processed and included in appendices to the appropriate reports (when generated). The original field logs, documents, and data reductions will be kept in the project file at the Arcadis office in Seattle, Washington.

- **Laboratory data reporting** — Data reports for all parameters will include, at a minimum, the following items:

  Narrative: Summary of activities that took place during sample analysis, including the following information:

  - Laboratory name and address
  - Date of sample receipt
  - Cross reference of laboratory identification number to contractor sample identification
  - Analytical methods used
  - Deviations from specified protocol
  - Corrective actions taken

  Included with the narrative will be any sample handling documents, including field and internal Chain-of-Custody forms, air bills, and shipping tags.

  ***Analytical Results*:** These will be reported according to analysis type and include the following information, as applicable:

  - Sample identification
  - Laboratory identification
  - Date of collection
  - Date of receipt
  - Date of extraction
  - Date of analysis
  - Detection limits

QAPP Worksheet #14 Summary of Project Tasks

Sample results on the report forms will be corrected for dilutions. Soil data will be reported on a dry-weight basis. Unless otherwise specified, all results will be reported uncorrected for blank contamination.

The data associated with Contract Laboratory Program-equivalent reporting will be expanded to include supporting documentation necessary to provide a Contract Laboratory Program-equivalent package. This additional documentation will include, but not be limited to, raw data required to recalculate any result, including instrument printouts and quantitation reports. The report also will include standards used in calibration and calculation of analytical results; sample extraction, digestion, and other preparation logs; standard preparation logs; instrument run logs; and moisture content calculations.

- **Data reporting levels are as follows**:
  - **Level 1 — Minimal Reporting**: Minimal or "results only" reporting is used for analyses that, due either to their nature (i.e., field monitoring) or the intended data use (i.e., preliminary screening) do not generate or require extensive supporting documentation.
  - **Level 2 — Modified Reporting**: Modified reporting is used for analyses that are performed following standard USEPA-approved methods and quality assurance/quality control protocols. Based on the intended data use, modified reporting may require some supporting documentation but not full Contract Laboratory Program or Contract Laboratory Program-type reporting.
  - **Level 3 — Full Reporting**: Full Contract Laboratory Program or Contract Laboratory Program-type reporting is used for those analyses that, based on the intended data use, require full documentation.
  - **Level 4 — Full Reporting**: Full Contract Laboratory Program or Contract Laboratory Program-type reporting is used for those analyses that, based on the intended data use, require full documentation. Level 4 reporting contains all the information including in a Level 3 report with the addition of all raw supporting data.

  Level 2 reporting will be used for this Project.

Assessment/Audit Tasks

Performance and systems audits will be completed in the field and laboratory during the site investigations, as described below and in Worksheets #32.

1. **Field Audits** — The following field performance and systems audits will be completed during this project.

   The Field Program Coordinator will monitor field performance. Field performance audit summaries will contain an evaluation of field activities to verify that the activities are performed according to established procedures. Field performance audits may be performed by the Project Manager

QAPP Worksheet #14 Summary of Project Tasks

(or his/her designee). The auditor(s) will review field reports and communicate concerns to the Project Coordinator and/or Field Program Coordinator, as appropriate.

The number and frequency of field performance audits conducted will be determined independently by the Project Manager or Field Program Coordinator. The Project Manager (or his/her designee) will conduct field performance audits at a frequency of approximately one per month during field activities. The observations made during field performance audits and any recommended changes/deviations to the field procedures will be recorded and documented.

In addition, the Data Quality Assurance Manager will review the rinsate blank data to identify potential deficiencies in field sampling and cleaning procedures. In addition, systems audits comparing scheduled quality assurance/quality control activities from this QAPP with actual quality assurance/quality control activities completed will be performed. The Field Program Coordinator and Data Quality Assurance Manager will periodically confirm that work is being performed consistent with this QAPP and the SAP (Arcadis 2019).

2. Laboratory Audits

As a participant in state and federal certification programs, the laboratory is audited by representatives of the regulatory agency issuing certification, in addition to the laboratory’s internal audits. Audits are usually conducted annually and focus on laboratory conformance to the specific program protocols for which the laboratory is seeking certification. The auditor reviews sample handling and tracking documentation, analytical methodologies, analytical supportive documentation, and final reports. The audit findings are formally documented and submitted to the laboratory for corrective action, if necessary.

The USCG reserves the right to conduct an on-site audit of the laboratory prior to the start of analyses for the project. Additional audits may be performed during the course of the project, as deemed necessary.

3. Corrective Action

Corrective actions are required when field or analytical data are not within the objectives specified in this QAPP. Corrective actions include procedures to promptly investigate, document, evaluate, and correct data collection and/or analytical procedures. Field and laboratory corrective action procedures for the actions are described below.

a. Field Procedures

If, during fieldwork, a condition is noted by the field crew that would have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause, and corrective action implemented by the Field Program Coordinator or a designee will be documented on a Corrective Action Form and reported to the appropriate Field Program Coordinator, Quality Assurance Manager, and Project Manager.

Examples of situations that would require corrective actions are provided below:

- Protocols as defined by the QAPP and/or the SAP (Arcadis 2019) have not been followed.
- Equipment is not in proper working order or is not properly calibrated.
- Quality control requirements have not been met.
- Issues resulting from performance or systems audits have not been resolved.

Project personnel will monitor ongoing work performance as part of daily responsibilities.

b. Laboratory Procedures

In the laboratory, when a condition is noted to have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause, and corrective action taken will be documented and reported to the appropriate Project Coordinator and Data Quality Assurance Manager.

Corrective action may be initiated, at a minimum, under the following conditions:

- Protocols as defined by this QAPP have not been followed.
- Predetermined data acceptance standards are not obtained.
- Equipment is not in proper working order or calibrated.
- Sample and test results are not completely traceable.
- Quality control requirements have not been met.
- Issues resulting from performance or systems audits have not been resolved.

Laboratory personnel will continuously monitor ongoing work performance as part of daily responsibilities. Corrective action is initiated at the point where the problem has been identified. At whatever level this occurs (analyst, supervisor, data review, or quality control), it is brought to the attention of the Laboratory Quality Assurance Manager and, ultimately, the Laboratory Director. Final approval of any action deemed necessary is subject to the approval of the Laboratory Director.

QAPP Worksheet #14 Summary of Project Tasks

Any corrective action deemed necessary based on system or performance audits, the analytical results of split samples, or the results of data review will be implemented. The corrective action may include sample re-extraction, re-preparation, reanalysis, cleanup, dilution, matrix modification, or other activities.
Data Review Tasks
See Worksheets #34 through #37.

QAPP Worksheet #15-1 Reference Limits and Evaluation — (Soil)

Analyte	CAS Number	Performance Standard Soil mg/kg	Soil	
			Laboratory MDL mg/kg	Laboratory PQL[1] mg/kg
Lead (6010) [2]				
Lead - Total	7439-92-1	250	1.42	5
Polychlorinated Biphenyls (PCBs) (8082) [2]				
Polychlorinated biphenyls (PCBs)	7439-92-1	1	1.62E-02	5.00E-02
BTEX and n-Hexane (8260)[2]				
Benzene	71-43-2	0.03	1.56E-04	1.00E-03
Carcinogenic Polycyclic Aromatic Hydrocarbons (PAHs) (8270-SIM)[2]				
Benzo(a)anthracene	56-55-3	0.1 [3]	1.02E-04	6.70E-03
Benzo(a)pyrene	50-32-8	0.1 [3]	1.23E-04	6.70E-03
Benzo(b)fluoranthene	205-99-2	0.1 [3]	1.94E-04	6.70E-03
Benzo(k)fluoranthene	207-08-9	0.1 [3]	2.03E-04	6.70E-03
Chrysene	218-01-9	0.1 [3]	1.22E-04	6.70E-03
Dibenzo(a,h)anthracene	53-70-3	0.1 [3]	2.62E-04	6.70E-03
Indeno(1,2,3-cd)pyrene	193-39-5	0.1 [3]	2.27E-04	6.70E-03
Petroleum Range Hydrocarbons (NWTPH-Gx and NWTPH-Dx)[2]				
Gasoline Range Organics (GRO)	8006-61-9	100	1.68	5.0
Diesel Range Organics (DRO)	68334-30-5	2,000	8.31	25
Diesel Range Organics (HO)	68334-30-5	2,000	17.2	50

Notes:

[1] The target reporting limits are based on wet weight. Actual reporting limits will vary based on sample weight and moisture content.

[2] USEPA. Office of Solid Waste and Emergency Response. Test Methods for Evaluating Solid Waste SW-846 3rd ed. Update IV/V Washington, DC.

[3] MTCA Cleanup Regulations specify that carcinogenic PAHs are to be held to the benzo(a)pyrene cleanup level of 0.1 mg/kg.

MDL	Method detection limit.
mg/kg	Milligrams per kilogram.
NA	Not applicable.
PQL	Practical Quantitation Limit
mg/kg	Milligrams per kilogram.

QAPP Worksheet #15-3 Reference Limits and Evaluation — (IDW)

Analyte	CAS Number	Criteria[3] mg/L	IDW Laboratory MDL mg/L	 Laboratory PQL mg/L
Waste Characteristics [2]				
RCRA Metals (8260)[2]	NA	NA	2.59E-02	0.1

Notes:

[1] The target reporting limits are based on wet weight. Actual reporting limits will vary based on sample weight and moisture content.

[2] USEPA. Office of Solid Waste and Emergency Response. Test Methods for Evaluating Solid Waste SW-846 3rd ed. Update IV/V Washington, DC.

[3] MTCA Cleanup Regulations specify that carcinogenic PAHs are to be held to the benzo(a)pyrene cleanup level of 0.1 mg/kg.

MDL	Method detection limit.
mg/kg	Milligrams per kilogram.
NA	Not applicable.
PQL	Practical Quantitative Limit
mg/kg	Milligrams per kilogram.

QAPP Worksheet #16 Project Schedule/Timeline

Activities	Organization	Anticipated Date(s) of Initiation	Anticipated Date of Completion	Deliverable	Deliverable Due Date
SAP/QAPP	USCG/Arcadis	November 2018	February 2019	Yes	February 15, 2019
Conduct Remedial Investigation Fieldwork	Arcadis	April 2018	April 2018	Yes	April 22, 2019
RI/FSS Report	USCG/Arcadis	April 2019	September 2019	Yes	September 23, 2019
Remedial Design	USCG/Arcadis	September 2019	January 2020	Yes	January 7, 2020,
Public Review/Final Cost Estimates	USCG/Arcadis	January 2020	April 2020	No	April 5, 2020

QAPP Worksheet #17 Sampling Design and Rationale

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach):

Discrete soil sampling as selected to assess concentrations of petroleum hydrocarbons and PCBs. These potential source areas are relatively small and lend themselves to discrete sampling:

Incremental composite sampling (ICS) will be performed to evaluate concentrations of lead is soils in the vicinity of former and existing structures. ISM provides a more accurate and precise representation of the mean concentration within a decision unit and is therefore considered more appropriate sampling methodology compared to discrete methods.

Decision Units (DUs) and Sampling Units (SUs) will be established at the following locations:

- DUs 1 and 2: Includes Area 105 (Existing Boathouse)
- DU 3: Covers unsampled area west of the Boathouse.
- DUs 4 and 5: Includes Area 104 (Former Officer in Charge Building).
- DUs 6 and 7: Includes Area 102 (Former Oil and Paint Storage Area)
- DUs 8 and 9: Includes Area 101 (Light Station) and Area (Former PCB Release Area).
- DU 10: Covers unsampled area between the Light Station and the Duplex and some ancillary low-concentration samples from the Duplex.
- DUs 11, 12, and 13: Includes Area 103 (Existing Duplex Building).
- DU 14: Includes the former 10,000-gallon storage tank.
- DU 15: Includes Area 107 (Former Fire Pump Building).
- DUs 16 and 17: Include the water tanks.

Discrete soil sampling will be conducted at the following locations:

- Area 101 – Former Fuel Oil Tank and PCBs
- Area 102 – Former gasoline AST, and oil storage
- Area 104 –Former fuel oil tank
- Area 107 –Two former 675-gallon fuel tanks

QAPP Worksheet #17 Sampling Design and Rationale

- Former 10,000-gallon AST
- Former 10,00-gallon AST pipeline

Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be taken, and the sampling frequency (including seasonal considerations) [May refer to map or Worksheet #18 for details]:

Soil will be sampled for lead related to lead-based paint impacts, total petroleum hydrocarbons (TPH) – gasoline range organics (GRO), diesel range organics (DRO), and heavy oil (HO) related to historical operations including potential petroleum hydrocarbon impacts associated with former storage tanks and piping, and PCBs related to a historical spill and cleanup of transformer oil. The goal is to delineate the nature and extent of impacts above the respective RAOs. All soil samples submitted for lead analysis will be prepared for fine and coarse fraction analysis. The fine fraction is defined as the portion of soil that passes through a 250-micron (60-mesh) sieve. The coarse fraction is the portion of sample retained by the 250-micron (60-mesh) sieve. The total lead concentration is then calculated based on the weight of each fraction.

Site evaluation soil samples will be collected to evaluate the nature and extent of soil lead impacts located adjacent to Site structures. The estimated number of samples, including type and frequency of quality control samples, is provided in Worksheet #20 and in the SAP (Arcadis 2019). Seasonal considerations are not expected to affect site evaluation sampling.

The SAP (Arcadis 2019) describes the number and location of site evaluation samples.

TPH-GRO, DRO, HO and associated constituents will be sampled in soil. Site evaluation samples will be collected to evaluate the potential for soil impacts related to lead-based paint impacts, former operations-related impacts including the former aboveground storage tanks (ASTs) associated pipelines and pumps.

Waste characterization samples will be collected from soils and analyzed for lead, PCBs, and petroleum hydrocarbons.

QAPP Worksheet #18 Sampling Locations and Methods/Standard Operating Procedure Requirements

Sampling Area Location/Identification Number	Number of Sub-Areas	Number of Borings	Number of Increments	Number of Composite Samples
DU 1 Boathouse (105)	4	30	60	10
DU 2 Boathouse (105)	3	90	120	10
DU 3 Northwest Open Area	4	30	60	10
DU 4 Former Officers in Charge (OIC) Quarters (104)	4	30	60	10
DU 5 Former Officers in Charge (OIC) Quarters (104)	4	30	60	10
DU 6 Former Oil and Paint Storage Building (102)	4	90	120	12
DU 7 Former Oil and Paint Storage Building (102)	3	30	60	8
DU 8 Light and Fog Signal Building (101)	4	90	120	12
DU 9 Light and Fog Signal Building (101)	4	30	60	10
DU 10 Southern Open Area	4	30	60	10
DU 11 Duplex (103)	4	30	60	10
DU 12 Duplex (103)	4	30	60	10
DU 13 Duplex (103)	3	90	120	10
DU 14 Former 10,000-Gallon AST	2	30	60	6
DU 15 Former Firehouse Pump Building (107)	4	30	60	10
DU 16 Former Water Tanks	2	30	60	6
DU 17 Former Water Tanks	4	30	60	10
DU 18 Limited Access Area Former Officers in Charge (OIC) Quarters (104	0	30[1]	60[1]	2
Totals	**61**	**780**	**1,320**	**166**

Notes:

1. Number of increments and boring locations is estimated. Number of samples collected will be determined based on field conditions and accessibility.

QAPP Worksheet #19 Analytical Standard Operating Procedure Requirements (Sample Containers, Preservation, and Holding Times)

Parameter	Analytical and Preparation Method/SOP Reference	Method	Bottle Type	Preservation	Holding Time[1]
Soil					
Metals (Lead)	SW846 6010D/L-1	6010D[2]	One 32-ounce wide-mouth glass jar	Cool to <6°C	6 months to analyze
Metals (Lead) Discrete		6010D[2]	One 4-oz wide-mouth glass jar	Cool to <6°C	6 months to analyze
Polychlorinated Biphenyls (PCBs)	SW846 8082A/L-3	8082A[2]	One 4-oz wide-mouth glass jar	Cool to <6°C	N/A
Total Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)	SW846 8270/L-7	8270[2]	One 4-oz wide-mouth glass jar	Cool to <6°C	14 days to extract, 40 days to analyze after extraction
Total Petroleum Hydrocarbons Gasoline Range Organics (GRO)	NWTPH-Gx/L-5	NWTPH-Gx	One 4-oz wide-mouth glass jar, field presevation kit	DI water/Methanol; Cool to <6°C	14 days to analysis
Total Petroleum Hydrocarbons Diesel Range Organics (DRO, HO)	NWTPH-Dx/L-6	NWTPH-Dx	One 4-oz wide-mouth glass jar	Cool to <6°C	14 days to extract, 40 days to analyze after extraction
Naphthalenes	SW846 8270D/L-4	8270D	One 4-oz wide-mouth glass jar	Cool to <6°C	14 days to extract, 40 days to analyze after extraction
Ethylene dibromide (EDB) and ethylene dichloride (EDC)	SW846 8260C/L-8	8260C[2]	One 4-oz wide-mouth glass jar, field presevation kit	Cool to <6°C	14 days
n-Hexane	SW846 8021B/L-9	8012B	One 4-oz wide-mouth glass jar, field presevation kit	Cool to <6°C	14 days
Benzene, toluene, ethylbenzene, xylenes (BTEX)	SW846 8021B/L-9	8012B	One 4-oz wide-mouth glass jar	Cool to <6°C	14 days
Waste Characterization					
IDW -- RCRA Metals	6010/7470A, 200.8/7470A	6010/7470A, 200.8/7470A	500 mL HDPE bottle	HNO3 pH<2, ≤6°C	6 months to analyze, 28 days for mercury
IDW -- Total Petroleum Hydrocarbons, Gasoline Range Organics (GRO)	NWTPH-Gx	NWTPH-Gx	40 mL glass vial (VOA)	HNO3 pH<2, ≤6°C	14 days
IDW -- Total Petroleum Hydrocarbons, Diesel Range Organics (DRO, HO)	NWTPH-Dx	NWTPH-Dx	500 mL amber bottle	HNO3 pH<2, ≤6°C	14 days to extract, 40 days to analyze after extraction

Notes:

1. All holding times are measured from date of collection
2. USEPA. Office of Solid Waste and Emergency Response. *Test*

°C Degrees Celsius.
SOP Standard Operating Procedure.
TCLP Toxicity Characteristic Leaching Procedure.

QAPP Worksheet #20 Sample Quantities and Control Frequencies

	Laboratory	Analytical and Preparation Standard Operating Procedure[1]	Estimated Environ. Sample Quanity	Field Quality Control Sample				Laboratory Quality Control Sample							
				Rinsate Blank		Field Duplicate		Matrix Spike		Matrix Spike Duplicate		Laboratory Duplicate		Equipment Duplicate	
				Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.
Soil Sampling															
Lead- Total	OnSite Environmental	L-1, F-4	Surface: 690(26)^{A,B} Depth: Conditional	1/day/ equipment	--	Triplicates performed at 3/20 DUs	270(9)^{A,B}	1/20 or 1/batch	2^A	1/20 or 1/batch	2^A	1/20 or 1/batch	2^A	1/day/ instrument	--
Polychlorinated Biphenyls (PCBs)	OnSite Environmental	L-3	Surface: 30^A Depth: Conditional	1/day/ equipment	--	1/20 samples	2^A	1/20 or 1/batch	2^A	1/20 or 1/batch	2^A	1/20 or 1/batch	2^A	1/day/ instrument	--
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)	OnSite Environmental	L-7	Surface: 38^A Depth: Conditional	1/day/ equipment	--	1/20 samples	2^A	1/20 or 1/batch	2^A	1/20 or 1/batch	2^A	1/20 or 1/batch	2^A	1/day/ instrument	--
Petroleum Hydrocarbons Gasoline Range (GRO)	OnSite Environmental	L-5	Surface: 38^A Depth: Conditional	1/day/ equipment	--	1/20 samples	2^A	1/20 or 1/batch	2^A	1/20 or 1/batch	2^A	1/20 or 1/batch	2^A	1/day/ instrument	--
Petroleum Hydrocarbons Diesel Range and Heavy Oil (DRO and HO)	OnSite Environmental	L-6	Surface: 38^A Depth: Conditional	1/day/ equipment	--	1/20 samples	2^A	1/20 or 1/batch	2^A	1/20 or 1/batch	2^A	1/20 or 1/batch	2^A	1/day/ instrument	--
Petroleum Hydrocarbons, Heavy Oil	OnSite Environmental	L-6	Surface: 38^A Depth: Conditional	1/day/ equipment	--	1/20 samples	2^A	1/20 or 1/batch	2^A	1/20 or 1/batch	2^A	1/20 or 1/batch	2^A	1/day/ instrument	--
BTEX and n-Hexane	OnSite Environmental	L-8, L-9	Contingent on analytical results	1/day/ equipment	--	1/20 samples	Contingent on analytical results	1/20 or 1/batch	Contingent on analytical results	1/20 or 1/batch	Contingent on analytical results	1/20 or 1/batch	Contingent on analytical results	1/day/ instrument	--
1,2-Dichloroethane (EDC) and 1,2-Dibromoethane (EDB)	OnSite Environmental	L-8	Contingent on analytical results	1/day/ equipment	--	1/20 samples	Contingent on analytical results	1/20 or 1/batch	Contingent on analytical results	1/20 or 1/batch	Contingent on analytical results	1/20 or 1/batch	Contingent on analytical results	1/day/ instrument	--
Naphthalenes	OnSite Environmental	L-4	Contingent on analytical results	1/day/ equipment	--	1/20 samples	Contingent on analytical results	1/20 or 1/batch	Contingent on analytical results	1/20 or 1/batch	Contingent on analytical results	1/20 or 1/batch	Contingent on analytical results	1/day/ instrument	--
IDW Waste Characterization															
IDW -- RCRA Metals	OnSite Environmental	L-1, L-2, L-10	2^A	NA	--	NA	--	NA	1^A	NA	1^A	NA	1^A	1/day/ instrument	--
IDW -- Petroleum Hydrocarbons, Gasoline Range (GRO)	OnSite Environmental	L-5	2^A	NA	--	NA	--	NA	1^A	NA	1^A	NA	1^A	1/day/ instrument	--
IDW -- Petroleum Hydrocarbons, Diesel Range and Heavy Oil (DRO, HO)	OnSite Environmental	L-6	2^A	NA	--	NA	--	NA	1^A	NA	1^A	NA	1^A	1/day/ instrument	--
IDWs -- PCBs	OnSite Environmental	L-3	1^A	NA	--	NA	--	NA	1^A	NA	1^A	NA	1^A	1/day/ instrument	--

Notes:

1. See Worksheet #23 for Standard Operating Procedure title, revision number, date details.

A. Number of surface samples is estimated. Number of samples collected will be based on Site evaluation results, field observations and final excavation sizes, etc.

B. Represents the number of surface incremental samples collected. Number in parentheses represents the number of composited samples submitted for analysis.
Additional samples will be collected at depths as described in the SAP.

1 composite sample will be taken per 30 incremental samples in each DU. Dus with triplicates will have 3 composite samples. DUs will be analyzed at depth when >250 mg/kg lead. Subunits will be abalyzed if DU >1000 mg/kg lead or between 250 and 400 mgkg lead. See SAP (Arcadis 2019) for futher details.)

1/day	One per day or one per 20 samples, whichever is more frequent. Rinseate blanks not required when dedicated sampling equipment is used.
Freq	Frequency.
NA	Not Applicable.
No.	Number.
SOP	Standard Operating Procedure.
TBD	To be determined.
TCLP	Toxicity characteristic leaching procedure

QAPP Worksheet #21 Sampling Analysis Plan Operating Procedure References

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
F-1	*Sampling Analysis Plan – Soil Drilling and Sample Collection SOP* (Arcadis 2018)	Arcadis	See *Sampling Analysis Plan* for specific equipment needs	N	Describes the procedures for soil drilling and sampling, and the required equipment
F-2	*Sampling Analysis Plan – Section 6.3 Soil Sample Collection* (Arcadis 2019)	Arcadis	See *Sampling Analysis Plan* for specific equipment needs	N	Describes the procedures for collecting soil for sampling, and the required equipment
F-3	*Sampling Analysis Plan - Section 6.3 Soil Sample Collection and QAPP Worksheet #19 –Analytical Standard Operating Procedure Requirements (Sample Containers, Preservation, and Holding Times) (Arcadis 2019)*	Arcadis	See *Sampling Analysis Plan* for specific equipment needs	N	Describes the procedures for preserving soil for VOC analysis, and the required equipment
F-4	*Sampling Analysis Plan – Screening Soil for Metals with Portable X-Ray Fluorescence Analyzer TGI (Arcadis 2018)*	Arcadis	See *Sampling Analysis Plan* for specific equipment needs	N	Describes use of the XRF as a screening tool for the detection of metals
F-5	*Sampling Analysis Plan – Sample Chain of Custody SOP (Arcadis 2017)*	Arcadis	See *Sampling Analysis Plan* for specific equipment needs	N	Describes required chain of custody procedure
F-6	*Sampling Analysis Plan – Soil Description SOP (Arcadis 2018)*	Arcadis	See *Sampling Analysis Plan* for specific equipment needs	N	Describes the standardized method for describing soil characteristics in the field.
F-7	*Sampling Analysis Plan and HASP – PID Field Screening and Air monitoring* (Arcadis 2019)	Arcadis	See *Sampling Analysis Plan* for specific equipment needs	N	Describes use of the PID as a screening toll for the detection of volatile organic hydrocarbons

QAPP Worksheet #21 Sampling Analysis Plan Operating Procedure References

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
F-8	*Sampling Analysis Plan — Groundwater and Soil Sampling Equipment Decontamination SOP (Arcadis 2017)*	Arcadis	See *Sampling Analysis Plan* for specific equipment needs	N	Describes the procedure for field equipment cleaning and decontamination
F-9	*Sampling Analysis Plan — Investigation-Derived Waste Management and Storage TGI* (Arcadis 2017)	Arcadis	See *Sampling Analysis Plan* for specific equipment needs	N	Describes the management, handling, sampling and analysis of investigation derived waste

Notes:
The SOPs referenced herein are part of the Sampling Analysis Plan, Arcadis 2019.
XRF X-Ray Fluorescence.

QAPP Worksheet #22 Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Equipment	Calibration Activity/ Frequency	Maintenance Activity	Testing Activity	Inspection Activity	Acceptance Criteria	Corrective Action	Responsible Person	Standard Operating Procedure Reference[1]
X-Ray fluorescence analyzer (XRF)	F-4	As required by manufacturer specifications	Screen for Lead	Check all sensors, cable and check battery charge	F-4	SAP (Arcadis 2019)	Arcadis Field Staff	F-4
PID	F-7	As required by manufacturer specification	Screen for VOCs	Batteries charge, acceptable memory	F-7	SAP (Arcadis 2019)	Arcadis Field Staff	F-7
GPS	Not Applicable	As required by manufacturer specification	Survey	Batteries charge, acceptable memory	Not Applicable	Not Applicable	Not Applicable	SAP (Arcadis 2019)

Notes:

GPS	Global Positioning System.
PID	Photo Ionization Detector.
XRF	X-Ray Fluorescence.

[1] Standard Operating Procedures are found in the Sampling Analysis Plan (SAP) (Arcadis 2019).

QAPP Worksheet #23 Analytical Standard Operating Procedure References

Standard Operating Procedure Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
F-4	"*TGI – Screening Soil for Metals with Portable X-Ray Fluorescence Analyzer*" (Arcadis 2018)	Screening	Metals (Lead)-Soil	X-Ray Fluorescence	Arcadis Field Team	N
L-1	*Analysis of Metals by ICP-AES Method 6010D.* SOP # 7.02. Rev. 5.0. 12/14/2018.	Definitive	Metals in soil and water	Inductively Coupled Plasma – Optical Emission Spectroscopy (ICP-OES)	OnSite Environmental	N
L-2	*Analysis of Metals by ICP-MS Method 200.8.* SOP # 7.03. Rev. 7.0. 12/4/2018.	Definitive	Metals in water	Inductively Coupled Plasma – Mass Spectrometry (ICP-MS)	OnSite Environmental	N
L-3	*Polychlorinated Biphenyls (PCBs) by GC-ECD Method 8082A.* SOP # 4.02. Rev. 7.0. 5/23/2018.	Definitive	PCBs in soil and water	Gas Chromatography – Electron Capture Detector (GC-ECD)	OnSite Environmental	N

QAPP Worksheet #23 Analytical Standard Operating Procedure References

Standard Operating Procedure Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
L-4	*Semivolatile Organic Compounds by GC/MS – Method 8270D.* SOP # 4.03. Rev. 13.0. 7/5/2017.	Definitive	Naphthalene in soil	Gas Chromatography – Mass Spectrometry (GC/MS)	OnSite Environmental	N
L-5	*Gasoline by GC-PID – Method NWTPH-Gx.* SOP # 5.00. Rev. 10.0. 4/13/2018.	Definitive	Gasoline range -- Petroleum Hydrocarbons in soil and water	Gas Chromatography – Photoionization Detector (GC-PID)	OnSite Environmental	N
L-6	*Semivolatile Petroleum Hydrocarbons by GC/FID Method NWTPH-Dx.* SOP # 4.06. Rev. 6.0. 7/5/2017.	Definitive	Diesel range and Heavy oils -- Petroleum Hydrocarbons in soil and water	Gas Chromatography – Flame Ionization Detector (GC-FID)	OnSite Environmental	N

QAPP Worksheet #23 Analytical Standard Operating Procedure References

Standard Operating Procedure Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
L-7	*Polynuclear Aromatic Hydrocarbons by GC/MS using Single Ion Monitoring (SIM) Method 8270-SIM.* SOP # 4.11. Rev. 12.0. 1/31/2018.	Definitive	Carcinogenic Polynuclear Aromatic Hydrocarbons (cPAHs)	Gas Chromatography Mass Spectrometry, Single Ion Monitoring	OnSite Environmental	N
L-8	*Volatile Organic Compounds by GC/MS Method 8260C.* SOP # 4.11. Rev. 12.0. 1/31/2018.	Definitive	Benzene, Toluene, Ethylene, Xylenes (BTEX), 1,2-Dibromoethane (EDB), and 1,2-Dichloroethane (EDC)	Gas Chromatography Mass Spectrometry	OnSite Environmental	N
L-9	*BTEX by GC-PID – Method 8021B.* SOP # 5.04. Rev. 8.0. 4/13/2018.	Definitive	Benzene, Toluene, Ethylene, Xylenes (BTEX), n-Hexane	Gas Chromatography – Photoionization Detector (GC-PID)	Gas Chromatography – Photoionization Detector (GC-PID)	N

QAPP Worksheet #23 Analytical Standard Operating Procedure References

Standard Operating Procedure Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
L-10	*Mercury in Water – Method 7470A.* SOP # 7.05. Rev. 4.0. 12/12/2018.	Definitive	Mercury in water (IDW)	Atomic absorption spectrophotometer	OnSite Environmental	N

SOPs are located in the SAP (Arcadis 2019)

QAPP Worksheet #24 -Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
ICP-OES (Multi Metal)	Interference Check Solution (ICS)	Daily after ICAL and at end of analytical batch	± 20% of known value (80-120% of known value)	Terminate analysis , locate and correct problem, reanalyze ICS, reanalyze all samples	QA Officer	L-11, L-12
	Initial Calibration (ICAL)	Analyzed and evaluated before any result can be	The correlation coefficient must be 0.995 or greater	Correct problem; recalibrate instrument; new calibration verified	QA Officer	
	Second source Independent Calibration Verification (ICV)	Once after each initial calibration	±10% (90-110% of known value)	Instrument maintenance. Reanalysis of ICV or initial calibration or re-prepration of the standards	QA Officer	
	Continuing Calibration Verification (CCV)	Each day that an ICAL is not performed a CCV must be performed before sample analysis. Also analyze every 10 samples	±10% (90-110% of known value)	Instrument maintenance. Reanalysis of CCV or initial calibration or re-preparation of the standards	QA Officer	
	LOQ verification	Quarterly	LOQ is within laboratory control limits	Perform instrument maintenance and repeat failed LOQ study		
	Continuing Calibration Blank (CCB)	Analyzed after every 10 samples or more frequently as needed	Concentration must be less than the LOQ	Correct problem; recalibrate instrument	QA Officer	

QAPP Worksheet #25-Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Shimadzu ICP 6000	Change pump tubing, clean nebulizer, change torch, clean or replace orifice assembly	Multi Metals	Monitor instrument performance via Continuing Calibration Verification and CC Blank	Daily or as needed basis	No maintenance is required as long as instrument QC meets DOD criteria	change torch and orifice assembly, Change nebulizer and tubing as needed basis; recalibrate and reanalyze affected data	Analyst, Supervisor, QA manager	L-11, L-12
Perkin Elmer PinAAcle 500	Check and replace nebulizer tubing, clean nebulizer, check torch, clean and purge nebulizer assembly	Lead only	Monitor instrument performance via ContinuingnCalibration Verification and CC Blank	Daily or as needed basis	No maintenance is required as long as instrument QC meets DOD criteria	clean torch, purge nebulizer assembly, Change nebulizer and tubing as needed basis; recalibrate and reanalyze affected data	Analyst or certified instrument technician	L-11, L-12

QAPP Worksheet #26 Sample Handling System

Sample Collection, Packaging and Shipment
Sample Collection (Personnel/Organization): Arcadis field staff
Sample Packaging (Personnel/Organization): Arcadis field staff
Coordination of Shipment (Personnel/Organization): Arcadis field staff
Type of Shipment/Carrier: Laboratory courier service to Onsite Environmental, Redmond, WA
Sample Receipt and Analysis
Sample Receipt (Personnel/Organization): David Baumeister/OnSite Environmental
Sample Custody and Storage (Personnel/Organization): David Baumeister/OnSite Environmental
Sample Preparation (Personnel/Organization): David Baumeister/OnSite Environmental
Sample Determinative Analysis (Personnel/Organization): David Baumeister/OnSite Environmental
Sample Archiving
Field Sample Storage (no. of days from sample collection): 60 days from submittal of final report.
Sample Extract/Digestate Storage (no. of days from extraction/digestion): Per laboratory hold times
Sample Disposal
Personnel/Organization: David Baumeister/OnSite Environmental
Number of Days from Analysis: 15 days from submittal of ICS samples until receipt of laboratory report. 7 days turnaround time for discrete samples.

QAPP Worksheet #27 Sample Custody Requirements

Sample Handling and Custody Requirements

Samples will be maintained under chain of custody from the time of sample collection to time of analysis. This Worksheet details sample handling and custody requirements from collection to ultimate disposal.

Sample Handling (Sample Packaging, Shipping Containers and Sample Shipment, Sample Custody)

Sample packaging and shipment procedures are designed so that the samples will arrive at the laboratory, with the chain-of-custody, intact.

Samples will be packaged for shipment as outlined below:

- Securely affix the sample label to the container with clear packing tape.
- Check the cap on the sample container to confirm that it is properly sealed.
- Wrap the sample container cap with clear packing tape to prevent the label from becoming loose.
- Complete the chain-of-custody form with the required sampling information and confirm that the recorded information matches the sample labels. NOTE: If the designated sampler relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the chain-of-custody form prior to this transfer. The appropriate personnel will sign and date the chain-of-custody form to document the sample custody transfer.
- Using duct tape, secure the outside drain plug at the bottom of the cooler.
- Wrap sample containers in bubble wrap or other cushioning material.
- Place 1 to 2 inches of cushioning material at the bottom of the cooler.
- Place the sealed sample containers into the cooler.
- Place ice in plastic bags and seal. Place loosely in the cooler.
- Fill the remaining space in the cooler with cushioning material.
- Place chain-of-custody forms in a plastic bag and seal. Tape the forms to the inside of the cooler lid.
- Close the lid of the cooler, lock and secure with duct tape.
- Wrap strapping tape around both ends of the cooler at least twice.
- Mark the cooler on the outside with the shipping address and return address. Cover the labels with clear plastic tape.
- Place a signed custody seal over the sample cooler lid.

Samples will be packaged by the field personnel and transported as low-concentration environmental samples. Samples will be hand delivered or delivered by an express carrier within 72 hours of the time of collection.

Sample Handling (Sample Packaging, Shipping Containers and Sample Shipment, Sample Custody) Continued

Shipments will be accompanied by the chain-of-custody form identifying the contents. The original form will accompany the shipment; copies will be retained by the sampler for the sampling office records. If the samples are sent by common carrier, a bill of lading will be used. Receipts or bills of lading will be retained as part of

QAPP Worksheet #27 Sample Custody Requirements

the permanent project documentation. Commercial carriers are not required to sign off on the chain-of-custody form as long as the forms are sealed inside the sample cooler, and the custody seals remain intact.

Sample custody seals and packing materials for filled sample containers will be provided by the analytical laboratory. The filled, labeled, and sealed containers will be placed in a cooler on ice and carefully packed to eliminate the likelihood of container breakage.

Additional procedures for packing, handling, and shipping environmental samples are presented in the SAP (Arcadis 2019).

Field Custody Procedures

The objective of field sample custody is to protect samples from tampering from the time of sample collection through time of transport to the analytical laboratory. Persons will have custody of samples when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

Field custody documentation consists of both field logbooks/daily log sheets and field chain-of-custody forms.

Field logbooks/sheets will provide the means of recording the data collecting activities that are performed. As such, entries will be described in as much detail as possible so that persons going to the Site could reconstruct a particular situation without reliance on memory.

Field logbooks/daily log sheets will be bound field survey books, notebooks, or paper sheets. Logbooks/log sheets will be assigned to field personnel but will be stored in a secure location when not in use. Each logbook/log sheets will be identified by the project-specific document number. The title page of each logbook/log sheet will contain the following:

- Person to whom the logbook/sheet is assigned
- Logbook/sheet number
- Project name
- Project start date
- End date

QAPP Worksheet #27 Sample Custody Requirements

Field Custody Procedures Continued

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather conditions, names of all sampling team members present, level of personal protection being used, and signature of the person making the entry will be provided. The names of visitors to the Site and field sampling or investigation team personnel, as well as the purpose of their visit, will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. Entries will be made in ink, with no erasures. If an incorrect entry is made, the information will be crossed out with one strike mark. Whenever a sample is collected or a measurement is made, a detailed description of the location of the station will be recorded. The number of the photographs taken, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures documented in SAP (Arcadis 2019). The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume and number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description.

Sample Labels

Preprinted sample labels will be affixed to sample bottles prior to delivery at the sampling site. The following information is required on each sample label:

- Project name
- Date collected
- Time collected
- Location
- Sampler
- Analysis to be performed
- Preservative
- Sample number

Sample labels will be completed for each sample using waterproof ink. The labels will include the information listed above. The completed sample labels will be affixed to each sample bottle and covered with clear tape.

QAPP Worksheet #27 Sample Custody Requirements

Chain of Custody Record

Completed chain-of-custody forms will be required for all samples to be analyzed. Chain-of-custody forms will be initiated by the sampling crew in the field. The chain-of-custody forms will contain the unique sample identification number, sample date and time, sample description, sample type, preservation (if any), and analyses required. The original chain-of-custody form will accompany the samples to the laboratory. Copies of the chain-of-custody will be made prior to shipment (or multiple copy forms will be used) for field documentation. The chain-of-custody forms will remain with the samples at all times. The samples and signed chain-of-custody forms will remain in the possession of the sampling crew until the samples are delivered to the express carrier (e.g., Federal Express), hand delivered to a mobile or permanent laboratory, or placed in secure storage.

Whenever samples are split with a government agency or other party, a separate chain of custody will be prepared for those samples and marked to identify the party with whom the samples are being split. The person relinquishing the samples to the facility or agency should request the representative’s signature acknowledging sample receipt. If the representative is unavailable or refuses, this is noted in the “Received By” space.

Laboratory Custody Procedures

Upon sample receipt, laboratory personnel will be responsible for sample custody. The original field chain-of-custody form will accompany all samples requiring laboratory analysis. The laboratory will use chain-of-custody guidelines described in the USEPA guidance documents. Samples will be kept secured in the laboratory until all stages of analysis are complete. All laboratory personnel having samples in their custody will be responsible for documenting and maintaining sample integrity.

Immediately upon sample receipt, the laboratory sample custodian will verify the integrity of the cooler seal, open the cooler, and compare the contents against the field chain of custody. If a sample container is missing, a sample container is received broken, the sample is in an inappropriate container, or the sample has not been preserved by appropriate means, Arcadis staff will be notified. The laboratory sample custodian will be responsible for logging the samples in, assigning a unique laboratory identification number to each sample, labeling the sample bottle with the laboratory identification number, and moving the sample to an appropriate storage location to await analysis. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory tracking system. Relevant custody documentation will be placed in the project file.

QAPP Worksheet #28-1 Quality Control Samples — Polychlorinated Biphenyls (PCBs)

Matrix	Solids	**Analytical Method/ SOP Reference**	SW846 8082A/L-3
Analytical Group	PCBs	**Sampler's Name**	Arcadis Field Personnel
Concentration Level	All	**Field Sampling Organization**	Arcadis Field Personnel
Sampling Standard Operating Procedure	F-1, F-2, F-3	**Analytical Organization**	OnSite Environmental

Quality Control Sample	Frequency/Number[1]	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria[2]
Field Duplicate	One per 20 field samples of similar matrix	Relative percent difference (RPD) < 50%	Qualify data as needed	Arcadis personnel	Precision — overall	RPD < 50%
Method Blanks	One per analytical batch	< Reporting Limit (RL)	Qualify data as needed or reanalysis of batch	Laboratory personnel	Accuracy/bias contamination	< RL
Equipment Blanks	One per day or one per 20 field samples, whichever is greater	< RL	Qualify data as needed	Arcadis personnel	Accuracy/bias contamination	< RL
Calibration Verification Standards	Numerous	Percent recovery (%R) 90-110%	Reanalysis of batch	Laboratory personnel	Accuracy/bias contamination	%R 90-110%
Matrix Spike/Matrix Spike Duplicate (MSD)	One per 20 field samples	%R 75-125%	Qualify data as needed	Lab personnel and/or Arcadis personnel	Accuracy/bias	%R 75-125%
Laboratory Duplicate or MSD	One per 20 field samples of similar matrix	RPD, < 20%	Qualify data as needed	Lab personnel and/or Arcadis personnel	Precision	RPD, < 20%
Laboratory Control Sample	One per analytical batch	%R, laboratory generated limits See Appendix B	Qualify data as needed or reanalysis of batch	Laboratory personnel	Accuracy/bias	%R, laboratory generated limits See Appendix B

QAPP Worksheet #28-1 Quality Control Samples — Polychlorinated Biphenyls (PCBs)

Matrix	Solids	**Analytical Method/ SOP Reference**	SW846 8082A/L-3			
Analytical Group	PCBs	**Sampler's Name**	Arcadis Field Personnel			
Concentration Level	All	**Field Sampling Organization**	Arcadis Field Personnel			
Sampling Standard Operating Procedure	F-1, F-2, F-3	**Analytical Organization**	OnSite Environmental			
Quality Control Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator**	**Measurement Performance Criteria[2]**
Post-Digestion Spike	One per batch	%R 75-125%	Qualify data as needed	Lab personnel and/or Arcadis personnel	Accuracy/bias	%R 75-125%
Serial Dilution	One per batch	Percent difference (%D) < 10%	Qualify data as needed or reanalysis of batch	Lab personnel and/or Arcadis personnel	Precision	%D < 10%

Notes:

[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.

[2] Measurement Performance Criteria (MPC) that is “laboratory generated limits” are re-generated annually. The MPCs in the laboratory analytical reports will reflect the most recent MPCs.

LCS	Laboratory control sample.
No.	Number.
RL	Reporting limit.
RPD	Relative percent difference.
SOP	Standard operating procedure.
%D	Percent difference.
%R	Percent recovery.

QAPP Worksheet #28-3 – Quality Control Samples (Carcinogenic Polycyclic Aromatic Hydrocarbons in Soil, 8270)

Matrix	Soil	**Analytical Method/ SOP Reference**	SW846 8270-SIM/L-7
Analytical Group	cPAHs	**Sampler's Name**	Arcadis Field Team
Concentration Level	All	**Field Sampling Organization**	Arcadis Field Team
Sampling Standard Operating Procedure (SOP)	F-1, F-2, F-3	**Analytical Organization**	OnSite Environmental

Quality Control (QC) Sample	Frequency/Number[1]	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field duplicate	One per 20 field samples of similar matrix	Relative percent difference (RPD) < 50%	Qualify data as needed	Arcadis personnel	Precision – overall	RPD < 50%
Surrogates	Minimum three per sample	Percent recovery (%R), laboratory generated limits	Reanalyze sample	Lab personnel	Accuracy/bias	%R
Method blanks	One per analytical batch	< Reporting limit (RL)	Qualify data as needed or reanalyze batch	Lab and/or Arcadis personnel	Accuracy/bias contamination	< RL
Equipment blanks	One per 20 field samples	< RL	Qualify data as needed	Arcadis personnel	Accuracy/bias contamination	< RL
Initial Calibration Verification Standards	Immediately after initial calibration	%R 80-120	Reanalysis of batch	Lab personnel	Accuracy/bias	%R 80-120
Calibration Verification Standards	At the beginning of each day and every 12 hours	%D ± 20%	Reanalysis of batch	Lab personnel	Accuracy/bias	%D ± 20%

QAPP Worksheet #28-3 – Quality Control Samples (Carcinogenic Polycyclic Aromatic Hydrocarbons in Soil, 8270)

Matrix	Soil	**Analytical Method/ SOP Reference**	SW846 8270-SIM/L-7
Analytical Group	cPAHs	**Sampler's Name**	Arcadis Field Team
Concentration Level	All	**Field Sampling Organization**	Arcadis Field Team
Sampling Standard Operating Procedure (SOP)	F-1, F-2, F-3	**Analytical Organization**	OnSite Environmental

Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Laboratory control sample/laboratory control sample duplicate (LCS/LCSD)[2]	One per analytical batch	%R, Per Laboratory Requirements	Qualify data as needed or reanalyze batch	Lab personnel	Accuracy/bias	%R, Per laboratory requirements
Internal standard	At least six per sample	Area response 50-200%	Reanalyze sample	Lab personnel	Precision	Area response 50-200%
Matrix spike (MS)/ Matrix spike duplicate (MSD)[2]	One per batch	%R, Per Laboratory Requirements	Qualify data as needed	Lab and/or Arcadis personnel	Accuracy/bias	%R, Per Laboratory Requirements
MS/MSD and LCS/LCSD[2]	One per batch	RPD, < 40%	Qualify data as needed	Lab and/or Arcadis personnel	Precision	RPD, < 40%

Notes:

[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.

[2] LCS/LCSD used when MS/MSD are not client-supplied.

[3] Measurement Performance Criteria (MPC) that is "laboratory generated limits" are re-generated annually. The MPCs in the laboratory analytical reports will reflect the most recent MPCs.

LCS Laboratory control sample.
No. Number.

RL	Reporting limit.
RPD	Relative percent difference.
SOP	Standard operating procedure.
%D	Percent difference.
%R	Percent recovery

QAPP Worksheet #28-5 Quality Control Samples — TPH Diesel Range Organics (DRO)/Gasoline Range Organics (GRO)/Heavy Oil (HO) in Soil

Matrix	Soil	**Analytical Method/ SOP Reference**	NWTPH-Gx, NWTPH-Dx/L-5, L-6
Analytical Group	GRO/DRO/HO	**Sampler's Name**	Arcadis Field Team
Concentration Level	All	**Field Sampling Organization**	Arcadis Field Team
Sampling SOP	F-1, F-2, F-3, and/or F-4	**Analytical Organization**	OnSite Environmental

QC Sample	Frequency/Number[1]	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria[3]
Field duplicate	One per 20 field samples of similar matrix	Relative percent difference (RPD) < 50%	Qualify data as needed	Arcadis personnel	Precision — overall	RPD < 50%
Surrogates	1 per sample	Percent recovery (%R), laboratory generated limits See Appendix B	Reanalysis or re-extraction/ reanalysis of sample	Lab personnel	Accuracy/bias	%R, See Appendix B
Method blanks	1 per analytical batch	< Reporting limit (RL)	Qualify data as needed or re-extraction/ reanalysis of batch	Lab personnel	Accuracy/bias contamination	< RL
Equipment blanks	1 per 20 field samples	< RL	Qualify data as needed	Arcadis personnel	Accuracy/bias contamination	< RL
Initial and Continuing calibration verification	Before sample analysis, after every 20 samples	% Difference (%D) ± 20%	Recalibration and/or reanalysis of batch	Lab personnel	Accuracy/bias	%D ± 20%
Laboratory control sample/laboratory control sample duplicate (LCS/LCSD)[2]	One per analytical batch	%R, See Appendix B	Reanalysis or re-extraction/ reanalysis of batch	Lab personnel	Accuracy/bias	%R, See Appendix B

QAPP Worksheet #28-5 Quality Control Samples — TPH Diesel Range Organics (DRO)/Gasoline Range Organics (GRO)/Heavy Oil (HO) in Soil

Matrix	Soil	**Analytical Method/ SOP Reference**	NWTPH-Gx, NWTPH-Dx/L-5, L-6			
Analytical Group	GRO/DRO/HO	**Sampler's Name**	Arcadis Field Team			
Concentration Level	All	**Field Sampling Organization**	Arcadis Field Team			
Sampling SOP	F-1, F-2, F-3, and/or F-4	**Analytical Organization**	OnSite Environmental			
QC Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria[3]**
Matrix spike/matrix spike duplicate (MS/MSD)[2]	One per batch	%R, Per laboratory requirements	Qualify data as needed	Lab and/or Arcadis personnel	Accuracy/bias	%R, Per laboratory requirements
MS/MSD and LCS/LCSD[2]	One per batch	RPD < 40%	Qualify data as needed	Lab and/or Arcadis personnel	Precision	RPD < 40%

Notes:

[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.

[2] LCS/LCSD used when MS/MSD are not client-supplied.

[3] Measurement Performance Criteria (MPC) that is "laboratory generated limits" are re-generated annually. The MPCs in the laboratory analytical reports will reflect the most recent MPCs.

LCS	Laboratory control sample.
No.	Number.
RL	Reporting limit.
RPD	Relative percent difference.
RSD	Relative standard deviation
SOP	Standard operating procedure.
%D	Percent difference.
%R	Percent recovery.
TBD	To be determined

QAPP Worksheet #28-7 Quality Control Samples — Fractionated Lead (Total, Coarse, Fine Solids)

Matrix	Solids	**Analytical Method/ SOP Reference**	SW846 6010D/L-1, L-2
Analytical Group	Fractionated Lead; Total, Coarse and Fine	**Sampler's Name**	Arcadis Field Team
Concentration Level	All	**Field Sampling Organization**	Arcadis Field Team
Sampling Standard Operating Procedure	F-1, F-2, F-3, and F-4	**Analytical Organization**	OnSite Environmental

Quality Control Sample	Frequency/Number[1]	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria[2]
Field Duplicate	One per 10 field samples of similar matrix	Relative percent difference (RPD) < 50%	Qualify data as needed	Arcadis personnel	Precision — overall	RPD < 50%
Method Blanks	One per analytical batch	< Reporting Limit (RL)	Qualify data as needed or reanalysis of batch	Laboratory personnel	Accuracy/bias contamination	< RL
Equipment Blanks	One per day or one per 20 field samples, whichever is greater	< RL	Qualify data as needed	Arcadis personnel	Accuracy/bias contamination	< RL
Calibration Verification Standards	Numerous	Percent recovery (%R) 90-110%	Reanalysis of batch	Laboratory personnel	Accuracy/bias contamination	%R 90-110%
Matrix Spike/Matrix Spike Duplicate (MSD)	One per 20 field samples	%R 75-125%	Qualify data as needed	Lab personnel and/or Arcadis personnel	Accuracy/bias	%R 75-125%
Laboratory Duplicate or MSD	One per 20 field samples of similar matrix	RPD, < 20%	Qualify data as needed	Lab personnel and/or Arcadis personnel	Precision	RPD, < 20%
Laboratory Control Sample	One per analytical batch	%R, laboratory generated limits Per laboratory requirements	Qualify data as needed or reanalysis of batch	Laboratory personnel	Accuracy/bias	%R, laboratory generated limits Per laboratory requirements

QAPP Worksheet #28-7 Quality Control Samples — Fractionated Lead (Total, Coarse, Fine Solids)

Matrix	Solids	**Analytical Method/ SOP Reference**	SW846 6010D/L-1, L-2
Analytical Group	Fractionated Lead; Total, Coarse and Fine	**Sampler's Name**	Arcadis Field Team
Concentration Level	All	**Field Sampling Organization**	Arcadis Field Team
Sampling Standard Operating Procedure	F-1, F-2, F-3, and F-4	**Analytical Organization**	OnSite Environmental

Quality Control Sample	Frequency/Number[1]	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria[2]
Post-Digestion Spike	One per batch	%R 75-125%	Qualify data as needed	Lab personnel and/or Arcadis personnel	Accuracy/bias	%R 75-125%
Serial Dilution	One per batch	Percent difference (%D) < 10%	Qualify data as needed or reanalysis of batch	Lab personnel and/or Arcadis personnel	Precision	%D < 10%

Notes:

[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.

[2] Measurement Performance Criteria (MPC) that is "laboratory generated limits" are re-generated annually. The MPCs in the laboratory analytical reports will reflect the most recent MPCs.

LCS	Laboratory control sample.
No.	Number.
RL	Reporting limit.
RPD	Relative percent difference.
SOP	Standard operating procedure.
%D	Percent difference.
%R	Percent recovery.

QAPP Worksheet #28-12 Quality Control Samples (Waste Characteristics, IDW)

Matrix	Aqueous	**Analytical Method/ SOP Reference**	SW846 8082A, NWTPH, 7470A,6010D, 200.8/L-1--L-3, L-5—L-7, L-10
Analytical Group	RCRA Metals	**Sampler's Name**	Arcadis Field Team
Concentration Level	All	**Field Sampling Organization**	Arcadis Field Team
Sampling Standard Operating Procedure (SOP)	F-9	**Analytical Organization**	OnSite Environmental

Quality Control (QC) Sample	Frequency/Number[1]	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field duplicate	One per 20 field samples of similar matrix	Relative percent difference (RPD) < 50%	Qualify data as needed	Arcadis personnel	Precision – overall	RPD < 50%
Method blanks	One per analytical batch	< Reporting limit (RL)	Qualify data as needed or reanalysis of batch	Lab and/or ARCADIS personnel	Accuracy/bias contamination	< RL
Equipment blanks	One per 20 field samples	< RL	Qualify data as needed	Arcadis personnel	Accuracy/bias contamination	< RL
Laboratory control sample (LCS)	One per analytical batch	See Analytical SOP	Reanalysis of batch	Lab personnel	Accuracy/bias	See Analytical SOP
Laboratory duplicate (Corrosivity, Paint Filter Test)	One per 20 field samples of similar matrix	RPD ≤10%	Qualify data as needed	Arcadis personnel	Precision	RPD ≤10%

Notes:

[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.

LCS	Laboratory control sample.
No.	Number.
RL	Reporting limit.
RPD	Relative percent difference.
SOP	Standard operating procedure.
%D	Percent difference.
%R	Percent recovery.

QAPP Worksheet #29 Project Documents and Records

Sample Collection Documents and Records	On-site Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records	Other
- Field Notes - Sampling Logs - Chain-of-Custody Records - Air Bills - Custody Seals	- Equipment Calibration Logs - Field Data Records - Field Instrument Maintenance Logs	- Sample Receipt, Custody and Tracking Records - Standard Traceability Logs - Equipment Calibration Logs - Sample Prep Logs - Run Logs - Equipment Maintenance, Testing, and Inspection Logs - Corrective Action Forms - Reported Field Sample Results - Reported Results for Standards, Quality Control Checks and Quality Control Samples - Instrument Printouts (raw data) for Field Samples, Standards, Quality Control Checks and Quality Control Samples - Data Package Completeness Checklists - Sample Disposal Records - Extraction/Cleanup Records - Raw Data (stored on disk or CD-R) - Analytical Reports	- Data Validation Checklists - Data Quality Assessments	- Health and Safety Plan - QAPP/SAP (Arcadis 2019)

QAPP Worksheet #30 Analytical Services

Matrix	Analytical Group	Concentration Level	Analytical Standard Operating Procedures	Data Package Turnaround Time (calendar days)	Laboratory/Organization (name and address, contact person and telephone number)	Backup Laboratory / Organization (name and address, contact person and telephone number)
Soil	Benzene cPAHs TPH- Gasoline Range Organics, Diesel Range Organics, Heavy Oils, Mineral Oils, PCBs Lead	All	See Worksheet #23	Level 2 data package: 7 business days for discrete samples; 15 business days for ISM samples	OnSite Environmental, Inc. 14648 NE 95th St. Redmond, WA 98052 Contact: David Baumeister Email: dbaumeister@onsite-env.com Phone: 425.883.3881	Not Applicable

Worksheet #31 – Planned Project Assessments

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CAs) (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (title and organizational affiliation)
Field Readiness Review	One time prior to mobilization	Internal	Arcadis	Kyle Haslam/Alex Pink Field Team Leader, Arcadis	Kyle Haslam/Alex Pink Field Team Leader, Arcadis	Paul McCullough, Technical Advisor, Arcadis	Josh Gravenmier, Project Manager Arcadis
Health and Safety Field Assessment (TIP)	One time in field	Internal	Arcadis	Kyle Haslam/Alex Pink Field Team Leader, Arcadis	Kyle Haslam/Alex Pink Field Team Leader, Arcadis	Paul McCullough, Technical Advisor, Arcadis	Josh Gravenmier, Project Manager Arcadis
Laboratory Audit of Onsite Laboratories	Per Laboratory Quality Assurance Program	Internal	Onsite Environment	Stacey Duran, Laboratory Quality Assurance (QA) Manager, Onsite Laboratories	David Baumeister Laboratory Director, Onsite Laboratories	Stacey Duran and David Baumeister Laboratory Director and QA Manager, Onsite Laboratories	Josh Gravenmier Project Manager, Arcadis
Field Inspections	Intermittent	Internal	Arcadis	Kyle Haslam/Alex Pink Field Team Leader, Arcadis	Kyle Haslam/Alex Pink Field Team Leader, Arcadis	Paul McCullough, Technical Advisor, Arcadis	Josh Gravenmier, Project Manager Arcadis
Safety Observations	Intermittent	Internal	Arcadis	Kyle Haslam/Alex Pink Field Team Leader, Arcadis	Kyle Haslam/Alex Pink Field Team Leader, Arcadis	Paul McCullough, Technical Advisor, Arcadis	Josh Gravenmier, Project Manager Arcadis

QAPP Worksheet #32 Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Time Frame of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Time Frame for Response
Field Sampling Readiness Review (internal)	Email to Field Team	Josh Gravenmier Paul McCullough Kyle Haslam Alex Pink Field Team	72 hours after readiness review	Memorandum or email	Josh Gravenmier (Project Manager) and Arcadis Field Team	48 hours after notification
Field Inspection (internal)	Memorandum	Josh Gravenmier (Project Manager)	Two days	Memorandum or email	Josh Gravenmier (Project Manager) and Arcadis Field Team	48 hours after notification
Contract Laboratory Technical Audit (internal)	Memorandum	David Baumeister, (Onsite Environmental, Vice President)	Two days	Memorandum or email	Stacey Duran (Laboratory Quality Assurance Manager, OnSite Environmental)	48 hours after notification

QAPP Worksheet #33 Quality Assurance Management Reports

Type of Report	Frequency (e.g., daily, weekly monthly, quarterly, annually)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (title and organizational affiliation)	Report Recipient(s) (title and organizational affiliation)
Field Sampling Technical Systems Audit Report	Once per year	Not Applicable	Josh Gravenmier, Certified Project Manager, Arcadis	Josh Gravenmier, Certified Project Manager, Arcadis
Contract Laboratory Technical Audit Report	As necessary during project	Not Applicable	Paul McCullough, Technical Advisor, Arcadis	Paul McCullough, Technical Advisor, Arcadis
Data Validation Reports	As specified in the Data Assessment section based on intended use of the data and required percentage to meet project data quality objectives. Data Validation Reports will be documented in the RI/FFS (site evaluation samples) or Removal Action Completion Report (soil removal confirmation samples).	As generated throughout project	Paul McCullough, Technical Advisor, Arcadis	Paul McCullough, Technical Advisor, Arcadis
Data Quality Summary Reports	As appropriate for data use and as required for report completion. A Data Quality Summary Report will be documented in the RI/FFS (site evaluation samples) or Removal Action Completion Report (soil removal confirmation samples).	As generated throughout project	Paul McCullough, Technical Advisor, Arcadis	Paul McCullough, Technical Advisor, Arcadis

QAPP Worksheet #34 Verification (Step I) Process

Verification Input	Description	Internal/ External	Responsible for Verification (name, organization)
Chain-of-Custody and Shipping Forms	Chain-of-custody forms and shipping documentation will be reviewed by laboratory upon receipt of samples for verification against the sample coolers they represent. The chain-of-custody form will be signed by all parties that had custody of samples, with the exception of commercial carriers.	External	David Baumeister, OnSite Environmental
Field Notes and Sampling Logs	All field notes and sampling logs will be reviewed internally and placed in the project file.	Internal	Paul McCullough, Arcadis
Laboratory Data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	External	David Baumeister, OnSite Environmental
Laboratory Data	All final data packages will be verified for content upon receipt.	Internal	Paul McCullough, Arcadis

Worksheet #35 – Validation (Steps IIa and IIb) Process

Steps IIa and IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
Step IIa	Sampling methods and procedures	Establish that required sampling methods were used and that any deviations were noted. Provide that the sampling procedures and field measurements met performance criteria and that any deviations were documented.	Site Manager, Arcadis
Step IIa	Analytical method and procedures	Establish that required analytical methods were used and that any deviations were noted. The laboratory will provide that quality control (QC) samples met performance criteria and that any deviations were documented in the report narrative.	Onsite Environmental, Inc.
Step IIa Modified	Analytical method and procedures	Review associated blanks for potential contamination and verify that all preparations and analyses have been performed within applicable holding times.	Arcadis Project Chemist
Step IIb	Documentation of Quality Assurance Project Plan (QAPP) QC sample results	Establish that all QAPP-required QC samples were collected and analyzed.	Arcadis Project Chemist
Step IIb	Project quantitation limits	Determine that the project quantitation limits were achieved, as outlined in the QAPP.	Arcadis Project Chemist

Worksheet #35 – Validation (Steps IIa and IIb) Process

Steps IIa and IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
Step IIb	Performance criteria	Evaluate QC data associated with the samples designated for intended uses stated in Worksheet #36 against project-specific performance criteria in the QAPP, and U.S. Department of Defense Quality Systems Manual Version 4.2	Arcadis Project Chemist
Step IIb	Validation Report	Summarize data verification and validation components included in the Performance Review. Include qualified data and explanation of all qualifiers. Tier 2 validation 90% of the data and 10% Tier 3 validation.	Arcadis Project Chemist

QAPP Worksheet #37 Usability Assessment

The Data Usability Assessment will be performed by Arcadis for data associated with delineation or confirmation of remedial action. Documentation generated during the usability assessment will consist of data validation checklists with a brief summary of overall data usability.

The Data Usability Assessment process involves data verification and data validation. Data verification is the process by which laboratory results are checked to provide that the proper quality control steps were performed, and key items have met quality control objectives (both analytical and contractual). The key items checked in a data verification include the following:

- Sample collection, handling, and analysis procedures;
- Field sampling, handling, and analysis activities documented (e.g., quality control signatures in field logs, quality control checklist);
- Sampling, handling, on-site analytical and off-site laboratory data verified internally at the data generator level;
- Laboratory data (e.g., laboratory-qualified data);
- Sampling, on-site analytical, and off-site laboratory data;
- Data package deliverable completeness;
- Review of case narrative;
- All analytical results presented;
- Quality control sample data summaries;
- Applicable raw data;

All required data deliverables must be present in the data package in order to proceed to the next step of data validation.

Data validation entails a review of the sample collection, handling, field analysis, and quality control data, and the raw data to verify that the laboratory was operating within required limits; analytical results were correctly transcribed from the instrument readouts; and which (if any) environmental samples were related to out-of-control quality control samples. The objective of data validation is to identify any questionable or invalid laboratory measurements.

The data quality indicators used to evaluate conformance with the project data quality objectives are presented below.

QAPP Worksheet #37 Usability Assessment

Data quality indicators are generally defined in terms of six parameters:

1. Representativeness
2. Comparability
3. Completeness
4. Precision
5. Accuracy
6. Sensitivity

Each parameter is defined below. Specific objectives for the Site actions are presented in other sections of this QAPP, as referenced below.

Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions and depends on sampling and analytical variability and the variability of environmental media at the site. Actions have been designed to assess the presence of chemical constituents at the time of sampling. The QAPP presents the rationale for sample quantities and location. This QAPP presents field sampling and laboratory analytical methodologies. Use of the prescribed field and laboratory analytical methods with associated holding times and preservation requirements is intended to provide representative data.

Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability among phases of the actions (if additional phases are required) will be maintained through consistent use of the sampling and analytical methodologies set forth in this QAPP, established quality assurance/quality control procedures, and use of appropriately trained personnel.

Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event and/or investigation compared to the total amount that was obtained. This will be determined upon final assessment of the analytical results. Completeness of a field or laboratory data set will be calculated by comparing the number of valid sample results generated to the total number of results generated.

$$\text{Completeness} = \frac{\text{Number valid results}}{\text{Total number of results generated}} \times 100$$

QAPP Worksheet #37 Usability Assessment

As a general guideline, overall project completeness is expected to be at least 90 percent. The assessment of completeness will require professional judgment to determine data usability for intended purposes.

Precision

Precision is a measure of the reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the objectives of the action. To maximize precision, sampling and analytical procedures will be followed. All work for the site actions will adhere to established protocols presented in the QAPP. Checks for analytical precision will include the analysis of matrix spikes/matrix spike duplicates, laboratory duplicates, and field duplicates. Checks for field measurement precision will include duplicate field measurements.

The precision of data will be measured by calculating the Relative Percent Difference by the following equation:

$$\text{RPD} = \frac{(A-B)}{(A+B)/2} \times 100$$

Where:

A = Analytical result from one of two duplicate measurements

B = Analytical result from the second measurement

Replicates and confidence intervals will be determined per ITRC guidance (ITRC 2012).

Accuracy

Accuracy is a measure of how close a measured result is to the true value. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, reference standards, matrix spikes, blank spikes, and surrogate standards will be used to assess the accuracy of the analytical data.

Accuracy will be calculated in terms of percent recovery as follows:

$$\%\ \text{Recovery} = \frac{A-X}{B} \times 100$$

Where:

A = Value measured in spiked sample or standard

X = Value measured in original sample

QAPP Worksheet #37 Usability Assessment

B = True value of amount added to sample or true value of standard

Sensitivity

Sensitivity is a quantitative measurement to determine if the analytical laboratory's procedures/methodologies and their associated method detection limits can satisfy the project requirements as they relate to the project action limits. Method detection limits are updated annually by the laboratory. The current method detection limits for the analytical laboratories are presented in Worksheet #15.

Data Validation and Usability

Validation will be performed on all data generated for Site evaluation, removal confirmation/risk assessment purposes using USEPA's National Functional Guidelines (USEPA 1999; 2004) and the most recent versions of the NFGs as appropriate, and USEPA Region II Standard Operating Procedures associated with SW-846 analysis for data validation available at the time of project initiation, where appropriate. These procedures and criteria may be modified, as necessary, to address project-specific and method-specific criteria, control limits, and procedures. Data validation will consist of data screening, checking, reviewing, editing, and interpretation to document analytical data quality and to determine whether the quality is sufficient to meet the data quality objectives.

The data validator will verify that reduction of laboratory measurements and laboratory reporting of analytical parameters is in accordance with the procedures specified for each analytical method and/or as specified in this QAPP. Any deviations from the analytical method or any special reporting requirements apart from those specified in this QAPP will be detailed on chain-of-custody forms.

Upon receipt of laboratory data, the following procedures will be executed by the data validator:

- Evaluate completeness of data package.
- Verify that field chain-of-custody forms were completed and that samples were handled properly.
- Verify that holding times were met for each parameter. Holding time exceedances, should they occur, will be documented. Data for all samples exceeding holding time requirements will be flagged as either estimated or rejected. The decision as to which qualifier is more appropriate will be made on a case-by-case basis.
- Verify that parameters were analyzed according to the methods specified.
- Review quality assurance/quality control data (i.e., confirm that duplicates, blanks, and spikes were analyzed on the required number of samples, as specified in the method and verify that duplicate and matrix spike recoveries are acceptable).
- Investigate anomalies identified during review. When anomalies are identified, they will be discussed with the Project Manager and/or Laboratory Manager, as appropriate.
- If data appear suspect, investigate the specific data of concern. Calculations will be traced back to raw data. If calculations do not agree, the cause will be

QAPP Worksheet #37 Usability Assessment

determined and corrected.

Deficiencies discovered as a result of the data review, as well as the corrective actions implemented in response, will be documented and submitted in the form of a written report addressing the following topics, as applicable to each method:

- Assessment of the data package
- Description of any protocol deviations
- Failures to reconcile reported and/or raw data
- Assessment of any compromised data
- Overall appraisal of the analytical data
- Table of site name, sample quantities, matrix, and fractions analyzed

It should be noted that qualified results do not necessarily invalidate data. The goal to produce the best possible data does not necessarily mean that data must be produced without quality control qualifiers. Qualified data can provide useful information.

During the review process, laboratory-qualified and unqualified data are verified against the supporting documentation. Based on this evaluation, qualifier codes may be added, deleted, or modified by the data reviewer. Results will be qualified with the codes as listed in Worksheet #36 and #36A.

Resolution of any issues regarding laboratory performance or deliverables will be handled between the laboratory and the data validator. Suggestions for reanalysis may be made by the Quality Assurance Coordinator at this point.

Validation Reports

The data validation reports will identify all deficiencies and the potential impact on the results. The Validation and Data Management Team will apply qualifiers generated during the validation process to the analytical data tables, with an explanation of how and why the data were qualified. The validation checklists and the data tables will be the primary location of all applicable data qualifiers. Qualifiers will not be applied to the original hard copy analytical reports.

Field Data Review

Field data are generated from in-field measurement, which may include global positioning system or physical survey data, x-ray fluorescence measurement data, groundwater quality field parameters, and qualitative soil characterization or site description results. The quality objective for the in-field measurement activities is to obtain accurate measurements using appropriate equipment. Data are recorded in field logbooks or on field sampling sheets and calibration logs. Calibration logs will be reviewed with other field documentation to identify any potential impacts to data quality and usability. Field logbooks are reviewed as part of the quality control inspections.

QAPP Worksheet #37 Usability Assessment

Reconciliation with Data Usability Requirements

The data results will be examined to determine the performance that was achieved for each data usability criterion. The performance will then be compared with the project objectives and data quality objectives. Deviations from objectives will be noted. Additional action may be warranted when performance does not meet performance objectives for critical data. Options for corrective action relating to incomplete information, questionable results, or inconsistent data may include any or all of the following:

- Retrieval of missing information
- Request for additional explanation or clarification
- Reanalysis of sample from extract (when appropriate)
- Recalculation or reinterpretation of results by the laboratory

These actions may improve the data quality, reduce uncertainty and eliminate the need to qualify or reject data.

If these actions do not improve the data quality to an acceptable level, the following additional actions may be taken:

- Extrapolation of missing data from existing data points
- Use of historical data
- Evaluation of the critical/noncritical nature of the sample

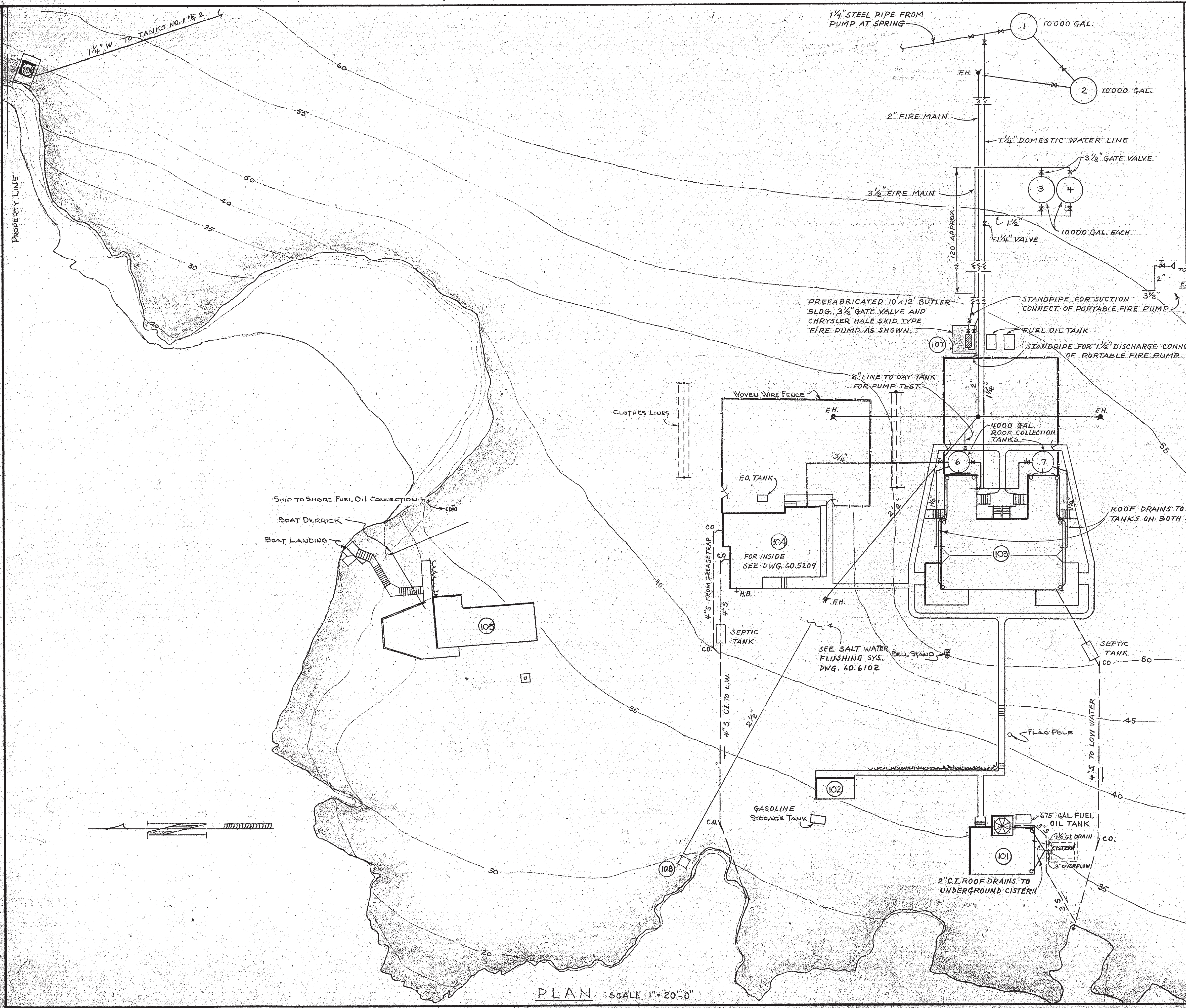
If the data gap cannot be resolved by these actions, the data bias and potential for false negatives and positives can be evaluated. If the resultant uncertainty level is unacceptable, the following action must be taken:

- Additional sample collection and analysis

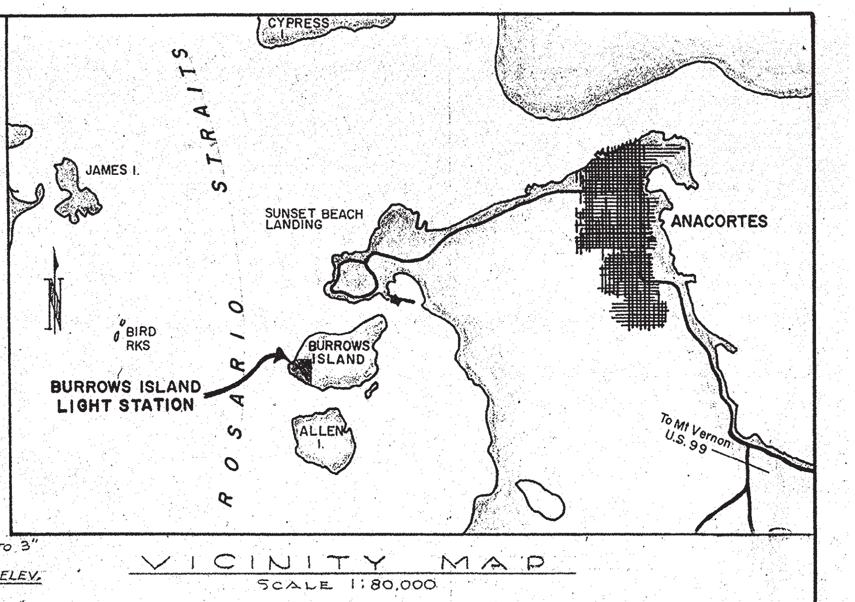
Notes:
ITRC: Interstate Technology Regulatory Council

APPENDIX B

Historical Documents and Reports



PLAN SCALE 1"=20'-0"



VICINITY MAP
SCALE 1:80,000

BUILDING INDEX

101.	LIGHT AND FOG SIGNAL BUILDING
102	OIL AND PAINT STORAGE BUILDING
103	DOUBLE DWELLING
104	OFFICER IN CHARGE QUARTERS
105	BOATHOUSE
106	PUMPHOUSE & SPRING CISTERN
107	FIRE PUMP BLDG.
108	SALT WATER FLUSHING PUMPHOUSE.

SYMBOLS

———	WATER LINE
—S—	SEWER LINE
F.H.	FIRE HYDRANT
C.O.	CLEAN OUT
—HB	HOSE BIBB
—⋈—	GATE VALVE.

NOTES:

1. TANKS NO. 1 & 2 ARE USED FOR DOMESTIC WATER STORAGE ONLY.
2. TANKS NO. 3 & 4 ARE USED FOR JOINT DOMESTIC AND FIRE WATER STORAGE.
3. ALL WATER TANKS ARE WOOD STAVE.

REVISION	DATE	APPD.		BY

U. S. COAST GUARD 13TH DISTRICT SEATTLE, WASHINGTON

CIVIL ENGINEERING

DESIGNED - ELW
DRAWN - KC
TRACED -
CHECKED - ELW
REVIEWED Byron J Clark
SUBMITTED H. Durgin
CAPT. U.S.C.G.
CHIEF OF SECTION

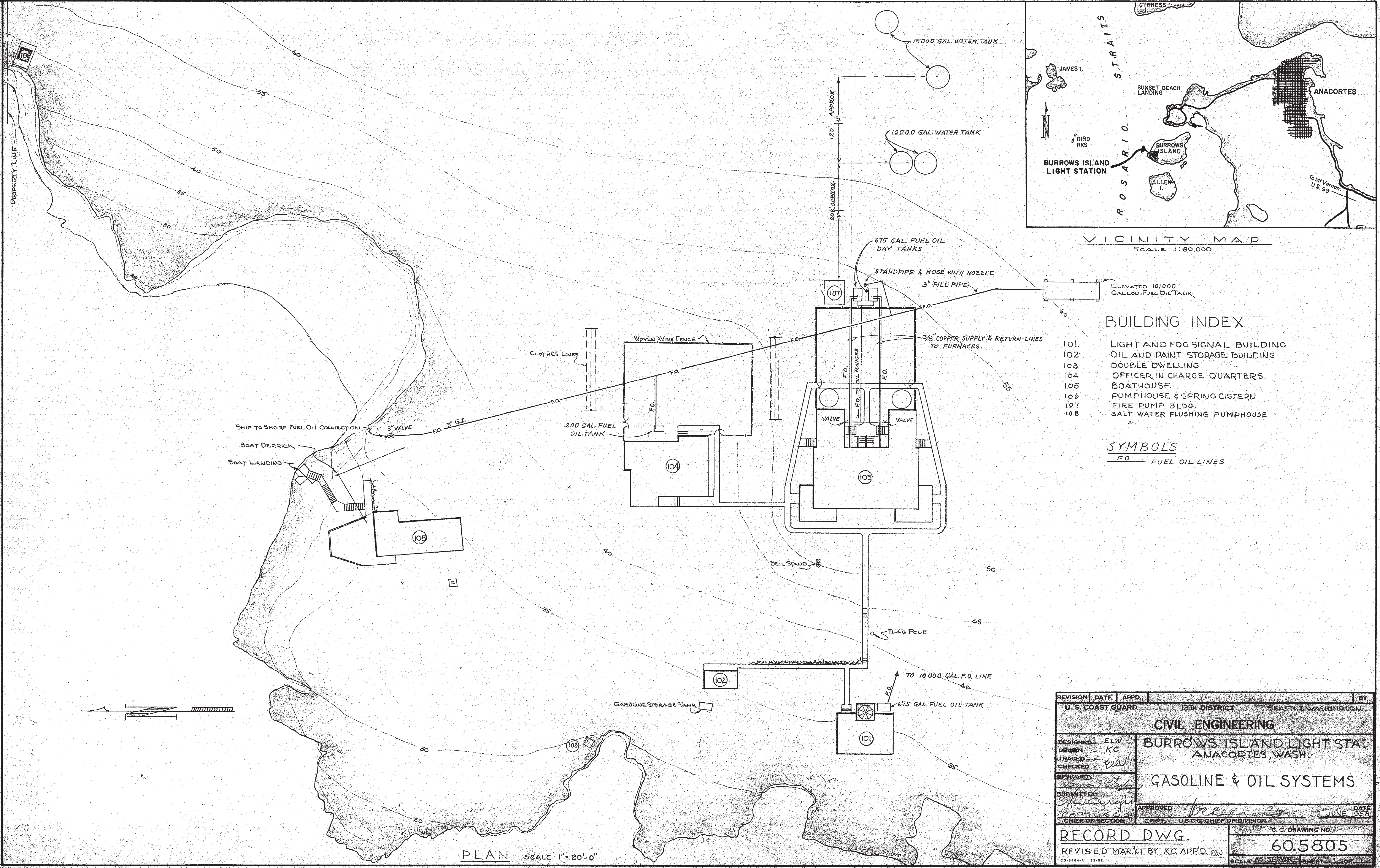
BURROWS ISLAND LIGHT STA.
ANACORTES, WASH.

FIRE PROTECTION,
WATER & SEWER SYSTEMS

APPROVED W. E. Needham DATE DEC 1960
CAPT. U.S.C.G. CHIEF OF DIVISION

RECORD DWG.
REVISED MAR '61 BY KC APP'D. ELW
CG-3404-A 12-52

C.G. DRAWING NO.
60.5804
SCALE AS SHOWN SHEET 1 OF 1



VICINITY MAP
SCALE 1:80,000

PLAN SCALE 1" = 20'-0"

BUILDING INDEX

101.	LIGHT AND FOG SIGNAL BUILDING
102	OIL AND PAINT STORAGE BUILDING
103	DOUBLE DWELLING
104	OFFICER IN CHARGE QUARTERS
105	BOATHOUSE
106	PUMPHOUSE & SPRING CISTERN
107	FIRE PUMP BLDG.
108	SALT WATER FLUSHING PUMPHOUSE

SYMBOLS

F.O. FUEL OIL LINES

REVISION	DATE	APPD.		BY

U. S. COAST GUARD 13TH DISTRICT SEATTLE, WASHINGTON

CIVIL ENGINEERING

DESIGNED ELW
DRAWN KC
TRACED
CHECKED Elw

BURROWS ISLAND LIGHT STA.
ANACORTES, WASH.

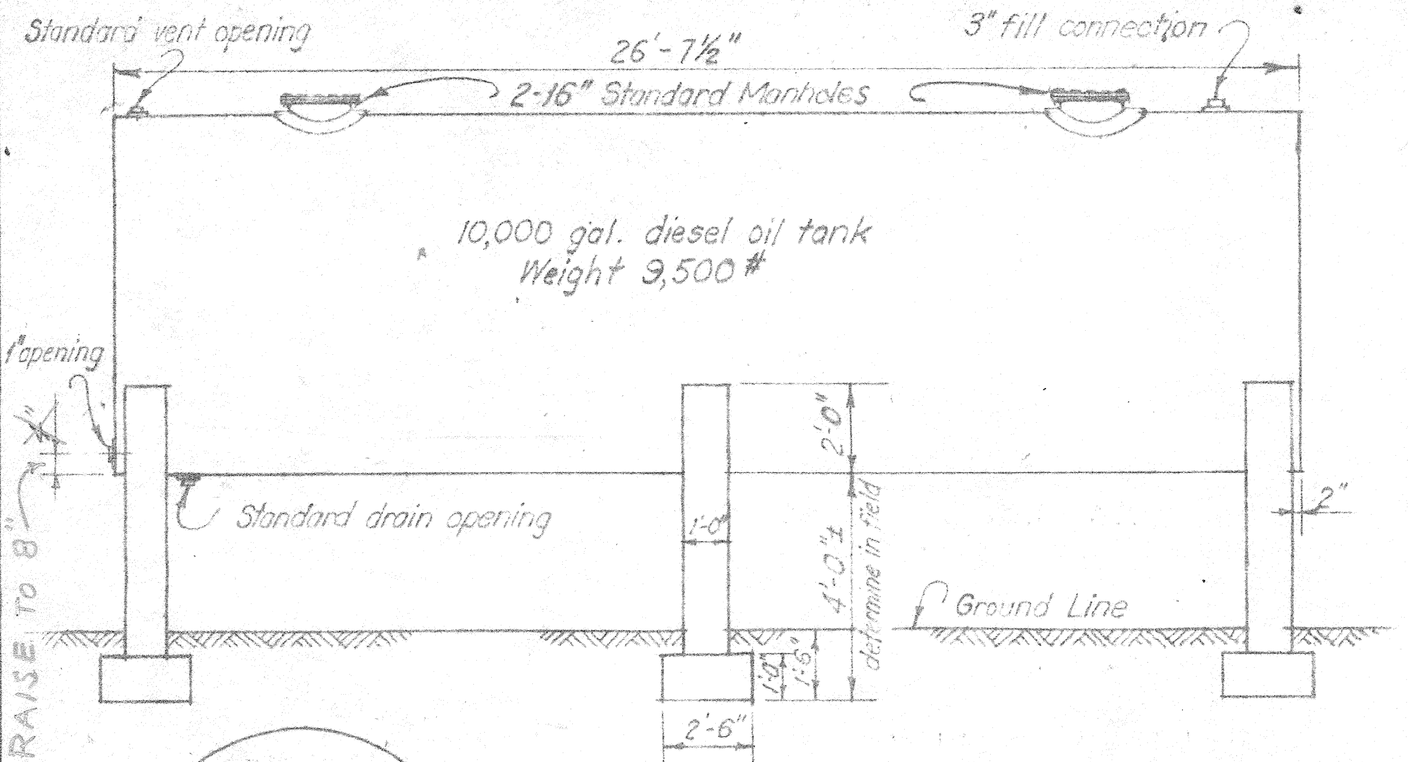
GASOLINE & OIL SYSTEMS

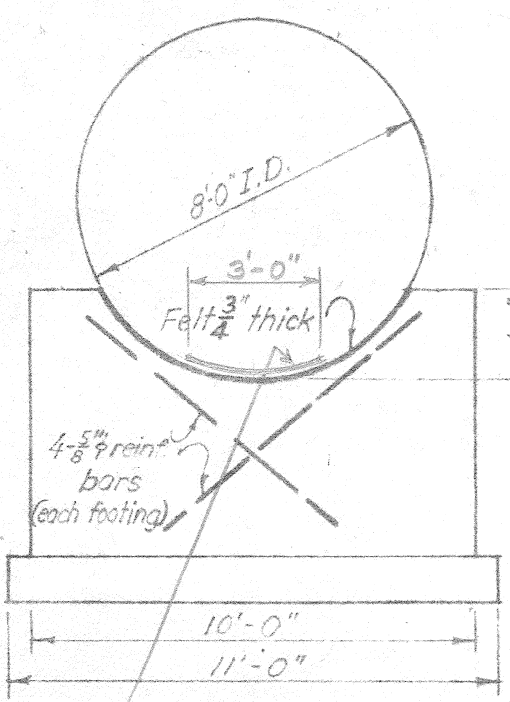
REVIEWED Byron J Clayton
SUBMITTED H. Dwyer
CAPT. U.S.C.G.
CHIEF OF SECTION

APPROVED
CAPT. U.S.C.G. CHIEF OF DIVISION
DATE JUNE 1958

RECORD DWG.
REVISED MAR.'61 BY KC, APP'D. Elw
CG-3404-A 12-52

C. G. DRAWING NO.
60.5805
SCALE AS SHOWN SHEET 1 OF 1





NOTE: TANK IS CONSTRUCTED OF ¼" STEEL WITH ¼" FLAT REINFORCED HEADS IN ACCORDANCE WITH UNDERWRITERS LABORATORIES, INC. REQUIREMENTS EXCEPT FOR SIZE REQUIREMENT FOR HORIZONTAL ABOVE GROUND TANKS.

WELD ¼" STEEL PLATE IN 3'-0" WIDE SECTIONS ALONG INSIDE OF TANK BOTTOM.

REV.	DATE	APP'D		BY

USCG 13TH DISTRICT SEATTLE, WASHINGTON

CIVIL ENGINEERING

DE. - ELW
DR. - KC
TR. -
C'K'D ELW
REV'D.

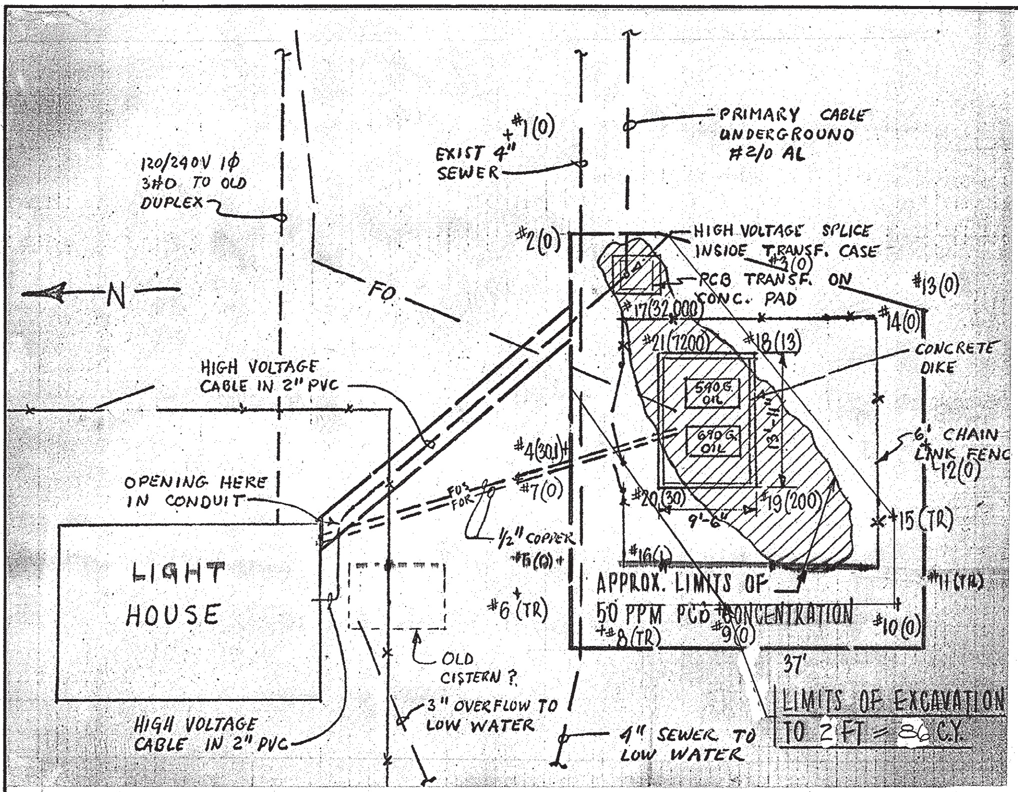
BURROWS ISLAND LIGHT STA
ANACORTES, WASHINGTON
REPAIRS TO BOTTOM OF
FUEL OIL STORAGE TANK

CH. SECT.

APPROVED
DATE 7/12/60
CAPT. U.S.C.G. CHIEF OF DIV.

C. G. DRAWING NO.
60.6003

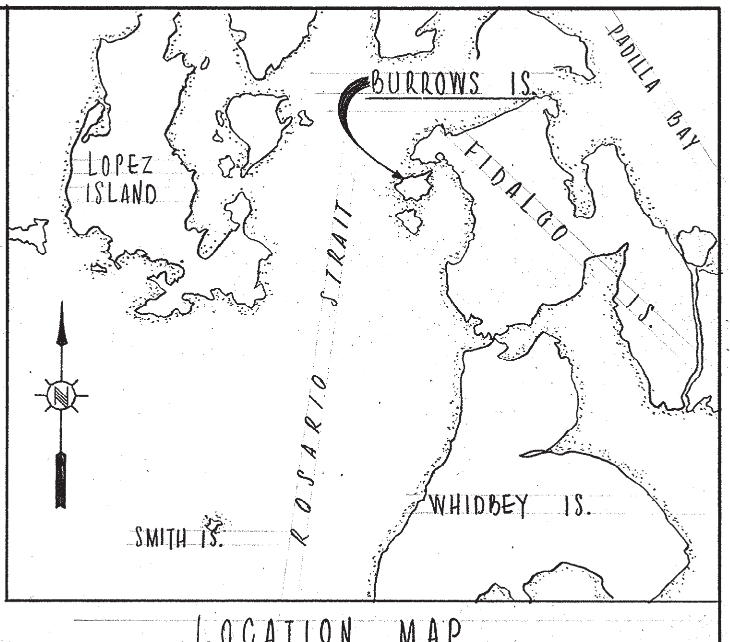
SCALE ¼" = 1'-0"
SHEET 1 OF 1



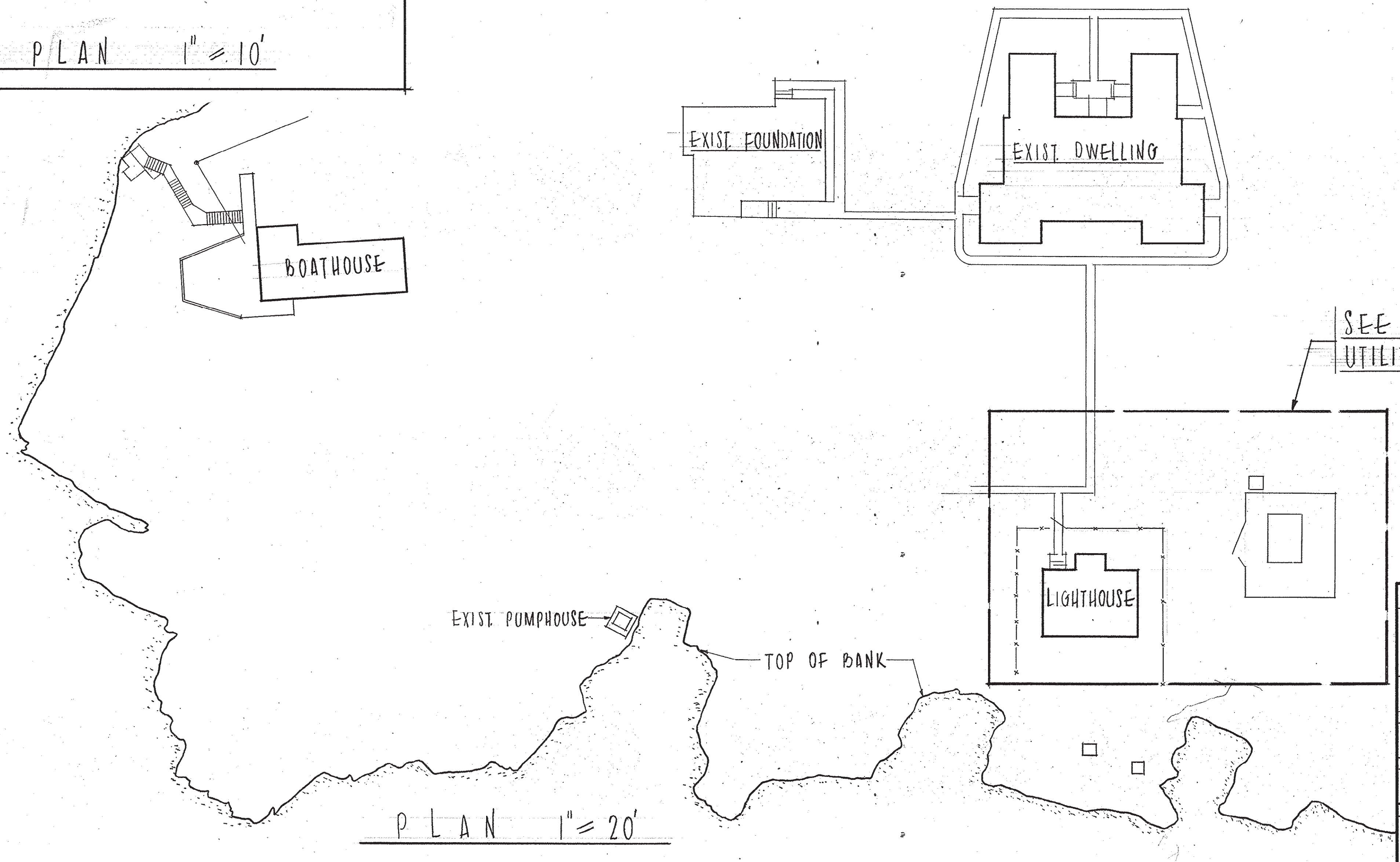
PARTIAL UTILITY PLAN 1" = 10'

LEGEND

#8 (10)
— INDICATES TEST NUMBER
— INDICATES PPM OF PCB



LOCATION MAP
SCALE 1 : 200,000



PLAN 1" = 20'

REV.	DATE	APPR.	DESCRIPTION	BY

DESIGNED:
DRAWN: VAE
TRACED:
CHECKED:
REVIEWED BY:
REVIEWED BY:
SUPV. GEN. ENGR.
REVIEWED BY:

U. S. COAST GUARD 13TH DISTRICT SEATTLE, WASHINGTON
CIVIL ENGINEERING
BURROWS ISLAND LIGHT STATION
ANACORTES, WASH.
PCB DECONTAMINATION PLAN

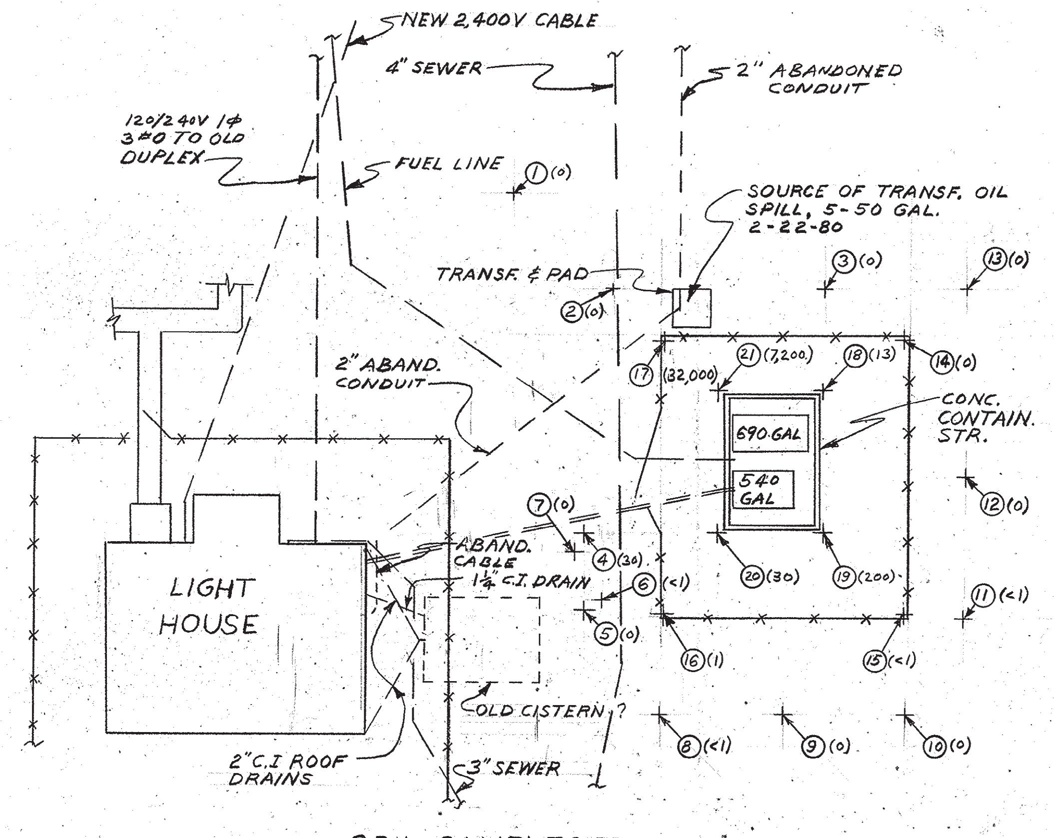
APPROVED
CDR. USCG. CHIEF OF BRANCH
DATE

DRAWING NUMBER 60.8001
SCALE: AS NOTED
SHEET 1 OF 1

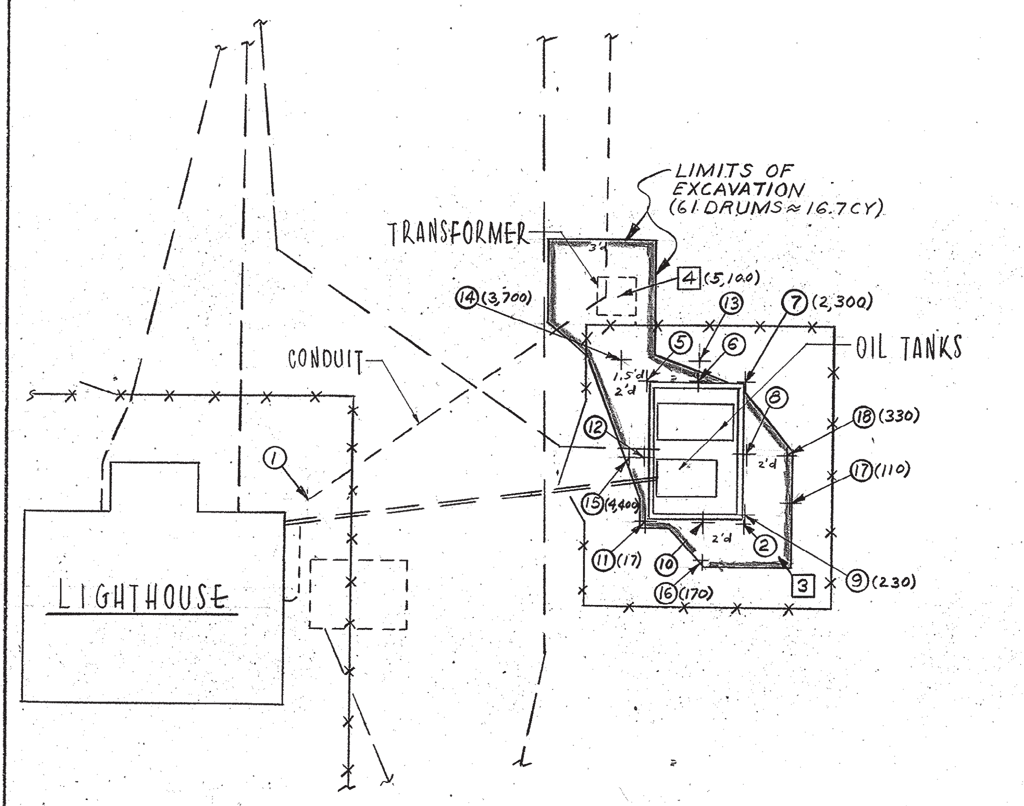
GAF Polytrace 033

☆ GPO: 1977-797-636

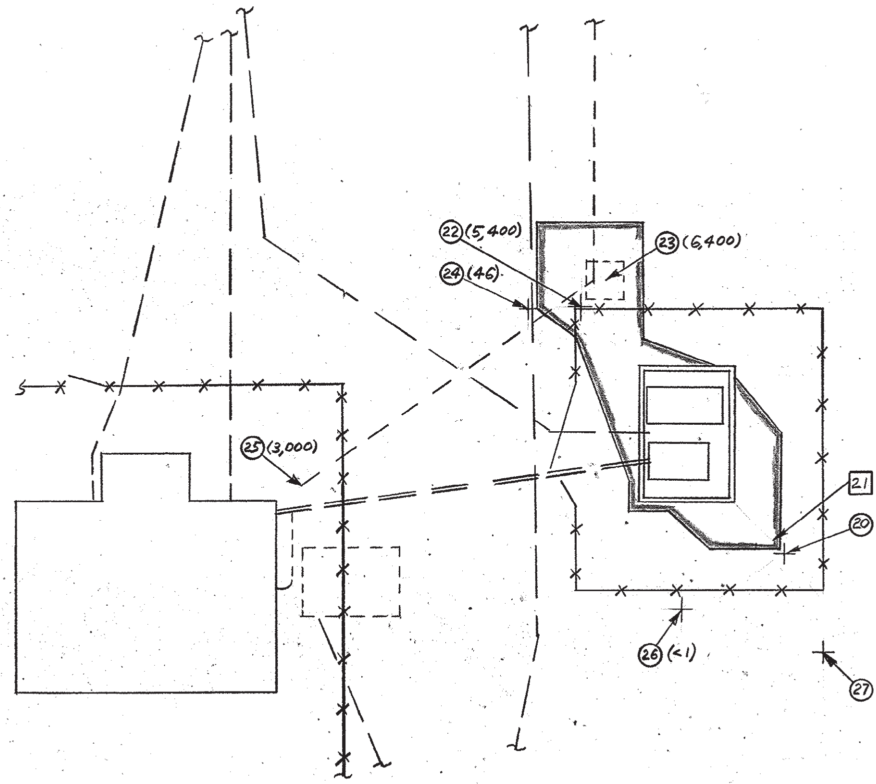
FILE



SOIL SAMPLES TAKEN (EES)
3-7-80



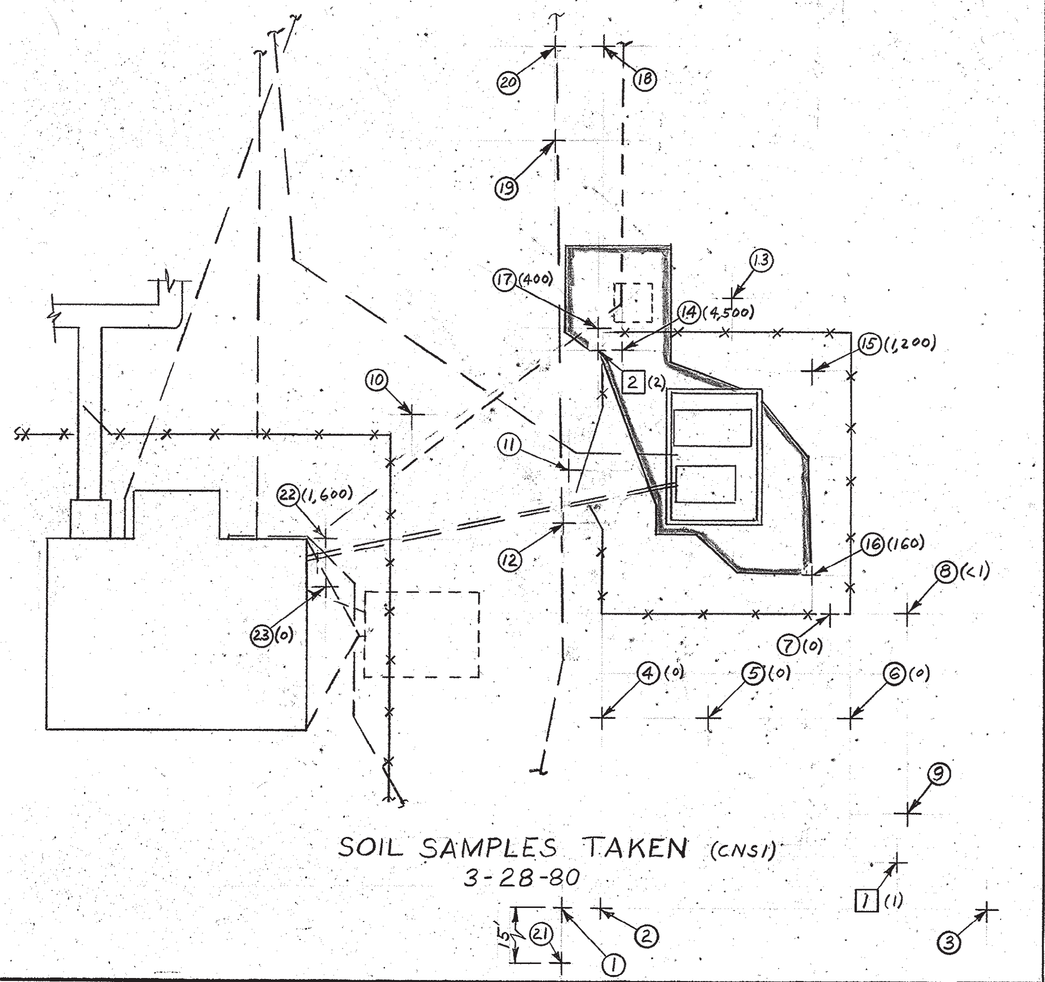
SOIL SAMPLES TAKEN (EES)
3-19-80



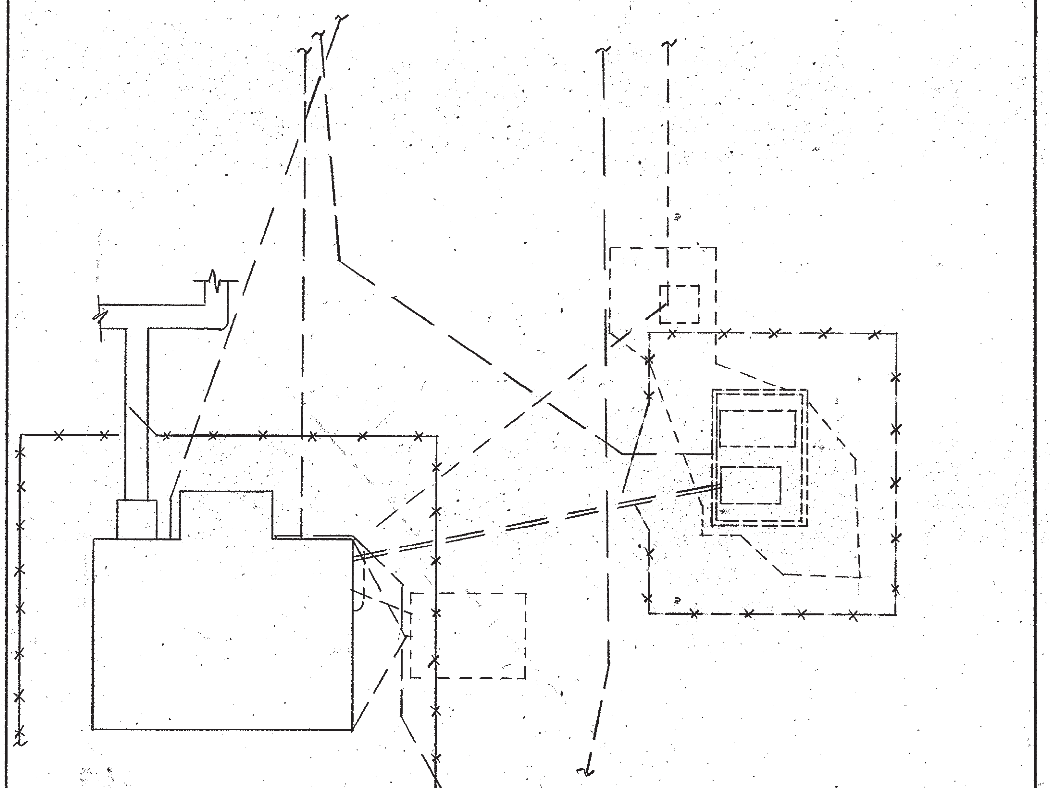
SOIL SAMPLES TAKEN
3-21-80

LEGEND

㉑ (3,200)	SOIL SAMPLE NO. WITH PCB CONCENTRATION IN PPM
1 (20)	WATER SAMPLE NO. WITH PCB CONCENTRATION IN PPM
▭	LIMITS OF EXCAVATED AREA.



SOIL SAMPLES TAKEN (CNSI)
3-28-80



NOTES

1. CONCENTRATION IN PPM IS ACCURATE TO ± 20%

REV.	DATE	APPR.	DESCRIPTION	BY

DESIGNED: TBR
DRAWN: TBR
TRACED:
CHECKED:
REVIEWED BY:
REVIEWED BY:
SUPV. GEN. ENGR.
REVIEWED BY:

U. S. COAST GUARD 13TH DISTRICT SEATTLE, WASHINGTON
CIVIL ENGINEERING

BURROWS ISLAND LIGHT
TRANSFORMER OIL (PCB) SPILL
SOIL SAMPLE/CONCENTRATION

APPROVED
CDR. USCG. CHIEF OF BRANCH
DATE 26 MAR 80

DRAWING NUMBER
60.8002
SCALE: 1" = 10'-0"
SHEET OF

GAF Polytrace 033

☆ GPO: 1977-797-636

AGI
TECHNOLOGIES

Removal of Heating Oil UST at Burrows Island Light Station
Project #13-01325
Contract #DTCG88-99-C-623039
Anacortes, Washington

June 18, 1999

Prepared For :

U.S. Coast Guard
Civil Engineering Unit - Oakland
Contracting and Procurement Division
2000 Embarcadero, Suite 200
Oakland, California 94606-5337

AGI Project No. 15,870.018

AGI
TECHNOLOGIES

A Report Prepared For:

U.S. Coast Guard
Civil Engineering Unit - Oakland
Contracting and Procurement Division
2000 Embarcadero, Suite 200
Oakland, California 94606-5337

REMOVAL OF HEATING OIL UST AT BURROWS ISLAND LIGHT STATION
PROJECT #13-01325
CONTRACT #DTCG88-99-C-623039
ANACORTES, WASHINGTON

June 18, 1999

Jessica R Garofalo

Jessica R. Garofalo
Staff Engineer

AGI Technologies
11811 N.E. 1st Street, Suite 201
Bellevue, Washington 98005
425/453-8383

AGI Project No. 15,870.018

INTRODUCTION

This report documents site assessment actions performed by AGI Technologies (AGI) on May 21, 1999, during removal of an underground storage tank (UST) at Burrows Island Light Station, near Anacortes, Washington. **Figure 1** shows the site location. Our services were performed according to your contract specifications.

SITE DESCRIPTION

The Burrows Island Light Station (the site) is at the west end of Burrows Island, near Anacortes, Washington. The site is considered remote, and is only accessible by boat or helicopter. The site is currently improved with an abandoned duplex dwelling, a lighthouse building, and a boathouse. The duplex was constructed in 1906. A paint storage building and dwelling quarters, formerly onsite, had been demolished. **Figure 1** shows the building locations. The footings of demolished quarters remain exposed. Before the Coast Guard presence, the island was inhabited by the Snohomish Tribe.

A 300-gallon (gal) fuel oil UST was located about 300 feet (ft) due north of the vacant house. Likely, this tank was previously used to fuel the former quarters' heating system. It is not known when this tank was installed.

Two additional USTs were suspected to have been located onsite: a 675-gal tank at the southeast corner of the lighthouse building, and a tank of unknown capacity located south of the former paint storage building. Further investigation was required to determine the existence of these tanks.

SOILS AND GROUNDWATER

Soil encountered during UST excavation was classified according to the Unified Soil Classification System. Native soil consists of dark brown silty sand fill. Minimal perched water was encountered at the bedrock contact.

PURPOSE AND SCOPE

The purpose of our services was to remove one known UST and two suspected USTs (if existence is confirmed) at Burrows Island Light Station. To address the potential of uncovering Native American artifacts and human remains, an archaeologist oversaw the site activities. This archaeologist was familiar with the Snohomish Tribe and human osteology, and was registered by the state of Washington. To achieve our goal, we:

- Removed and disposed of the 300-gal underground fuel oil storage tank, associated fill ports, vent pipes, petroleum-contaminated soil, and residual oil and sludge.
- Excavated one posthole at the southeast corner of the lighthouse building, and three in the vicinity of the demolished paint storage building, to determine the existence of two suspected additional tanks.

- Collected soil samples from the bottom and sidewalls of the fuel oil tank excavation and submitted them to an analytical laboratory. Samples were analyzed for total petroleum hydrocarbon (TPH) compounds quantified as diesel and oil. Additionally, the SS-2 Bottom sample was analyzed for extractable petroleum hydrocarbons (EPHs).

- Backfilled tank excavation using imported clean fill to restore the surface to its preexisting condition.

- Prepared this report documenting our observations, findings, and conclusions.

The following is a list of the subcontractors used on this project:

Contact	Affiliation	Phone Number
Leslie K. Norman, Archaeologist	Northwest Archaeological Associates, Inc.	(206) 781-1909
Tony Reese	Skyline Helicopter	(360) 436-1302
Rick Marsden, Dispatcher	Seattle Iron and Metal, Seattle	(206) 682-0040
Allan Bluett	Phillips Environmental, Seattle	(206) 227-0311
Peter Hogan	TPS Technologies, Tacoma	(206) 938-6297
David Braumeister	OnSite Environmental Laboratories	(425) 883-3881

The following sections describe these tasks and our conclusions.

UST REMOVAL AND SOIL EXCAVATION

Approximately 45 gal of residual fuel oil and sludge was pumped from the 300-gal UST and placed in three 15-gal poly tanks that were transported offsite to Phillips Environmental of Seattle. The UST was rendered inert, removed, cut apart, and transported offsite to Seattle Iron and Metal of Seattle, Washington. The UST cavity extended about 5 ft below ground surface (bgs). The UST was 3.2 ft in diameter. About 1 ft of soil was above the tank, and 1 ft of soil was below the base. **Attachment A** includes copies of UST decommissioning and site assessment forms, and receipts for waste disposal.

The bottom of the steel UST exhibited pitting and corrosion at the time of removal, and petroleum-contaminated soil was identified beneath the tank. Two cubic yards of petroleum contaminated soil was excavated and placed in two Big Bags, which were transported offsite by TPS Technologies of Tacoma, Washington. Eight yards of clean fill was transported in by helicopter for backfilling.

To determine the existence of two additional tanks, one posthole was dug at the southeast corner of the lighthouse building. Bedrock was encountered at a depth less than 3 ft bgs. In addition, three postholes were dug near the demolished paint storage building. Bedrock was encountered about 2 ft bgs in this location. No USTs were identified in the suspected areas.

SAMPLE COLLECTION

Two soil samples (SS-1 Sidewall and SS-2-Bottom) were collected during UST removal. One sample (SS-1 Sidewall) was collected from the sidewall of the tank excavation at 3 ft bgs, and one sample (SS-2 Bottom) was collected from the bottom of the excavation at 5 ft bgs. Soil samples were collected using a clean stainless steel spoon; packed in 4-ounce, laboratory-supplied glass jars; secured with chain-of-custody seals; labeled; and packed in a cooler chilled with Blue Ice. **Figure 2** shows the location of the excavation samples. At the time the soil samples were taken, it was sunny and 55 to 65 degrees Fahrenheit, and a slight breeze was blowing from the southwest.

ANALYICAL RESULTS

Soil samples were delivered on May 24, 1999 under chain-of-custody procedures to OnSite Environmental Laboratories (OSE) of Redmond, Washington, lab certification C115. Laboratory analysis results were reviewed by an AGI chemist for completeness and data quality; copies of the laboratory data are included in **Attachment B**. Soil samples were analyzed using the Washington State Department of Ecology extended method for TPHs quantified as diesel and oil (the NWTPH-Dx method). One sample was submitted for further analysis for EPHs using Washington State Interim TPH method. The results of EPH analysis are detailed in **Table 2** and summarized in **Table 1.**

CONCLUSIONS

Based on field observations and laboratory analytical results, no further action is required at this site.

LIMITATIONS

This report has been prepared for exclusive use by the U.S. Coast Guard Civil Engineering Unit-Oakland and its consultants for this project only. The opinions and conclusions contained in this report are based on data described herein and our experience and engineering judgment. The referenced data were made available or were reasonably obtained by us within the practical constraints and scope of this site assessment. We cannot be responsible for interpretation or extrapolation by others of data contained herein, except as expressly stated in our opinions and conclusions.

AGI's services were performed with due diligence in a manner consistent with the current standard of care and skill ordinarily exercised by members of the engineering profession practicing under similar conditions in the project area. No other warranty, express or implied, is made. Due diligence, as applied to site assessments and as used herein, is specifically limited to this standard of care. AGI cannot be responsible for a more stringent due diligence standard that may exist in the future or be required of you in the future by a court of law or other parties.

DISTRIBUTION

1 Copy	U.S. Coast Guard Civil Engineering Unit - Oakland Contracting and Procurement Division 2000 Embarcadero, Suite 200 Oakland, California 94606-5337 Attention: Mrs. Almer Adams, Contracting Officer

Quality Assurance / Technical Review by:

Peter P. Barry, P.G.
Associate Geologist

TABLES

Table 1
Summary of Analytical Results - Soil

U.S. Coast Guard/Burrows Island Light Station
Anacortes, Washington

Sample I.D.	Approximate Sample Depth (ft bgs)	Date Sampled	Washington State Test Methods		
			WTPH-D (extended)		EPH
			Diesel	Oil	
			mg/kg		mg/L
SS-1 Sidewall	3	05/21/99	ND	190	NA
SS-2 Bottom	5	05/21/99	ND	240	0.25 [a]
Laboratory Detection Limit			25	50	N/A

Notes:

a) Result from Table 2.
EPH - extractable petroleum hydrocarbons.
ft bgs - feet below ground surface.
mg/kg - milligram per kilogram.
mg/L - milligram per liter.
NA - not analyzed.
N/A - not applicable.
ND - not detected.
WTPH-D (extended - total petroleum hydrocarbons quantified as diesel and oil.

Table 2
Soil to Groundwater Calculations
Excavation Samples, Ecology Method EPH Analyses

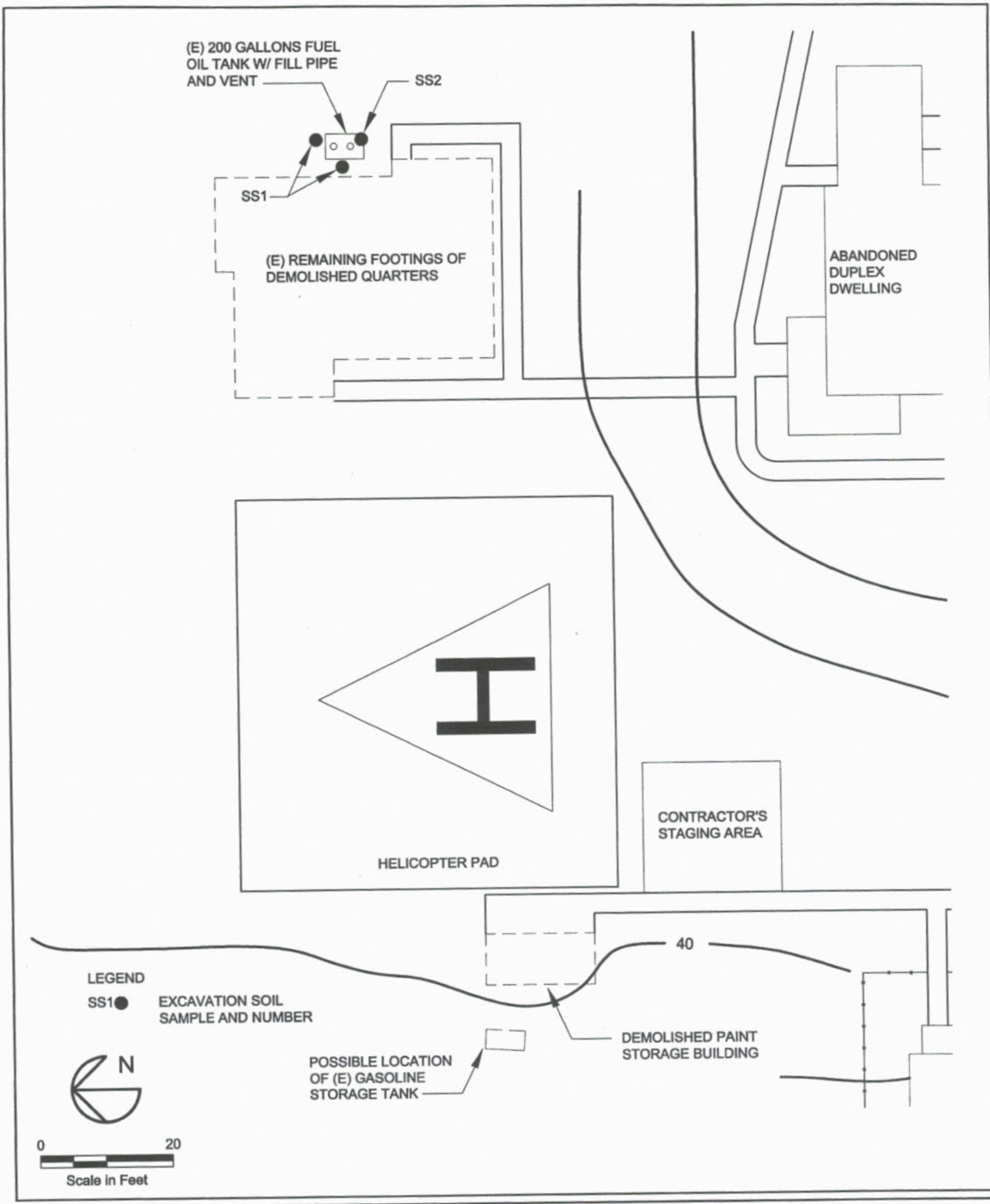
U.S. Coast Guard/Burrows Island Light Station
Anacortes, Washington

Sample ID: S189 Compound	2 Soil (mg/kg)	3 MW (g/mol)	4 Moles (mmol/kg)	5 Mol.Frac (%)	6 Solubility (mg/L)	7 Effect.Sol. (mg/L)	8 Dilution Factor	9 Conc.@ well (mg/L)
Aliphatics								
EC 5-6*	2.8	81	0.0	0.02	28	0.59	20	0.030
EC 6-8*	2.8	100	0.0	0.02	4.2	0.07	20	0.004
EC 8-10*	2.8	130	0.0	0.01	0.33	0.004	20	0.0002
EC 10-12	2.8	160	0.0	0.01	0.026	0.00028	20	0.00001
EC 12-16	29	200	0.1	0.09	0.00059	0.0000523	20	0.00000
EC 16-21	235	270	0.9	0.53	0.000001	0.0000005	20	0.00000
Aromatics								
Benzene*	0.17	78	0.0	0.00	1,780	2.37	20	0.12
Toluene*	0.17	92	0.0	0.00	520	0.59	20	0.029
EC 8-10*	2.8	120	0.0	0.01	65	0.93	20	0.046
EC 10-12	2.8	130	0.0	0.01	25	0.33	20	0.016
EC 12-16	2.8	150	0.0	0.01	5.8	0.07	20	0.003
EC 16-21	57	190	0.3	0.18	0.51	0.09360	20	0.0047
EC 21-35	36.0	240	0.2	0.09	0.01	0.0009177	20	0.0000
			1.6	1.00				0.25

Notes:

Compounds followed by an asterisk are assumed to be non-detect based on site knowledge and a review of the sample chromatogram.
mg/kg - milligram per kilogram.
g/mol - gram per mole.
mmol/kg - micromoles per kilogram.
mg/L - milligram per liter.

FIGURES



AGI
TECHNOLOGIES

Excavation Soil Sample Locations

US Coast Guard / Burrows Island Light Station
Anacortes, Washington

FIGURE
2

fig2.dwg	PROJECT NO.	DRAWN	DATE	APPROVED	REVISED	DATE
	15,870.018	SMP	23 JUN 99	PMB		

APPENDIX A

APPENDIX A

UST Decommissioning and Site Assessment Forms
Waste Disposal Receipts

WASHINGTON STATE DEPARTMENT OF ECOLOGY

UNDERGROUND STORAGE TANK
Site Check / Site Assessment Checklist

FOR OFFICE USE ONLY
Site #: ____
Owner #: ____

INSTRUCTIONS

When a release has **not** been confirmed and reported, this Site Check/Site Assessment Checklist must be completed and signed by a person certified by IFCI or a Washington registered professional engineer who is competent, by means of examination, experience, or education, to perform site assessments. **The results of the site check or site assessment must be included with this checklist.** This form must be submitted to Ecology at the address shown below within 30 days after completion of the site check/site assessment.

SITE INFORMATION: Include the Ecology site ID number if the tanks are registered with Ecology. This number may be found on the tank owner's invoice or tank permit.

TANK INFORMATION: Please list all tanks for which the site check or site assessment is being conducted. Use the owner's tank ID numbers if available, and indicate tank capacity and substance stored.

REASON FOR CONDUCTING SITE CHECK/SITE ASSESSEMENT: Please check the appropriate item.

CHECKLIST: Please initial each item in the appropriate box.

SITE ASSESSOR INFORMATION: This form must be signed by the registered site assessor who is responsible for conducting the site check/site assessment.

Underground Storage Tank Section
Department of Ecology
PO Box 47655
Olympia WA 98504-7655

SITE INFORMATION

Site ID Number (Available from Ecology if the tanks are registered): ____

Site/Business Name: ____

Site Address: Burrows Island Lighthouse (Street) Telephone: (___) ____

City Near Anacortes State WA Zip Code

TANK INFORMATION

Tank ID No.	Tank Capacity	Substance Stored
	300 gallons	Heating Oil

REASON FOR CONDUCTING SITE CHECK / SITE ASSESSMENT

Check one:

____ Investigate suspected release due to on-site environmental contamination.
____ Investigate suspected release due to off-site environmental contamination.
____ Extend temporary closure of UST system for more than 12 months.
____ UST system undergoing change-in-service.
____ UST system permanently closed-in service.
__X__ UST system permanently closed with tank removed.
____ Abandoned tank containing product.
____ Required by Ecology or delegated agency for UST system closed before 12/22/88.
____ Other (describe): ____

ECOLOGY

UNDERGROUND STORAGE TANK
Closure and Site Assessment Notice

See back of form for instructions

FOR OFFICE USE ONLY
Site ID #
Owner ID #

Please ✓ the appropriate box(es)
☐ TemporaryTank Closure ☐ Change-in-Service ☒ Permanent Tank Closure ☒ Site Check/Site Assessment

Site Information

Site ID Number None
(Available from Ecology if the tanks are registered)
Site/Business Name U.S. Coast Guard.
Site Address Burrows Island Light House Near Anacortes, WA
Street
City/State
Zip Code
Telephone ( ) None
Owner's Signature Dave Stalters

Owner Information

UST Owner/Operator U.S. Coast Guard - Civil Engineering Unit, Oakla
Mailing Address 2000 Embarcadero, Suite 200
Street
P.O. Box
City/State Oakland, CA
Zip Code 94606 Telephone (510) 535-7262

Tank Closure/Change-In-Service Company

Service Company AGI Technologies
Certified Supervisor Peter Barry
Decommissioning Certification No. IFCI No. 1064624-26
Supervisor's Signature
Address 11811 NE 1st Street, Suite 201
Street P.O. Box
Telephone (425) 453-8383
Bellevue WA 98005
City State Zip Code

Site Check/Site Assessor

Certified Site Assessor Peter Barry - AGI Technologies
Address 11811 NE 1st Street, Suite 201
Street P.O. Box
Telephone (425) 453-8383
Bellevue WA 98005
City State Zip Code

Tank Information

Tank ID	Closure Date	Closure Method	Tank Capacity	Substance Stored
	05/21/99	Removal	300 gal.	Heating Oil

Contamination Present at the Time of Closure

☐ Yes ☒* No ☐ Unknown

Check unknown if no obvious contamination was observed and sample results have not yet been received from analytical lab.

☐ Yes ☐ No

If contamination is present, has the release been reported to the appropriate regional office?

*Deminimus

To receive this document in an alternative format, contact the TOXICS CLEANUP PROGRAM at 1-800-826-7716 (voice) OR (360) 407-6006 (TDD).

ECY 020-94 (Rev. 6/98)

CHECKLIST

Each item of the following checklist shall be initialed by the person registered with the Department of Ecology whose signature appears below.	YES	NO
1. The location of the UST site is shown on a vicinity map.	X	
2. A brief summary of information obtained during the site inspection is provided. (see Section 3.2 in site assessment guidance)	X	
3. A summary of UST system data is provided. (see Section 3.1.)	X	
4. The soils characteristics at the UST site are described. (see Section 5.2)	X	
5. Is there any apparent groundwater in the tank excavation?		X
6. A brief description of the surrounding land use is provided. (see Section 3.1)	X	
7. Information has been provided indicating the number and types of samples collected, methods used to collect and analyze the samples, and the name and address of the laboratory used to perform the analyses.	X	
8. A sketch or sketches showing the following items is provided:		
- location and ID number for all field samples collected	X	
- groundwater samples distinguished from soil samples (if applicable) N/A		
- samples collected from stockpiled excavated soil N/A		
- tank and piping locations and limits of excavation pit	X	
- adjacent structures and streets	X	
- approximate locations of any on-site and nearby utilities N/A		
9. If sampling procedures different from those specified in the guidance were used, has justification for using these alternative sampling procedures been provided? (see Section 3.4)		X
10. A table is provided showing laboratory results for each sample collected including; sample ID number, constituents analyzed for and corresponding concentration, analytical method and detection limit for that method.	X	
11. Any factors that may have compromised the quality of the data or validity of the results are described.		X

12. The results of this site check/site assessment indicate that a confirmed release of a regulated substance has occurred.		X

SITE ASSESSOR INFORMATION

Person registered with Ecology: Peter Barry

Firm Affiliated with: AGI Technologies

Business Address: 11811 NE 1st Street, Suite 201 (Street)

Telephone: (425) 453-8383

City: Bellevue

State: WA

Zip Code: 98005

I hereby certify that I have been in responsible charge of performing the site check/site assessment described above. Persons submitting false information are subject to penalties under Chapter 173.360 WAC.

Date: 06/08/99

Signature of Person Registered with Ecology:

Northwest Archaeological Associates, Inc.
Cultural Resources Management Services
5416½ 20th Avenue NW Seattle, WA 98107

June 4, 1999

AGI Technologies
Attn: Dan Henninger
11811 N.E. 1st Street
Suite 201
Bellevue, Wa. 98005

Re: Archaeological Monitoring of Excavations at the Burrows Island Coast Guard Light Station

Dear Mr. Henninger:

On May 21, 1999, an archaeologist from Northwest Archaeological Associates (NWAA) monitored excavations at the Burrows Island Light Station located in Skagit County, Washington (Figure 1 and 2). At the request of the Coast Guard, AGI contracted NWAA personnel to observe all ground disturbing activities and to inspect exposed profiles and sediments for cultural resources. The work plan required removal of a diesel fuel tank and ground inspection of two areas that were suspected of containing additional underground fuel tanks (see Project Plan Map, Figure 3). The two fuel tank locations, identified on a historical map of the Light Station compound, were near a demolished paint storage building and adjacent to the southeast corner of the light house. Excavation in these areas would clarify whether the tanks remained in the ground or were removed sometime in the past.

The Coast Guard Light Station property is located on Burrows Island, part of the San Juan archipelago. Burrows Island lies approximately ¼ mile off the northwest corner of Fidalgo Island in between Burrows Bay and Rosario Strait (T. 35N., R. 1 E., Section 32). The island is undeveloped except for the Light Station on the western shore and two buildings on the northeast tip. The USGS map of the area, Deception Pass, shows that there are no beaches on the island and over 95% of the shoreline is rocky.

Information on previously recorded archaeological resources on Burrows Island was obtained through a records search undertaken at the Washington Office of Archaeology and Historic Preservation (OAHP) archives in Olympia. The only recorded site on the island is the project property, the Burrows Island Light Station (45-SK-164H), which has been nominated for the National Register of Historic Places. The historic development of the project property has been documented, however it is possible that a yet undiscovered prehistoric site would be found during project excavations.

Burrows Island and the project property are located within the ethnographic territory of the Samish. The Samish are related in language and culture to the Straits Salish and practiced a seasonal round of resource exploitation. Permanent winter camps were often located near the shoreline and fresh water resources. During the other seasons, temporary camps were located both near the shore and inland at favored fishing, hunting and shellfish and plant gathering sites. Resources such as salmon, berries, and camas were harvested during their peak of abundance, processed for storage, and stored for later use.

Typical prehistoric sites found in the vicinity include residential base camps, temporary camps and locations. Residential base camps are often recognized as large shell middens located near the current shoreline and fresh water resources. Shell midden artifact assemblages often include projectile points, scrapers, bifaces, groundstone, bone tools, and ornamental objects. Temporary camps may be found near the shore or inland and represent the exploitation of specific plant and animal resources by small groups from the residential base camp. Examples of temporary camp site assemblages are hunting sites represented by projectile points and scraping tools or plant processing sites represented by earth ovens. Locations refer to specific special use sites such as quarries, peeled cedars or rock features. Due to the lack of beaches, shellfish beds or fresh water resources near the project property, it is not likely that a shell midden site would be found. The potential for a temporary camp or location site on the project property is consider moderate to low.

The Light Station compound consists of a duplex house and yard, a light house, a boat house, helicopter pad, and a fog horn. A buoy and walkway on the northern border of the property provide boat anchorage and access to the shore. Steep and jagged bedrock cliffs, 40-50 ft. high, are exposed on the western and northern sides of the property. From the duplex house the ground slopes at approximately a 25° angle down to the light house on the cliff edge below. Bedrock is visible on this lower surface in between the light and boat houses, and the remainder of the compound is covered with tall grass, small bushes, and a few trees.

Exploration for the gasoline storage tank near the demolished paint storage building began by excavating three post holes. Excavation was monitored and spoils were carefully inspected. The soil consisted of a grass and moss surface above brown loam with 20% gravels and cobbles. The holes were terminated due to bedrock between 6.5 inches and 1 foot in depth. No cultural resources or features were observed.

One post hole was excavated on the southeast corner of the light house to search for a underground oil storage tank. Bedrock was encountered at 2.6 feet deep and no tank or contaminated soils were found. Sediments from the post hole included a rocky brown loam in the upper 1 foot followed by grayish-brown silt with gravels. No cultural resources or features were observed.

Monitoring of the diesel fuel tank removal continued for the remainder of the day. The post holes excavated within the western portion of the property demonstrated the lack of significant sediments above the bedrock. It became apparent that the diesel fuel tank was not buried into the ground but had been built primarily above ground by placing the tank on bedrock, surrounding the tank with a cement retaining wall and burying it. Fill was removed from the top, east, and north sides of the tank (measuring 3.2 ft. in diameter and 5 ft. long) until it could be lifted from the hole. Excavation of the fill was monitored and spoils were inspected for cultural resources; none were found.

In summary, all excavations were monitored. The diesel fuel tank was buried by fill likely gathered from the surrounding area and may have contained dislocated cultural resources. Excavation in the suspected fuel tank locations confirmed that the tanks also were formerly above the ground surface and had already been removed from the property. The four post holes provided the only exploration of potentially undisturbed sediments on the project property. No cultural materials or features were observed during the project.

Thank you for contributing to efforts to identify heritage resources in this region. If you should have any questions, please do not hesitate to call me at the number listed below.

Leslie K. Norman

Leslie K. Norman

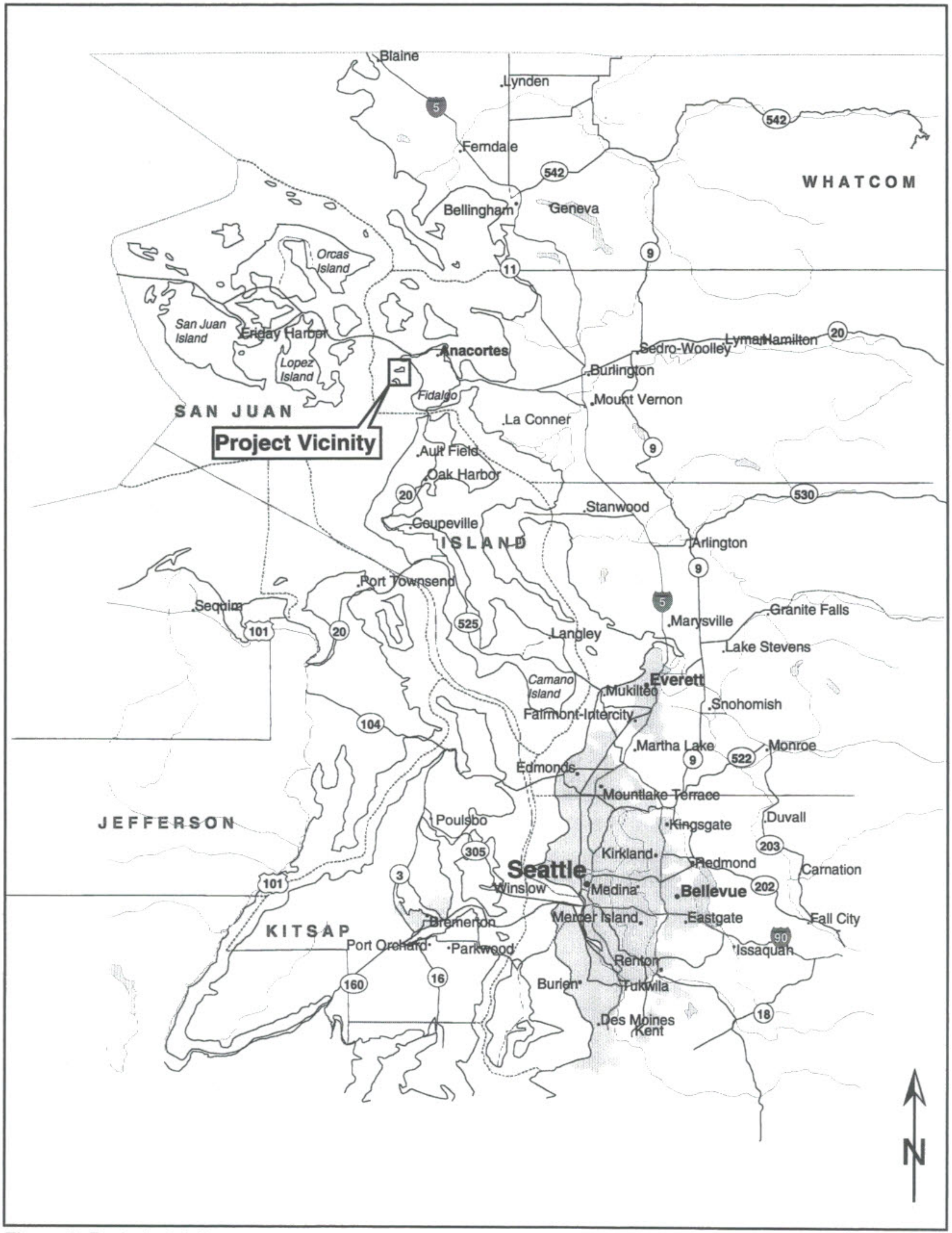
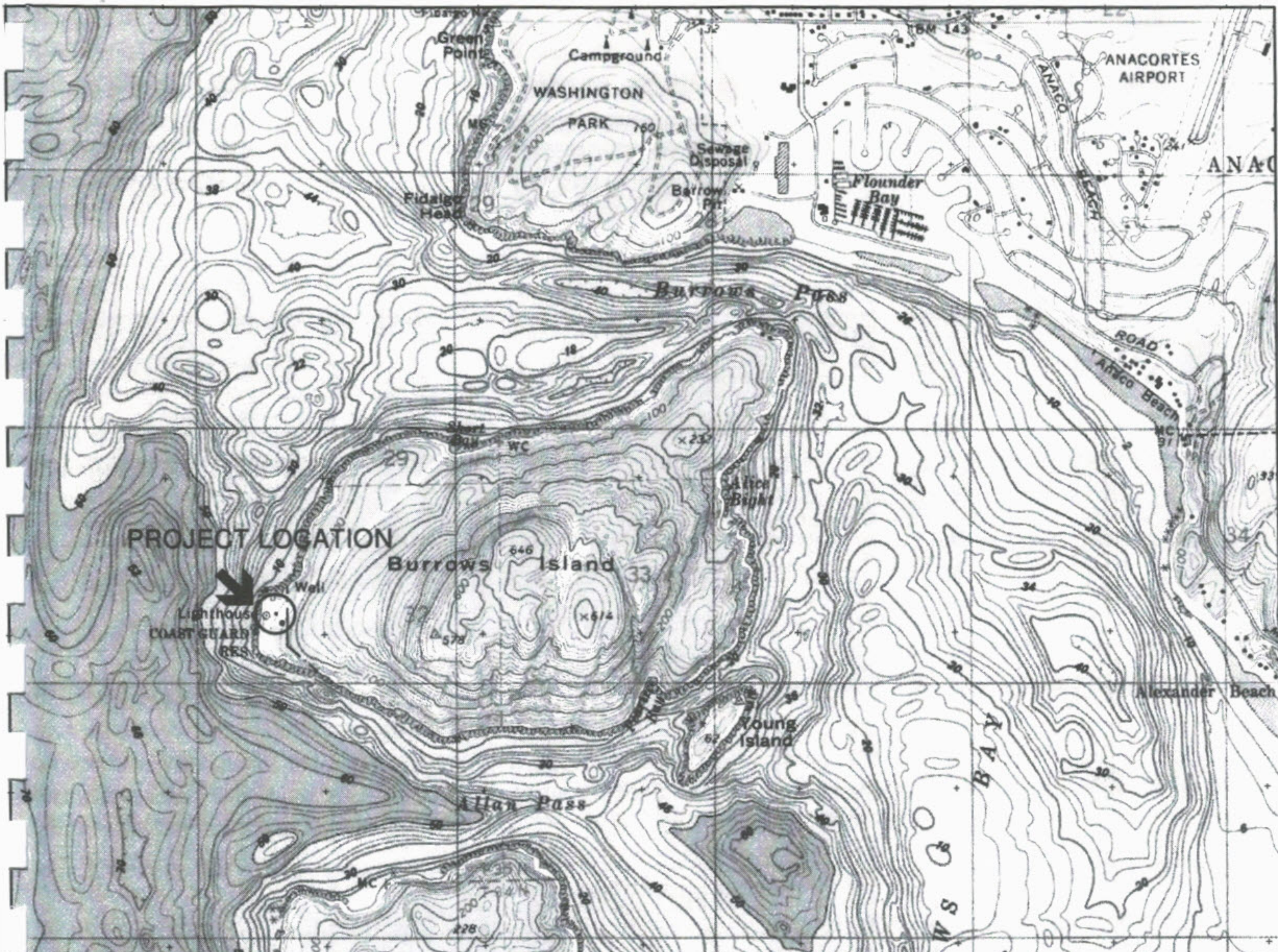


Figure 1. Projcet vicinity.



Name: DECEPTION PASS
Date: 6/4/99
Scale: 1 inch equals 2000 feet

Location: 10 522652 5368647
Caption: Figure 2. Project location.

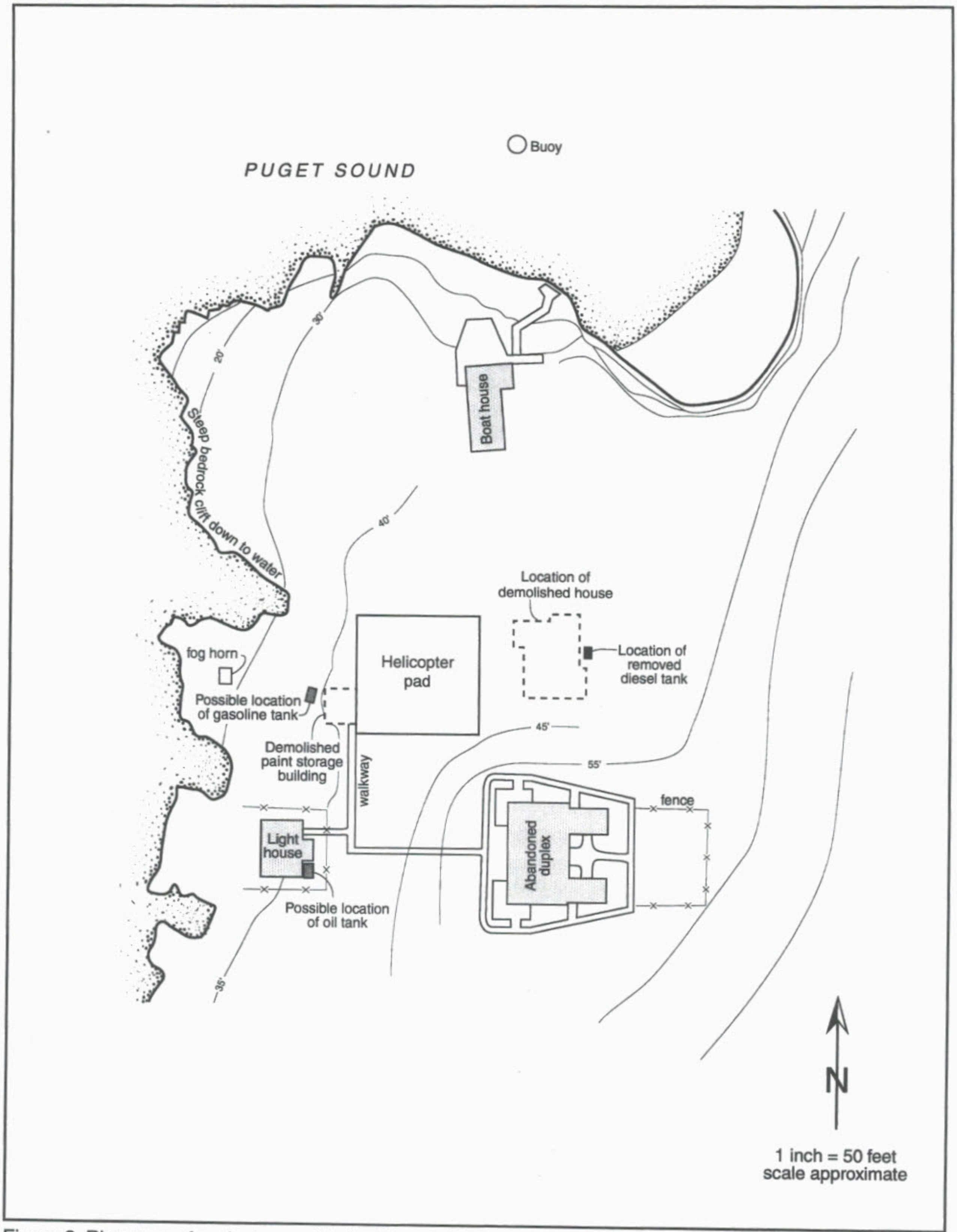


Figure 3. Plan map of project area (drafted from U.S. Coast Guard Engineering Plans).

OnSite
Environmental Inc.

14924 NE 31st CIRCLE, REDMOND, WA 98052
PHONE (206) 883-3881 FAX (206) 885-4603

To: Dan Henninger

Company : AGI Technologies

Fax Number : +1 (425) 646-9523

From : Robert Wallace

Fax Number : 1-425-885-4603

Subject :

Pages including cover page: 8

Date : 5/28/99

Time : 1:35:48 PM

MESSAGE

WinFax PRO Cover Page

May 28, 1999

Dan Henninger
AGI Technologies
11811 NE 1st Street, Suite 201
Bellevue, WA 98005

Re: Analytical Data for Project 15,870.018
Laboratory Reference No. 9905-134

Dear Dan:

Enclosed are the analytical results and associated quality control data for samples submitted on May 24, 1999.

The standard policy of OnSite Environmental Inc. is to store your samples for 30 days from the date of receipt. If you require longer storage, please contact the laboratory.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the data, or need additional information, please feel free to call me.

Sincerely,

David Baumeister
Project Chemist

Enclosures

Date of Report: May 28, 1999
Samples Submitted: May 24, 1999
Lab Traveler: 05-134
Project: 15,870.018

NWTPH-Dx

Date Extracted:	5-24-99
Date Analyzed:	5-24-99
Matrix:	Soil
Units:	mg/Kg (ppm)

Client ID:	SS1-Sidewall	SS2-Bottom
Lab ID:	05-134-01	05-134-02
Diesel Fuel:	ND	ND
PQL:	29	28
Heavy Oil:	190	240
PQL:	57	56
Surrogate Recovery:		
o-Terphenyl	94%	67%
Flags:	Z	Z

Date of Report: May 28, 1999
Samples Submitted: May 24, 1999
Lab Traveler: 05-134
Project: 15,870.018

NWTPH-Dx
METHOD BLANK QUALITY CONTROL

Date Extracted:	5-24-99
Date Analyzed:	5-24-99
Matrix:	Soil
Units:	mg/Kg (ppm)
Lab ID:	MB0524S1
Diesel Fuel:	ND
PQL:	25
Heavy Oil:	ND
PQL:	50
Surrogate Recovery:	
o-Terphenyl	93%
Flags:	

Date of Report: May 28, 1999
Samples Submitted: May 24, 1999
Lab Traveler: 05-134
Project: 15,870.018

NWTPH-Dx
DUPLICATE QUALITY CONTROL

Date Extracted: 5-24-99
Date Analyzed: 5-24-99

Matrix: Soil
Units: mg/Kg (ppm)

Lab ID:	05-126-01	05-126-01 DUP
Diesel Fuel:	ND	ND
PQL:	25	25
RPD:	N/A	
Surrogate Recovery:		
o-Terphenyl	88%	90%

Flags:

Date of Report: May 28, 1999
Samples Submitted: May 24, 1999
Lab Traveler: 05-134
Project: 15,870.018

Date Analyzed:5-24-99

% MOISTURE

Client ID	Lab ID	% Moisture
SS1-Sidewall	05-134-01	13
SS2-Bottom	05-134-02	11

OnSite Environmental Inc.

DATA QUALIFIERS AND ABBREVIATIONS

A - Due to a high sample concentration, the amount spiked is insufficient for meaningful MS/MSD recovery data.

B - The analyte indicated was also found in the blank sample.

C - The duplicate RPD is outside control limits due to high result variability when analyte concentrations are within five times the quantitation limit.

D - Data from 1:____ dilution.

E - The value reported exceeds the quantitation range, and is an estimate.

F - Surrogate recovery data is not available due to the high concentration of coeluting target compounds.

G - Insufficient sample quantity for duplicate analysis.

H - The analyte indicated is a common laboratory solvent and may have been introduced during sample preparation, and be impacting the sample result.

I - Compound recovery is outside of the control limits.

J - The value reported was below the practical quantitation limit. The value is an estimate.

K - Sample duplicate RPD is outside control limits due to sample inhomogeniety. The sample was re-extracted and re-analyzed with similar results.

L - The RPD is outside of the control limits.

M - Hydrocarbons in the gasoline range (toluene-napthalene) are present in the sample.

O - Hydrocarbons outside the defined gasoline range are present in the sample; NWTPH-Dx recommended.

P - The RPD of the detected concentrations between the two columns is greater than 25.

Q - Surrogate recovery is outside of the control limits.

S - Surrogate recovery data is not available due to the necessary dilution of the sample.

T - The sample chromatogram is not similar to a typical ____________.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

V - Matrix Spike/Matrix Spike Duplicate recoveries are outside control limits due to matrix effects.

W - Matrix Spike/Matrix Spike Duplicate RPD are outside control limits due to matrix effects.

X - Sample extract treated with a silica gel cleanup procedure.

Y - Sample extract treated with an acid cleanup procedure.

Z – Quantified as light oil.

ND - Not Detected
MRL - Method Reporting Limit
PQL - Practical Quantitation Limit
RPD - Relative Percent Difference

INVOICE #: 9905-134

Dan Henninger
AGI Technologies
11811 NE 1st Street, Suite 201
Bellevue, WA 98005

ATTENTION: ACCOUNTS PAYABLE
Terms: Net 30 days
Past Due Accounts: 1.5% interest per month

Date of Report: May 28, 1999
Samples Submitted: May 24, 1999
Project: 15,870.018

Quantity	Analysis	Unit Price	Amount
2	NWTPH-Dx	60.00	$ 120.00
		Total Due	$ 120.00

Customer Job Report

Gross & Tare Weight Codes: M=Manual; S=Scale; T=Trk File

Job Number Name	SiteAddress	SiteCity	State	ZipCode
A03 -- 02362 USCG BURROWS ISLAND LI	(NEAR ANACORDES)	BURROWS ISLAND	WA	00000

Load #	Date & Time Out	Transporter #	Truck & Trailer Number	Gross (lb)	Tare (lb)	Net (lb)	Net Wt (tons)
1	05/24/99 08:22	3AGITEC	PAUL	6,780M	4,640M	2,140	1.07

Completed Loads	Manifests Received	Completed Weight	Estimated Weight	TOTAL Net Wt:
100.00%	1	53.50%	2.00(tons)	1.07 (tons)

6780.

Manifest

TPS Technologies Soil Recycling

Non-Hazardous Soils

↓ Manifest # ↓

Date of Shipment:	Responsible for Payment:	Transporter Truck #:	Facility #:	Given by TPS:	Load #
	Consultant		A03	02362	001

Generator and/or Consultant

Generator's Name and Billing Address: US COAST GUARD/CEU OAKLAND 2000 EMBRARCADERO ST. SUITE 200 OAKLAND, CA 94606-5337 USA	Generator's Phone #: (510) 535-7262 Person to Contact: ROY CLARK FAX#: (510) 535-7288	Generator's US EPA ID No. Customer Account Number with TPS: 3USCOAS
Consultant's Name and Billing Address: AGI TECHNOLOGIES, INC. PO BOX 3885 11811 NE 1st STREET - 98005 BELLEVUE, WA 98009-3885 USA	Consultant's Phone #: (425) 453-8383 Person to Contact: PETER BARRY FAX#: (425) 646-9523	Customer Account Number with TPS: 1001368
Generation Site (Transport from): *(name & address)* USCG BURROWS ISLAND LIGHTHOUSE (NEAR ANACORDES) BURROWS ISLAND, WA 00000 USA	Site Phone #: Person to Contact: FAX#:	BTEX Levels TPH Levels AVG. Levels
Designated Facility (Transport to): *(name & address)* TPS Technologies Inc. 2800 - 104th Street Court South Lakewood, WA 98499 USA	Facility Phone #: (253)584-8430 Person to Contact: Renee Avelino FAX#: (253)584-8309	Facility Permit Numbers
Transporter Name and Mailing Address: AGI TECHNOLOGIES PO BOX 3885 BELLEVUE, WA 98009-3885 USA	Transporter's Phone #: (425) 453-8383 Person to Contact: PETER BARRY FAX#: (425) 646-9523	Transporter's US EPA ID No.: Transporter's DOT No.: Customer Account Number with TPS: 3AGITEC

Description of Soil	Moisture Content	Contaminated by:	Approx. Qty:	Description of Delivery	Gross Weight	Tare Weight	Net Weight
Sand ☐ Organic ☐ Clay ☐ Other ☐	0 - 10% ☐ 10 - 20% ☐ 20% - over ☐	Gas ☐ Diesel ☐ Other ☐			6780	4640	2140
Sand ☐ Organic ☐ Clay ☐ Other ☐	0 - 10% ☐ 10 - 20% ☐ 20% - over ☐	Gas ☐ Diesel ☐ Other ☐		NET TONS=	1.07		

List any exception to items listed above: 2 Ton Minimum

Generator's and/or consultant's certification: I/We certify that the soil referenced herein is taken entirely from those soils described in the Soil Data Sheet completed and certified by me/us for the Generation Site shown above and nothing has been added or done to such soil that would alter it in any way.

Print or Type Name: Generator ☐ Consultant ☐ ->

Signature and date: Month Day Year

Transporter

Transporter's certification: I/We acknowledge receipt of the soil described above and certify that such soil is being delivered in exactly the same condition as when received. I/We further certify that this soil is being directly transported from the Generation Site to the Designated Facility without off-loading, adding to, subtracting from or in any way delaying delivery to such site.

Print or Type Name: Paul A Hohner

Signature and date: Month 05 Day 24 Year 99

Recycling Facility

Discrepancies:

Recycling Facility certifies the receipt of the soil covered by this manifest except as noted above:

Print or Type Name: RENEE AVELINO - CSM

Signature and date: Renee 5/24

Please print or type.

TPS INVOICING COPY

Woodworth & Company, Inc.

GENERAL CONTRACTORS

1200 East D Street / Tacoma, Washington 98421
Telephone (253) 383-3585

LAKEVIEW PIT TICKET

Contractors Lic. # WOODW 377NO

MEMBER NAPA NATIONAL ASPHALT PAVEMENT ASSOCIATION

Ticket # 393797
Wmaster REBA!

CAUTION: HOT ASPHALT WILL BURN YOU!

RECEIVED *

CUSTOMER: T.P.S. 81384	PURCHASE ORDER T.P.S.	JOB LOAD	JOB TONS
	TOTAL		
	DAILY	1	1.0

DATE 05/24/99

TIME 11:51

PLANT	SILO #	JOB	PLANT	TRUCK	SEQUENCE	REFEREN
		61-		DD		

MIXTURE 200
CONT. SOIL

GROSS	TARE	NET WT. TONS	PRICE	TOTAL
6780	4640	1.07		

2140 Net LB

SPECIAL INSTRUCTIONS

Net Metric Tons
0.97

TAX %
PAY THIS AMOUNT

PIT B160

CUBIC YDS

REMARKS

X

SCALE OPERATOR

VISA MasterCard

Soil Recycling Certificate

TPS Technologies Inc. does hereby certify

that 1.07 tons of petroleum - contaminated soil

received from

United States Coast Guard
Applied Geotechnology/AGI (Consultant)
Burrows Island Lighthouse
Burrows Island, WA

Under Manifest/authorization number 03-02362

have been properly recycled to approved regulatory standards

at our Soil Recycling Facility in Lakewood, WA

Dated this 29th day of May, 1999
Sworn and Attested by:
TPS Technologies Inc.

By: ______________________

CERTIFICATE OF WEIGHT

ISSUED UNDER AUTHORITY OF CITY OF SEATTLE ORD. 41014, AS AMENDED

SEATTLE IRON & METALS CORPORATION

2955 11TH AVE. S.W. SEATTLE, WASH. 98134 682-0040

DATE 5/25/89

387134

WEIGHED FOR AG1

DRIVER ON ✓ OFF

ADDRESS

COMMODITY S) NV

4950 LB

4550 LB	lbs. Gross
	lbs. Tare
300	lbs. Net

I, THE UNDERSIGNED, CERTIFY THAT THE WEIGHTS INDICATED HEREON ARE TRUE AND CORRECT, AND DO HEREBY IMPRESS THE SEAL OF THE ABOVE LICENSED CITY WEIGHMASTER IN AUTHENTICATION THEREOF.

WEIGHED BY LICENSED CITY WEIGHER

FEE $1

PHILIP ENVIRONMENTAL
CHEMICAL GROUP
WESTERN REGION

PHILIP ENVIRONMENTAL
Corporate Sales: 1100 Oakesdale Ave. SW
Renton, WA 98055 • (206) 227-0311

For Pre-registration & Billing Questions call:
CORPORATE OFFICE: 1100 Oakesdale Ave. S.W.
Renton, WA 98055 • (206) 204-7049 or 1-800-327-7759

☐ Kent Facility: 20245 77th Ave. S.
Kent, WA 98032 (206) 872-8030
☐ Tacoma Facility: 1701 Alexander
Tacoma, WA 98421 (206) 627-7568
☒ Georgetown Facility: 734 S. Lucile St.
Seattle, WA 98108 (206) 762-3362
☐ Other: ____________________

Project No. 996055

Pg. 1 of 1

SMALL QUANTITY GENERATOR WASTE ACCEPTANCE PROGRAM CHECK-IN RECEIPT AND CERTIFICATION STATEMENT

TO BE COMPLETED BY CONDITIONALLY EXEMPT SMALL QUANTITY GENERATOR:

I certify that the following information is correct, and I have read and understand the requirements for participation in the PHILIP ENVIRONMENTAL or ____________________ Small Quantity Generator Waste Acceptance Program. I further certify that I am a small quantity generator as defined by Washington State regulations, and this quantity of waste does not exceed the specified limits for the type of waste being disposed. If this waste is later found to exceed small quantity limits or contain materials not accepted under this program, I agree to complete a hazardous waste manifest and comply with other state regulations as appropriate.

COMPANY NAME: AGI
COMPANY REP: (PLEASE PRINT) Peter Sajer
COMPANY ADDRESS: (NO P.O. BOX) P.O. BOX 3385
SIGNATURE: X
CITY, STATE, ZIP Bellevue WA 98005
TITLE: ENGINEER
DATE: 5.25.99
COMPANY PHONE: (425) 453-8383
EPA ID# (IF APPLICABLE) ____________________

TO BE COMPLETED BY PHILIP ENVIRONMENTAL CHECK-IN ATTENDANT

ITEM NUMBERS	MSDS COPY	GENERAL WASTE DESCRIPTION (CHEM. CONST., pH, ETC.)	DOT HAZARD CLASS AND/OR STATE CODES (IF APPLICABLE)	S	L	NEW	SPENT	# OF CONT	CONTAINER TYPE/SIZE	TOTAL WT (LB)	PRICE RATE	TOTAL CHARGE	PROCESS AREA/ CONTAINER NO.
1		Oil Sludge	NA		✓			1	DM16	41#	5/gal	60-	
2		Heating ~~Machine~~ Oil	NA		✓			3	DF15	120#	5/gal	225-	
									4		160#		305 -	

Credit to
C.C. # __________ Generator # __________ P.O. ☐ # __________

METHOD OF PAYMENT: CASH ☐ CHECK ☒ CHECK NO. [illegible] TOTAL PAID $ ______ CASH CHANGE $ ______

Philip Environmental certifies that the materials accepted below as conditionally exempt Small Quantity Generator Waste will be managed in compliance with all applicable Federal, State, and local rules, regulations and mandates.

Facility Owner/Operator: Certification of receipt of Conditionally Exempt Small Quantity Waste covered by this check-in receipt.

Printed/Typed Name: A. Blatt
Signature:
Date: 5-25-99

REVISED 12/96

MANIFEST NO. /WASTE REC. NO. 96055

CHECK-IN RECEIPT № 10738

KELLCO

PAINT STABALIZATION and SOIL REMOVAL
U.S. COAST GUARD LIGHTHOUSE STATION
BURROWS ISLAND, WASHINGTON

GSA Contract No. GS-10F-0279N

Task order # HSCG88-05-F6XA015

Requisition Reference # 24058856XA015

Prepared for

United States Coast Guard
Civil Engineering Unit Oakland
2000- Embarcadero, Suite 200
Oakland, California 94606-5337

October 12, 2005

California: 3137 Diablo Avenue • Hayward, CA 94545-2701• (510) 786-9751 • fax (510) 786-9625
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Coast Guard Site Manager	Chris Sage 206-217-6915
Contents:	This Report describes the stabilization of lead based paint on three US Coast Guard structures on Burrows Island, Washington..
Prepared for:	United States Coast Guard Civil Engineering Unit, Oakland Oakland, California 94606-5337

DISTRIBUTION LIST

UNITED STATES COAST GUARD

Aid to Navigation Team Puget Sound

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Civil Engineering Unit, Oakland

Joseph Sabel (3 copies and 1 CD)	Contract Manager

KELLCO Services, Inc.

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TABLE OF CONTENTS

List of Figures

Figure 1:	Site location map of Burrows Island
Figure 2:	Drawing of relative locations of structures sampled
Figure 3	Duplex Footprint with Sidewalk after Soil removal
Figure E1	Boat House Identification of Test Sides
Figure E2	Duplex Identification of Test Sides
Figure E3	Lighthouse Identification of Test Sides
Figure G	Duplex Post Soil Removal Representative Readings

List of Tables

Table 1	Disposition of Waste
Table 2	Estimated Barrels of Soil Remaining
Table F1-	XRF Calibration Data
Table G1	Duplex Post Soil Removal XRF readings

List of Appendices

Appendix A:	Selected photos
Appendix B:	MSDS and Specifications for Paints/Encapsulant and Coatings
Appendix C:	Workers training certificates
Appendix D:	Worker Air Sampling Results
Appendix E	Moisture Readings
Appendix F	XRF Calibration Data
Appendix G	XRF Test Result for Duplex
Appendix H	Duplex Testing Logs
Appendix I	Certified Weight Tickets
Appendix J	Waste Manifests

Abbreviations

DHS	Department of Health Services
EPA	Environmental Protection Agency
HUD	Department of Housing and Urban Development
LOD	Level of Detection
μg/kg	Micrograms per killogram
Mil	millimeter
MTBE	methyl-tert-butyl-ether
MTCA	Model Toxics Control Act
NIST	National Institute of Standards Technology
Pb	Lead
ppm	Parts per Million
QA/QC	Quality assurance/ quality control
RFP	Request for Proposal
SOW	Scope of Work
USCG	United States Coast Guard
XRF	X-ray Fluorescence

I. Background

Burrows Island is located approximately a quarter mile off the western coast of the town of Anacortes, Washington (see Figure 1: Site Location Map). It is less than a square mile in size, with an approximate circumference of 4 miles. Most of the island is forested. At one time a small area on the western part of the island was in use by the United States Coast Guard and three intact Coast Guard buildings remain: The Boat House, the Duplex and the Lighthouse. (See Figure 2: Relative Locations of Buildings).

In the past these structures were treated with paint that contained lead. As the lead-containing paint has deteriorated over the years, chips have fallen to the ground where some remain intact and others have decomposed into the soil.

In August, 2005, KELLCO sampled soil surrounding the three remaining structures and identified locations where lead in the soil exceeded. 1000 ppm.[1] Following that study KELLCO was asked to perform the following tasks:

1) Stabilize the paint remaining on the Boat House, Duplex and Lighthouse with an approved encapsulant a minimum of 7 millimeters thick; and

2) Remove up to 300 barrels of soil with lead greater than 1000 ppm from around the buildings, starting with the Duplex.

Guidelines for the work were outlined US Coast Guard PSN 33-o05069 "Specifications to Restore Soil Burrows Island Light Station, revised SOW chg 1" dated 26 May 2005.

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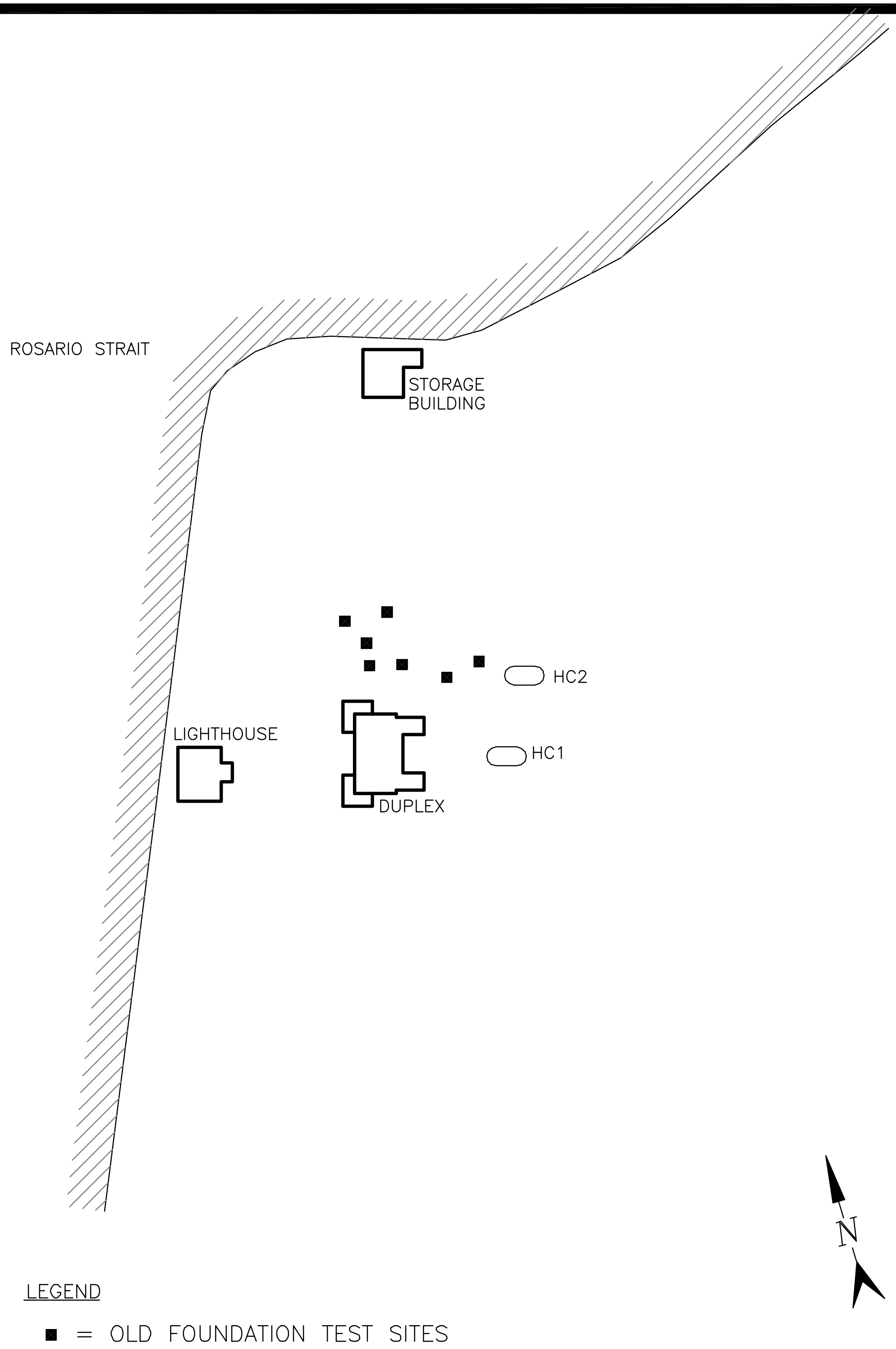
[1] See *Phase II Environmental Due Diligence Audit Soil Screening for Lead Paint and Hydrocarbons, , U.S. Coast Guard Lighthouse Station, Burrows Island, Washington,* by KELLCO Services, Inc., dated 8/25/05.

Shore
Prop
Anacortes-San Juan Islands-Sidney
Rosario Strait
7th
9th
20-SPUR
Florida
2nd
16th
17th
D Av Nur
20-SPUR
Illinois
Anacopper
4th
5th
21st
22nd
Kansas
Ohio
E
Creeksi
Sheila Ann
Puget
Rosario Strait
D
Alexander Beach
11th
B
D
30th
5th
Burrows
Parkside
32nd
Little Fo
33rd
Cay
Windsor
Twin
F
Cabana
024
Dover
Kingsway
37th
A
Spruce
39th
Anaco Beach
Rye
Bryce
41st
D
E
Pick's Tax Servi
B
Marine
San Juan
Lake Park
Welch
Peace Cliff
Burrows Island
USCG
Duck
Spinnaker
Coronado
Havekost
Del Mar
Pepper's Greenhouse & Nursery
Rosario Strait
Burrows Bay
Abbott
Heart Lake
Allen Island
Erie Moun
Marine
Wildwood
Marine Wa



Drawing Not to Scale

KELLCO Services, Inc. 3137 Diablo Avenue Hayward, CA	(510) 786-9751 Fax (510) 786-9625	Date: August 24, 2005
Client: US Coast Guard		Job #: 0508-05
Job Site: Burrows Island, WA	Structure Location Map	Figure No.: 2

II. Paint Stabilization

A. Material Used

The structures are coated with three predominant colors: white, dark grey and dark green. The color scheme of each structure was to be maintained. The Coast Guard specified white 17875 as found in the Coast Guard Colors and Coatings Manual with additional reference to Federal Paint Standards 595a, Colors. This color is no longer available, so alternatives that would meet the specification were presented to and accepted by the Coast Guard.

During meetings at the US Coast Guard offices in Oakland on 8/30-8/31/05, the Coast Guard was given the Material Safety Data Sheets and specifications from three manufacturers whose products met the Coast Guard requirements. Based on specifications the Coast Guard selected the two part encasement system “PrepLESS Primer™” and “Leadlock™” from Global Encasements.

The trim and deck paints selected were from Sherwin Williams A-100® Exterior Latex Satin A82 Series. This paint was custom blended to the match Coast Guard provided designated colors (14159 and 16187).

Please refer to Appendix B for specific specifications, Material Safety Data Sheets and color charts.

B. Preparation, Worker Training and Protection

The ground surrounding each building was covered with 10 mil polyethylene plastic out 10 to 20 feet from the building. Loose, chipping and peeling paint was scraped from each structure and collected as hazardous waste. The workers performing this and other tasks were all trained in accordance with the Federal OSHA 29 CFR 1926.62 Construction Standard and 29 CFR 1910.134 Respiratory Protection Standard. Worker training and respirator documents are in Appendix C.

Protective clothing, respiratory protection and fall protection was used throughout the work. Personnel air samples were taken during the manual paint scrape and subsequent soil removal using manual methods, as described in Section III below.

Air sampling results are summarized in Appendix D.

C. Moisture Testing

A Delmhorst BD-2100 moisture meter was used to moisture test the wood after the paint scrape and before application of new coatings. The range of moisture for the buildings was 6% to >40% (maximum possible reading for the machine). Appendix E shows the actual readings and their locations.

Chris McDonald of Global Encasements acknowledged that we had the moisture readings recorded were above “normal.” He said their products were designed to “breathe” and the moisture would not have a negative effect, and he told us to apply their products over these surfaces with no other treatment or drying.

D. Product Application

Parts of the structures that were not designated for painting (e.g., windows) were masked off. A 7 mil minimum coating thickness was specified for the application of the stabilizing/encapsulating paint.

The Global Encasement encapsulation/stabilization system consists of two parts. The first application was a clear “PrepLESS Primer” (lot #4009050). This was applied to all designated surfaces on all structures.

The Global Encasement white topcoat paint “Leadlock™ GE40” (lot # 4307050) was spray applied using an airless sprayer with paint manufacturer recommended applicator tips. These high volume sprayers were powered by gasoline generators. The product, applied first to the Light House, did not perform according to manufacturer’s specifications. The coverage rate was approximately a third of that expected by their specifications, and the application goal of 7 mil could not be achieved without adding additional coats.

Global Encasements then shipped “Leadlock™ Topcoat” (lot #G020805-72). Chris McDonald said that “Leadlock™ GE40” and “Leadlock™ Topcoat” are the same product, even though the product labels differed.

“Leadlock™ Topcoat” was sprayed at least twice on the Duplex and Storage Building until the 7 mils minimum thickness was achieved, as determined by core sampling and measurement with a micrometer.

The Lighthouse had been covered with four to five coats of “Leadlock™ GE40” before Global Encasements sent “Leadlock™ Topcoat” as a substitute.. We noticed that the original product was a brighter white. After the “Leadlock™ Topcoat” was applied at the correct thickness to the Duplex and Boat House, the difference in color was obvious.

In order for the buildings to be painted with the same color, Chris McDonald told us to apply “Leadlock™ GE40 to the Duplex and Boat House. As a result of the multiple paint applications, in some locations the paint thickness measured at 20 millimeters..

After the white paint had been applied to all surfaces, grey and gray-green were brush and spray painted on top in appropriate areas to return the buildings’ color schemes to those documented in photos taken in August, 2005.

1. Boat House

The Coast Guard sign over the Boat House was completely removed and stored during the painting process and was reinstalled following completion of that structure's painting. Due to shade and high humidity (>70%) the curing process took longer than expected in some areas, but no intervention was needed

2. Light House

The light house has virtually no shade, and the top coast curing process was relatively quick with full sun and wind exposure. It was not necessary to wait 24 hours before applying the second coat to this building.

3. Duplex

The Duplex had higher moisture content in the wood than the other buildings. The building location has become relatively "forested." Prior to this project the Duplex was almost completely covered with vines and foliage, preventing sun from reaching the building surfaces. Removal of growth within 10 feet of the building was still inadequate to allow sufficient sun and wind for natural paint curing. As remedy, propane "blast" heaters were used to expedite drying.

III. Soil Removal and Final Testing

The Coast Guard contract for this project called for up to 300 barrels of soil with lead above 1000 ppm to be collected and removed from the island. The first priority for soil removal was the Duplex.

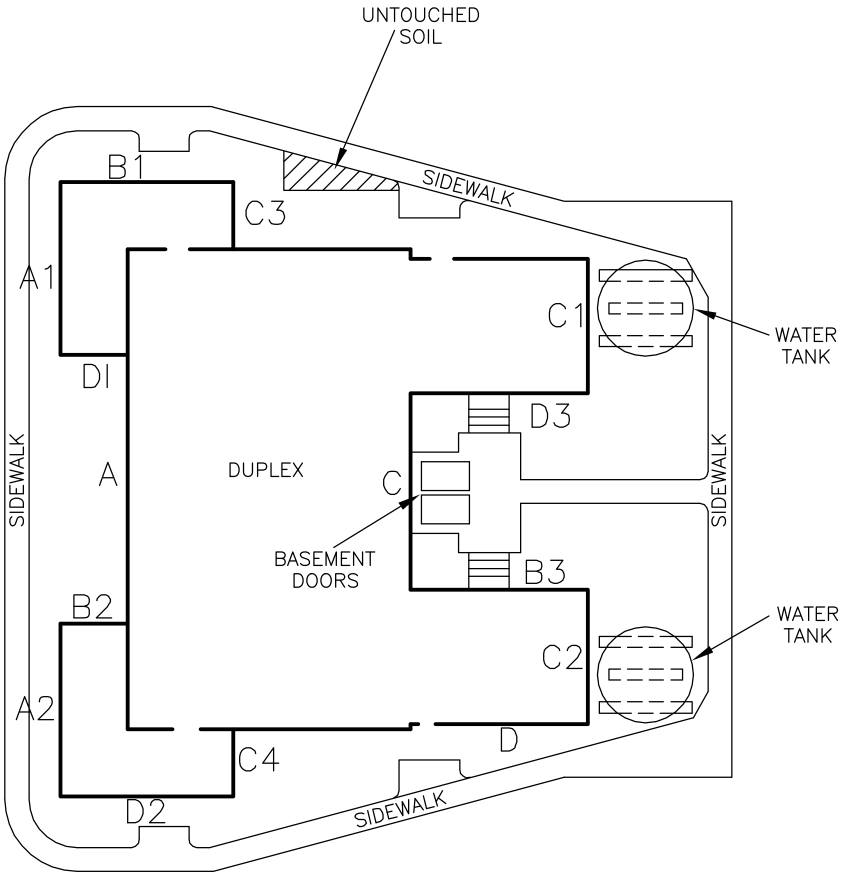
Contaminated soil around the Duplex extended farther and deeper than originally anticipated. The sidewalk that was supposed to have been 6-10 feet from the structure was only 3 feet from the building and buried 8 inches below the surface in soil with lead contamination.

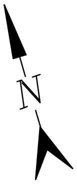
As soil was removed the surface below was tested with the portable XRF to determine whether additional removal would be necessary. The XRF equipment and calibration data are in Appendix F

After 300 barrels of soil were removed from around the Duplex, surface soil in some remaining areas still exceeded 1000 ppm. Appendix G is the soil testing data and Appendix H is the field logs of the XRF readings after the final removal.

Following the Coast Guard specification for this work, the areas where soil was removed was not filled in. There now is a “trench” surrounding the Duplex. In some areas this trench is 18” deep.

Figure 3 depicts the Duplex after soil removal.





LEGEND

A = BUILDING SIDE

Scale: 0 20 feet 40 feet

KELLCO Services, Inc.
3137 Diablo Avenue Hayward, CA
(510) 786-9751
Fax (510) 786-9625

Date: October 16, 2005

Client: US Coast Guard

Job #: 0508-05

Job Site: Burrows Island, WA

Duplex Lead Test
Side Identification

Figure No.: 2

IV. Clean Up and Disposal of Waste

Waste from the site fell into the following categories

Table 1: Disposition of Waste Types Burrows Light Station September 2005	
Type of Waste	**Disposal Method**
Contaminated Soil	Placed in 55 gallon metal barrels and trucked to approved disposal site
Paint chips	Placed in a 55 gallon barrel an trucked to approved disposal site
Poly drop cloths	Cleaned, packaged and bagged in double 6-mil bags. These were taken back to Oakland to San Leandro for proper disposal
Worker protective equipment	Bagged in double 6-mil bags. These were taken back to San Leandro for proper disposal
Plywood used for walkways,etc.	Cleaned and taken back to Oakland to San Leandro.
Daily trash, food waste and general debris	Bagged and taken to the mainland for disposal in a trash dumpster.
Sanitary Waste	Collected and given to the provider of the portable toilet facilities for proper disposal.

Barrels of soil were removed from the island and transferred to Clean Harbors Environmental Services, Inc. for final disposal at Clean Harbors Grassy Mountain in Olive Utah. There were four truckloads of barrels, totaling 153,920 pounds. The average weight per barrel was 513 pounds.

Certified weight certificates from empty and full waste trucks are in Appendix I.

The shipping manifests are Appendix J. Completed manifests will be sent from the waste site directly to the owner of record, US Coast Guard Burrows Light Station, in care of Chris Sage.

V. Recommendations

The ultimate goal of removal of soil with greater than 1000 ppm lead was not achieved. Based on our observation of the removal of the 300 barrels of soil around the Duplex only, we believe there is **at least** an additional 300 barrels to be removed as follows:

Table 2

Estimated Barrels of Soil Remaining

Building	**Estimated barrels of soil remaining to achieve <1000 ppm lead**
Duplex	75+
Boat House	50+
Lighthouse	75+

The trench around the Duplex presents a potential hazard liability. If it is not filled in, minimally the Coast Guard is recommended to install signage sufficient to warn visitors to the island to watch their step when nearing the Duplex.

APPENDIX A: Selected Photos

APPENDIX B: MSDS and Specifications for Paint/Encapsulant and Coatings

MATERIAL SAFETY DATA SHEET

PrepLESS Primer™

Updated: June 2005

SECTION I – PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	**PrepLESS PRIMER** (formerly PSN 10/11)
PRODUCT USE:	Primer-Sealer-Neutralizer
PRODUCT DESCRIPTION:	100% Acrylic Copolymer, Water-Base
Manufacturer:	GLOBAL Encasement, Inc. 132 - 32nd St., Union City, NJ 07087
Contact #s:	Tel. # (201) 902-9770 / Fax (201) 902-9835
Emergency Contact #:(CHEMTREC)	Tel. # (800) 424-9300
Website Address:	www.encasement.com

SECTION II – COMPONENT INFORMATION

Material or Component:	**CAS No.:**
Water	7732-18-5
Styrene/acrylate copolymer	Not Hazardous

OSHA PEL or ACGIH TLV: This product contains no hazardous ingredients as per OSHA 29 CFR 1910.1200

SECTION III – HAZARDS IDENTIFICATION

HMIS HAZARD RATING: Health: 1 Flammability: 0 Reactivity: 0
HAZARD INDEX: 0= Minimal. 1= Slight. 2- Moderate. 3= Serious. 4= Severe

EFFECTS OF OVER EXPOSURE:
Inhalation: Vapors or spray mists may be slightly irritating to the eyes, nose, throat, and mucous membrane of the respiratory tract, producing symptoms of a headache and nausea in poorly ventilated areas.
Eye Exposure: Direct contact; slightly irritating to eyes.
Skin exposure: Prolonged or repeated contact with primer may cause slight skin irritation.
Ingestion: May cause nausea.

SECTION IV – FIRST AID INFORMATION

EMERGENCY FIRST AID PROCEDURES:
For inhalation, move subject to fresh air. For eye contact, flush with a large amount of water for at least 15 minutes. See a physician if irritation persists. Wash affected skin area with soap and water. If swallowed dilute by giving 2 glasses of water to drink. Call a physician. Never give anything by mouth to an unconscious subject.

SECTION V – FIRE AND EXPLOSION INFORMATION

FLAMMABILITY CLASSIFICATION:	DOT - Not Regulated Flash Point - N/A LEL - N/A
EXTINGUISHING MEDIA:	N/A
UNUSUAL FIRE & EXPLOSION HAZARDS:	Material can splatter above 212°F Polymer film can burn.

SPECIAL FIRE FIGHTING PROCEDURES: For fires involving this material, do not enter any enclosed or confined fire space without proper protective equipment, including self-contained breathing apparatus to protect against the hazardous effects of normal products of combustion or oxygen deficiency.

SECTION VI – ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Keep unnecessary people away. Dike and contain with inert absorbent material (sand, earth, etc.). Transfer to containers for recovery or disposal. Floors may be slippery; use care to avoid falls. Flush final traces with water.

SECTION VII – HANDLING AND STORAGE INFORMATION

PRECAUTIONS TO BE TAKEN IN HANDLING: Do not take internally. KEEP AWAY FROM CHILDREN. Use approved clothing when using **PrepLESS Primer™** over Lead-Based Paint. Also, follow all applicable OSHA & EPA, (etc.) regulations concerning lead abatement and normal latex paint spraying activities.

PRECAUTIONS TO BE TAKEN IN STORING: Maximum storage temperature 100°F. Keep container tightly closed and upright to prevent leakage. Precautionary Labeling: "Keep from Freezing", product may coagulate. Material may develop bacterial odor on long term storage if contaminated.

SECTION VIII – EXPOSURE CONTROLS/PERSONAL PROTECTION INFORMATION

RESPIRATORY PROTECTION: None required if good ventilation is maintained. Wear MSHA/NIOSH approved dust respirator during spray applications.
VENTILATION: Sufficient ventilation, in pattern and volume, should be provided to keep the air contaminant concentration below applicable exposure limits. All application areas should be ventilated in accordance with OSHA regulation 29 CFR Part 1910.94.
PROTECTIVE GLOVES: Impervious gloves for prolonged or repeated contact.
EYE PROTECTION: Use safety eyewear including side shields, face shields, or chemical splash goggles (ANSI 2-87.1) or approved equivalent.

SECTION IX – PHYSICAL AND CHEMICAL PROPERTIES

Boiling Point:	212°F
Evaporation Rate:	Equal to water
Vapor Density:	Lighter than air
Specific Gravity (water = 1.0):	1.04
Percent Volatile by weight:	50

SECTION X – STABILITY AND REACTIVITY INFORMATION

STABILITY: Stable.
HAZARDOUS POLYMERIZATION: Will not occur.
HAZARDOUS DECOMPOSITION PRODUCTS: Will not occur.
CONDITIONS TO AVOID: Keep from freezing.
INCOMPATIBILITY: None reasonably foreseeable.

SECTION XI – TOXICOLOGICAL INFORMATION (will only print available data)

Carcinogenicity?: NO
Refer to section VII for proper handling.
No other toxicological information available.

SECTION XII – ECOLOGICAL INFORMATION

AQUATIC TOXICITY: Non-toxic
TERRESTRIAL TOXICITY: Non-toxic
No other ecological information available.

SECTION XIII – DISPOSAL INFORMATION

WASTE DISPOSAL METHOD: Disposal should be in accordance with Federal, State and local regulations for water base coatings. Refer to section xv for more information.

SECTION XIV – TRANSPORTATION INFORMATION

DOT CLASSIFICATION: Non-hazardous
UN NUMBER: None

SECTION XV – REGULATORY INFORMATION

SARA TITLE III, SECTION 313, SUPPLIER NOTIFICATION. This product contains the following toxic chemicals subject to the reporting requirements of the Emergency Planning and Community Right-To-Know Act of 1986 and of CFR 372: None

SECTION XVI – OTHER INFORMATION

The information contained herein is to the best of our knowledge and belief has been compiled from sources considered to be dependable and is accurate and reliable to the best of our knowledge and belief but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained on our written contract of sale or acknowledgment.

Information complies with New Jersey DOH Right-To-Know Labeling Law (N.J.A.C. 8:59 –5.1 & 5.2)

MATERIAL SAFETY DATA SHEET

LeadLock™

Updated: January 2002

SECTION I - PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	**LeadLock™**
PRODUCT USE:	Encasement TopCoat
PRODUCT DESCRIPTION:	Acrylic Copolymer, Water-Base
Manufacturer:	GLOBAL Encasement, Inc., 132 - 32nd St., Union City, NJ 07087
Contact #s:	Tel. # (201) 902-9770 / Fax (201) 902-9835
Website Address:	www.encasement.com

SECTION II – COMPONENT INFORMATION

Material or Component:	**CAS No.:**
Inert Pigment:	Mixture*
Water	7732-18-5
Styrene/acrylic copolymer	Not Hazardous
Titanium dioxide	13463-67-7

*Pigment color may contain calcium carbonate, alumina trihydrate, zinc oxide, and other particulates not otherwise regulated in varying amounts, depending on color of product.

OSHA PEL or ACGIH TLV: This product contains no hazardous ingredients as per OSHA 29 CFR 1910.1200

SECTION III – HAZARDS IDENTIFICATION

HMIS HAZARD RATING: Health: 1 Flammability: 0 Reactivity: 0
HAZARD INDEX: 0= Minimal, 1= Slight, 2- Moderate, 3=Serious, 4= Severe

PRIMARY ROUTE (S) OF EXPOSURE: Skin/eye contact.
ACUTE AFFECTS FROM EXPOSURE: May cause moderate to severe irritation in eyes.
CHRONIC EFFECTS FROM CHRONIC INGESTION: None known.
CONDITIONS TO AVOID: Keep from freezing. Avoid strong oxidizers, acids and alkalis.
INCOMPATIBILITY: None known.

SECTION IV – FIRST AID INFORMATION

INHALATION: Remove to fresh air. If breathing is difficult, give oxygen. Call a physician.

EYE CONTACT: Immediately flush eyes with running water for at least 15 minutes. Insure complete flushing by holding the eyelids apart during irrigation. Call a physician for further instruction.

SKIN CONTACT: Immediately remove contaminated clothing. Wash affected area thoroughly with soap and water. Call a physician if irritation develops or persists.

INGESTION: Do not induce vomiting if person is conscious. Call a physician who can treat symptoms that are present.

SECTION V – FIRE AND EXPLOSION INFORMATION

FLAMMABILITY CLASSIFICATION:	Flash Point – 212°F
EXTINGUISHING MEDIA:	Dry Chemical, carbon dioxide, or foam.
UNUSUAL FIRE & EXPLOSION HAZARDS:	This product is water-based.

SPECIAL FIRE FIGHTING PROCEDURES: Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes. Do not breathe smoke or fumes.

HAZARDOUS COMBUSTION BY-PRODUCTS: CARBON DIOXIDE, CARBON MONOXIDE.

SECTION VI – ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Keep unnecessary people away. Floor may be slippery, use care to avoid falling. Stop any leakage, if possible without risk. Use sand or other absorbent to contain the spill, then scoop into a container for disposal.

SECTION VII – HANDLING AND STORAGE INFORMATION

PRECAUTIONS TO BE TAKEN IN HANDLING: Avoid eye, skin and clothing contact. Keep hands away from face. Avoid breathing mists. Use with adequate ventilation. Keep container closed when not in use. Wash thoroughly after handling. Change clothing if exposed to heavy mist or spillage; clothing should be laundered before reuse.

PRECAUTIONS TO BE TAKEN IN STORING: Store in dry, well-ventilated area. Keep from freezing, product may coagulate. Maximum storage temperature is 100°F. Keep container tightly closed and upright to prevent leakage.

SECTION VIII – EXPOSURE CONTROLS/PERSONAL PROTECTION INFORMATION

PERSONAL PROTECTIVE EQUIPMENT: 1) Chemical goggles or safety glasses. 2) Gloves.
VENTILATION: Local exhaust ventilation sufficient to maintain good airflow. This is a must if the product is to be used in a spray application. All application areas should be ventilated in accordance with OSHA regulation 29 CFR Part 1910.94.

SECTION IX – PHYSICAL AND CHEMICAL PROPERTIES

Physical Form:	Liquid	Odor:	Mild scent, slight polymer
Color:	Off White	Lbs/GAL:	11.1
Flash Point:	N/A	pH:	8.0 – 9.0
Specific Gravity (water = 1.0):	1.2 – 1.4	Viscosity (CPS*):	<15000
VOCs, lbs/gal:	1.2	VOCs, grams/liter:	100

*@ 77°F #5 Spindle, 20 rpm

SECTION X – STABILITY AND REACTIVITY INFORMATION

CONDITIONS CONTRIBUTING TO INSTABILITY: Stable, however avoid high temperatures. Avoid strong oxidizing or reducing agents.
INCOMPATIBILITY: None expected.

SECTION XI – TOXICOLOGICAL INFORMATION (will only print available data)

PRIMARY ROUTE (S) OF EXPOSURE: Skin/eye contact.
Carcinogenicity?: NO
Refer to section VII for proper handling.
No other toxicological information available.

SECTION XII – ECOLOGICAL INFORMATION

AQUATIC TOXICITY: Non-toxic
TERRESTRIAL TOXICITY: Non-toxic
No other ecological information available.

SECTION XIII – DISPOSAL INFORMATION

WASTE DISPOSAL METHOD: Disposal should be in accordance with Federal, State and local regulations for water base coatings. Refer to section xv for more information.

SECTION XIV – TRANSPORTATION INFORMATION

DOT CLASSIFICATION: Non-hazardous.
UN NUMBER: None

SECTION XV – REGULATORY INFORMATION

SARA TITLE III, SECTION 313, SUPPLIER NOTIFICATION. This product contains the following toxic chemicals subject to the reporting requirements of the Emergency Planning and Community Right-To-Know Act of 1986 and of CFR 372: None

SECTION XVI – OTHER INFORMATION

The information contained herein is to the best of our knowledge and belief has been compiled from sources considered to be dependable and is accurate and reliable to the best of our knowledge and belief but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained on our written contract of sale or acknowledgment.

Information complies with New Jersey DOH Right-To-Know Labeling Law (N.J.A.C. 8:59 –5.1 & 5.2)

*

This

GLOBAL Encasement, Inc.

1. PRODUCT NAME

LEADLOCK™

2. MANUFACTURER

GLOBAL Encasement, Inc.
132 – 32ND Street
Union City, NJ 07087
PHONE: (201) 902-9770
FAX: (201) 902-9835
Www.encasement.com

3. PRODUCT DESCRIPTION

LeadLock™ TopCoat is a high performance, water-based, acrylic, non-toxic, abuse- rust-, mildew-, fire- and chemical-resistant top coat that can be custom tinted almost any color. It functions as a tough membrane that encloses Lead-Based Paint for long-lasting protection against the hazards of deteriorating Lead-Based Painted surfaces.

It can be applied alone over intact surfaces, or over surfaces stabilized with PrepLESS Primer™ (formerly PSN-10/11) to form a GLOBAL Encasement System.

LeadLock™ TopCoat is approved for use in all 50 states and has passed Independent Testing by third party accredited laboratories, including **ASTM E-1795**, the Standard for Liquid Coating Encapsulation Products for Leaded Paint in Buildings.

LeadLock™ Features:

- One Coat - 7 Mil Dry Film Thickness (DFT) - (Interior)
- Two Coats - 14 Mil DFT (Exterior)
- Can be custom tinted almost any color
- Quick Dry Time
- Cures out Completely in 7-10 Days
- Extremely Tough, Durable and Flexible
- Mildew and Mold Resistant
- Low Volatile Organic Content (V.O.C.)
- No Offensive Odors

LeadLock™ is excellent for walls, ceilings, trim, ducts, pipes and all non-friction surfaces. It can be used over treated or untreated wood, stone, metal, wallboard, sheet rock, cracked and painted plaster, stucco, masonry, concrete and various fibrous materials.

4. TECHNICAL DATA

Solids by weight:	62%
Solids by volume:	55%
Weight per gallon:	11.1 lbs
Liquid appearance:	Bright White with mild scent
Viscosity:	135 +/- 5 KU
Drying time:	To Touch: 1-4 Hours Recoat After Dry To Touch: 2-8 Hrs Full Cure: 7-10 Days

Toxicological Report states: "There is no toxicological basis for limiting occupancy of a dwelling unit, or restricting entry of any resident including pregnant women and children under six years of age, to dwelling units during the application of your encapsulant."

5. PRODUCT INSTALLATION

- **LeadLock™** TopCoat is ready to use and should not be diluted.
- Apply by brush or roller, or airless sprayer.
- All surfaces must be clean, dry, and free of dirt, grease, oil, or other contaminants that would interfere with proper adhesion.
- Apply in temperatures between 50ºF and 100ºF.
- Can dry in 2-4 hours. Cool temperatures and high humidity can affect dry and cure time.
- Follow manufacturer's application guidelines.
- Easy to use and clean up is with water.

COVERAGE:

LeadLock™ coverage rate on a flat surface is:

- 126 sq.ft./gallon for 7 mils DFT
- 63 sq.ft./gallon for 14 mils DFT

Coverage varies depending upon the porosity and texture of the surface being encased.

Spray Application: Use self-cleaning reversible spray tip, size .019-.025 (.021 is most often used).
Brush: Use any nylon bristle brushes.
Roller: Use a ¾ inch nap, may require two passes to obtain 7 Mil DFT.

6. AVAILABILITY AND COST

Call GLOBAL Encasement, Inc. at 800-266-3982 for pricing and availability.

7. WARRANTY

GLOBAL Encasement, Inc. can warrant for a period of up to twenty (20) years from the date of purchase that LeadLock™ TopCoat is free of any defects in manufacturing. The Limited Warranty herein described shall be in lieu of any other warranty, expressed or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose.

GLOBAL Encasement's sole liability under this Limited Warranty shall be, at its option, to replace any portion of the product proven to be defective in manufacture.

Any defects discovered must be reported to GLOBAL Encasement, Inc. within the Limited Warranty period, and no later than 30 days after discovery.

This Limited Warranty does not extend to liability for any damages due to abuse by occupants, improper maintenance, water damage, or any other causes beyond anticipated conditions and the manufacturer's control.

MATERIAL SAFETY DATA SHEET

LeadLock™

Updated: January 2002

SECTION I - PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	**LeadLock™**
PRODUCT USE:	Encasement TopCoat
PRODUCT DESCRIPTION:	Acrylic Copolymer, Water-Base

Manufacturer:	GLOBAL Encasement, Inc., 132 - 32nd St., Union City, NJ 07087
Contact #s:	Tel. # (201) 902-9770 / Fax (201) 902-9835
Website Address:	www.encasement.com

SECTION II – COMPONENT INFORMATION

Material or Component:	**CAS No.:**
Inert Pigment:	Mixture*
Water	7732-18-5
Styrene/acrylic copolymer	Not Hazardous
Titanium dioxide	13463-67-7

*Pigment color may contain calcium carbonate, alumina trihydrate, zinc oxide, and other particulates not otherwise regulated in varying amounts, depending on color of product.

OSHA PEL or ACGIH TLV: This product contains no hazardous ingredients as per OSHA 29 CFR 1910.1200

SECTION III – HAZARDS IDENTIFICATION

HMIS HAZARD RATING: Health: 1 Flammability: 0 Reactivity: 0

HAZARD INDEX: 0= Minimal, 1= Slight, 2- Moderate, 3=Serious, 4= Severe

PRIMARY ROUTE (S) OF EXPOSURE: Skin/eye contact.

ACUTE AFFECTS FROM EXPOSURE: May cause moderate to severe irritation in eyes.

CHRONIC EFFECTS FROM CHRONIC INGESTION: None known.

CONDITIONS TO AVOID: Keep from freezing. Avoid strong oxidizers, acids and alkalis.

INCOMPATIBILITY: None known.

SECTION IV – FIRST AID INFORMATION

INHALATION: Remove to fresh air. If breathing is difficult, give oxygen. Call a physician.

EYE CONTACT: Immediately flush eyes with running water for at least 15 minutes. Insure complete flushing by holding the eyelids apart during irrigation. Call a physician for further instruction.

SKIN CONTACT: Immediately remove contaminated clothing. Wash affected area thoroughly with soap and water. Call a physician if irritation develops or persists.

INGESTION: Do not induce vomiting if person is conscious. Call a physician who can treat symptoms that are present.

SECTION V – FIRE AND EXPLOSION INFORMATION

FLAMMABILITY CLASSIFICATION:	Flash Point – 212°F
EXTINGUISHING MEDIA:	Dry Chemical, carbon dioxide, or foam.
UNUSUAL FIRE & EXPLOSION HAZARDS:	This product is water-based.

SPECIAL FIRE FIGHTING PROCEDURES: Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes. Do not breathe smoke or fumes.

HAZARDOUS COMBUSTION BY-PRODUCTS: CARBON DIOXIDE, CARBON MONOXIDE.

SECTION VI – ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Keep unnecessary people away. Floor may be slippery, use care to avoid falling. Stop any leakage, if possible without risk. Use sand or other absorbent to contain the spill, then scoop into a container for disposal.

SECTION VII – HANDLING AND STORAGE INFORMATION

PRECAUTIONS TO BE TAKEN IN HANDLING: Avoid eye, skin and clothing contact. Keep hands away from face. Avoid breathing mists. Use with adequate ventilation. Keep container closed when not in use. Wash thoroughly after handling. Change clothing if exposed to heavy mist or spillage; clothing should be laundered before reuse.

PRECAUTIONS TO BE TAKEN IN STORING: Store in dry, well-ventilated area. Keep from freezing, product may coagulate. Maximum storage temperature is 100°F. Keep container tightly closed and upright to prevent leakage.

SECTION VIII – EXPOSURE CONTROLS/PERSONAL PROTECTION INFORMATION

PERSONAL PROTECTIVE EQUIPMENT: 1) Chemical goggles or safety glasses. 2) Gloves.
VENTILATION: Local exhaust ventilation sufficient to maintain good airflow. This is a must if the product is to be used in a spray application. All application areas should be ventilated in accordance with OSHA regulation 29 CFR Part 1910.94.

SECTION IX – PHYSICAL AND CHEMICAL PROPERTIES

Physical Form:	Liquid	Odor:	Mild scent, slight polymer
Color:	Off White	Lbs/GAL:	11.1
Flash Point:	N/A	pH:	8.0 – 9.0
Specific Gravity (water = 1.0):	1.2 – 1.4	Viscosity (CPS*):	<15000
VOCs, lbs/gal:	1.2	VOCs, grams/liter:	100

*@ 77°F #5 Spindle, 20 rpm

SECTION X – STABILITY AND REACTIVITY INFORMATION

CONDITIONS CONTRIBUTING TO INSTABILITY: Stable, however avoid high temperatures. Avoid strong oxidizing or reducing agents.
INCOMPATIBILITY: None expected.

SECTION XI – TOXICOLOGICAL INFORMATION (will only print available data)

PRIMARY ROUTE (S) OF EXPOSURE: Skin/eye contact.
Carcinogenicity?: NO
Refer to section VII for proper handling.
No other toxicological information available.

SECTION XII – ECOLOGICAL INFORMATION

AQUATIC TOXICITY: Non-toxic
TERRESTRIAL TOXICITY: Non-toxic
No other ecological information available.

SECTION XIII – DISPOSAL INFORMATION

WASTE DISPOSAL METHOD: Disposal should be in accordance with Federal, State and local regulations for water base coatings. Refer to section xv for more information.

SECTION XIV – TRANSPORTATION INFORMATION

DOT CLASSIFICATION: Non-hazardous.
UN NUMBER: None

SECTION XV – REGULATORY INFORMATION

SARA TITLE III, SECTION 313, SUPPLIER NOTIFICATION. This product contains the following toxic chemicals subject to the reporting requirements of the Emergency Planning and Community Right-To-Know Act of 1986 and of CFR 372: None

SECTION XVI – OTHER INFORMATION

The information contained herein is to the best of our knowledge and belief has been compiled from sources considered to be dependable and is accurate and reliable to the best of our knowledge and belief but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained on our written contract of sale or acknowledgment.

Information complies with New Jersey DOH Right-To-Know Labeling Law (N.J.A.C. 8:59 –5.1 & 5.2)

ATTN: Rick

GLOBAL Encasement, Inc.

Environmentally Advanced Coatings℠

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- Contact Us
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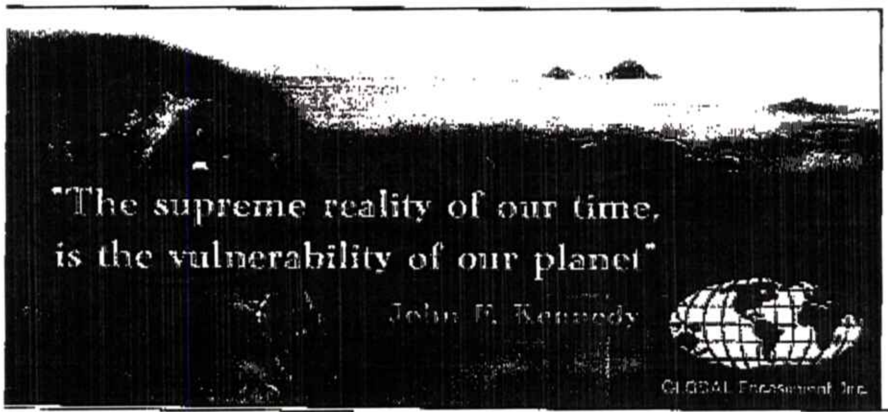

Our Websites

AsbestoSafe
Mold Mildew

Case History Spotlight

154 - Hamilton Health Sciences Corporation

All Case Histori

FAQs About Lead-Based Paint.

Got a question? See if we answer it in our FAQ's!

MORE

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Contact Us

Contact us by mail, phone, fax or email!

Contact Us>

GLOBAL Encasement's powerful LeadLock™ System incorporates the use of the following products:

I. **LeadLock™ Topcoat**
II. **PrepLESS Primer™**
III **PSN-12 Rust Inhibiting Primer**
IV. **GE-15 100% Acrylic Caulk**

LeadLock is a tough, **non-toxic**, liquid applied coating process that is extremely effective in helping prevent lead poisoning. LeadLock products are suitable for interior and exterior use over most smooth or irregular surfaces that contain lead-based paint. These surfaces include bare or painted wood, plastic, metal, drywall, ductwork, pipes, cement, cement blocks, bricks, Transite, bridges, water towers, and steel decks.

About Us

GLOBAL Encasement, Inc. manufactures premium environmentally advanced coatings that save our cli millions of dollars by providing them with solid soluti to the complicated issues of hazardous building materials and the harmful health concerns that arise from them.

More About

American Environmental Review

GLOBAL Encasement, Inc. was featured on *American Environmen Review* with Morley Safer for their outstanding commitment to the environment.

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GSA Contractor #GS06F0010J - c UL us

INSTALLATION GUIDE SPECIFICATION

09940 GEI-LBP

GLOBAL Encasement, Inc.

APPLICATIONS OVER LEAD-BASED PAINT (LBP)

I. GENERAL

1.01 SUMMARY

A. Provide labor, materials, equipment and supervision necessary to install (spray-apply, brush or roller) GLOBAL Encasement, Inc. systems outlined in this specification to safely abate Lead-Based Paint.

B. GLOBAL Encasement, Inc.'s application instructions for each product used are considered part of these specifications and should be followed at all times.

1.02 SUBMITTALS

A. Submit reports and literature verifying compliance with fire ratings, physical properties or approvals earned by specified materials.

B. Submit material safety data sheets on all materials.

1.03 QUALITY ASSURANCE

A. Supplier Qualifications: GLOBAL Encasement, Inc. products, as supplied by GLOBAL Encasement, Inc., shall be approved for use on the project.

The product manufacturer shall have been in business for a minimum of ten (10) years.

B. Applicator Qualifications: GLOBAL Encasement, Inc. shall approve the application contractor. GLOBAL Encasement, Inc.'s written verification of applicator approval shall be required.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Containers and packaging: Deliver materials in original sealed containers, clearly marked with Global Encasement, Inc.'s logo, brand name, type of material and production lot numbers.

B. Storage: Store materials between 40°F and 90°F with careful handling to prevent damage to products. Do not store for long periods in direct sunlight, at excessive temperatures or at temperatures below freezing.

C. Protection: Protect all materials from damage during transit, handling, storage and installation.

D. Verify dates of manufacture and confirm that material is within one year shelf life.

INSTALLATION GUIDE SPECIFICATION

09940 GEI-LBP

1.05 PROJECT CONDITIONS

A. Environmental Requirements Conditions.

1. These minimum recommendations for material coverage are for ideal conditions. The number of gallons to coat 100 square feet may need to be increased due to uneven application, rough surface texture, heat and wind conditions while spraying or applying and other variables.

2. Do not apply materials unless surface to receive GLOBAL Encasement, Inc. system is dry and materials are applied over a test area to ensure proper adhesion.

3. Install all material in strict accordance with all published safety or applicable regulations of GLOBAL Encasement, Inc. and/or local, state, and/or federal agencies that have jurisdiction.

4. Do not proceed with application of coating or sealing materials when surface temperature is less than 50°F. No coating system shall be applied if precipitation or freezing temperatures are expected within 72 hours.

5. Instructions for use of all GLOBAL Encasement, Inc. materials and application equipment should be read and followed at all times.

II. PRODUCTS

2.01 GLOBAL Encasement, Inc. Systems

A. The encasement system is an acrylic, spray, brush or roller-applied GLOBAL Encasement, Inc. system manufactured by GLOBAL Encasement, Inc.

1. Coatings shall be non-toxic, safe and easy to use, contain no hazardous ingredients by OSHA definition, be nonflammable, cleanup with water and finished surface shall have a tested Class "A" fire rating.

2. Coating materials shall be warranted to be heavy-bodied (62% solids content), from the same manufacturer and shall be long lasting, remain highly flexible, chalk resistant, resist cracking, peeling, algae and fungus that cause future indoor air quality concerns.

INSTALLATION GUIDE SPECIFICATION

09940 GEI-LBP

3. Coatings shall have independent ASTM laboratory test data on adhesion, permeability, and aged flexibility, with elastic properties of over 300% to allow for building movement without cracking.

4. Coating materials shall have low V.O.C. (Volatile Organic Compound) content.

5. Coating materials shall be safe to use, shall not release health threatening toxic smoke in a fire and will comply with all building codes.

B. Coating Material shall have passed the following testing standards:

1. ASTM E-1795-96, the National Standard for Encapsulation materials (approved Nationwide for interior and exterior use).

2. Class "A" Surface Flammability and Burning Characteristics, by method ASTM E-84 (Flame Spread = 0, Smoke Developed = 5). This is equal to NFPA 255, UL No. 723, ANSI 2.5 and U.B.C. 42-1.

3. ASTM E-162-90 - passed (Fs = 1.00; Q = 0.49; Is = 0.49; where Flame Spread Index = Is = Fs x Q).

4. Scrub Resistance by ASTM D-2486 passed after more than 2500 cycles (1200 cycles min. to pass).

5. Impact Resistance by ASTM D-2794 = exceeds 160 in. lb. (80 in. lb. min. to pass).

6. Accelerated Weather Test by ASTM C-732 G 26 (passed 1000 hour testing).

7. Water Vapor Permeability (Perms) - ASTM D-1653 Method A = 1.0 grains/ft2/hr./in. Hg. (The coating can breathe; allows water vapor to pass through the surface).

8. Tensile Strength by ASTM D-2370 = 260 psi, Elongation = 355%.

9. Mildew Resistance by ASTM D-3273 and D-3274 = 8 (no observed mildew).

10. Yellowing by ASTM E-313 (no visible yellowing after 1000-hour exposure test).

11. Chalking by ASTM D-4214 (exceeded St'd. #1 after 1000 hour Accelerated Weathering).

12. Blister Resistance by ASTM D-714 (no blistering observed after exposure testing).

13. Rust Resistance by ASTM D-610 (no rust observed after exposure testing).

14. Distilled Water and Chemical Resistance by ASTM D-1308 (no effect).

15. Volatile Organic Content (by EPA Method 24) - 100 g/L (0.8 lbs./gallon).

16. ASTM G-53-93, QUV 1000 hour Weatherization Exposure (passed the Lead leachate testing).

17. Certified by or compliant with Dept. of Health (encapsulation testing protocol)

2.02 RELATED MATERIALS

A. GLOBAL Encasement, Inc. shall approve elastomeric caulking compounds, primers, and similar materials. All materials used shall be applied in accordance with GLOBAL Encasement, Inc.'s recommendations.

2.03 EQUIPMENT RECOMMENDATIONS

GLOBAL Encasement, Inc. materials are prescreened at the factory and can be applied with nylon bristle brushes, roller, or airless equipment. Roller nap size will depend on the substrate being encased; ½ inch nap to 1¼ inch is recommended. Airless piston-type spray equipment may also be used for application. Equipment selection will depend on the size and nature of the encasement project.

For airless spray equipment recommendations have the percent solids by volume for the particular product available and call:

A. **Graco** – Tech. Support line is (800) 690-2894.
B. **Titan Tool Inc.** – Tech. Support line is (800) 526-5362.

3.01 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with GLOBAL Encasement, Inc.'s product data, including product technical bulletins and product guide specification instructions.

INSTALLATION GUIDE SPECIFICATION

09940 GEI-LBP

3.02 PREPARATION

A. Protect floors, windows, mechanical items or any areas not to be coated to protect from over-spray or dripping.

B. All surfaces to be encased must be free of moisture.

C. GLOBAL Encasement, Inc. coatings being applied over potential surface contaminants, such as glossy, greasy, dirty, or otherwise questionable surfaces, should be tested for surface compatibility. When applying PrepLESS Primer™ over dirty surfaces back rolling will pick up any loose material and embed it in the encasement. Also, this procedure will provide better adhesion.

D. If product spray should occur on any surface not to be coated, wipe immediately to avoid staining or permanent adhering.

3.03 APPLICATION

The following are general application guidelines. For site specific recommendations, please contact our office at: (800) 266-3982

Under no circumstances are GLOBAL Encasement, Inc.'s products to be diluted with water, solvents or paint additives. Diluting GLOBAL Encasement, Inc. materials voids all warranties with the following exceptions:

GE-MPE (Multi-Purpose Encapsulant):

This product has been fully tested up to a dilution rate of 10:1.

PremeClean Industrial Cleaner Concentrate:

This product has been tested up to a dilution rate of 50:1.

A. Application first seals and stabilizes the surfaces, then produces a durable, long-lasting protective jacket over the aging paint. The application of a test area is recommended.

INSTALLATION GUIDE SPECIFICATION

09940 GEI-LBP

B. For Metal Surfaces that rust:

1. Use PremeClean Industrial Cleaner, our non-corrosive, biodegradable, and water-soluble product to prepare surfaces using wet removal technique to remove all loose and flaking paint from the metal surfaces, wipe and rinse clean, allow to dry.

2. Apply one coat of PSN-12 Rust-Inhibiting Primer (corrosion inhibitor) directly over all metal surfaces, apply two coats over rusted areas. Apply PSN-12 at a coverage rate of 100 to 150 square foot per gallon, per coat (12 - 16 wet mils). This will dry to 4 - 7 dry mils of primer per coat. Allow to dry thoroughly before applying second coat.

3. Apply LeadLock™ over dried primed surfaces. Apply at a coverage rate of 126 square feet per gallon per coat (14 - 18 wet mils) to produce 7 dry mils per coat.

If there is no rust and the paint is intact, use LeadLock™ TopCoat directly.

C. For Highly Weathered Wood and Damaged, Loose and Flaking Paint:

1. Use PremeClean™ Industrial Cleaner, a non-corrosive, biodegradable, water-soluble product to prepare surfaces. Use wet removal technique to remove all excessive loose and flaking paint from the surfaces, break all bubbles, rinse clean and allow to dry.

Dust-free techniques for removing excessive loose damaged paint is to apply a thin coat of PrepLESS Primer™ (formerly PSN-10) (as described in step 2 below) then selectively scrape off only the excessively loose paint. Then complete application of PrepLESS Primer™ as in step 2 below.

2. Apply two coats of PrepLESS Primer™ directly over all surfaces including over damaged, loose and flaking paint or bare spots. The first coat of PrepLESS Primer™ can be spray, brush, roller or cloth applied to a thin coat (3 to 6 wet mils) over all surfaces.

INSTALLATION GUIDE SPECIFICATION

09940 GEI-LBP

Use a wet mil gauge to determine proper wet coating thickness to yield the desired dry mil thickness. Next, before a skin forms on the coating, go over the surface with a roller to push the material into any cracks or voids in the surface. This process will also help to embed any loose material into the encasement system. Thirty to sixty (30 to 60) minutes later, apply the balance of the PrepLESS Primer™ materials and work onto the loose and flaking areas. Apply at a coverage rate of 80 to 100 square foot per gallon (use more PrepLESS Primer™ material over rough and bare areas). Allow primer coat to dry thoroughly before over-coating.

Note: PrepLESS Primer™ goes on milky white and dries clear, forming a flexible membrane that remains tacky when dry.

3. Where caulking is required to produce a smooth surface and/or to seal around windows, doors and seams, use compatible GE-15 100% Acrylic Caulk (trowelable grade or in tubes). Patch damaged areas as needed. Allow to dry before applying the topcoat.

4. Next, apply one or two coats of LeadLock™ over all the dry primed surfaces. Apply at a coverage rate of 126 square feet per gallon per coat (13 wet mils). This will produce 7 dry mils per coat. Allow to dry before applying second coat and let the system dry overnight before removing tape. LeadLock™ dries to form a matte finish surface.

5. To prevent damage to the coatings when removing all plastic and masking tape, use a utility knife to cut masking at painted edges. Prompt cleanup of equipment is recommended. Cleanup is with warm soapy water.

D. PrepLESS Primer™ is a high solid engineered coating material (45% solids content - by volume). PrepLESS Primer™ can penetrate and stabilize unstable surfaces. **PrepLESS Primer™ has excellent adhesion and adheres to most surfaces. A test area should be used to verify surface compatibility on any questionable surfaces.**

Allow to dry 2 to 24 hours before applying topcoats.

(The environment in a containment area can extend dry times.)

Note: PrepLESS Primer™ goes on milky white and dries clear.

INSTALLATION GUIDE SPECIFICATION

09940 GEI-LBP

E. GE-15 100% Acrylic Caulk (trowelable grade) can be used to bridge and seal cracks up to a ¼" thick and to fill in shallow voids. On surfaces where GE-15 100% Acrylic Caulk is used directly over unsealed substrates, a test area should be used prior to application.

F. LeadLock™ is a high solids content material. When applying LeadLock™, (through brush, roller, or spray), **use a wet mil gauge to determine proper wet coating thickness to yield the desired dry film thickness.** Apply LeadLock™ in two passes with the second pass perpendicular (at 90° angle) to the first pass. Back-rolling LeadLock™ on rough surfaces can help to fill visible voids while conserving the use of materials. *A finished GLOBAL Encasement, Inc. system shall be seamless and form a uniform, continuous, flexible coating that encloses the painted surface.*

G. Coverage rate per gallon varies depending upon porosity, texture, condition of the surface and the mil thickness. Rough, highly textured surfaces require more material than flat or smooth surfaces.

The calculated coverage rate for LeadLock™ on a flat, non-porous surface is: <u>126 sq. ft per gallon (applied @ 13 wet mils = 7 dry film thickness per coat.)</u>

LeadLock™ can be used over various interior or exterior surfaces including: walls, ceilings, trim, flat Transite, rough, porous, textured or irregular surfaces, cementitious surfaces, stucco, wood siding, shingle siding, window frames, windowsills & porch walls, wood overhangs, porch ceilings, wood trim & posts, *porch floors.

H. To prevent damage to the coatings when removing all plastic and masking tape, use a utility knife to first cut at coating edges. Under normal drying conditions, GLOBAL Encasement, Inc. products develop their full strength and chemical resistance properties 7 to 10 days following application. The circulation of air helps water-based materials to dry more rapidly. Follow all applicable state and/or federal OSHA Guidelines.

3.04 CLEANING

A. Use soapy water while coatings are still wet and wipe clean. Surfaces not intended to receive GLOBAL Encasement, Inc. system shall be protected during the application process.

INSTALLATION GUIDE SPECIFICATION

09940 GEI-LBP

IV. MATERIALS

The following materials listed in these recommendations are available from:

GLOBAL Encasement, Inc.
132 - 32nd Street
Union City, NJ 07087 USA
(800) 266-3982 / (201) 902-9770
Website: www.encasement.com

1) GE-1C1 Industrial Cleaner (concentrate)
2) PrepLESS Primer™
3) PSN-12 Rust-Inhibiting Primer
4) LeadLock™ TopCoat
5) GE-15 100% Acrylic Caulk
6) GE-60 Clear Coat

These suggestions and data are based on information we believe to be reliable. They are offered in good faith, but without guarantee, as conditions and methods of use are beyond our control. The prospective user should determine the suitability of our materials and installation recommendations before adopting them for commercial use.

102.11

A-100®

EXTERIOR LATEX SATIN
A82 SERIES

CHARACTERISTICS

A-100 Exterior Latex Satin is recommended for use on aluminum, vinyl siding, and wood siding, clapboard, shakes, shingles, plywood, masonry, and metal down to a surface and air temperature of 35°F.

Colors: most colors
Coverage: 350 - 400 sq ft/gal @ 4 mils wet; 1.3 mils dry
Drying Time, @ 50% RH:
temperature and humidity dependent

	@ 35-45°F	**@ 45°F +**
Touch:	2 hour	2 hours
Recoat:	24-48 hours	4 hours

Flash Point: N/A
Finish: 10-20 units @ 85°
Tinting with Blend-A-Color:

Base	**oz/gal**	**Strength**
Extra White	0-5	100%
Light Yellow	4-12	100%
Deep Base	4-12	100%
Ultradeep Base	4-12	100%

Vehicle Type: Acrylic
A82W51
VOC (less exempt solvents):
109 g/L; 0.91 lb/gal
Volume Solids: 33 ± 2%
Weight Solids: 45 ± 2%
Weight per Gallon: 10.1 lb
OTC Compliant

Mildew Resistant
This coating contains agents which inhibit the growth of mildew on the surface of this coating film.

SPECIFICATIONS

Standard latex primers cannot be used below 50°F. See specific primer label for that product's application conditions.

Aluminum & Aluminum Siding[1]
2 cts. A-100 Exterior Latex Satin
Concrete Block, CMU, Split face Block
1 ct. Loxon Block Surfacer
2 cts. A-100 Exterior Latex Satin
Brick
1 ct. Loxon Conditioner [2]
2 cts. A-100 Exterior Latex Satin
Cement Composition Siding/Panels
1 ct. Loxon Masonry Primer
or Loxon Conditioner[2]
2 cts. A-100 Exterior Latex Satin
Galvanized Steel[1]
2 cts. A-100 Exterior Latex Satin
Stucco, Cement, Concrete
1 ct. Loxon Masonry Primer
2 cts. A-100 Exterior Latex Satin
Plywood
1 ct. A-100 Exterior Latex Wood Primer
2 cts. A-100 Exterior Latex Satin
Steel[1]
1 ct. All Surface Enamel Latex Primer[2]
2 cts. A-100 Exterior Latex Satin
Vinyl Siding
2 cts. A-100 Exterior Latex Satin
Wood, Composition Board
1 ct. A-100 Oil Exterior Stain Blocking Primer
2 cts. A-100 Exterior Latex Satin

[1] On large expanses of metal siding, the air, surface, and material temperatures must be 50°F or higher.

[2] Not for use at temperatures under 50°F. See specific primer label for that product's application conditions.

SURFACE PREPARATION

WARNING! Removal of old paint by sanding, scraping or other means may generate dust or fumes that contain lead. Exposure to lead dust or fumes may cause brain damage or other adverse health effects, especially in children or pregnant women. Controlling exposure to lead or other hazardous substances requires the use of proper protective equipment, such as a properly fitted respirator (NIOSH approved) and proper containment and cleanup. For more information, call the National Lead Information Center at 1-800-424-LEAD (in US) or contact your local health authority.

Remove all surface contamination by washing with ProClean Professional® Prep Wash Concentrated Cleaner or other appropriate cleaner, rinse thoroughly and allow to dry. Scrape and sand peeled or checked paint to a sound surface. Sand glossy surfaces dull. Seal stains from water, smoke, ink, pencil, grease, etc. with PrepRite® ProBlock® Primer Sealer.

Aluminum and Galvanized Steel
Wash with a ProClean Professional® Prep Wash Concentrated Cleaner to remove any oil, grease, or other surface contamination. All corrosion must be removed with sandpaper, steel wool, or other abrading method.
Cement Composition Siding/Panels
Remove all dirt, dust, grease, oil, loose particles, laitance, foreign material, and peeling or defective coatings. Allow the surface to dry thoroughly. If the surface is new, test it for pH, if the pH is higher than 8, prime with Loxon Acrylic Primer.

continued on back

LOW TEMPERATURE 35° ... APPLICATION ...

SHERWIN WILLIAMS.

A-100®
EXTERIOR LATEX SATIN
A82 SERIES

SURFACE PREPARATION

Masonry, Concrete, Cement, Block
All new surfaces must be cured according to the supplier's recommendations—usually about 30 days. Remove all form release and curing agents. Rough surfaces can be filled to provide a smooth surface. If painting cannot wait 30 days, allow the surface to cure 7 days and prime the surface with Loxon Acrylic Primer. Cracks, voids, and other holes should be repaired with ConSeal Patch or Sealant.

Steel
Rust and mill scale must be removed using sandpaper, steel wool, or other abrading method. Bare steel must be primed the same day as cleaned.

Stucco
Remove any loose stucco, efflorescence, or laitance. Allow new stucco to cure at least 30 days before painting. If painting cannot wait 30 days, allow the surface to dry 5-7 days and prime with Loxon Masonry Primer. Repair cracks, voids, and other holes with ConSeal™ Patches and Sealants.

Vinyl
Clean the surface thoroughly by scrubbing with warm, soapy water. Rinse thoroughly. Do not paint vinyl siding with any color darker than the original color. Painting with darker colors may cause the siding to warp.

Wood, Plywood, Composition Board
Sand any exposed wood to a fresh surface. Patch all holes and imperfections with a wood filler or putty and sand smooth. All patched areas must be primed.

Caulking
Gaps between windows, doors, trim, and other through-wall openings can be filled with the appropriate Pro Select® Caulk after priming the surface.

SURFACE PREPARATION

Mildew
Remove before painting by washing with ProClean Professional Mildew Eliminator or a solution of 1 part liquid bleach and 3 parts water. Apply the solution and scrub the mildewed area. Allow the solution to remain on the surface for 10 minutes. Rinse thoroughly with water and allow the surface to dry before painting. Wear protective eyewear, waterproof gloves, and protective clothing. Quickly wash off any of the mixture that comes in contact with your skin. Do not add detergents or ammonia to the bleach/water solution.

APPLICATION

When the air temperature is at 35°F, substrates may be colder; prior to painting, check to be sure the **air, surface, and material temperature** are above 35°F and at least 5°F above the dew point. Avoid using if rain or snow is expected within 2-3 hours.
Do not apply at air or surface temperatures below 35°F or when air or surface temperatures may drop below 35°F within 48 hours.
No reduction necessary.

Brush
Use a nylon/polyester brush.

Roller
Use a 3/8" - 3/4" nap synthetic cover.

Spray—Airless

Pressure	2000 psi
Tip	.015"-.019"

CLEANUP INFORMATION

Clean spills, spatters, hands and tools immediately after use with soap and warm water. After cleaning, flush spray equipment with mineral spirits to prevent rusting of the equipment.
Follow manufacturer's safety recommendations when using mineral spirits.

CAUTIONS

For exterior use only.
Protect from freezing.
Non-photochemically reactive.

LABEL CAUTION

CAUTION contains CRYSTALLINE SILICA and ZINC. Use only with adequate ventilation. To avoid overexposure, open windows and doors or use other means to ensure fresh air entry during application and drying. If you experience eye watering, headaches, or dizziness, increase fresh air, or wear respiratory protection (NIOSH approved) or leave the area. Adequate ventilation required when sanding or abrading the dried film. If adequate ventilation cannot be provided wear an approved particulate respirator (NIOSH approved). Follow respirator manufacturer's directions for respirator use. Avoid contact with eyes and skin. Wash hands after using. Keep container closed when not in use. Do not transfer contents to other containers for storage. FIRST AID: In case of eye contact, flush thoroughly with large amounts of water. Get medical attention if irritation persists. If swallowed, call Poison Control Center, hospital emergency room, or physician immediately. DELAYED EFFECTS FROM LONG TERM OVEREXPOSURE. Abrading or sanding of the dry film may release crystalline silica which has been shown to cause lung damage and cancer under long term exposure. WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. DO NOT TAKE INTERNALLY. KEEP OUT OF THE REACH OF CHILDREN
HOTW 10/14/2004 A82W51 08 00

The information and recommendations set forth in this Product Data Sheet are based upon tests conducted by or on behalf of The Sherwin-Williams Company. Such information and recommendations set forth herein are subject to change and pertain to the product offered at the time of publication. Consult your Sherwin-Williams representative to obtain the most recent Product Data Sheet.

MATERIAL SAFETY DATA SHEET

A82W51
11 00

Section 1 -- PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NUMBER

A82W51

HMIS CODES
Health 2*
Flammability 0
Reactivity 0

PRODUCT NAME
A-100* Exterior Satin Latex Paint, Extra White

MANUFACTURER'S NAME
THE SHERWIN-WILLIAMS COMPANY
101 Prospect Avenue N.W.
Cleveland, OH 44115

EMERGENCY TELEPHONE NO.
(216) 566-2917

DATE OF PREPARATION
30-JUL-05

INFORMATION TELEPHONE NO.
(216) 566-2902

Section 2 -- COMPOSITION/INFORMATION ON INGREDIENTS

% by WT	CAS No.	INGREDIENT		UNITS	VAPOR PRESSURE
2	107-21-1	Ethylene Glycol			
		ACGIH TLV	100	mg/m3 CEILI (aerosol)	0.12 mm
		OSHA PEL	50	ppm CEILING	
0.3	14464-46-1	Cristobalite			
		ACGIH TLV	0.05	mg/m3 as Resp. Dust	
		OSHA PEL	0.05	mg/m3 as Resp. Dust	
3	1332-58-7	Kaolin			
		ACGIH TLV	2	mg/m3 as Resp. Dust	
		OSHA PEL	10	mg/m3 Total Dust	
		OSHA PEL	5	mg/m3 Respirable Fraction	
14	13463-67-7	Titanium Dioxide			
		ACGIH TLV	10	mg/m3 as Dust	
		OSHA PEL	10	mg/m3 Total Dust	
		OSHA PEL	5	mg/m3 Respirable Fraction	
2	1314-13-2	Zinc Oxide			
		ACGIH TLV	10	mg/m3 as Dust	
		OSHA PEL	10	mg/m3 Total Dust	
		OSHA PEL	5	mg/m3 Respirable Fraction	

Section 3 -- HAZARDS IDENTIFICATION

ROUTES OF EXPOSURE
INHALATION of vapor or spray mist.
EYE or SKIN contact with the product, vapor or spray mist.

EFFECTS OF OVEREXPOSURE
EYES: Irritation.
SKIN: Prolonged or repeated exposure may cause irritation.
INHALATION: Irritation of the upper respiratory system.

In a confined area vapors in high concentration may cause headache, nausea or dizziness.

SIGNS AND SYMPTOMS OF OVEREXPOSURE

Redness and itching or burning sensation may indicate eye or excessive skin exposure.

Continued on page 2

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

None generally recognized.

CANCER INFORMATION

For complete discussion of toxicology data refer to Section 11.

Section 4 -- FIRST AID MEASURES

EYES: Flush eyes with large amounts of water for 15 minutes. Get medical attention.

SKIN: Wash affected area thoroughly with soap and water. Remove contaminated clothing and launder before re-use.

INHALATION: If affected, remove from exposure. Restore breathing. Keep warm and quiet.

INGESTION: Do not induce vomiting. Get medical attention immediately.

Section 5 -- FIRE FIGHTING MEASURES

FLASH POINT	LEL	UEL
Not Applicable	N.A.	N.A.

FLAMMABILITY CLASSIFICATION

Not Applicable

EXTINGUISHING MEDIA

Carbon Dioxide, Dry Chemical, Alcohol Foam

UNUSUAL FIRE AND EXPLOSION HAZARDS

Closed containers may explode (due to the build-up of pressure) when exposed to extreme heat.

During emergency conditions overexposure to decomposition products may cause a health hazard. Symptoms may not be immediately apparent. Obtain medical attention.

SPECIAL FIRE FIGHTING PROCEDURES

Full protective equipment including self-contained breathing apparatus should be used.

Water spray may be ineffective. If water is used, fog nozzles are preferable. Water may be used to cool closed containers to prevent pressure build-up and possible autoignition or explosion when exposed to extreme heat.

Section 6 -- ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Remove all sources of ignition. Ventilate the area.

Remove with inert absorbent.

Section 7 -- HANDLING AND STORAGE

STORAGE CATEGORY

Not Applicable

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

Keep container closed when not in use. Transfer only to approved containers with complete and appropriate labeling. Do not take internally. Keep out of the reach of children.

Continued on page 3

Section 8 -- EXPOSURE CONTROLS/PERSONAL PROTECTION

PRECAUTIONS TO BE TAKEN IN USE

Use only with adequate ventilation.

Avoid contact with skin and eyes. Avoid breathing vapor and spray mist.

Wash hands after using.

This coating may contain materials classified as nuisance particulates (listed "as Dust" in Section 2) which may be present at hazardous levels only during sanding or abrading of the dried film. If no specific dusts are listed in Section 2, the applicable limits for nuisance dusts are ACGIH TLV 10 mg/m3 (total dust), 3 mg/m3 (respirable fraction), OSHA PEL 15 mg/m3 (total dust), 5 mg/m3 (respirable fraction).

Removal of old paint by sanding, scraping or other means may generate dust or fumes that contain lead. Exposure to lead dust or fumes may cause brain damage or other adverse health effects, especially in children or pregnant women. Controlling exposure to lead or other hazardous substances requires the use of proper protective equipment, such as a properly fitted respirator (NIOSH approved) and proper containment and cleanup. For more information, call the National Lead Information Center at 1-800-424-LEAD (in US) or contact your local health authority.

VENTILATION

Local exhaust preferable. General exhaust acceptable if the exposure to materials in Section 2 is maintained below applicable exposure limits. Refer to OSHA Standards 1910.94, 1910.107, 1910.108.

RESPIRATORY PROTECTION

If personal exposure cannot be controlled below applicable limits by ventilation, wear a properly fitted organic vapor/particulate respirator approved by NIOSH/MSHA for protection against materials in Section 2.

When sanding or abrading the dried film, wear a dust/mist respirator approved by NIOSH/MSHA for dust which may be generated from this product, underlying paint, or the abrasive.

PROTECTIVE GLOVES

Wear gloves which are recommended by glove supplier for protection against materials in Section 2.

EYE PROTECTION

Wear safety spectacles with unperforated sideshields.

Section 9 -- PHYSICAL AND CHEMICAL PROPERTIES

PRODUCT WEIGHT	10.06 lb/gal	1205 g/l
SPECIFIC GRAVITY	1.21	
BOILING POINT	212 - 388 F	100 - 197 C
MELTING POINT	Not Available	
VOLATILE VOLUME	66 %	
EVAPORATION RATE	Slower than ether	
VAPOR DENSITY	Heavier than air	
SOLUBILITY IN WATER	N.A.	
pH	9.5	

VOLATILE ORGANIC COMPOUNDS (VOC Theoretical)

0.91 lb/gal	109 g/l	Less Water and Federally Exempt Solvents
0.34 lb/gal	40 g/l	Emitted VOC

Continued on page 4

Section 10 -- STABILITY AND REACTIVITY

STABILITY -- Stable

CONDITIONS TO AVOID
None known.

INCOMPATIBILITY
None known.

HAZARDOUS DECOMPOSITION PRODUCTS
By fire: Carbon Dioxide, Carbon Monoxide

HAZARDOUS POLYMERIZATION
Will not occur

Section 11 -- TOXICOLOGICAL INFORMATION

CHRONIC HEALTH HAZARDS

Crystalline Silica (Quartz, Cristobalite) is listed by IARC and NTP. Long term exposure to high levels of silica dust, which can occur only when sanding or abrading the dry film, may cause lung damage (silicosis) and possibly cancer.

Ethylene Glycol is considered an animal teratogen. It has been shown to cause birth defects in rats and mice at high doses when given in drinking water or by gavage. There is no evidence to indicate it causes birth defects in humans.

Prolonged overexposure to solvent ingredients in Section 2 may cause adverse effects to the liver and urinary systems.

Rats exposed to titanium dioxide dust at 250 mg./m3 developed lung cancer, however, such exposure levels are not attainable in the workplace.

TOXICOLOGY DATA

CAS No.	Ingredient Name				
107-21-1	Ethylene Glycol				
		LC50	RAT	4HR	Not Available
		LD50	RAT		4700 mg/kg
14464-46-1	Cristobalite				
		LC50	RAT	4HR	Not Available
		LD50	RAT		Not Available
1332-58-7	Kaolin				
		LC50	RAT	4HR	Not Available
		LD50	RAT		Not Available
13463-67-7	Titanium Dioxide				
		LC50	RAT	4HR	Not Available
		LD50	RAT		Not Available
1314-13-2	Zinc Oxide				
		LC50	RAT	4HR	Not Available
		LD50	RAT		Not Available

Section 12 -- ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION
No data available.

Continued on page 5

Section 13 -- DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD

Waste from this product is not hazardous as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR 261.

Incinerate in approved facility. Do not incinerate closed container. Dispose of in accordance with Federal, State/Provincial, and Local regulations regarding pollution.

Section 14 -- TRANSPORT INFORMATION

No data available.

Section 15 -- REGULATORY INFORMATION

SARA 313 (40 CFR 372.65C) SUPPLIER NOTIFICATION

CAS No.	CHEMICAL/COMPOUND	% by WT	% Element
107-21-1	Ethylene Glycol	2	
	Zinc Compound	2	1.9

CALIFORNIA PROPOSITION 65

WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

TSCA CERTIFICATION

All chemicals in this product are listed, or are exempt from listing, on the TSCA Inventory.

Section 16 -- OTHER INFORMATION

This product has been classified in accordance with the hazard criteria of the Canadian Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

The above information pertains to this product as currently formulated, and is based on the information available at this time. Addition of reducers or other additives to this product may substantially alter the composition and hazards of the product. Since conditions of use are outside our control, we make no warranties, express or implied, and assume no liability in connection with any use of this information.

TABLE VI. Predomi

15

GLOSS
☐
☐
☐
☐
☐
■ 14158
■ 14159
☐
■ 14187
☐
■ 14223

* 14

TABLE VIII. Predominantly gray (16000, 2600

13 *

GLOSS	SEMIGLOSS
☐	■ 26173
☐	■ 26176
■ 16187	■ 26187
☐	■ 26231
☐	■ 26250
■ 16251	■ 26251
☐	■ 26270
☐	■ 26280
☐	■ 26293
☐	■ 26306
■ 16307	■ 26307

APPENDIX C: Worker Training Certificates

Training Submittal Summary

9/13/2005

Project ID 10571

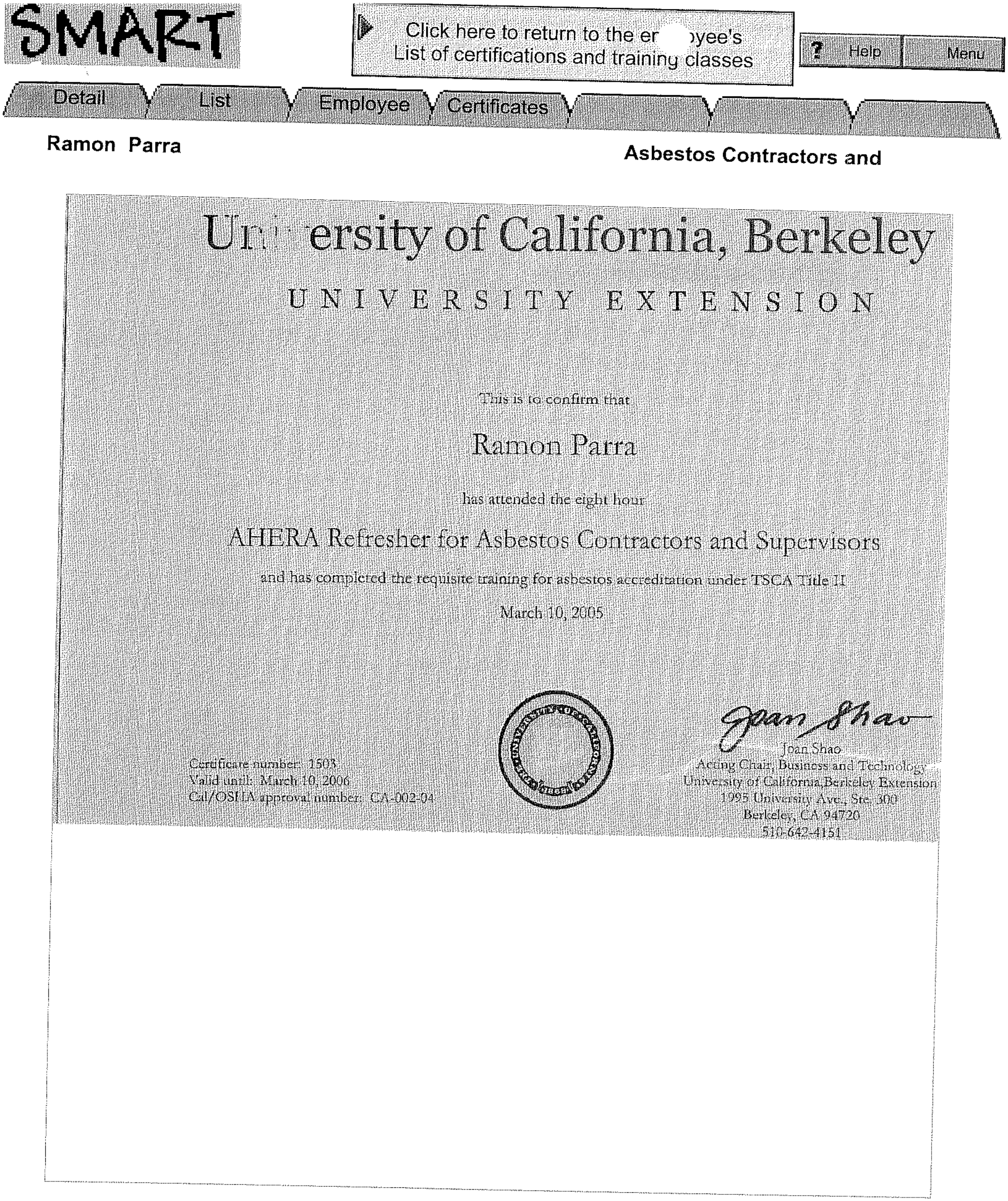
Project Name Kellco/ck/Burroughs Island

Forman Ramon Parra

Start Date 9-14-2005 **End Date** 9-28-2005

Crew Size 250000

Employee Name	Asbestos	Lead	Asbestos Medical	Respirator Fit Test	Blood Lead
Juan C Alejandre	12/6/2009	12/6/2009	2/7/2006	8/18/2006	
Manuel Benitez	6/4/2006	5/16/2006	6/27/2006	8/18/2006	
Ricardo Cardenas	4/9/2006	6/14/2006	6/16/2006	8/18/2006	
Jose M. Cervantes	8/13/2006	7/22/2006	10/05/2005	8/18/2006	
Cristobal Estrada	10/10/2005	2/2/2006	7/27/2006	8/18/2006	
Santiago Estrada	9/10/2006	12/5/2005	9/12/2006	8/18/2006	
Jose G. Gastelum	10/10/2005	12/1/2005	1/17/2006	8/18/2006	
Jose Magallon	3/5/2006	3/2/2006	3/14/2006	8/18/2006	
Antonio N Mendoza-Navarro	10/16/2005	2/23/2006	1/7/2006	8/18/2006	
Jose Munoz-V	9/17/2005	8/27/2006	2/25/2006	8/18/2006	
Ramon Parra	3/10/2006	12/3/2005	9/13/2006	9/13/2006	
Salvador Perez	1/16/2006	2/9/2006	2/14/2006	8/18/2006	
Juan A Torres-Cervantes	8/11/2006	8/20/2006	10/21/2005	8/18/2006	



Ramon Parra

Asbestos Contractors and

University of California, Berkeley

UNIVERSITY EXTENSION

This is to confirm that

Ramon Parra

has attended the eight hour

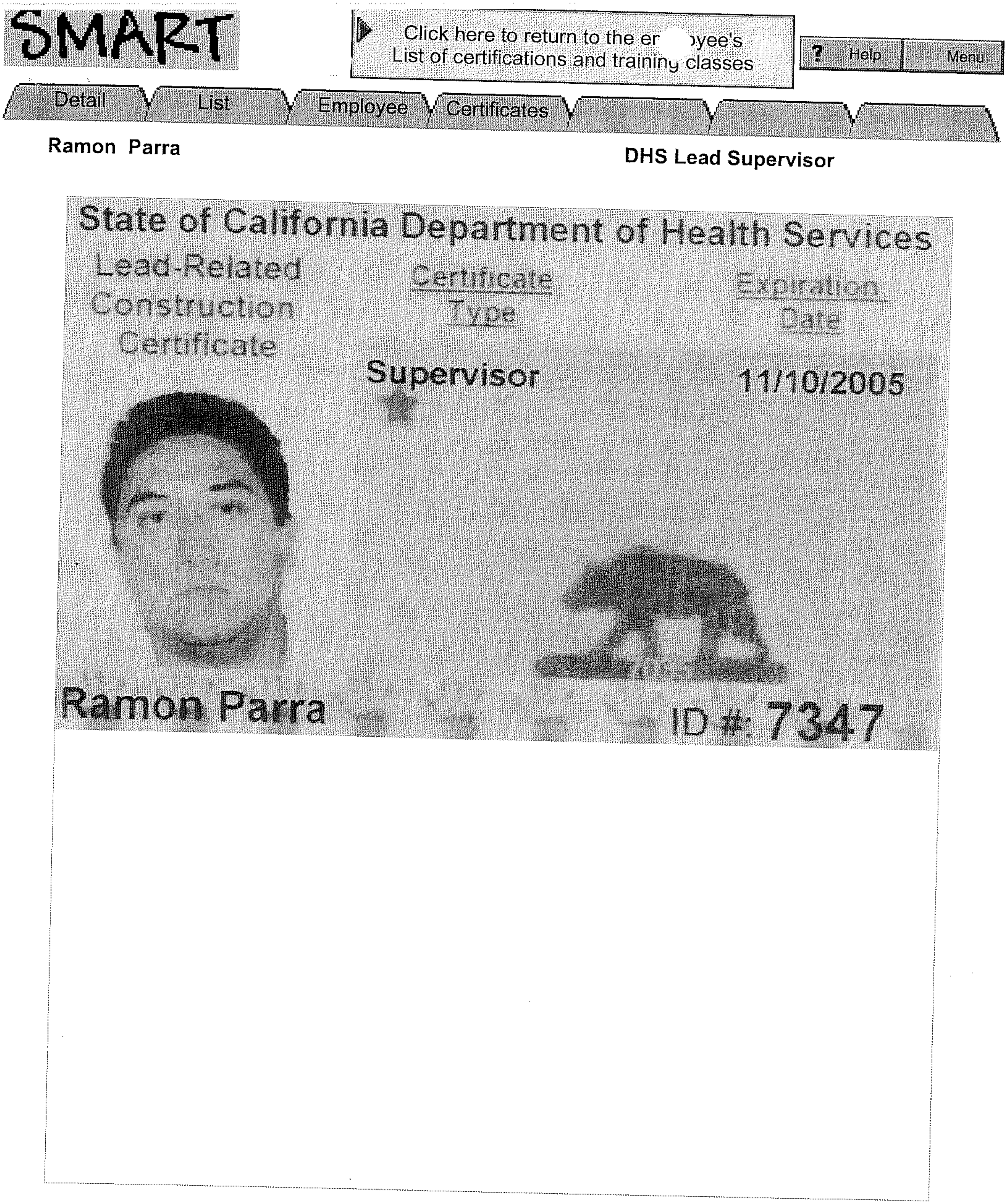
AHERA Refresher for Asbestos Contractors and Supervisors

and has completed the requisite training for asbestos accreditation under TSCA Title II

March 10, 2005

Certificate number: 1503
Valid until: March 10, 2006
Cal/OSHA approval number: CA-002-04

Joan Shao
Joan Shao
Acting Chair, Business and Technology
University of California,Berkeley Extension
1995 University Ave., Ste. 300
Berkeley, CA 94720
510-642-4151



Ramon Parra

DHS Lead Supervisor

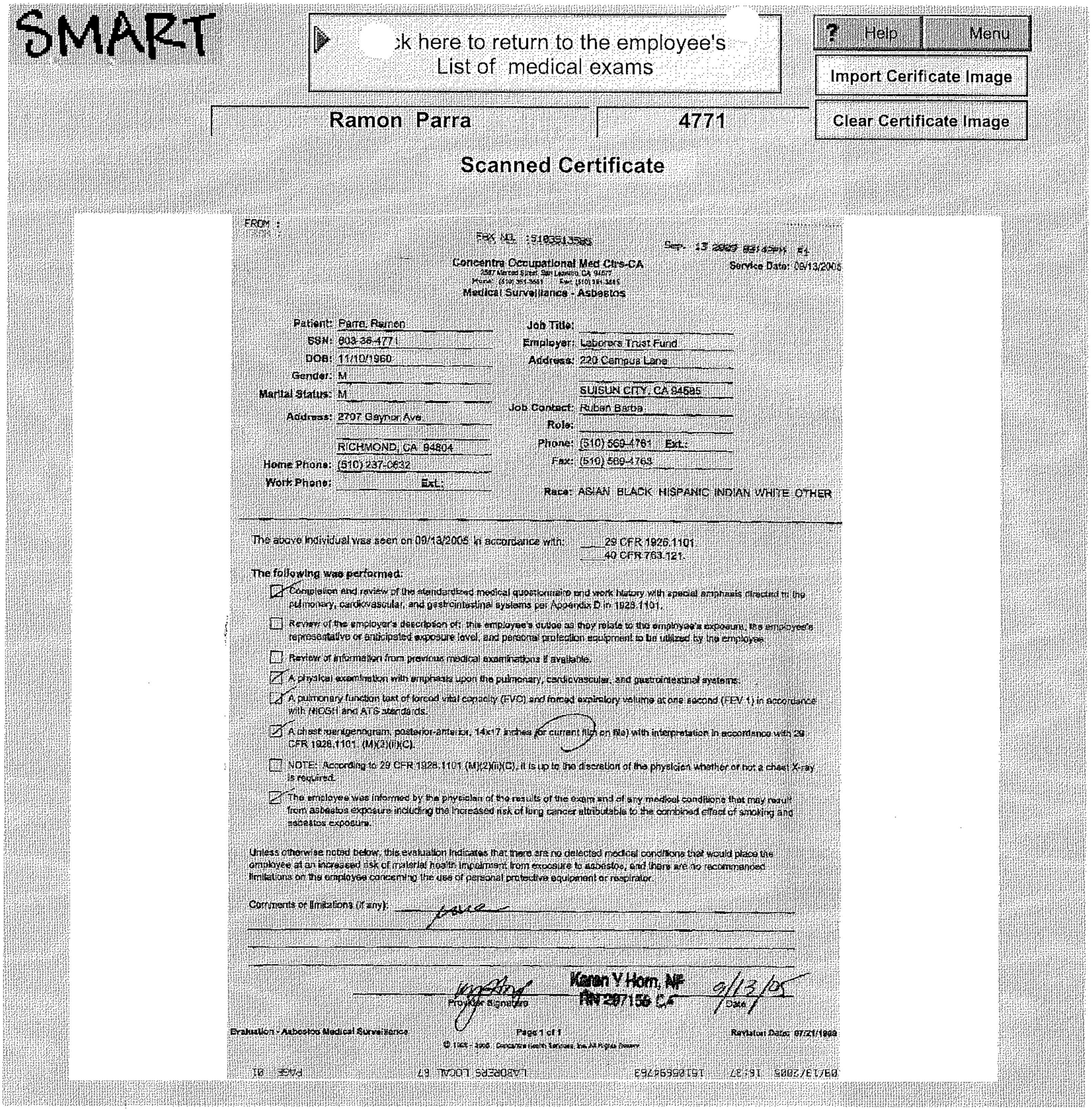
State of California Department of Health Services

Lead-Related Construction Certificate

Certificate Type	Expiration Date
Supervisor	11/10/2005

Ramon Parra

ID #: 7347



Ramon Parra | **4771**

Scanned Certificate

FROM :

FAX NO. :5103513585 Sep. 13 2005 03:42PM P1

Concentra Occupational Med Ctrs-CA
2587 Merced Street, San Leandro, CA 94577
Phone: (510) 351-3551 Fax: (510) 351-3445
Medical Surveillance - Asbestos

Service Date: 09/13/2005

Patient:	Parra, Ramon	**Job Title:**	
SSN:	603-36-4771	**Employer:**	Laborers Trust Fund
DOB:	11/10/1960	**Address:**	220 Campus Lane
Gender:	M		
Marital Status:	M		SUISUN CITY, CA 94585
Address:	2707 Gaynor Ave.	**Job Contact:**	Ruben Barba
		Role:	
	RICHMOND, CA 94804	**Phone:**	(510) 569-4761 Ext.:
Home Phone:	(510) 237-0632	**Fax:**	(510) 569-4763
Work Phone:	Ext.:	**Race:**	ASIAN BLACK HISPANIC INDIAN WHITE OTHER

The above individual was seen on 09/13/2005 in accordance with: ___ 29 CFR 1926.1101
___ 40 CFR 763.121.

The following was performed:

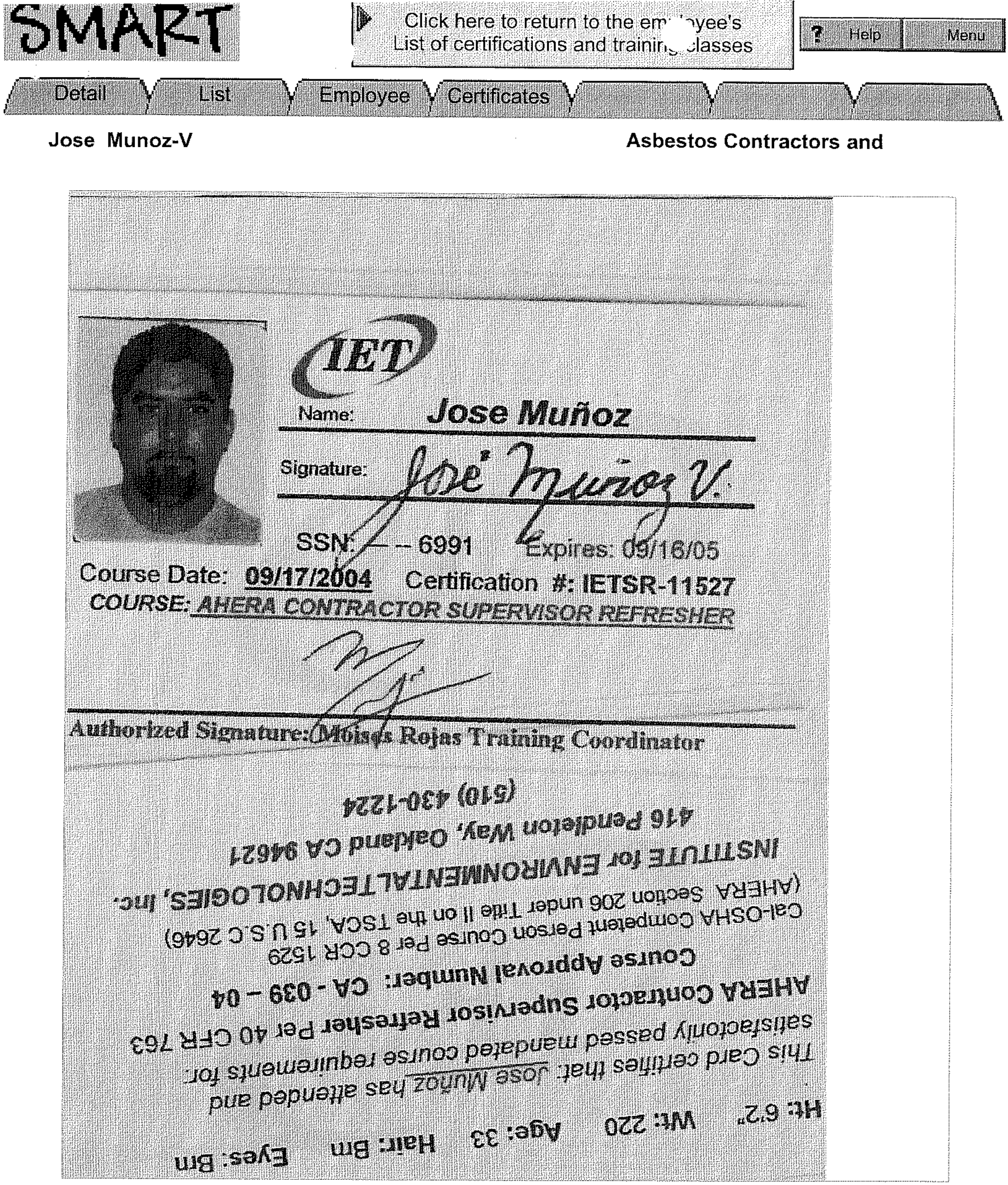
- ☑ Completion and review of the standardized medical questionnaire and work history with special emphasis directed to the pulmonary, cardiovascular, and gastrointestinal systems per Appendix D in 1926.1101.
- ☐ Review of the employer's description of: this employee's duties as they relate to the employee's exposure, the employee's representative or anticipated exposure level, and personal protection equipment to be utilized by the employee.
- ☐ Review of information from previous medical examinations if available.
- ☑ A physical examination with emphasis upon the pulmonary, cardiovascular, and gastrointestinal systems.
- ☑ A pulmonary function test of forced vital capacity (FVC) and forced expiratory volume at one second (FEV 1) in accordance with NIOSH and ATS standards.
- ☑ A chest roentgenogram, posterior-anterior, 14x17 inches (or [✓ current film] on file) with interpretation in accordance with 29 CFR 1926.1101. (M)(2)(ii)(C).
- ☐ NOTE: According to 29 CFR 1926.1101 (M)(2)(ii)(C), it is up to the discretion of the physician whether or not a chest X-ray is required.
- ☑ The employee was informed by the physician of the results of the exam and of any medical conditions that may result from asbestos exposure including the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure.

Unless otherwise noted below, this evaluation indicates that there are no detected medical conditions that would place the employee at an increased risk of material health impairment from exposure to asbestos, and there are no recommended limitations on the employee concerning the use of personal protective equipment or respirator.

Comments or limitations (if any): pass

Provider Signature **Karen Y Horn, NP**
RN 287156 CA 9/13/05 Date

Evaluation - Asbestos Medical Surveillance | Page 1 of 1 | Revision Date: 07/21/1999



Jose Munoz-V

Asbestos Contractors and

IET

Name: **Jose Muñoz**

Signature: José Muñoz V.

SSN: – – 6991 Expires: 09/16/05

Course Date: **09/17/2004** Certification **#: IETSR-11527**

COURSE: AHERA CONTRACTOR SUPERVISOR REFRESHER

Authorized Signature: Moises Rojas Training Coordinator

Ht: 6'2" Wt: 220 Age: 33 Hair: Brn Eyes: Brn

This Card certifies that: Jose Muñoz has attended and
satisfactorily passed mandated course requirements for
AHERA Contractor Supervisor Refresher Per 40 CFR 763
Course Approval Number: CA - 039 - 04
Cal-OSHA Competent Person Course Per 8 CCR 1529
(AHERA Section 206 under Title II on the TSCA, 15 U.S.C 2646)

INSTITUTE for ENVIRONMENTALTECHNOLOGIES, Inc.
416 Pendleton Way, Oakland CA 94621
(510) 430-1224

State of California – Health and Human Services Agency

Department of Health Services
Childhood Lead Poisoning Prevention Branch (CLPPB)

No. 71500
Form Number

COURSE COMPLETION FORM

Instructions: The top half of this form is to be completed by the student, and the bottom half is to be completed by the accredited training provider. The accredited training provider must submit the top (white) copy of this form to CLPPB ***and*** the last two (pink and yellow) copies to the student within ***30 calendar days*** of the student's successful completion of the final examination. / ***Instrucciones:*** *La parte superior de este formulario deberá ser completada por el estudiante y la parte inferior por el Proveedor acreditado del entrenamiento. El Proveedor del entrenamiento tiene que mandar la copia blanca a CLPPB y las copias rosada y amarilla al estudiante dentro de los siguientes 30 días de haber pasado el examen final.*

Student Information – To be completed by the student. Please print or type. Press firmly./*Deberá completarse por el estudiante. Favor de escribir firmemente y con letra de molde.*

Name / *Nombre* (last / *apellido*) MUNOZ (first / *primer nombre*) JOSE. (middle initial / *segundo nombre*)

Telephone number / *Número de teléfono* (510) 772-7454.

Home address (number, street, apartment number, PO box number / ***Dirección*** *(número, calle, número de apartamento, apartado postal)*
16171 MARSELLA ST #8

City / *Ciudad* SAN LEANDRO — State / *Estado* CA — ZIP code / *Código postal* 94578

Date of birth (month/day/year)/ ***Fecha de nacimiento*** *(mes/día/año)* 02 / 28 / 1971.

Photo identification / *Tarjeta de identificación con foto*
Number / *Número* AB748861
Type / *Tipo*
☒ Driver's license / *Licencia de manejar*
☐ Resident alien card / *Tarjeta de residencia*
☐ Other ID / *Otro tipo de ID* (specify / *especifique*):

Mailing address, if different (employer or union name, number, street, apartment number, PO box number) /
Dirección de correo, si es diferente *(nombre de patron or unión, número, calle, número de apartamento, apartado postal)*
Local 167
2400 Enterprise Way # 11

City / *Ciudad* Oakland — State / *Estado* CA — ZIP code / *Código postal* 94621

Gender / *Sexo*
☒ Male / *Masculino* ☐ Female / *Femenino*

If currently DHS certified, provide DHS certificate ID number / *Si está certificado por DHS, favor de dar su número de DHS* 11917

Race/Ethnicity / *Raza/Etnia*
☐ Asian / *Asiático* ☐ Black/African American / *Negro/Africano Americano* ☒ Latino/Hispanic / *Latino Americano* ☐ Native American / *Americano Nativo*
☐ White / *Blanco* ☐ Pacific Islander / *Pacifico Isleño* ☐ Other / *Otro:*

Prior to signing, read the Privacy Statement and other information on the back of the form.
Antes de firmar, lea la Declaración Sobre la Privacidad, y otra información en la parte de atrás de este formulario.

Signature of student / *Firma del estudiante* Jose Munoz V.

Date (month/day/year) / *Fecha (mes/día/año)* 08 / 27 / 05

Training Information – To be completed by accredited training provider. Please print or type. Press firmly.

Accredited Training Provider name and address
ESTP
11315 Sunrise Gold Cir
Rancho Cordova, CA

Training Provider Phone Number (916) 638-5550

Course Number ESTP-024-CEW(SP)

Course title:
☐ Work
☐ Inspection/Assessment
☐ Certified Industrial Hygienist
☐ Project Designer
☒ Continuing Education for Workers
☐ General Continuing Education
☐ Supervision and Project Monitoring
☐ Supplemental Supervision and Project Monitoring

Instructor Name(s): Herminio Trujillo
☐ English
☒ Spanish

Course dates (mm/dd/yy) 08 / 27 / 05 to 08 / 27 / 05

Number of contact hours of instruction completed 7

Date student passed course or continuing education **final examination** (mm/dd/yy) 08 / 27 / 05

Core Instruction (if different)
Core instruction CCF number
Core CCF date (mm/dd/yy) / /

Location of course
1001 Westside Dr San Ramon CA

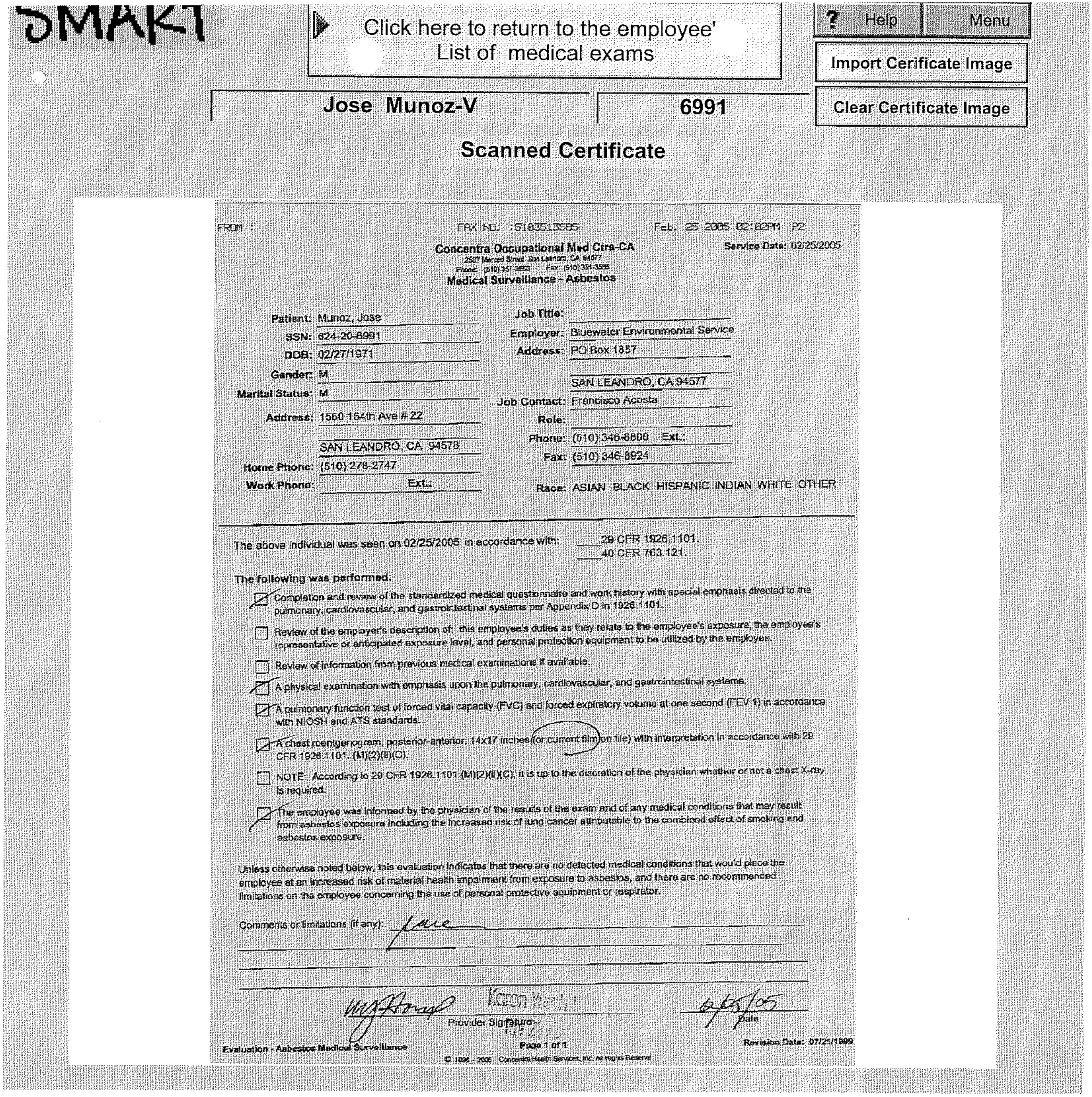
As Training Director, I hereby certify, under penalty of perjury, that the information provided herein is true and correct.

Name of Training Director – please print or type Neta Snider

Signature of Training Director for Neta Snider

Date (mm/dd/yy) 8 / 29 / 05

White Copy - CLPPB Blue Copy - Training Provider Pink Copy - Student (for Certification Application) YELLOW COPY - STUDENT



Jose Munoz-V | **6991**

Scanned Certificate

FROM : FAX NO. :5103513585 Feb. 25 2005 02:02PM P2

Concentra Occupational Med Ctrs-CA
2500 Merced Street San Leandro, CA 94577
Phone: (510) 351-3553 Fax: (510) 351-3585
Medical Surveillance - Asbestos

Service Date: 02/25/2005

Patient: Munoz, Jose
SSN: 624-20-6991
DOB: 02/27/1971
Gender: M
Marital Status: M
Address: 1560 164th Ave # 22
SAN LEANDRO, CA 94578
Home Phone: (510) 278-2747
Work Phone: Ext.:

Job Title:
Employer: Bluewater Environmental Service
Address: PO Box 1857
SAN LEANDRO, CA 94577
Job Contact: Francisco Acosta
Role:
Phone: (510) 346-8800 Ext.:
Fax: (510) 346-8924
Race: ASIAN BLACK HISPANIC INDIAN WHITE OTHER

The above individual was seen on 02/25/2005 in accordance with: ____29 CFR 1926.1101. ____40 CFR 763.121.

The following was performed:

- ☒ Completion and review of the standardized medical questionnaire and work history with special emphasis directed to the pulmonary, cardiovascular, and gastrointestinal systems per Appendix D in 1926.1101.
- ☐ Review of the employer's description of: this employee's duties as they relate to the employee's exposure, the employee's representative or anticipated exposure level, and personal protection equipment to be utilized by the employee.
- ☐ Review of information from previous medical examinations if available.
- ☒ A physical examination with emphasis upon the pulmonary, cardiovascular, and gastrointestinal systems.
- ☒ A pulmonary function test of forced vital capacity (FVC) and forced expiratory volume at one second (FEV 1) in accordance with NIOSH and ATS standards.
- ☒ A chest roentgenogram, posterior-anterior, 14x17 inches [✓ (or current film] on file) with interpretation in accordance with 29 CFR 1926.1101. (M)(2)(II)(C).
- ☐ NOTE: According to 29 CFR 1926.1101 (M)(2)(II)(C), it is up to the discretion of the physician whether or not a chest X-ray is required.
- ☒ The employee was informed by the physician of the results of the exam and of any medical conditions that may result from asbestos exposure including the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure.

Unless otherwise noted below, this evaluation indicates that there are no detected medical conditions that would place the employee at an increased risk of material health impairment from exposure to asbestos, and there are no recommended limitations on the employee concerning the use of personal protective equipment or respirator.

Comments or limitations (if any): fine

Provider Signature

2/25/05
Date

Evaluation - Asbestos Medical Surveillance
Page 1 of 1
Revision Date: 07/21/1999

Qualitative Fit Testing Certificate

PERSON TESTED: Jose Munoz-V

EMPLOYEE NUMBER: 624-20-6991

CLASSIFICATION: SP1

Respirator(s) Issued

	1	2	3
MAKE OF RESPIRATOR	North	Survivair	
MODEL OF RESPIRATOR	1/2 Face	PAPR	
SIZE	Medium	One-Size-Fits-All	
CARTRIDGE TYPE	HEPA	HEPA	

Type of Test:
- Qualitative using irritant smoke

Test Exercises:
- Positive & negative pressure tests
- Visual test
- Normal breathing
- Deep Breathing
- Nod head side to side
- Nod head up and down
- Grimace
- Bend over
- Jogging-in-place
- Breathe normally

I certify that I understand the exercises which have been shown to me today in properly fitting my respirator. I have been instructed about how to properly clean and maintain the respirator and how to field test and inspect my respirator. I agree to maintain and field check the respirator as instructed. I acknowledge that I have been issued the above type of respirator after successfully completing the qualitative fit test and I have received a copy of the SFUSD respiratory protection program and current regulations. An individual has been available to interpret this information to me in the event that I do not speak English.

Jose Munoz V

Jose Munoz-V

This certifies that the above named test subject has demonstrated an understanding of the hazards involved in working with: has been given instruction in the use and care of the respirator selected above.

Jose C. [illegible]

Agent for Owner

☐ Original Issuance

☐ Six-month Reissuance

This qualitative fit test expires on ***Aug 18, 2006***

SMART

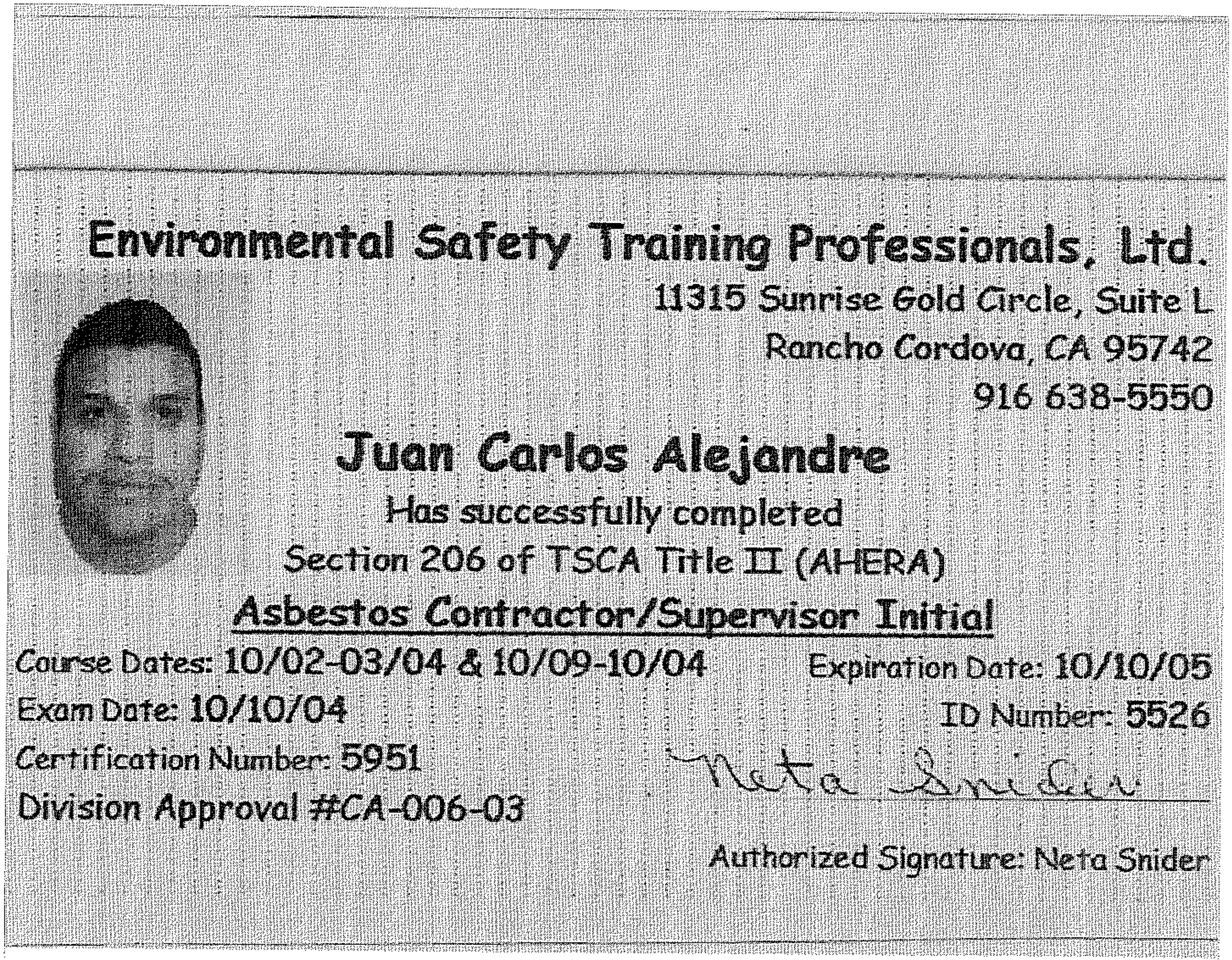
Click here to return to the em[illegible]yee's List of certifications and training classes

? Help | Menu

Detail | List | Employee | Certificates

Juan C Alejandre

Asbestos Contractors and Supervisor



Environmental Safety Training Professionals, Ltd.

11315 Sunrise Gold Circle, Suite L
Rancho Cordova, CA 95742
916 638-5550

Juan Carlos Alejandre

Has successfully completed
Section 206 of TSCA Title II (AHERA)

Asbestos Contractor/Supervisor Initial

Course Dates: 10/02-03/04 & 10/09-10/04
Expiration Date: 10/10/05
Exam Date: 10/10/04
ID Number: 5526
Certification Number: 5951
Division Approval #CA-006-03

Neta Snider

Authorized Signature: Neta Snider

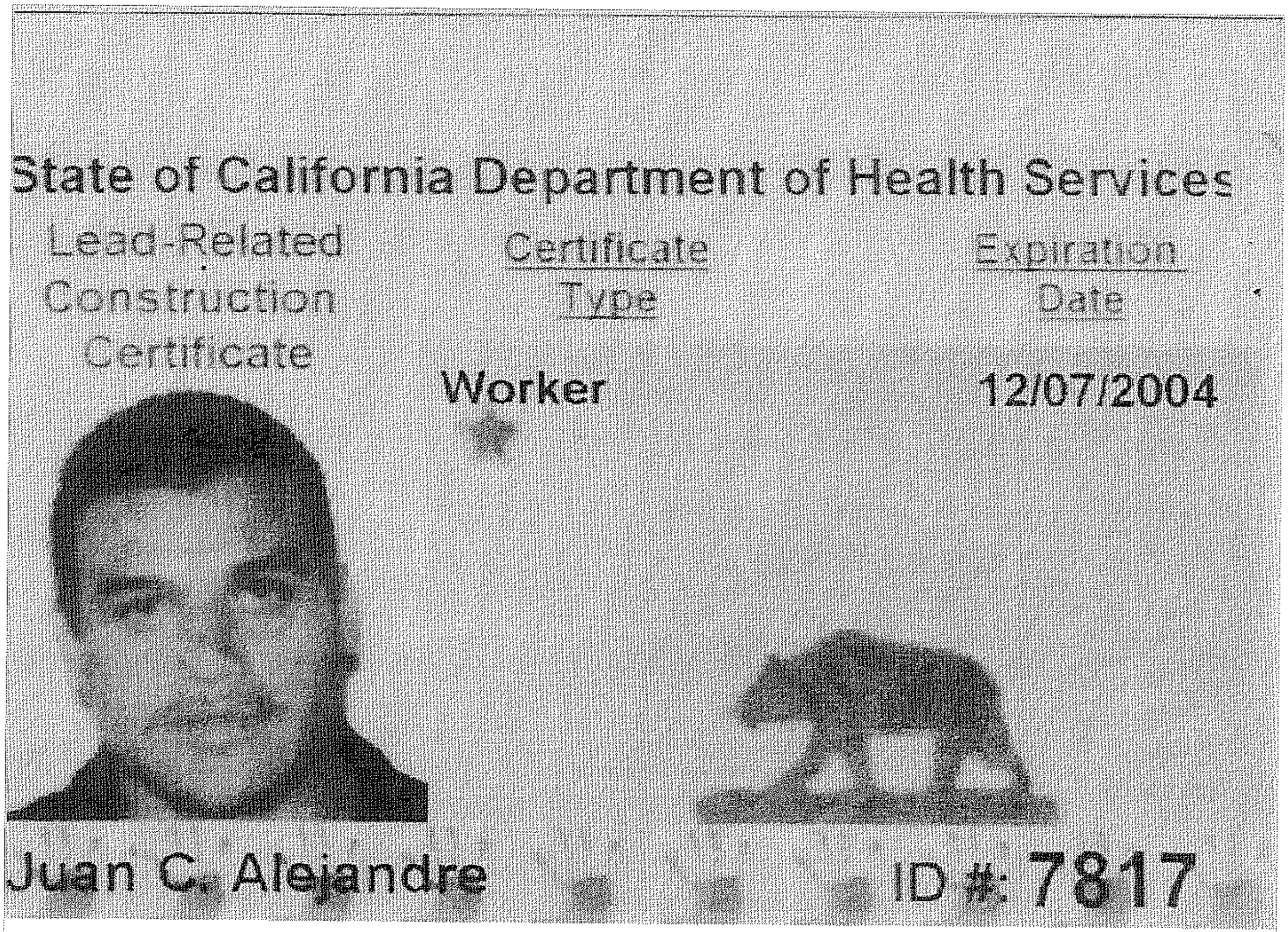
SMART

Click here to return to the em[illegible]yee's List of certifications and training [illegible]lasses

? Help | Menu

Detail | List | Employee | Certificates

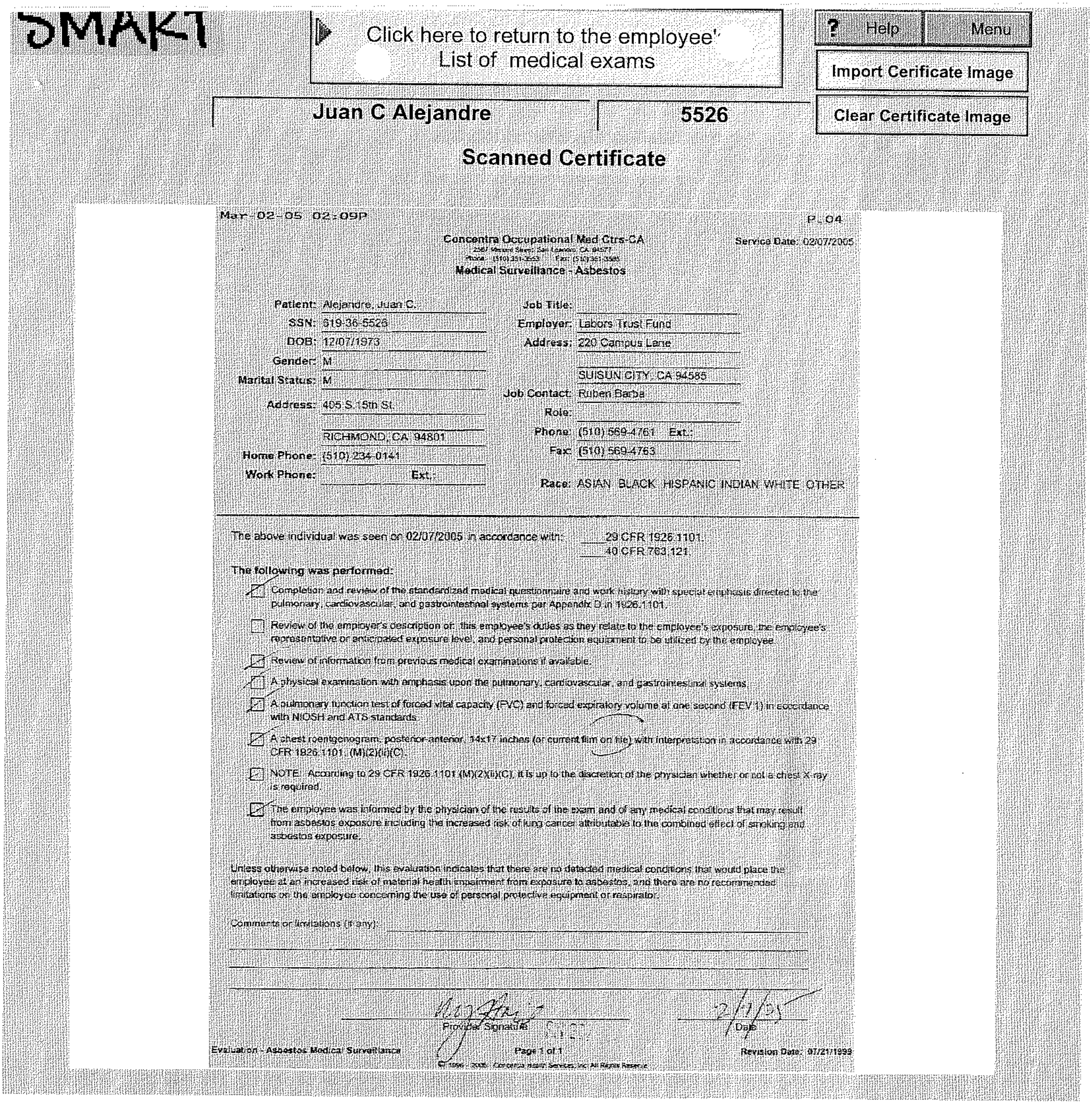
Juan C Alejandre **DHS Lead Worker**



State of California Department of Health Services

Lead-Related Construction Certificate	Certificate Type	Expiration Date
	Worker	12/07/2004

Juan C. Alejandre ID #: 7817



Juan C Alejandre
5526

Scanned Certificate

Mar-02-05 02:09P P.04

Concentra Occupational Med Ctrs-CA
2587 Merced Street, San Leandro, CA 94577
Phone: (510) 351-3553 Fax: (510) 351-3586
Medical Surveillance - Asbestos

Service Date: 02/07/2005

Patient: Alejandre, Juan C.
SSN: 619-36-5526
DOB: 12/07/1973
Gender: M
Marital Status: M
Address: 405 S 15th St.
RICHMOND, CA 94801
Home Phone: (510) 234-0141
Work Phone: Ext.:

Job Title:
Employer: Labors Trust Fund
Address: 220 Campus Lane
SUISUN CITY, CA 94585
Job Contact: Ruben Barba
Role:
Phone: (510) 569-4761 Ext.:
Fax: (510) 569-4763

Race: ASIAN BLACK HISPANIC INDIAN WHITE OTHER

The above individual was seen on 02/07/2005 in accordance with: ___ 29 CFR 1926.1101. ___ 40 CFR 763.121.

The following was performed:

☒ Completion and review of the standardized medical questionnaire and work history with special emphasis directed to the pulmonary, cardiovascular, and gastrointestinal systems per Appendix D in 1926.1101.

☐ Review of the employer's description of: this employee's duties as they relate to the employee's exposure, the employee's representative or anticipated exposure level, and personal protection equipment to be utilized by the employee.

☒ Review of information from previous medical examinations if available.

☒ A physical examination with emphasis upon the pulmonary, cardiovascular, and gastrointestinal systems.

☒ A pulmonary function test of forced vital capacity (FVC) and forced expiratory volume at one second (FEV 1) in accordance with NIOSH and ATS standards.

☒ A chest roentgenogram, posterior-anterior, 14x17 inches (or current film on file) with interpretation in accordance with 29 CFR 1926.1101. (M)(2)(ii)(C).

☒ NOTE: According to 29 CFR 1926.1101 (M)(2)(ii)(C), it is up to the discretion of the physician whether or not a chest X-ray is required.

☒ The employee was informed by the physician of the results of the exam and of any medical conditions that may result from asbestos exposure including the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure.

Unless otherwise noted below, this evaluation indicates that there are no detected medical conditions that would place the employee at an increased risk of material health impairment from exposure to asbestos, and there are no recommended limitations on the employee concerning the use of personal protective equipment or respirator.

Comments or limitations (if any):

Provider Signature

2/7/05
Date

Evaluation - Asbestos Medical Surveillance Page 1 of 1 Revision Date: 07/21/1999

Juan C Alejandre Employee Number **5526**

Qualitative Fit Testing Certificate

PERSON TESTED: Juan C Alejandre

EMPLOYEE NUMBER: 619-36-5526

CLASSIFICATION: WK3

Respirator(s) Issued

1	2	3
MAKE OF RESPIRATOR North	MAKE OF RESPIRATOR North	MAKE OF RESPIRATOR Survivair
MODEL OF RESPIRATOR 1/2 Face	MODEL OF RESPIRATOR 1/2 Face	MODEL OF RESPIRATOR PAPR
SIZE large	SIZE large	SIZE One-Size-Fits-All
CARTRIDGE TYPE HEPA	CARTRIDGE TYPE HEPA	CARTRIDGE TYPE HEPA

Type of Test:

- Qualitative using irritant smoke

Test Exercises:

- Positive & negative pressure tests
- Visual test
- Normal breathing
- Deep Breathing
- Nod head side to side
- Nod head up and down
- Grimace
- Bend over
- Jogging-in-place
- Breathe normally

I certify that I understand the exercises which have been shown to me today in properly fitting my respirator. I have been instructed about how to properly clean and maintain the respirator and how to field test and inspect my respirator. I agree to maintain and field check the respirator as instructed. I acknowledge that I have been issued the above type of respirator after successfully completing the qualitative fit test and I have received a copy of the SFUSD respiratory protection program and current regulations. An individual has been available to interpret this information to me in the event that I do not speak English.

Juan C Alejandre

Juan C Alejandre

This certifies that the above named test subject has demonstrated an understanding of the hazards involved in working with has been given instruction in the use and care of the respirator selected above.

Agent for Owner

☐ Original Issuance

☐ Six-month Reissuance

This qualitative fit test expires on Aug 18, 2006

SMART

Click here to return to the employee's List of certifications and traini classes

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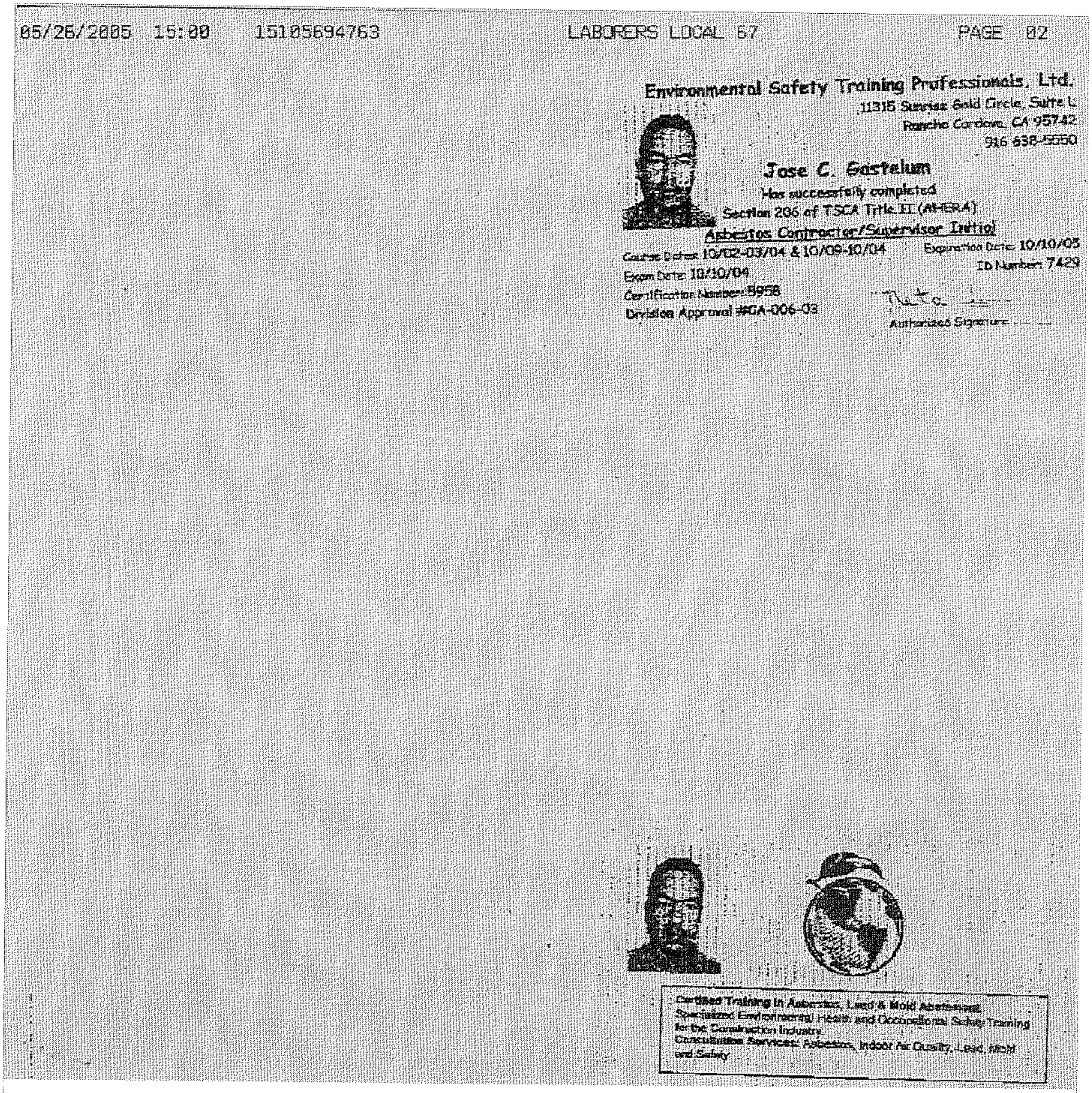
Detail | List | Employee | Certificates

Jose G. Gastelum **Asbestos Contractors and Supervisor**



05/26/2005 15:00 15105694763 LABORERS LOCAL 67 PAGE 02

Environmental Safety Training Professionals, Ltd.
11316 Sunrise Gold Circle, Suite L
Rancho Cordova, CA 95742
916 638-5550

Jose C. Gastelum
Has successfully completed
Section 206 of TSCA Title II (AHERA)
Asbestos Contractor/Supervisor Initial

Course Dates: 10/02-03/04 & 10/09-10/04
Expiration Date: 10/10/05
ID Number: 7429
Exam Date: 10/10/04
Certification Number: 5958
Division Approval #CA-006-03

Authorized Signature

Certified Training in Asbestos, Lead & Mold Abatement
Specialized Environmental Health and Occupational Safety Training for the Construction Industry
Consultation Services: Asbestos, Indoor Air Quality, Lead, Mold and Safety

SMART

Click here to return to the employee's List of certifications and traini[illegible]lasses

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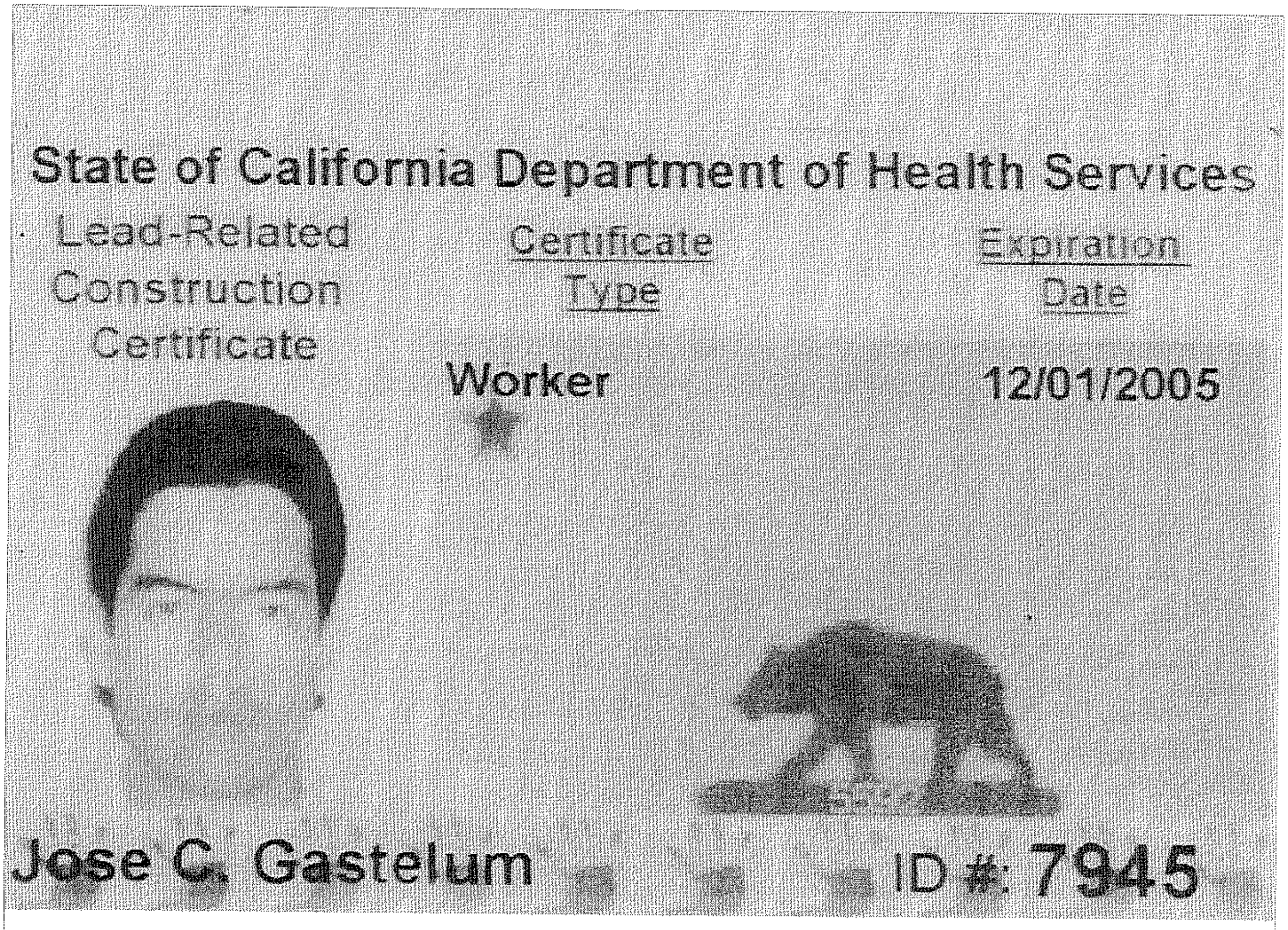
Jose G. Gastelum **DHS Lead Worker**

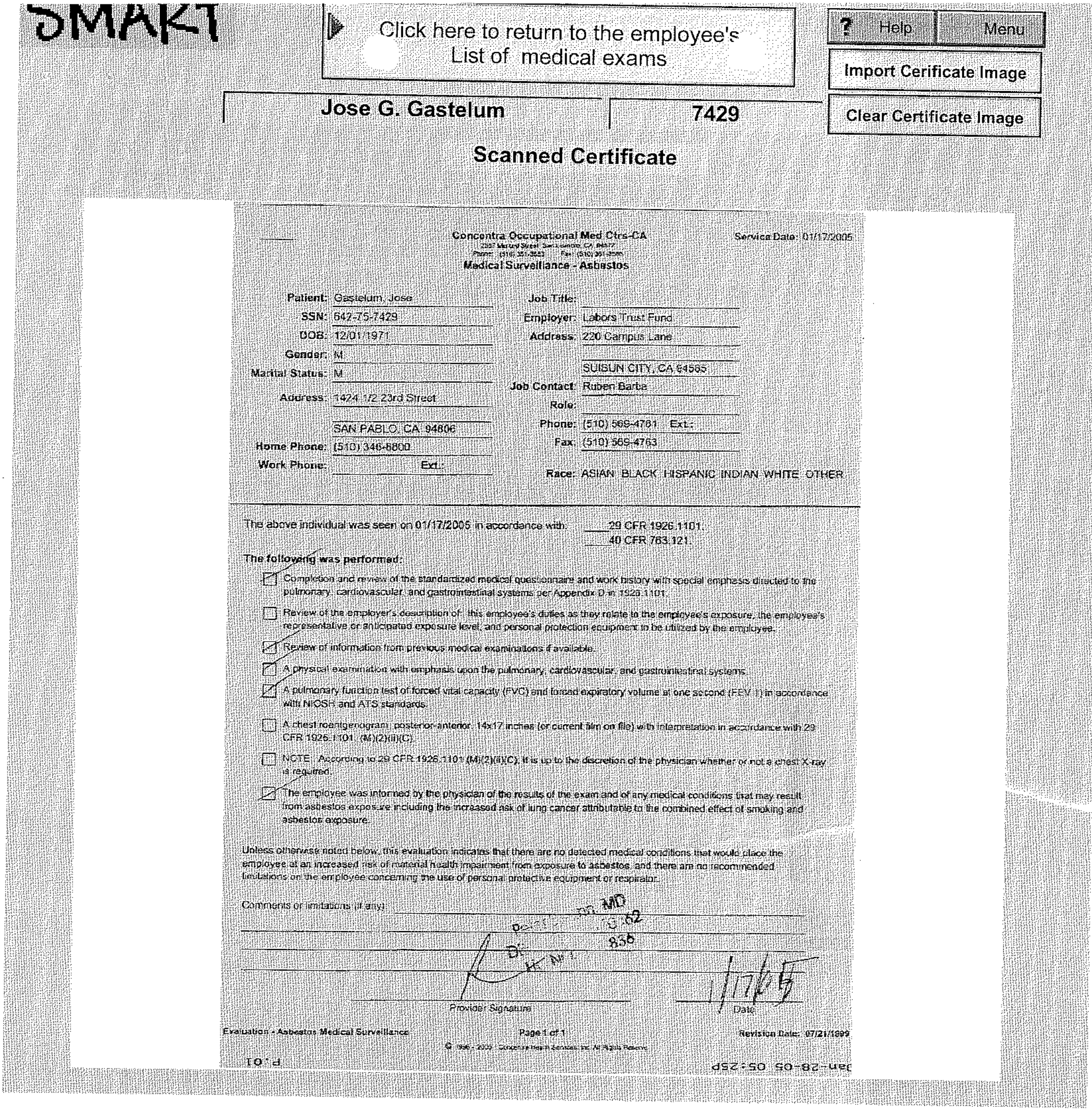


State of California Department of Health Services

Lead-Related Construction Certificate

Certificate Type	Expiration Date
Worker	12/01/2005

Jose C. Gastelum ID #: 7945



Jose G. Gastelum **7429**

Scanned Certificate

Concentra Occupational Med Ctrs-CA

Service Date: 01/17/2005

Medical Surveillance - Asbestos

Patient: Gastelum, Jose
SSN: 642-75-7429
DOB: 12/01/1971
Gender: M
Marital Status: M
Address: 1424 1/2 23rd Street
SAN PABLO, CA 94806
Home Phone: (510) 346-8800
Work Phone: Ext.:

Job Title:
Employer: Labors Trust Fund
Address: 220 Campus Lane
SUISUN CITY, CA 94585
Job Contact: Ruben Barba
Role:
Phone: (510) 569-4761 Ext.:
Fax: (510) 569-4763
Race: ASIAN BLACK HISPANIC INDIAN WHITE OTHER

The above individual was seen on 01/17/2005 in accordance with: ____29 CFR 1926.1101. ____40 CFR 763.121.

The following was performed:

- ☑ Completion and review of the standardized medical questionnaire and work history with special emphasis directed to the pulmonary, cardiovascular, and gastrointestinal systems per Appendix D in 1926.1101.
- ☐ Review of the employer's description of: this employee's duties as they relate to the employee's exposure, the employee's representative or anticipated exposure level, and personal protection equipment to be utilized by the employee.
- ☑ Review of information from previous medical examinations if available.
- ☑ A physical examination with emphasis upon the pulmonary, cardiovascular, and gastrointestinal systems.
- ☑ A pulmonary function test of forced vital capacity (FVC) and forced expiratory volume at one second (FEV 1) in accordance with NIOSH and ATS standards.
- ☐ A chest roentgenogram, posterior-anterior, 14x17 inches (or current film on file) with interpretation in accordance with 29 CFR 1926.1101. (M)(2)(ii)(C).
- ☐ NOTE: According to 29 CFR 1926.1101 (M)(2)(ii)(C), it is up to the discretion of the physician whether or not a chest X-ray is required.
- ☑ The employee was informed by the physician of the results of the exam and of any medical conditions that may result from asbestos exposure including the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure.

Unless otherwise noted below, this evaluation indicates that there are no detected medical conditions that would place the employee at an increased risk of material health impairment from exposure to asbestos, and there are no recommended limitations on the employee concerning the use of personal protective equipment or respirator.

Comments or limitations (if any):

[illegible] MD
[illegible] 62
836

Provider Signature

1/17/05
Date

Evaluation - Asbestos Medical Surveillance Page 1 of 1 Revision Date: 07/21/1999

P.01 Jan-28-05 05:25P

Jose G. Gastelum Employee Number **7429**

Qualitative Fit Testing Certificat

PERSON TESTED: Jose G. Gastelum

EMPLOYEE NUMBER: 642-75-7429

CLASSIFICATION: WK3

Respirator(s) Issued

1	2	3
MAKE OF RESPIRATOR North	MAKE OF RESPIRATOR Survivair	MAKE OF RESPIRATOR
MODEL OF RESPIRATOR 1/2 Face	MODEL OF RESPIRATOR PAPR	MODEL OF RESPIRATOR
SIZE large	SIZE One-Size-Fits-All	SIZE
CARTRIDGE TYPE HEPA	CARTRIDGE TYPE HEPA	CARTRIDGE TYPE

Type of Test:
- Qualitative using irritant smoke

Test Exercises:
- Positive & negative pressure te
- Visual test
- Normal breathing
- Deep Breathing
- Nod head side to side
- Nod head up and down
- Grimace
- Bend over
- Jogging-in-place
- Breathe normally

I certify that I understand the exercises which have been shown to me today in properly fitting my respirator. I have been instructed about how to properly clean and maintain the respirator and how to field test and inspect my respirator. I agree to maintain and field check the respirator as instructed. I acknowledge that I have been issued the above type of respirator after successfully completing the qualitative fit test and I have received a copy of the SFUSD respiratory protection program and current regulations. An individual has been available to interpret this information to me in the event that I do not speak English.

Jose G Gastelum

Jose G. Gastelum

This certifies that the above named test subject has demonstrated an understanding of the hazards involved in working with has been given instruction in the use and care of the respirator selected above.

Agent for Owner

☐ Original Issuance

☐ Six-month Reissuance

This qualitative fit test expires on ***Aug 18, 2006***

SMART

Click here to return to the employee's List of certifications and trainir lasses

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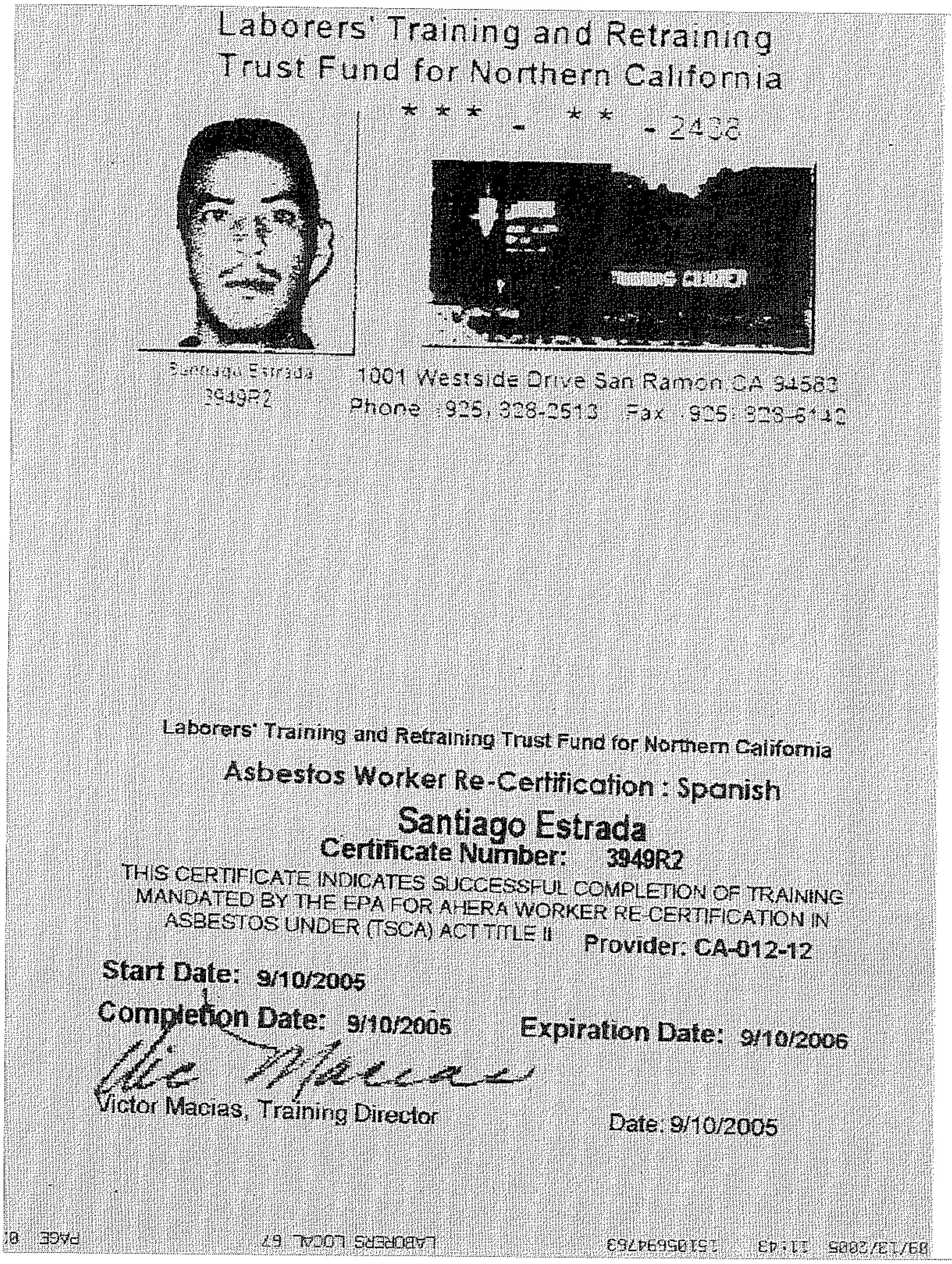
Detail | List | Employee | Certificates

Santiago Estrada **Asbestos AHERA Worker Refresher**



Laborers' Training and Retraining
Trust Fund for Northern California

*** - ** -2438

Santiago Estrada
3949R2

1001 Westside Drive San Ramon CA 94583
Phone (925) 828-2513 Fax (925) 828-6140

Laborers' Training and Retraining Trust Fund for Northern California

Asbestos Worker Re-Certification : Spanish

Santiago Estrada

Certificate Number: 3949R2

THIS CERTIFICATE INDICATES SUCCESSFUL COMPLETION OF TRAINING MANDATED BY THE EPA FOR AHERA WORKER RE-CERTIFICATION IN ASBESTOS UNDER (TSCA) ACT TITLE II

Provider: CA-012-12

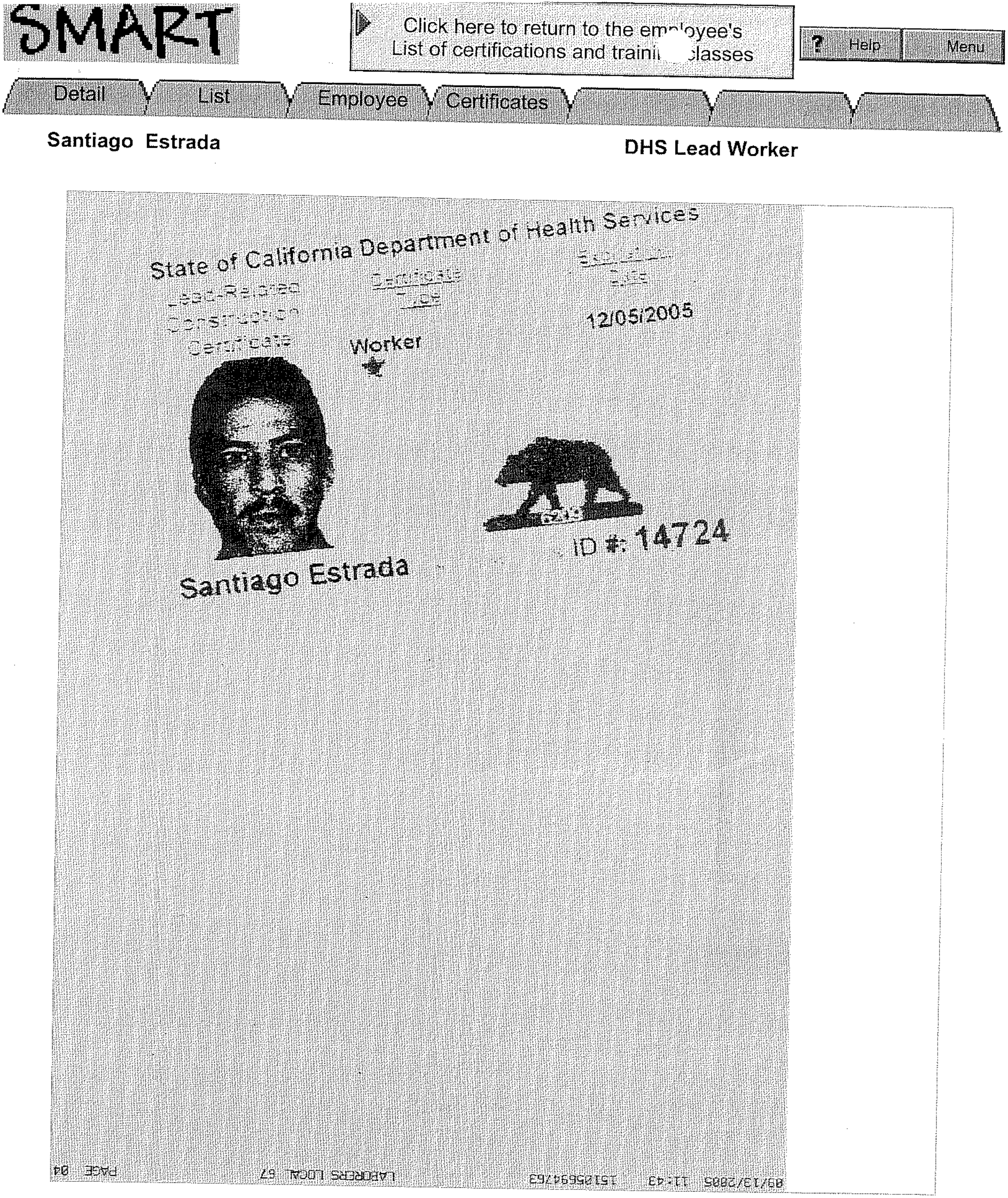
Start Date: 9/10/2005

Completion Date: 9/10/2005 **Expiration Date: 9/10/2006**

Vic Macias

Victor Macias, Training Director

Date: 9/10/2005



Santiago Estrada

DHS Lead Worker

State of California Department of Health Services

Lead-Related Construction Certificate

Certificate Type

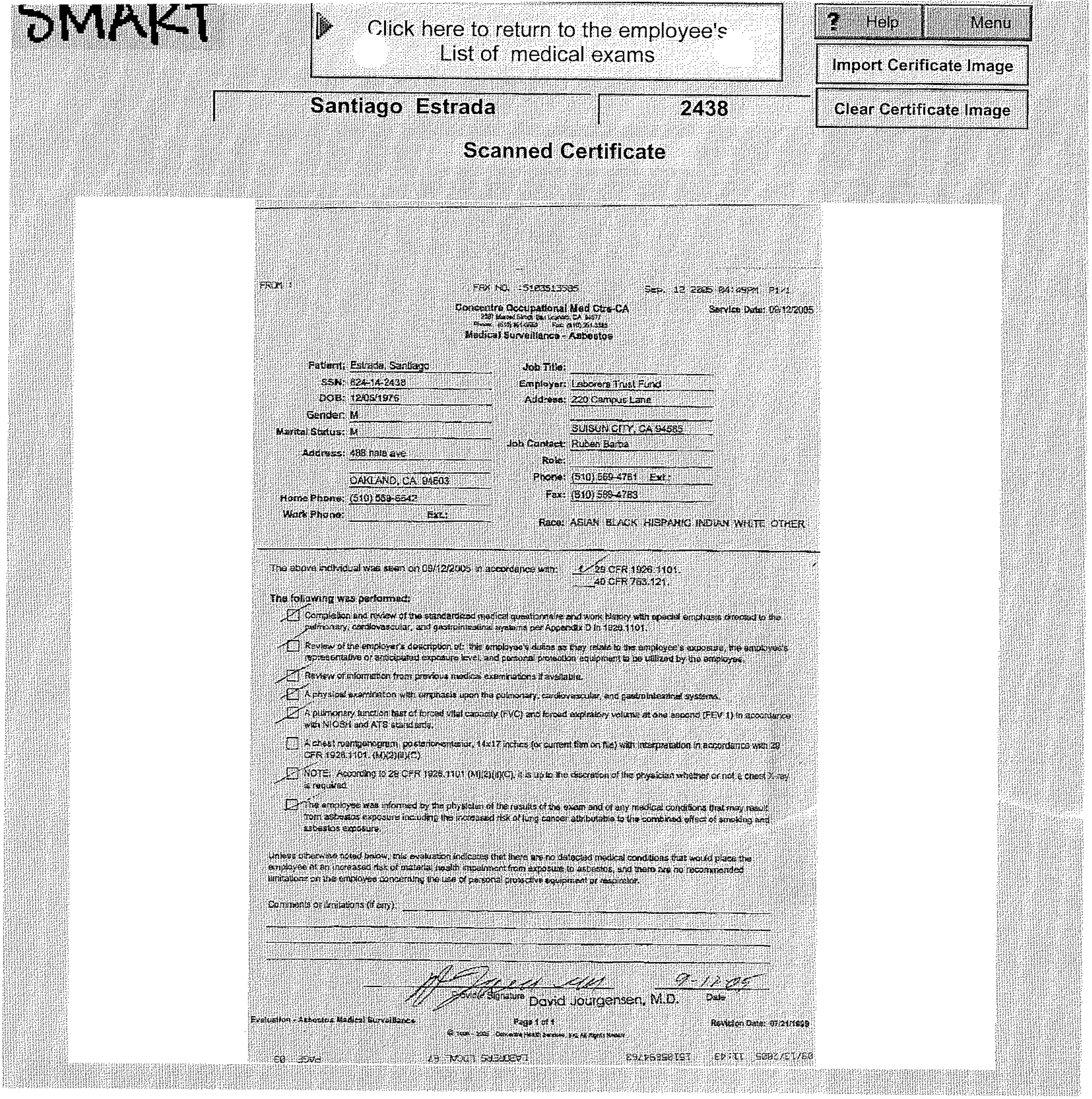
Expiration Date

12/05/2005

Worker

Santiago Estrada

ID #: 14724



Santiago Estrada **2438**

Scanned Certificate

FROM : FAX NO. :5103513585 Sep. 12 2005 04:49PM P1/1

Concentra Occupational Med Ctrs-CA
2587 Merced Street San Leandro, CA 94577
Phone: (510) 351-0582 Fax: (510) 351-3585
Medical Surveillance - Asbestos

Service Date: 09/12/2005

Patient: Estrada, Santiago
SSN: 624-14-2438
DOB: 12/05/1976
Gender: M
Marital Status: M
Address: 488 hale ave
OAKLAND, CA 94603
Home Phone: (510) 569-6542
Work Phone: Ext.:

Job Title:
Employer: Laborers Trust Fund
Address: 220 Campus Lane
SUISUN CITY, CA 94585
Job Contact: Ruben Barba
Role:
Phone: (510) 569-4761 Ext.:
Fax: (510) 569-4783

Race: ASIAN BLACK HISPANIC INDIAN WHITE OTHER

The above individual was seen on 09/12/2005 in accordance with: ✓ 29 CFR 1926.1101.
___ 40 CFR 763.121.

The following was performed:

- ☑ Completion and review of the standardized medical questionnaire and work history with special emphasis directed to the pulmonary, cardiovascular, and gastrointestinal systems per Appendix D in 1926.1101.
- ☑ Review of the employer's description of: the employee's duties as they relate to the employee's exposure, the employee's representative or anticipated exposure level, and personal protection equipment to be utilized by the employee.
- ☑ Review of information from previous medical examinations if available.
- ☑ A physical examination with emphasis upon the pulmonary, cardiovascular, and gastrointestinal systems.
- ☑ A pulmonary function test of forced vital capacity (FVC) and forced expiratory volume at one second (FEV 1) in accordance with NIOSH and ATS standards.
- ☐ A chest roentgenogram, posterior-anterior, 14x17 inches (or current film on file) with interpretation in accordance with 29 CFR 1926.1101. (M)(2)(ii)(C).
- ☑ NOTE: According to 29 CFR 1926.1101 (M)(2)(ii)(C), it is up to the discretion of the physician whether or not a chest X-ray is required.
- ☑ The employee was informed by the physician of the results of the exam and of any medical conditions that may result from asbestos exposure including the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure.

Unless otherwise noted below, this evaluation indicates that there are no detected medical conditions that would place the employee at an increased risk of material health impairment from exposure to asbestos, and there are no recommended limitations on the employee concerning the use of personal protective equipment or respirator.

Comments or limitations (if any): ______

Provider Signature David Jourgensen, M.D. 9-12-05 Date

Evaluation - Asbestos Medical Surveillance Page 1 of 1 Revision Date: 07/21/1999

09/13/2005 11:43 15105694763 LABORERS LOCAL 67 PAGE 08

Santiago Estrada

Employee Number **2438**

Qualitative Fit Testing Certificate

PERSON TESTED: Santiago Estrada

EMPLOYEE NUMBER: 624-14-2438

CLASSIFICATION: WK3

Respirator(s) Issued

1	2	3
MAKE OF RESPIRATOR North	MAKE OF RESPIRATOR Survivair	MAKE OF RESPIRATOR
MODEL OF RESPIRATOR 1/2 Face	MODEL OF RESPIRATOR PAPR	MODEL OF RESPIRATOR
SIZE Small	SIZE One-Size-Fits-All	SIZE
CARTRIDGE TYPE HEPA	CARTRIDGE TYPE HEPA	CARTRIDGE TYPE

Type of Test:
- Qualitative using irritant smoke

Test Exercises:
- Positive & negative pressure tests
- Visual test
- Normal breathing
- Deep Breathing
- Nod head side to side
- Nod head up and down
- Grimace
- Bend over
- Jogging-in-place
- Breathe normally

I certify that I understand the exercises which have been shown to me today in properly fitting my respirator. I have been instructed about how to properly clean and maintain the respirator and how to field test and inspect my respirator. I agree to maintain and field check the respirator as instructed. I acknowledge that I have been issued the above type of respirator after successfully completing the qualitative fit test and I have received a copy of the SFUSD respiratory protection program and current regulations. An individual has been available to interpret this information to me in the event that I do not speak English.

SantiaGo Estrada

Santiago Estrada

This certifies that the above named test subject has demonstrated an understanding of the hazards involved in working with asbestos has been given instruction in the use and care of the respirator selected above.

Agent for Owner

☐ Original Issuance

☐ Six-month Reissuance

This qualitative fit test expires on Aug 18, 2006

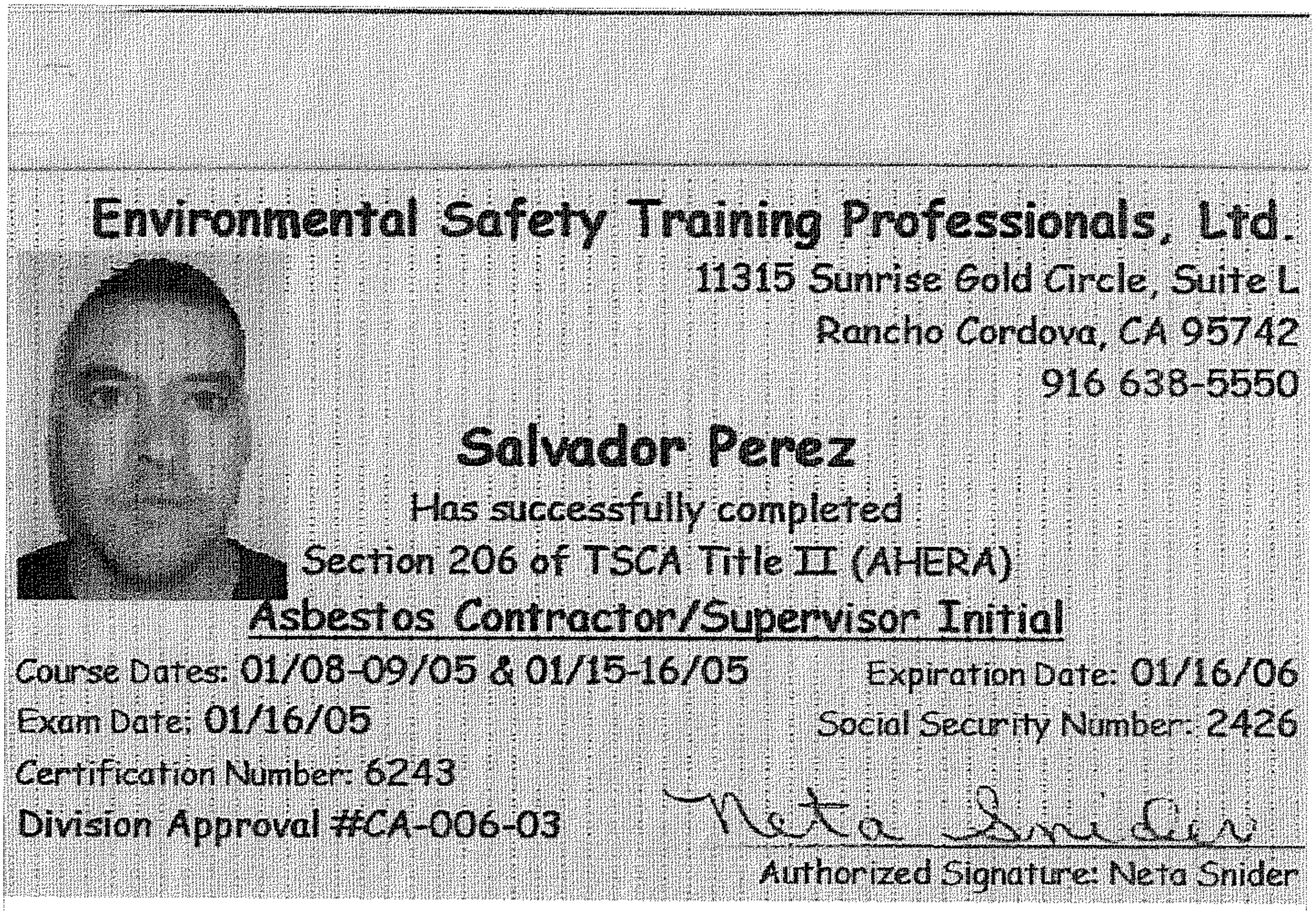
SMART

Click here to return to the employee's List of certifications and traini[illegible]lasses

? Help | Menu

Detail | List | Employee | Certificates

Salvador Perez **Asbestos Contractors and Supervisor**



Environmental Safety Training Professionals, Ltd.

11315 Sunrise Gold Circle, Suite L
Rancho Cordova, CA 95742
916 638-5550

Salvador Perez

Has successfully completed

Section 206 of TSCA Title II (AHERA)

Asbestos Contractor/Supervisor Initial

Course Dates: 01/08-09/05 & 01/15-16/05 Expiration Date: 01/16/06

Exam Date: 01/16/05 Social Security Number: 2426

Certification Number: 6243

Division Approval #CA-006-03

Neta Snider

Authorized Signature: Neta Snider

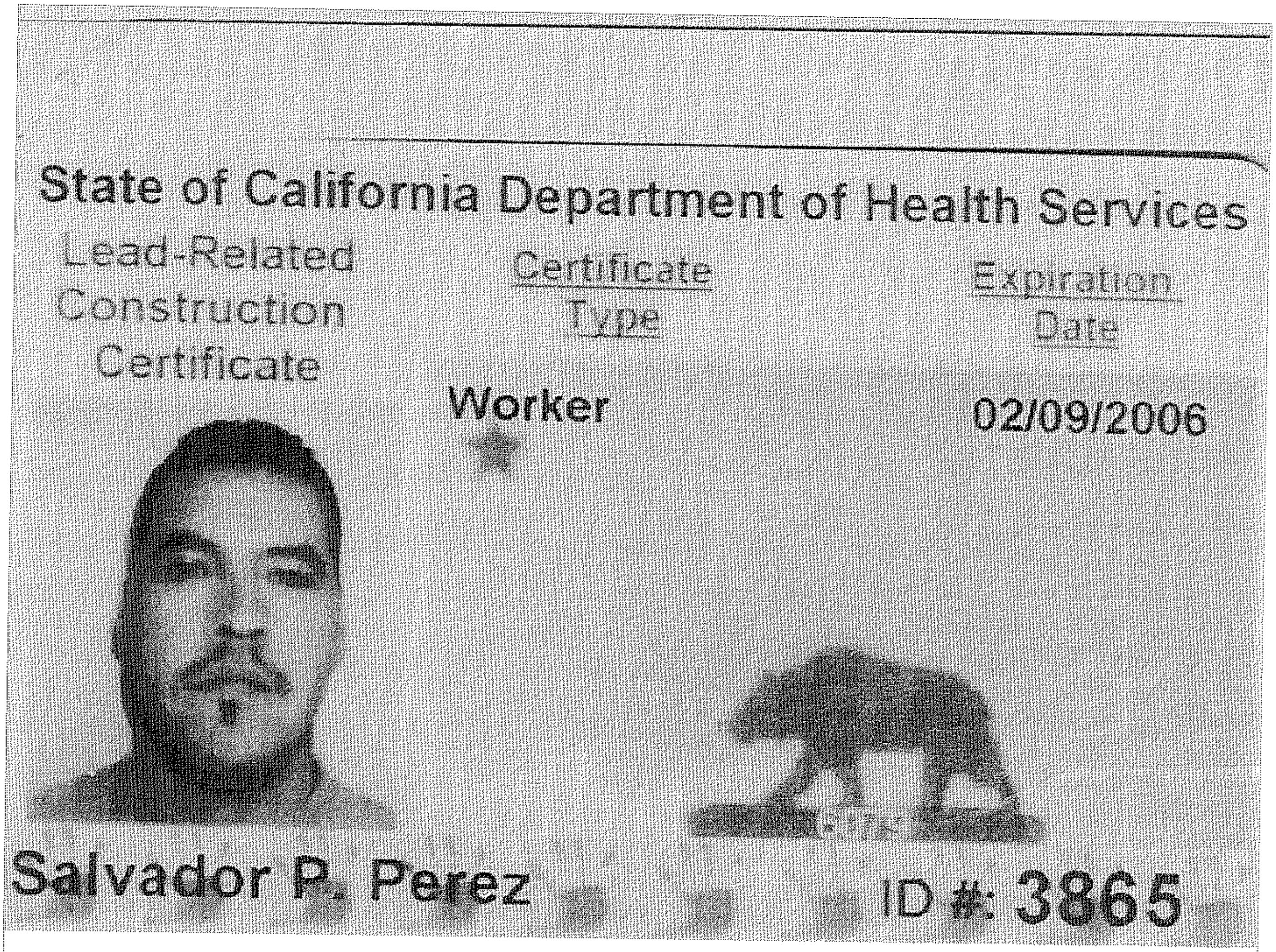
SMART

▶ Click here to return to the employee's List of certifications and training classes

? Help | Menu

Detail | List | Employee | Certificates

Salvador Perez **DHS Lead Worker**



State of California Department of Health Services

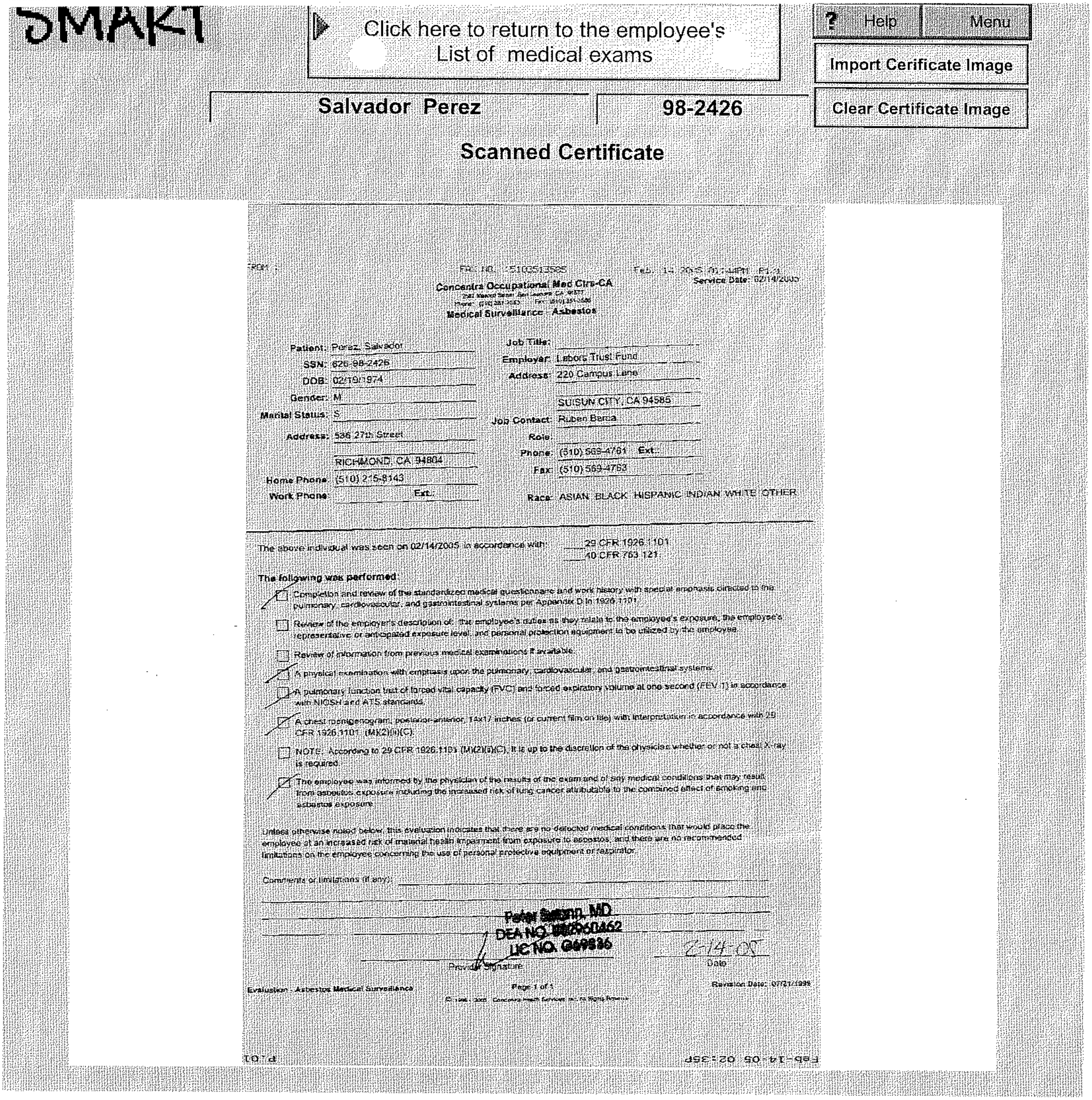
Lead-Related Construction Certificate

Certificate Type: Worker

Expiration Date: 02/09/2006

Salvador P. Perez

ID #: 3865



Salvador Perez **98-2426**

Scanned Certificate

FROM : FAX NO. :5103513585 Feb. 14 2005 01:44PM P1

Service Date: 02/14/2005

Concentra Occupational Med Ctrs-CA

Medical Surveillance - Asbestos

Patient: Perez, Salvador
SSN: 626-98-2426
DOB: 02/19/1974
Gender: M
Marital Status: S
Address: 536 27th Street
RICHMOND, CA 94804
Home Phone: (510) 215-8143
Work Phone: Ext.:

Job Title:
Employer: Labors Trust Fund
Address: 220 Campus Lane
SUISUN CITY, CA 94585
Job Contact: Ruben Barca
Role:
Phone: (510) 569-4761 **Ext.:**
Fax: (510) 569-4763
Race: ASIAN BLACK HISPANIC INDIAN WHITE OTHER

The above individual was seen on 02/14/2005 in accordance with: ___29 CFR 1926.1101
___40 CFR 763.121

The following was performed:

- ☑ Completion and review of the standardized medical questionnaire and work history with special emphasis directed to the pulmonary, cardiovascular, and gastrointestinal systems per Appendix D in 1926.1101.
- ☐ Review of the employer's description of: the employee's duties as they relate to the employee's exposure, the employee's representative or anticipated exposure level, and personal protection equipment to be utilized by the employee.
- ☐ Review of information from previous medical examinations if available.
- ☑ A physical examination with emphasis upon the pulmonary, cardiovascular, and gastrointestinal systems.
- ☑ A pulmonary function test of forced vital capacity (FVC) and forced expiratory volume at one second (FEV 1) in accordance with NIOSH and ATS standards.
- ☑ A chest roentgenogram, posterior-anterior, 14x17 inches (or current film on file) with interpretation in accordance with 29 CFR 1926.1101 (M)(2)(ii)(C).
- ☐ NOTE: According to 29 CFR 1926.1101 (M)(2)(ii)(C), it is up to the discretion of the physician whether or not a chest X-ray is required.
- ☑ The employee was informed by the physician of the results of the exam and of any medical conditions that may result from asbestos exposure including the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure.

Unless otherwise noted below, this evaluation indicates that there are no detected medical conditions that would place the employee at an increased risk of material health impairment from exposure to asbestos, and there are no recommended limitations on the employee concerning the use of personal protective equipment or respirator.

Comments or limitations (if any): __________

Peter [illegible], MD
DEA NO. [illegible]
LIC NO. G69836

Provider Signature

2-14-05
Date

Evaluation - Asbestos Medical Surveillance

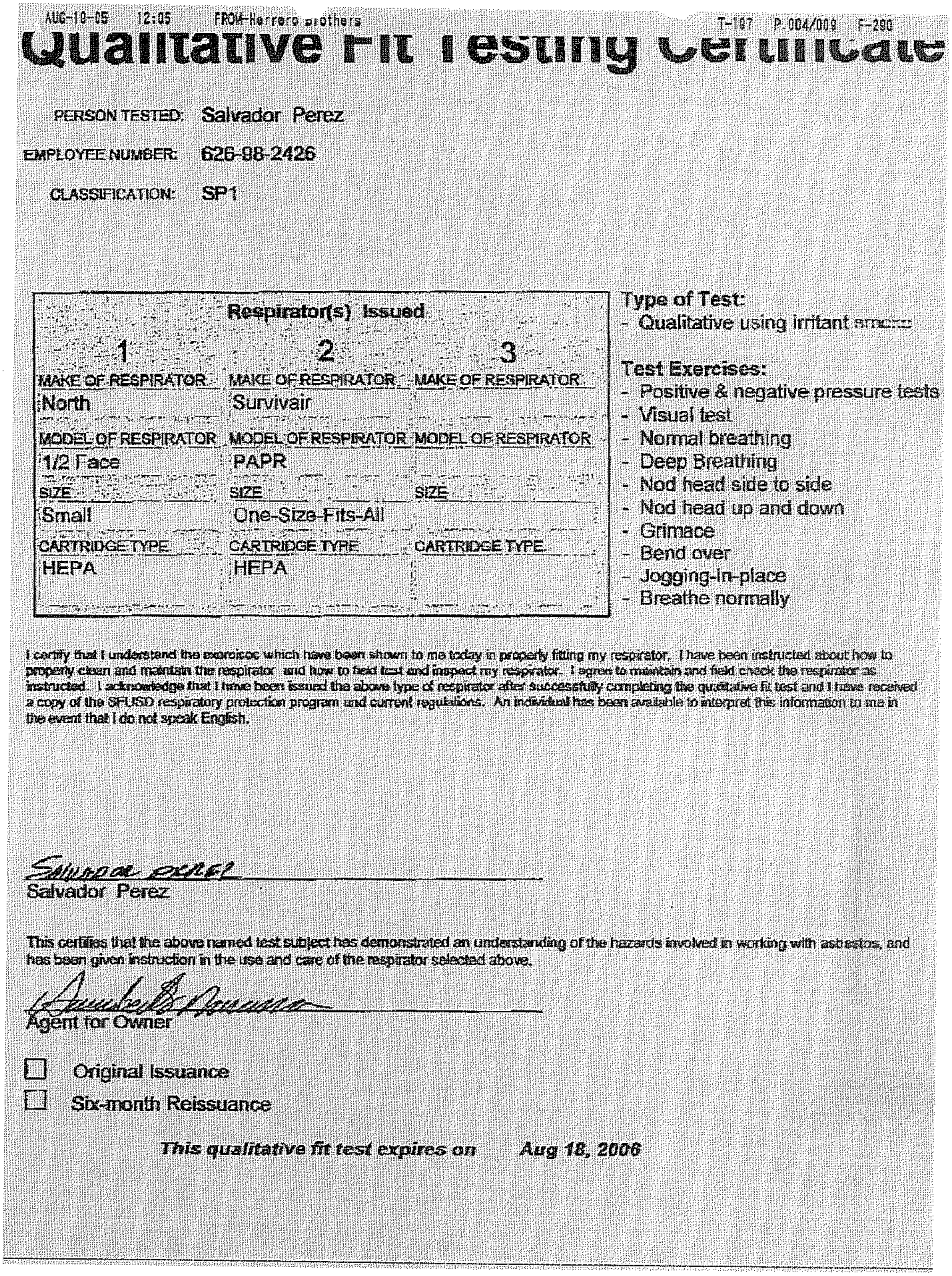
Page 1 of 1

Revision Date: 07/21/1998

Feb-14-05 02:35P P.01

Salvador Perez

Employee Number **98-2426**



AUG-18-05 12:05 FROM-Herrero Brothers T-197 P.004/009 F-290

Qualitative Fit Testing Certificate

PERSON TESTED: Salvador Perez

EMPLOYEE NUMBER: 626-98-2426

CLASSIFICATION: SP1

Respirator(s) Issued

	1	2	3
MAKE OF RESPIRATOR	North	Survivair	
MODEL OF RESPIRATOR	1/2 Face	PAPR	
SIZE	Small	One-Size-Fits-All	
CARTRIDGE TYPE	HEPA	HEPA	

Type of Test:
- Qualitative using irritant smoke

Test Exercises:
- Positive & negative pressure tests
- Visual test
- Normal breathing
- Deep Breathing
- Nod head side to side
- Nod head up and down
- Grimace
- Bend over
- Jogging-In-place
- Breathe normally

I certify that I understand the exercises which have been shown to me today in properly fitting my respirator. I have been instructed about how to properly clean and maintain the respirator and how to field test and inspect my respirator. I agree to maintain and field check the respirator as instructed. I acknowledge that I have been issued the above type of respirator after successfully completing the qualitative fit test and I have received a copy of the SFUSD respiratory protection program and current regulations. An individual has been available to interpret this information to me in the event that I do not speak English.

Salvador perez

Salvador Perez

This certifies that the above named test subject has demonstrated an understanding of the hazards involved in working with asbestos, and has been given instruction in the use and care of the respirator selected above.

Agent for Owner

☐ Original Issuance

☐ Six-month Reissuance

This qualitative fit test expires on Aug 18, 2006

SMART

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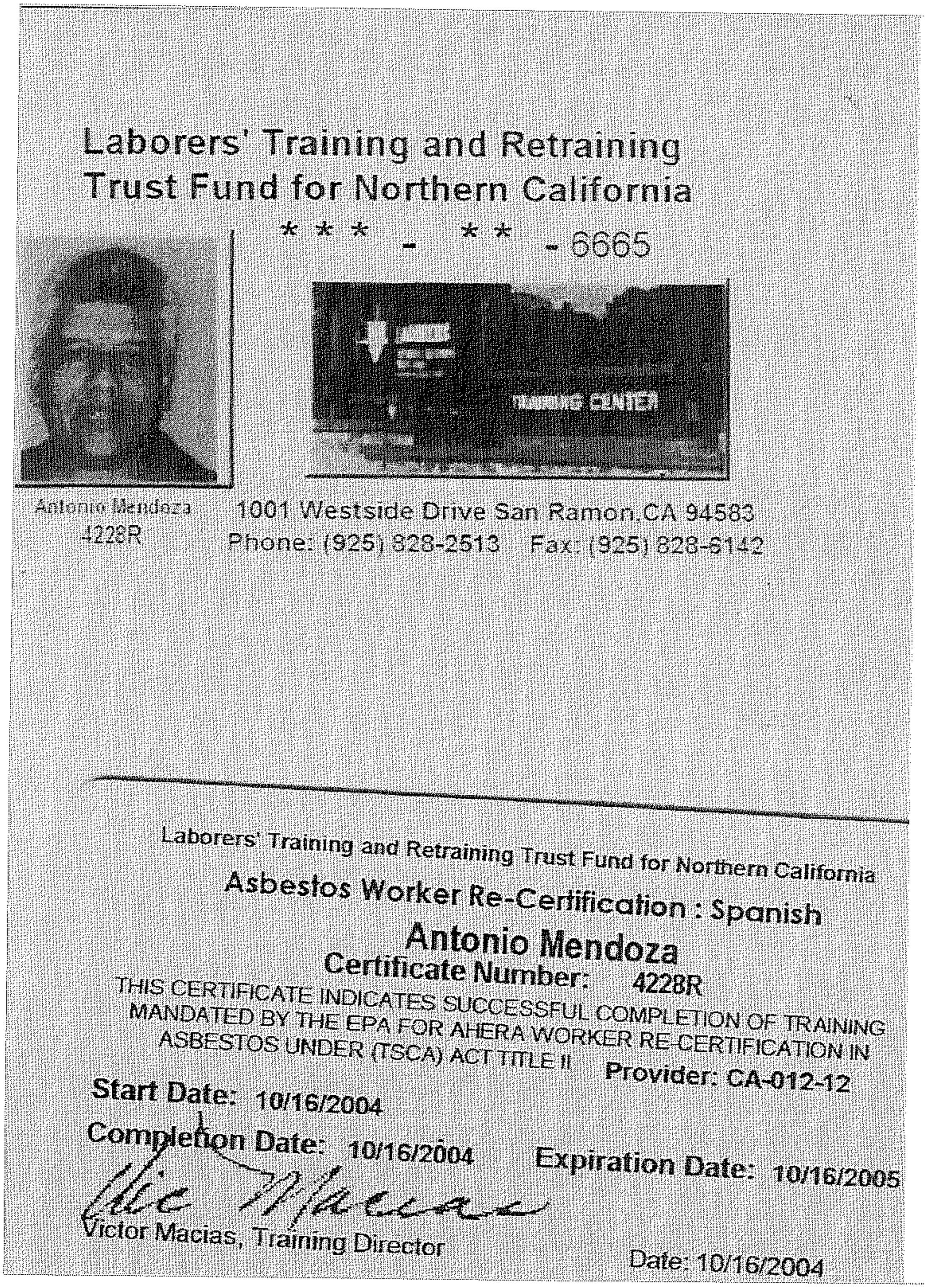
? Help | Menu

Detail | List | Employee | Certificates

Antonio N Mendoza-Navarro **Asbestos AHERA Worker Refresher**



Laborers' Training and Retraining Trust Fund for Northern California

* * * - * * - 6665

Antonio Mendoza
4228R

1001 Westside Drive San Ramon,CA 94583
Phone: (925) 828-2513 Fax: (925) 828-6142

Laborers' Training and Retraining Trust Fund for Northern California

Asbestos Worker Re-Certification : Spanish

Antonio Mendoza

Certificate Number: 4228R

THIS CERTIFICATE INDICATES SUCCESSFUL COMPLETION OF TRAINING MANDATED BY THE EPA FOR AHERA WORKER RE-CERTIFICATION IN ASBESTOS UNDER (TSCA) ACT TITLE II **Provider: CA-012-12**

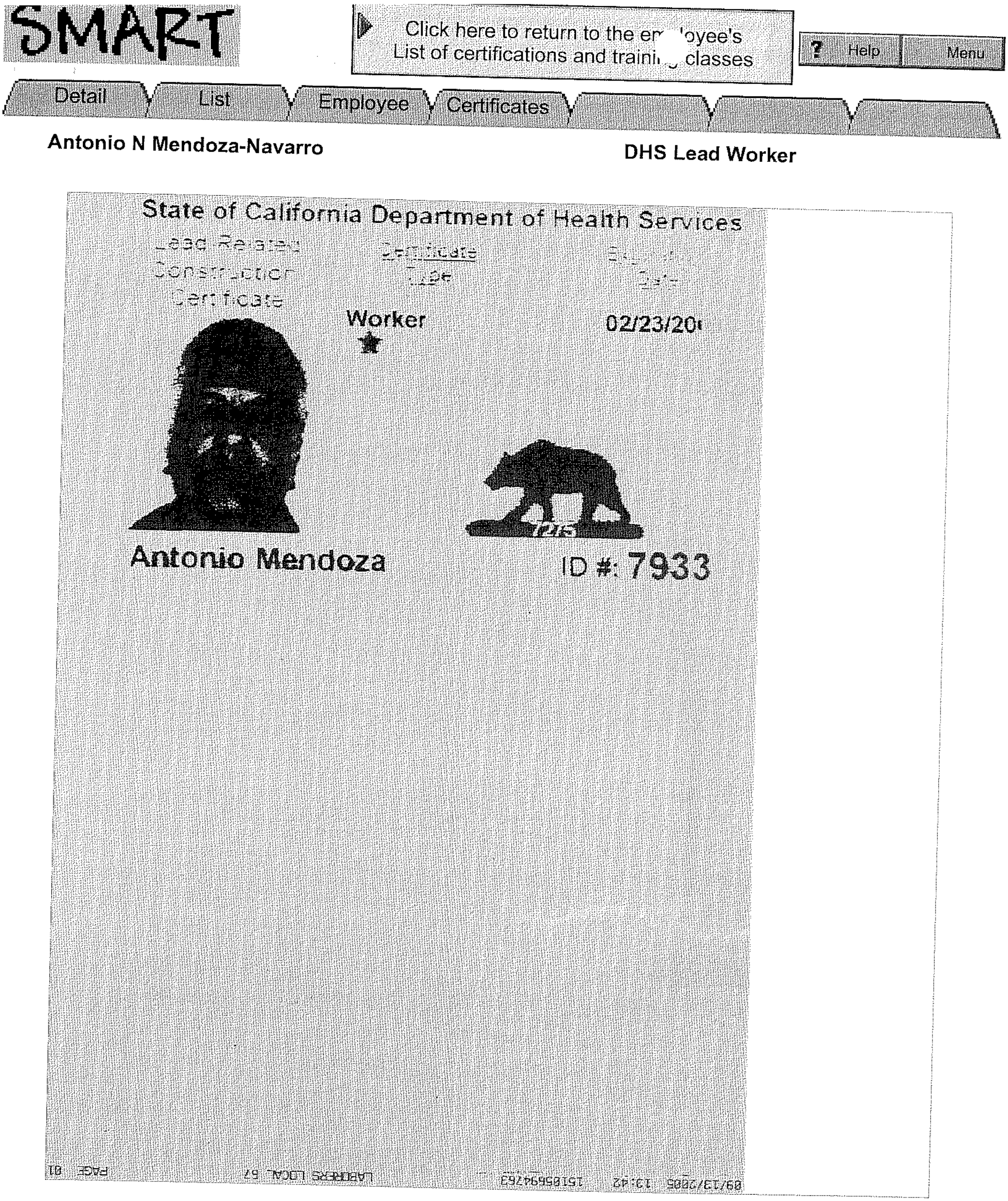
Start Date: 10/16/2004

Completion Date: 10/16/2004 **Expiration Date:** 10/16/2005

Vic Macias

Victor Macias, Training Director

Date: 10/16/2004



Antonio N Mendoza-Navarro

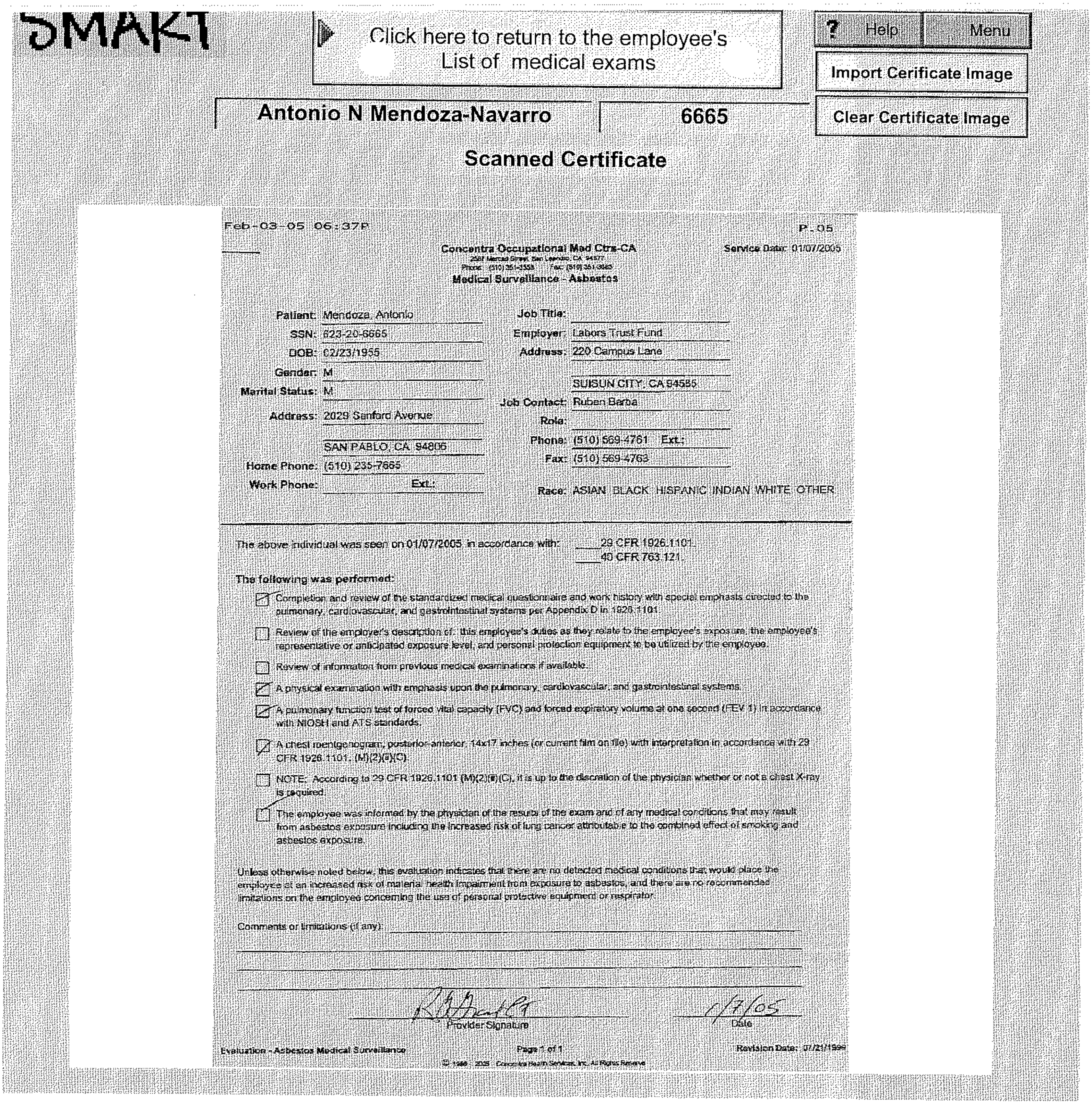
DHS Lead Worker

State of California Department of Health Services

Lead Related Construction Certificate	Certificate Type	[illegible] Date
	Worker	02/23/20

Antonio Mendoza

ID #: 7933



Antonio N Mendoza-Navarro **6665**

Scanned Certificate

Feb-03-05 06:37P P.05

Concentra Occupational Med Ctrs-CA
2587 Merced Street, San Leandro, CA 94577
Phone: (510) 351-3553 Fax: (510) 351-3965
Medical Surveillance - Asbestos

Service Date: 01/07/2005

Patient:	Mendoza, Antonio	**Job Title:**	
SSN:	623-20-6665	**Employer:**	Labors Trust Fund
DOB:	02/23/1955	**Address:**	220 Campus Lane
Gender:	M		SUISUN CITY, CA 94585
Marital Status:	M	**Job Contact:**	Ruben Barba
Address:	2029 Sanford Avenue	**Role:**	
	SAN PABLO, CA 94806	**Phone:**	(510) 569-4761 **Ext.:**
Home Phone:	(510) 235-7665	**Fax:**	(510) 569-4763
Work Phone:	**Ext.:**	**Race:**	ASIAN BLACK HISPANIC INDIAN WHITE OTHER

The above individual was seen on 01/07/2005 in accordance with: ____29 CFR 1926.1101
____40 CFR 763.121

The following was performed:

- ☑ Completion and review of the standardized medical questionnaire and work history with special emphasis directed to the pulmonary, cardiovascular, and gastrointestinal systems per Appendix D in 1926.1101.
- ☐ Review of the employer's description of: this employee's duties as they relate to the employee's exposure, the employee's representative or anticipated exposure level, and personal protection equipment to be utilized by the employee.
- ☐ Review of information from previous medical examinations if available.
- ☑ A physical examination with emphasis upon the pulmonary, cardiovascular, and gastrointestinal systems.
- ☑ A pulmonary function test of forced vital capacity (FVC) and forced expiratory volume at one second (FEV 1) in accordance with NIOSH and ATS standards.
- ☑ A chest roentgenogram, posterior-anterior, 14x17 inches (or current film on file) with interpretation in accordance with 29 CFR 1926.1101. (M)(2)(ii)(C).
- ☐ NOTE: According to 29 CFR 1926.1101 (M)(2)(ii)(C), it is up to the discretion of the physician whether or not a chest X-ray is required.
- ☑ The employee was informed by the physician of the results of the exam and of any medical conditions that may result from asbestos exposure including the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure.

Unless otherwise noted below, this evaluation indicates that there are no detected medical conditions that would place the employee at an increased risk of material health impairment from exposure to asbestos, and there are no recommended limitations on the employee concerning the use of personal protective equipment or respirator.

Comments or limitations (if any): __________

Provider Signature

1/7/05
Date

Evaluation - Asbestos Medical Surveillance Page 1 of 1 Revision Date: 07/21/1999

Antonio N Mendoza-Navarro Employee Number **6665**

Qualitative Fit Testing Certificate

PERSON TESTED: Antonio N Mendoza-Navarro

EMPLOYEE NUMBER: 623-20-6665

CLASSIFICATION: WK3

Respirator(s) Issued

1	2	3
MAKE OF RESPIRATOR North	MAKE OF RESPIRATOR Survivair	MAKE OF RESPIRATOR
MODEL OF RESPIRATOR 1/2 Face	MODEL OF RESPIRATOR PAPR	MODEL OF RESPIRATOR
SIZE large	SIZE One-Size-Fits-All	SIZE
CARTRIDGE TYPE HEPA	CARTRIDGE TYPE HEPA	CARTRIDGE TYPE

Type of Test:

- Qualitative using irritant smoke

Test Exercises:

- Positive & negative pressure tests
- Visual test
- Normal breathing
- Deep Breathing
- Nod head side to side
- Nod head up and down
- Grimace
- Bend over
- Jogging-in-place
- Breathe normally

I certify that I understand the exercises which have been shown to me today in properly fitting my respirator. I have been instructed about how to properly clean and maintain the respirator and how to field test and inspect my respirator. I agree to maintain and field check the respirator as instructed. I acknowledge that I have been issued the above type of respirator after successfully completing the qualitative fit test and I have received a copy of the SFUSD respiratory protection program and current regulations. An individual has been available to interpret this information to me in the event that I do not speak English.

Antonio mendoza

Antonio N Mendoza-Navarro

This certifies that the above named test subject has demonstrated an understanding of the hazards involved in working with asbestos has been given instruction in the use and care of the respirator selected above.

Agent for Owner

☐ Original Issuance

☐ Six-month Reissuance

This qualitative fit test expires on Aug 18, 2006

SMART

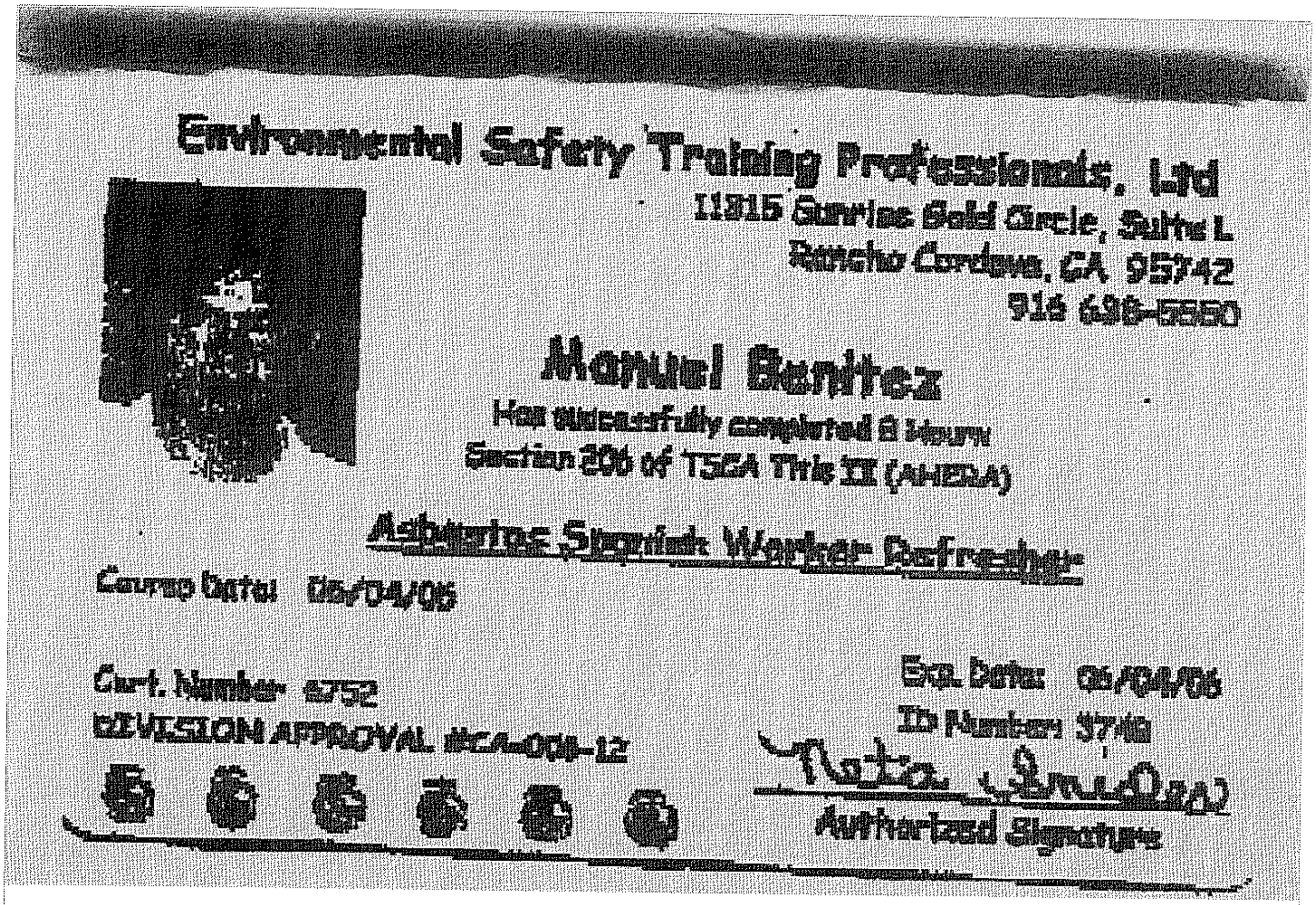
Click here to return to the employee's List of certifications and training classes

? Help | Menu

Detail | List | Employee | Certificates

Manuel Benitez

Asbestos AHERA Worker Refresher



Environmental Safety Training Professionals, Ltd

11315 Sunrise Gold Circle, Suite L
Rancho Cordova, CA 95742
916 638-5550

Manuel Benitez

Has successfully completed 8 Hours
Section 206 of TSCA Title II (AHERA)

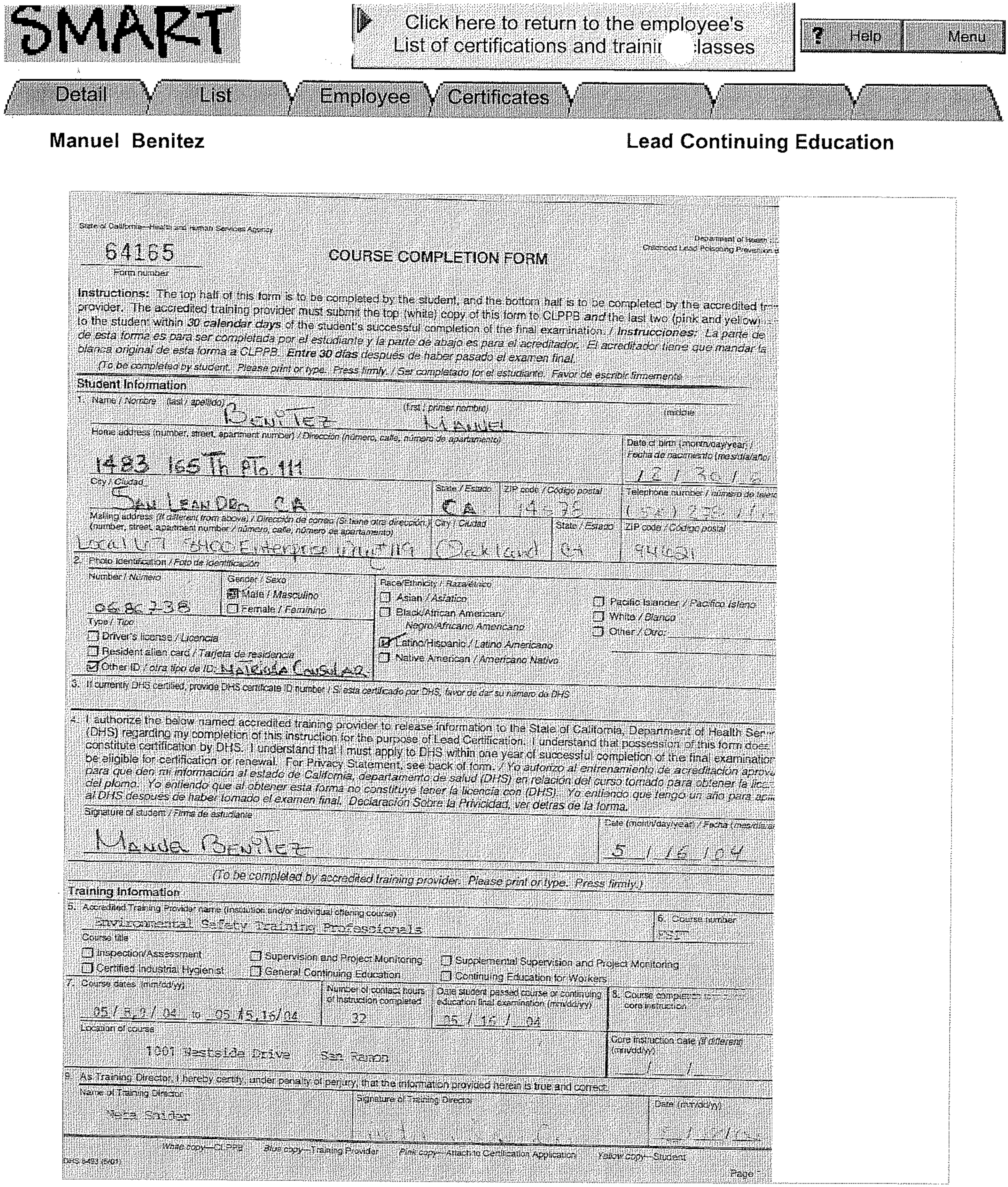
Asbestos Spanish Worker Refresher

Course Date: 06/04/05

Cert. Number 6752
DIVISION APPROVAL #CA-008-12

Exp. Date: 06/04/06
ID Number 3748

Authorized Signature



Manuel Benitez

Lead Continuing Education

State of California—Health and Human Services Agency

Department of Health
Childhood Lead Poisoning Prevention

64165
Form number

COURSE COMPLETION FORM

Instructions: The top half of this form is to be completed by the student, and the bottom half is to be completed by the accredited tr provider. The accredited training provider must submit the top (white) copy of this form to CLPPB *and* the last two (pink and yellow) to the student within *30 calendar days* of the student's successful completion of the final examination. / ***Instrucciones:*** *La parte de de esta forma es para ser completada por el estudiante y la parte de abajo es para el acreditador. El acreditador tiene que mandar la blanca original de esta forma a CLPPB.* ***Entre 30 días*** *despúes de haber pasado el examen final.*

(To be completed by student. Please print or type. Press firmly. / Ser completado for el estudiante. Favor de escribir firmemente.

Student Information

1. Name / *Nombre* (last / *apellido*) Benitez (first / *primer nombre*) Manuel (middle

Home address (number, street, apartment number) / *Dirección (número, calle, número de apartamento)* 1483 165Th Ap. 111

Date of birth (month/day/year) / *Fecha de nacimiento (mes/día/año)* 12 / 30 / 2

City / *Ciudad* San Leandro CA

State / *Estado* CA

ZIP code / *Código postal* 14578

Telephone number / *número de telefo* ([illegible]) 25[illegible]

Mailing address *(If different from above)* / *Dirección de correo (Si tiene otra dirección.)* (number, street, apartment number / *número, calle, número de apartamento*) Local 67 8400 Enterprise Way #119

City / *Ciudad* Oakland

State / *Estado* CA

ZIP code / *Código postal* 94621

2. Photo Identification / *Foto de identificación*

Number / *Número* 068C738

Gender / *Sexo*
☒ Male / *Masculino*
☐ Female / *Femenino*

Type / *Tipo*
☐ Driver's license / *Licencia*
☐ Resident alien card / *Tarjeta de residencia*
☑ Other ID / *otra tipo de ID:* Matricula Consular

Race/Ethnicity / *Raza/étnico*
☐ Asian / *Asiatico*
☐ Black/African American/ *Negro/Africano Americano*
☒ Latino/Hispanic / *Latino Americano*
☐ Native American / *Americano Nativo*
☐ Pacific Islander / *Pacifico Isleno*
☐ White / *Blanco*
☐ Other / *Otro:*

3. If currently DHS certified, provide DHS certificate ID number / *Si esta certificado por DHS, favor de dar su número de DHS*

4. I authorize the below named accredited training provider to release information to the State of California, Department of Health Ser (DHS) regarding my completion of this instruction for the purpose of Lead Certification. I understand that possession of this form does constitute certification by DHS. I understand that I must apply to DHS within one year of successful completion of the final examinatior be eligible for certification or renewal. For Privacy Statement, see back of form. / *Yo autorizo al entrenamiento de acreditación aprova para que den mi información al estado de California, departamento de salud (DHS) en relación del curso tomado para obtener la lice del plomo. Yo entiendo que al obtener esta forma no constituye tener la licencía con (DHS). Yo entiendo que tengo un año para ap al DHS despues de haber tomado el examen final. Declaración Sobre la Privicidad, ver detras de la forma.*

Signature of student / *Firma de estudiante* Manuel Benitez

Date (month/day/year) / *Fecha (mes/día/a* 5 / 16 / 04

(To be completed by accredited training provider. Please print or type. Press firmly.)

Training Information

5. Accredited Training Provider name (institution and/or individual offering course) Environmental Safety Training Professionals

6. Course number EST

Course title
☐ Inspection/Assessment
☐ Certified Industrial Hygienist
☐ Supervision and Project Monitoring
☐ General Continuing Education
☐ Supplemental Supervision and Project Monitoring
☐ Continuing Education for Workers

7. Course dates (mm/dd/yy) 05 / 8,9 / 04 to 05 / 15,16 / 04

Number of contact hours of instruction completed 32

Date student passed course or continuing education final examination (mm/dd/yy) 05 / 16 / 04

8. Course completion core instruction

Location of course 1001 Westside Drive San Ramon

Core instruction date *(if different)* (mm/dd/yy) / /

9. As Training Director, I hereby certify, under penalty of perjury, that the information provided herein is true and correct.

Name of Training Director Vera Snider

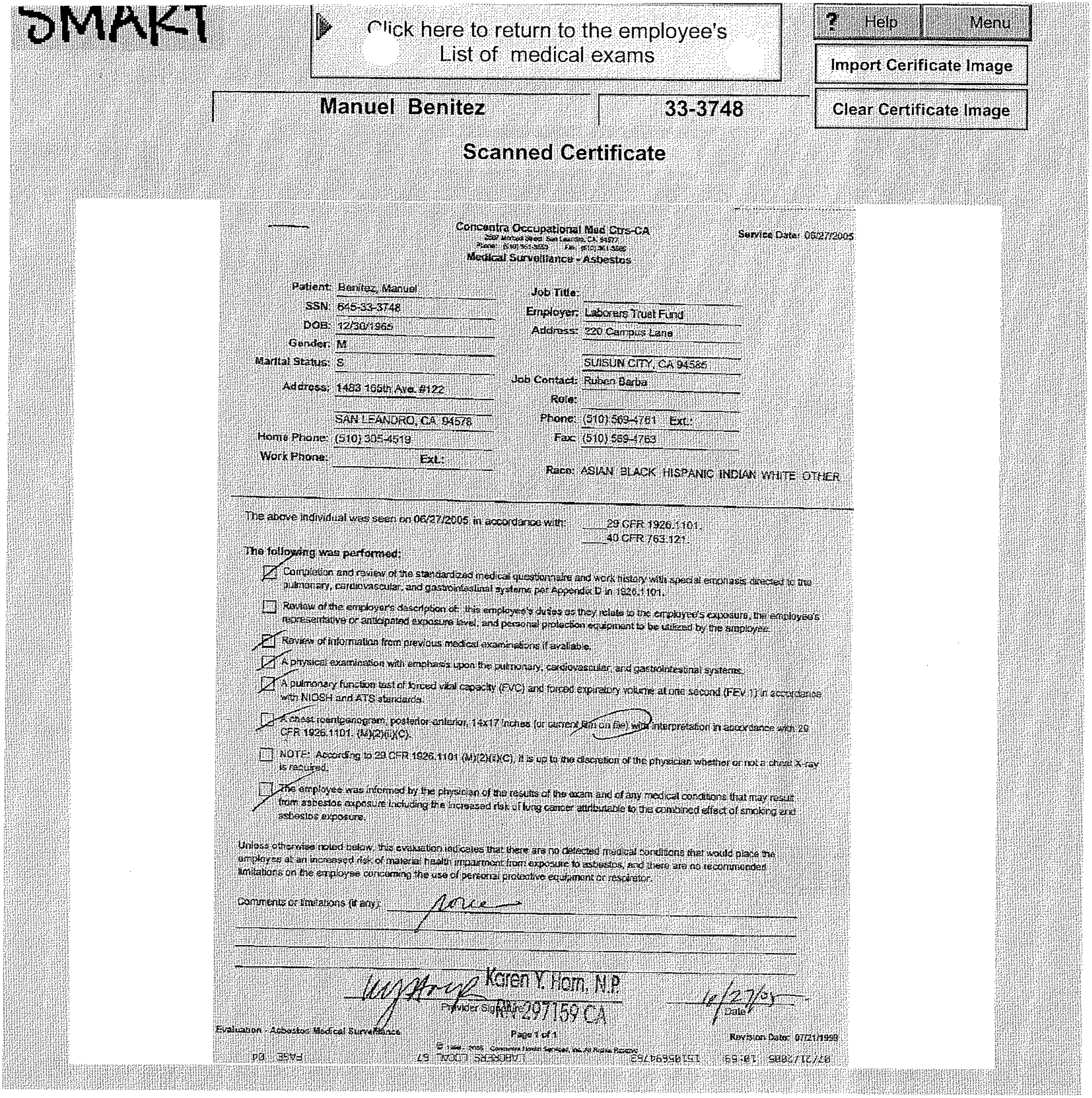
Signature of Training Director

Date (mm/dd/yy) 5 / [illegible] / [illegible]

White copy—CLPPB *Blue copy*—Training Provider *Pink copy*—Attach to Certification Application *Yellow copy*—Student

DHS 8493 (6/01)

Page



Manuel Benitez **33-3748**

Scanned Certificate

Concentra Occupational Med Ctrs-CA
2587 Merced Street San Leandro, CA 94577
Phone: (510) 351-3553 Fax: (510) 351-3585
Medical Surveillance - Asbestos

Service Date: 06/27/2005

Patient: Benitez, Manuel
SSN: 645-33-3748
DOB: 12/30/1965
Gender: M
Marital Status: S
Address: 1483 165th Ave. #122
SAN LEANDRO, CA 94578
Home Phone: (510) 305-4519
Work Phone: **Ext.:**

Job Title:
Employer: Laborers Trust Fund
Address: 220 Campus Lane
SUISUN CITY, CA 94585
Job Contact: Ruben Barba
Role:
Phone: (510) 569-4761 Ext.:
Fax: (510) 569-4763

Race: ASIAN BLACK HISPANIC INDIAN WHITE OTHER

The above individual was seen on 06/27/2005 in accordance with: ____29 CFR 1926.1101.
____40 CFR 763.121.

The following was performed:

- ☑ Completion and review of the standardized medical questionnaire and work history with special emphasis directed to the pulmonary, cardiovascular, and gastrointestinal systems per Appendix D in 1926.1101.
- ☐ Review of the employer's description of: this employee's duties as they relate to the employee's exposure, the employee's representative or anticipated exposure level, and personal protection equipment to be utilized by the employee.
- ☑ Review of information from previous medical examinations if available.
- ☑ A physical examination with emphasis upon the pulmonary, cardiovascular, and gastrointestinal systems.
- ☑ A pulmonary function test of forced vital capacity (FVC) and forced expiratory volume at one second (FEV 1) in accordance with NIOSH and ATS standards.
- ☑ A chest roentgenogram, posterior-anterior, 14x17 inches (or current film on file) with interpretation in accordance with 29 CFR 1926.1101. (M)(2)(ii)(C).
- ☐ NOTE: According to 29 CFR 1926.1101 (M)(2)(ii)(C), it is up to the discretion of the physician whether or not a chest X-ray is required.
- ☑ The employee was informed by the physician of the results of the exam and of any medical conditions that may result from asbestos exposure including the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure.

Unless otherwise noted below, this evaluation indicates that there are no detected medical conditions that would place the employee at an increased risk of material health impairment from exposure to asbestos, and there are no recommended limitations on the employee concerning the use of personal protective equipment or respirator.

Comments or limitations (if any): none

Karen Y. Horn, N.P.
RN 297159 CA
Provider Signature

6/27/05
Date

Evaluation - Asbestos Medical Surveillance

Page 1 of 1

Revision Date: 07/21/1999

07/21/2005 10:59 15105694763 LABORERS LOCAL 67 PAGE 04

Manuel Benitez Employee Number **33-3748**

Qualitative Fit Testing Certificat

PERSON TESTED: Manuel Benitez

EMPLOYEE NUMBER: 645-33-3748

CLASSIFICATION: WK3

Respirator(s) Issued

1	2	3
MAKE OF RESPIRATOR 3M	MAKE OF RESPIRATOR Survivair	MAKE OF RESPIRATOR
MODEL OF RESPIRATOR 1/2 Face	MODEL OF RESPIRATOR PAPR	MODEL OF RESPIRATOR
SIZE Medium	SIZE One-Size-Fits-All	SIZE
CARTRIDGE TYPE HEPA	CARTRIDGE TYPE HEPA	CARTRIDGE TYPE

Type of Test:

- Qualitative using irritant smoke

Test Exercises:

- Positive & negative pressure tes
- Visual test
- Normal breathing
- Deep Breathing
- Nod head side to side
- Nod head up and down
- Grimace
- Bend over
- Jogging-in-place
- Breathe normally

I certify that I understand the exercises which have been shown to me today in properly fitting my respirator. I have been instructed about how to properly clean and maintain the respirator and how to field test and inspect my respirator. I agree to maintain and field check the respirator as instructed. I acknowledge that I have been issued the above type of respirator after successfully completing the qualitative fit test and I have received a copy of the SFUSD respiratory protection program and current regulations. An individual has been available to interpret this information to me in the event that I do not speak English.

Manuel Benitez

Manuel Benitez

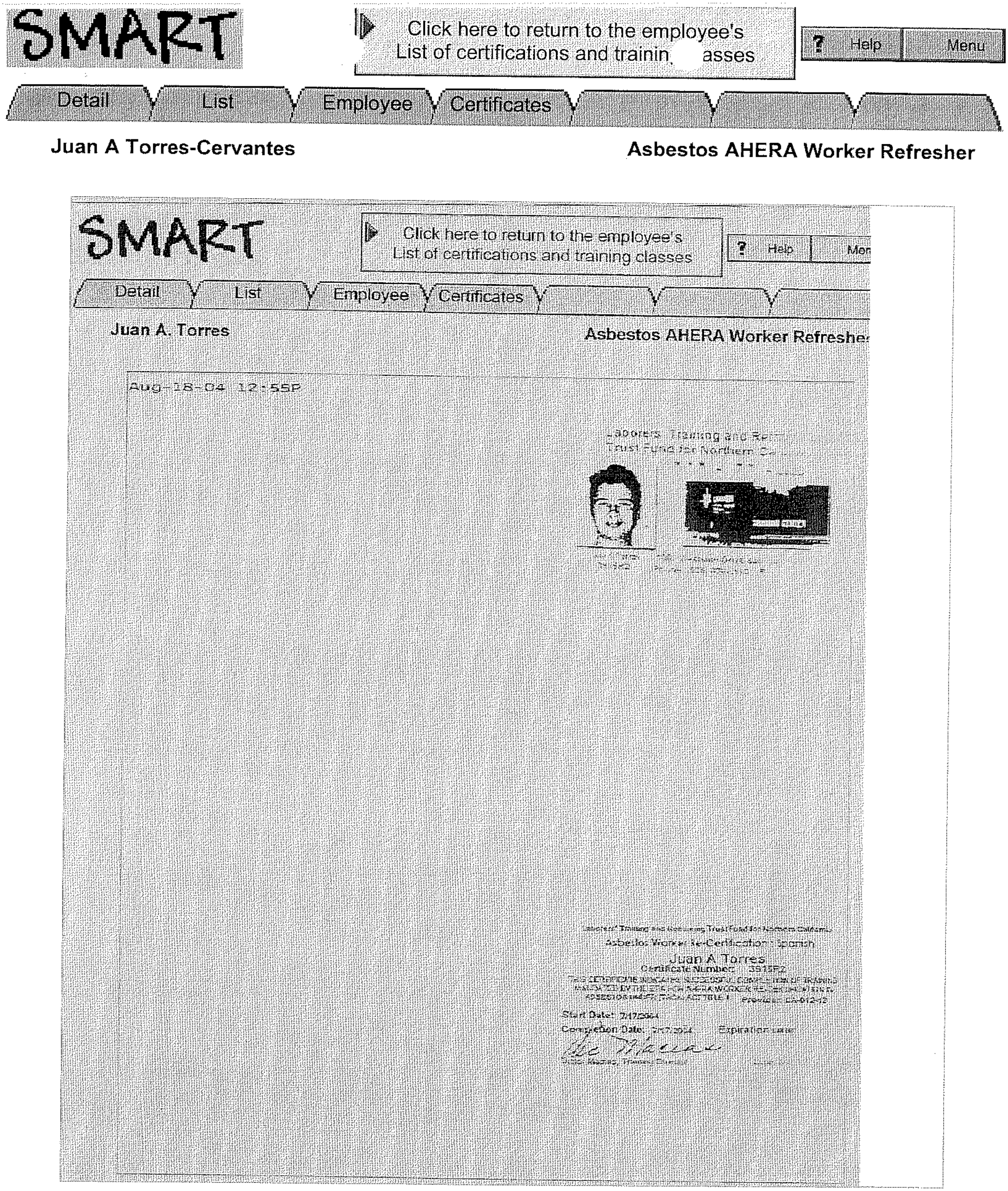
This certifies that the above named test subject has demonstrated an understanding of the hazards involved in working with as[illegible] has been given instruction in the use and care of the respirator selected above.

Agent for Owner

☐ Original Issuance

☐ Six-month Reissuance

This qualitative fit test expires on Aug 18, 2006



Juan A Torres-Cervantes

Asbestos AHERA Worker Refresher

Juan A. Torres

Asbestos AHERA Worker Refreshe

Aug-18-04 12:55P

Laborers' Training and Re
Trust Fund for Northern Ca

Laborers' Training and Retraining Trust Fund for Northern California

Asbestos Worker Re-Certification - Spanish

Juan A Torres

Certificate Number: 391582

THIS CERTIFICATE INDICATES SUCCESSFUL COMPLETION OF TRAINING [illegible]

Provider: CA-012-12

Start Date: 7/17/2004

Completion Date: 7/17/2004 Expiration Date:

SMART

Click here to return to the employee's
List of certifications and trainin[illegible] asses

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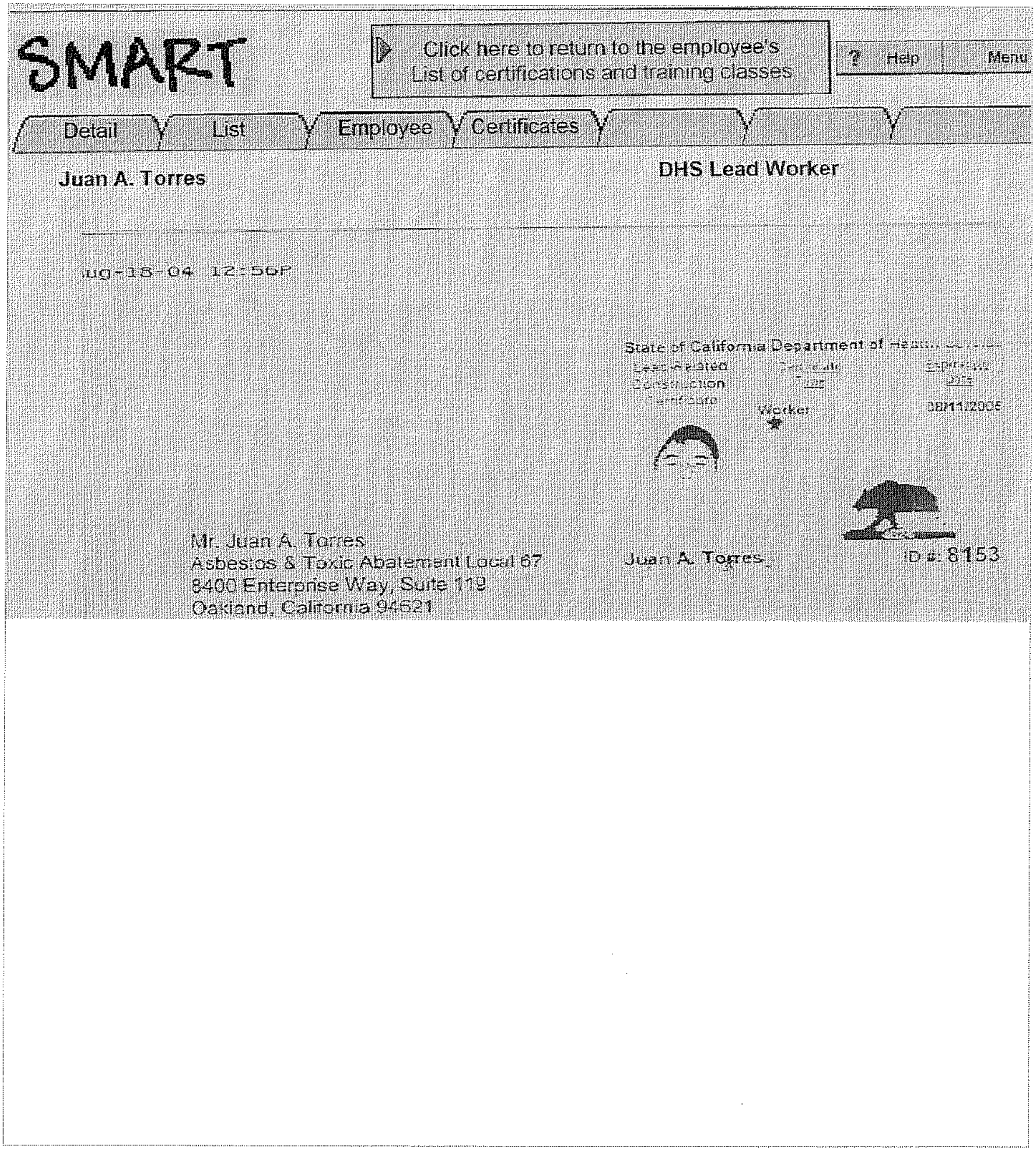
Detail | List | Employee | Certificates

Juan A Torres-Cervantes **DHS Lead Worker**



Juan A. Torres **DHS Lead Worker**

ug-18-04 12:56P

State of California Department of Health Services
Lead-Related Construction Certificate
Certificate Type: Worker
Expiration Date: 08/11/2005

Juan A. Torres
ID #: 8153

Mr. Juan A. Torres
Asbestos & Toxic Abatement Local 67
8400 Enterprise Way, Suite 119
Oakland, California 94621

SMART

Click here to return to the employee's
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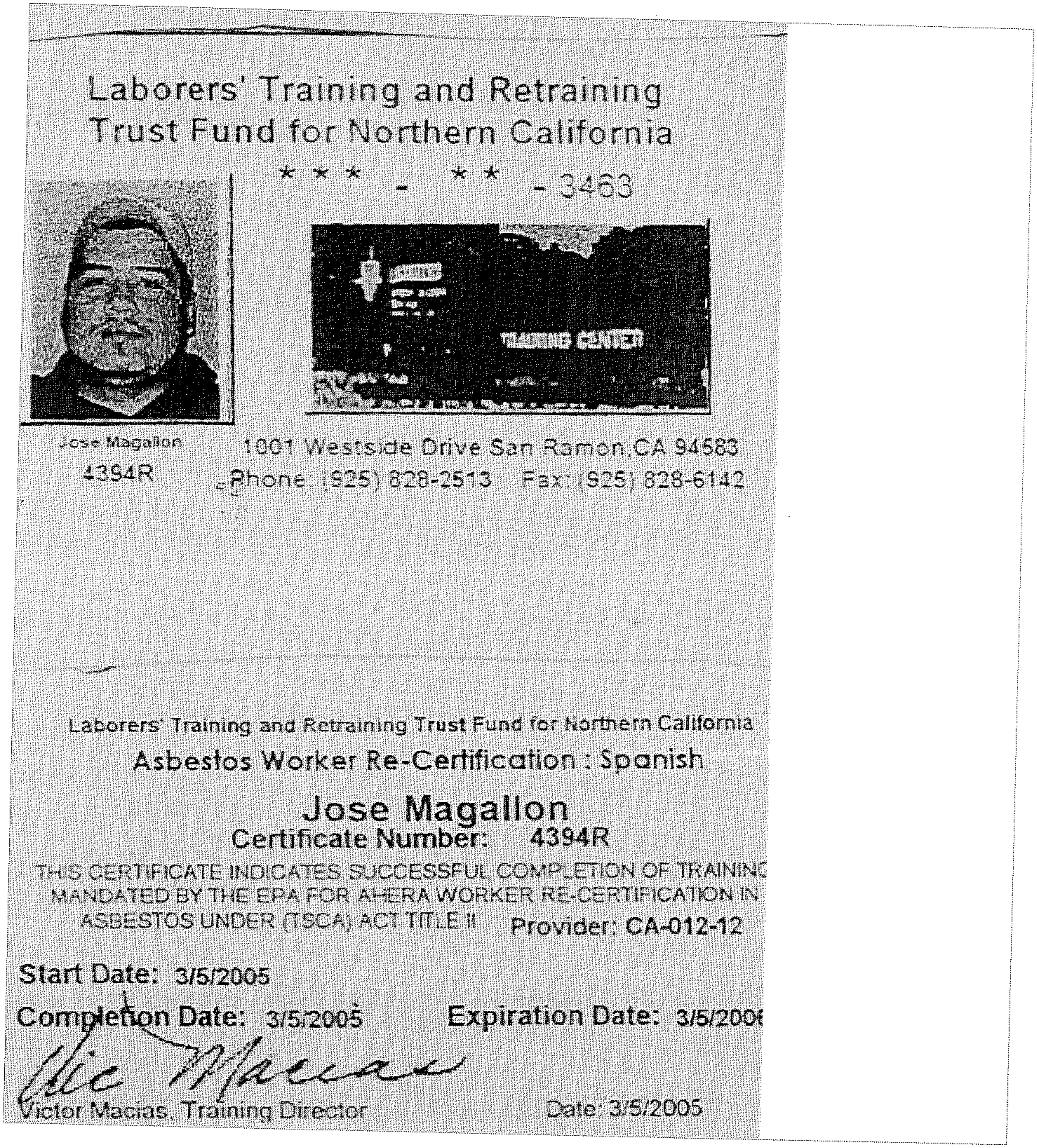
? Help | Menu

Detail | List | Employee | Certificates

Jose Magallon

Asbestos AHERA Worker Refresher



Laborers' Training and Retraining Trust Fund for Northern California

*** - ** - 3463

Jose Magallon
4394R

1001 Westside Drive San Ramon,CA 94583
Phone: (925) 828-2513 Fax: (925) 828-6142

Laborers' Training and Retraining Trust Fund for Northern California

Asbestos Worker Re-Certification : Spanish

Jose Magallon

Certificate Number: 4394R

THIS CERTIFICATE INDICATES SUCCESSFUL COMPLETION OF TRAINING MANDATED BY THE EPA FOR AHERA WORKER RE-CERTIFICATION IN ASBESTOS UNDER (TSCA) ACT TITLE II **Provider: CA-012-12**

Start Date: 3/5/2005

Completion Date: 3/5/2005 **Expiration Date:** 3/5/200

Vic Macias

Victor Macias, Training Director Date: 3/5/2005

SMART

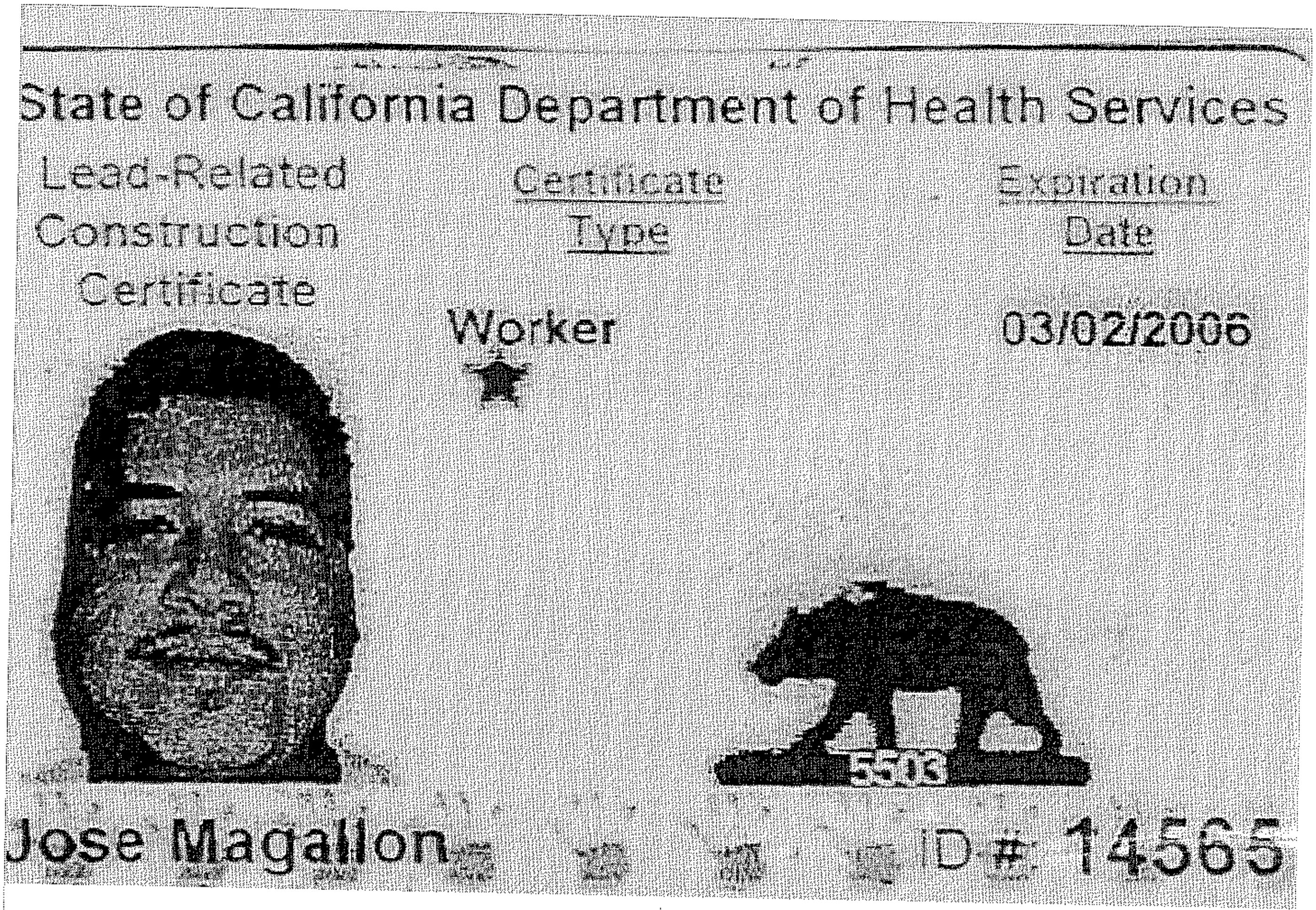
Click here to return to the employee's
List of certifications and training classes

? Help | Menu

Detail | List | Employee | Certificates

Jose Magallon

DHS Lead Worker



State of California Department of Health Services

Lead-Related
Construction
Certificate

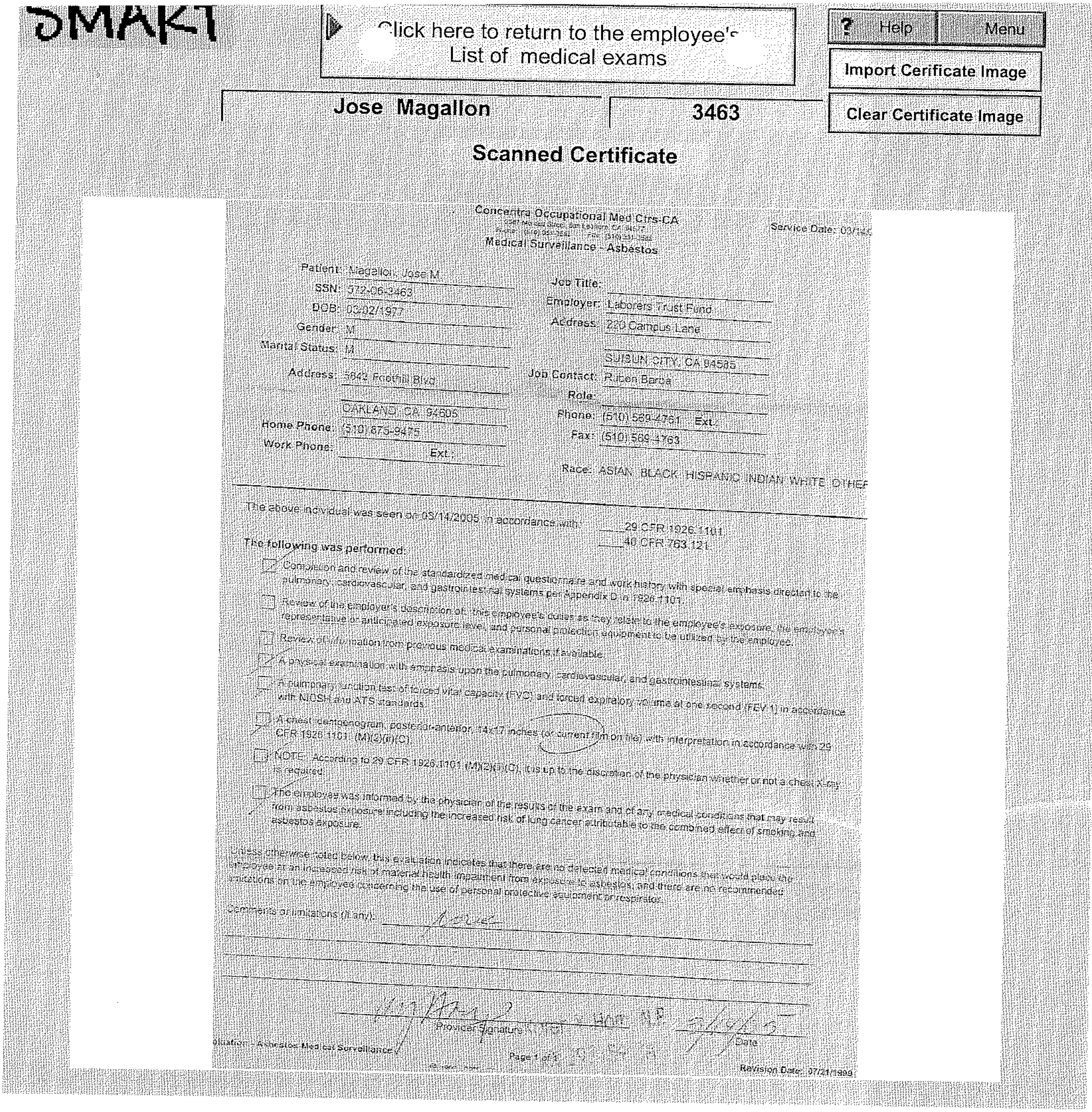
Certificate Type: Worker

Expiration Date: 03/02/2006

5503

Jose Magallon

ID #: 14565



Jose Magallon | **3463**

Scanned Certificate

Concentra Occupational Med Ctrs-CA

Medical Surveillance - Asbestos

Service Date: 03/1

Patient: Magallon, Jose M.
SSN: 572-06-3463
DOB: 03/02/1977
Gender: M
Marital Status: M
Address: 5842 Foothill Blvd
OAKLAND, CA 94605
Home Phone: (510) 875-9475
Work Phone: Ext.:

Job Title:
Employer: Laborers Trust Fund
Address: 220 Campus Lane
SUISUN CITY, CA 94585
Job Contact: Ruben Barba
Role:
Phone: (510) 569-4761 Ext.:
Fax: (510) 569-4763

Race: ASIAN BLACK HISPANIC INDIAN WHITE OTHER

The above individual was seen on 03/14/2005 in accordance with: ___29 CFR 1926.1101 ___40 CFR 763.121

The following was performed:

- ☑ Completion and review of the standardized medical questionnaire and work history with special emphasis directed to the pulmonary, cardiovascular, and gastrointestinal systems per Appendix D in 1926.1101.
- ☐ Review of the employer's description of: this employee's duties as they relate to the employee's exposure, the employer's representative or anticipated exposure level, and personal protection equipment to be utilized by the employee.
- ☐ Review of information from previous medical examinations if available.
- ☑ A physical examination with emphasis upon the pulmonary, cardiovascular, and gastrointestinal systems.
- ☐ A pulmonary function test of forced vital capacity (FVC) and forced expiratory volume at one second (FEV 1) in accordance with NIOSH and ATS standards.
- ☑ A chest roentgenogram, posterior-anterior, 14x17 inches (or current film on file) with interpretation in accordance with 29 CFR 1926.1101. (M)(2)(ii)(C).
- ☑ NOTE: According to 29 CFR 1926.1101 (M)(2)(ii)(C), it is up to the discretion of the physician whether or not a chest X-ray is required.
- ☑ The employee was informed by the physician of the results of the exam and of any medical conditions that may result from asbestos exposure including the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure.

Unless otherwise noted below, this evaluation indicates that there are no detected medical conditions that would place the employee at an increased risk of material health impairment from exposure to asbestos, and there are no recommended limitations on the employee concerning the use of personal protective equipment or respirator.

Comments or limitations (if any): None

Provider Signature NP

Date 3/14/05

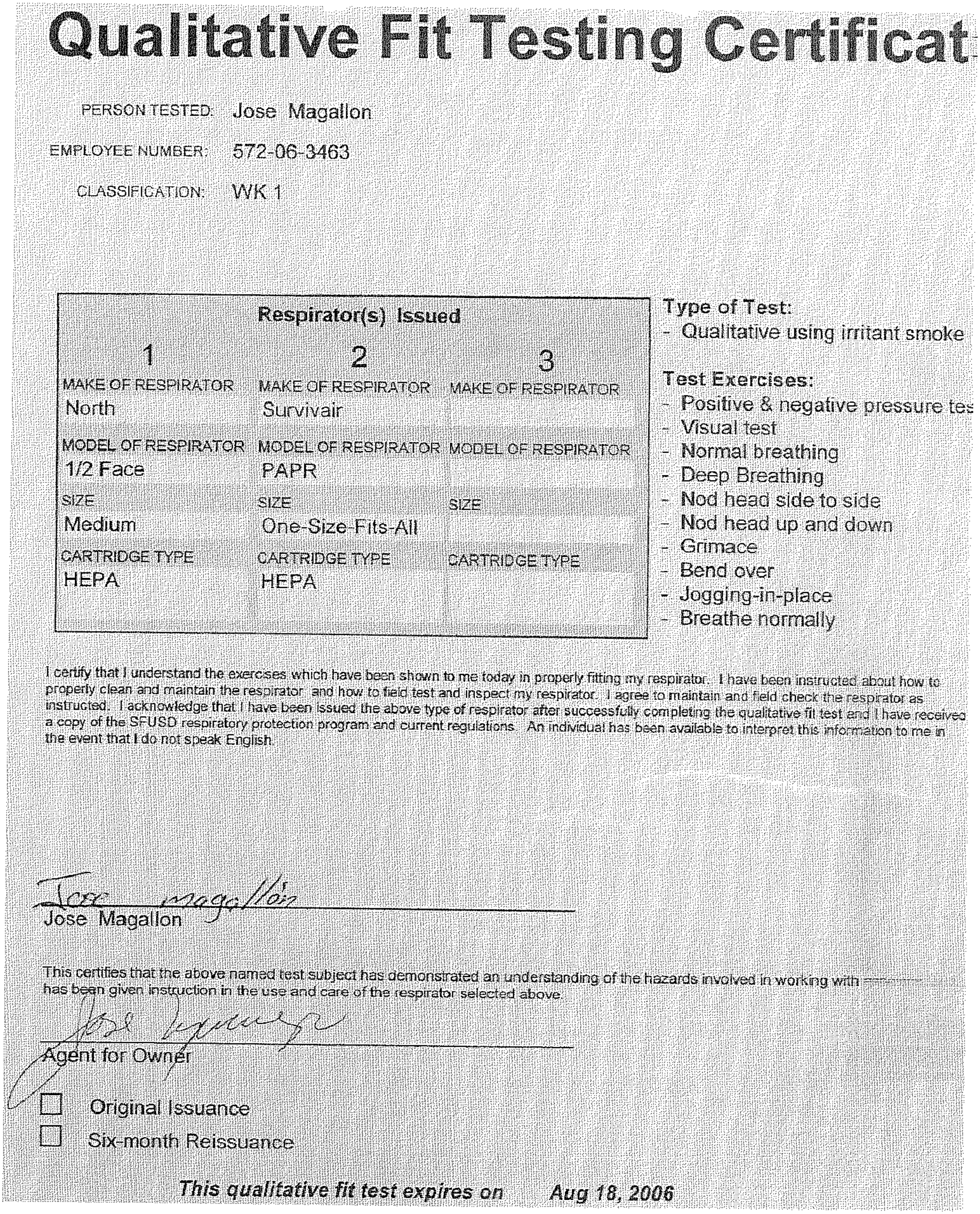
aluation - Asbestos Medical Surveillance

Page 1 of 1

Revision Date: 07/21/1999

Jose Magallon

Employee Number **3463**



Qualitative Fit Testing Certificat

PERSON TESTED: Jose Magallon

EMPLOYEE NUMBER: 572-06-3463

CLASSIFICATION: WK 1

Respirator(s) Issued

1	2	3
MAKE OF RESPIRATOR North	MAKE OF RESPIRATOR Survivair	MAKE OF RESPIRATOR
MODEL OF RESPIRATOR 1/2 Face	MODEL OF RESPIRATOR PAPR	MODEL OF RESPIRATOR
SIZE Medium	SIZE One-Size-Fits-All	SIZE
CARTRIDGE TYPE HEPA	CARTRIDGE TYPE HEPA	CARTRIDGE TYPE

Type of Test:
- Qualitative using irritant smoke

Test Exercises:
- Positive & negative pressure tes
- Visual test
- Normal breathing
- Deep Breathing
- Nod head side to side
- Nod head up and down
- Grimace
- Bend over
- Jogging-in-place
- Breathe normally

I certify that I understand the exercises which have been shown to me today in properly fitting my respirator. I have been instructed about how to properly clean and maintain the respirator and how to field test and inspect my respirator. I agree to maintain and field check the respirator as instructed. I acknowledge that I have been issued the above type of respirator after successfully completing the qualitative fit test and I have received a copy of the SFUSD respiratory protection program and current regulations. An individual has been available to interpret this information to me in the event that I do not speak English.

Jose magallón

Jose Magallon

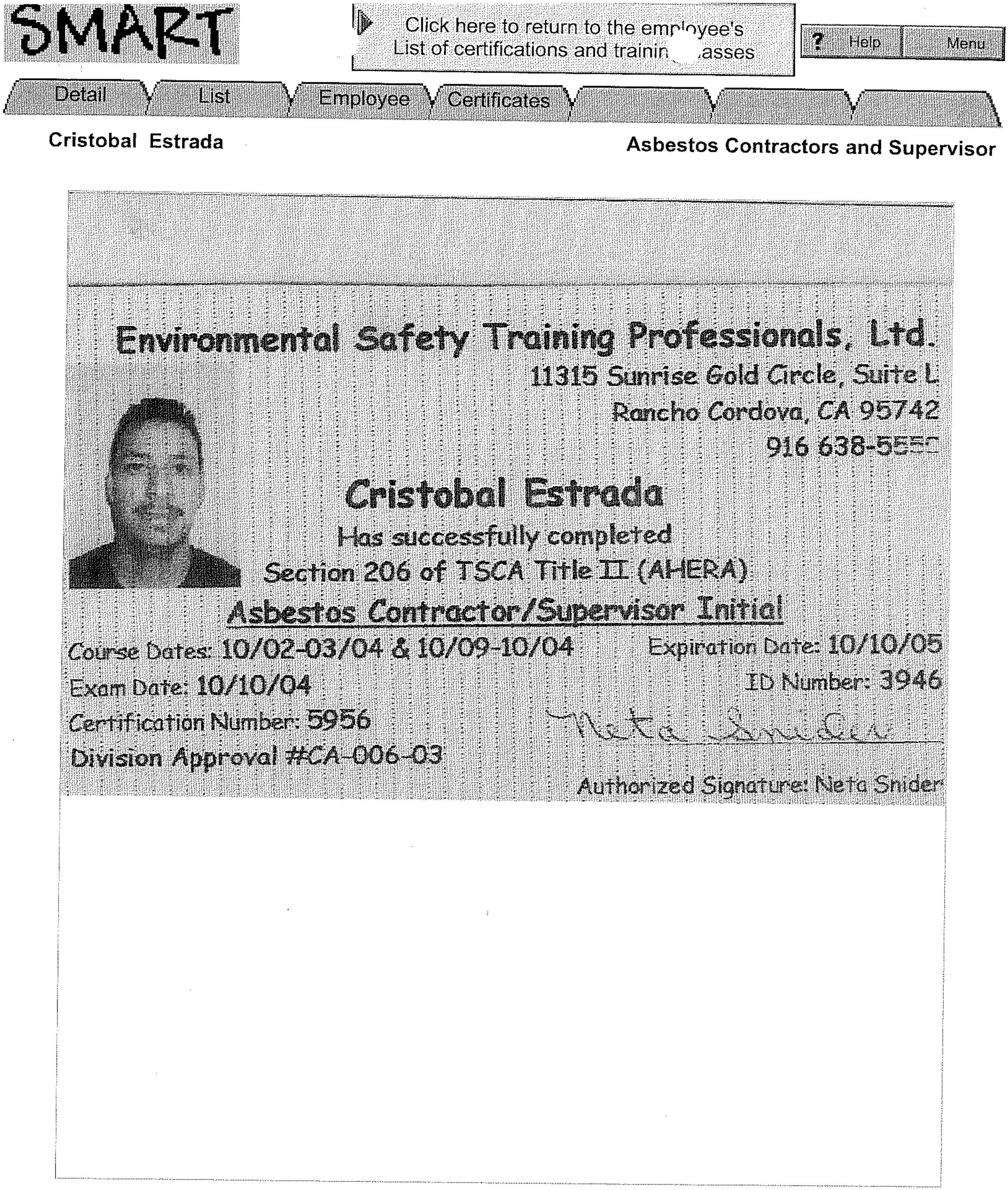
This certifies that the above named test subject has demonstrated an understanding of the hazards involved in working with -------- has been given instruction in the use and care of the respirator selected above.

Agent for Owner

☐ Original Issuance

☐ Six-month Reissuance

This qualitative fit test expires on Aug 18, 2006



Cristobal Estrada

Asbestos Contractors and Supervisor

Environmental Safety Training Professionals, Ltd.

11315 Sunrise Gold Circle, Suite L
Rancho Cordova, CA 95742
916 638-5550

Cristobal Estrada

Has successfully completed
Section 206 of TSCA Title II (AHERA)

Asbestos Contractor/Supervisor Initial

Course Dates: 10/02-03/04 & 10/09-10/04

Expiration Date: 10/10/05

Exam Date: 10/10/04

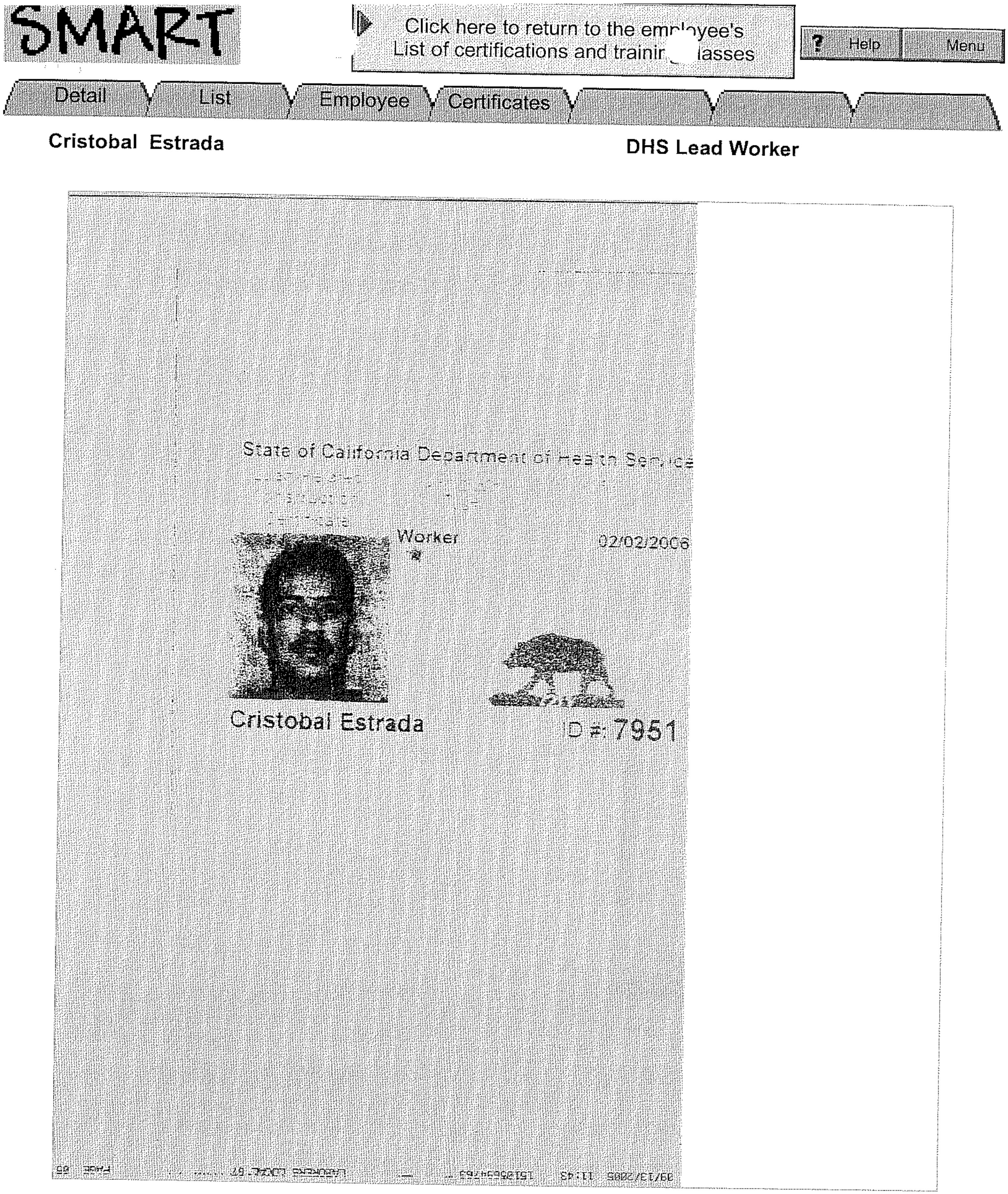
ID Number: 3946

Certification Number: 5956

Division Approval #CA-006-03

Neta Snider

Authorized Signature: Neta Snider



Cristobal Estrada

DHS Lead Worker

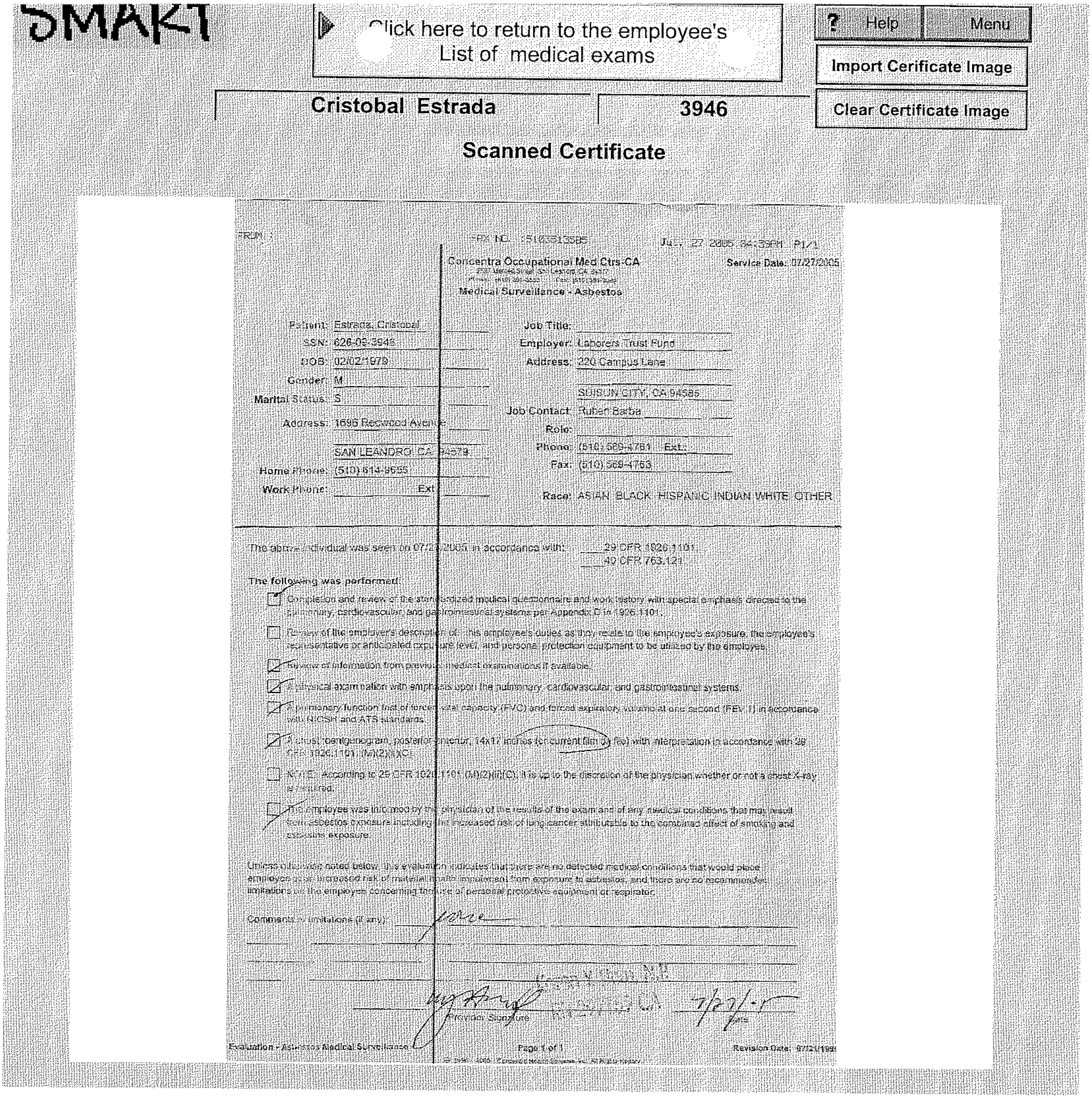
State of California Department of Health Service

Worker

02/02/2006

Cristobal Estrada

ID #: 7951



Cristobal Estrada **3946**

Scanned Certificate

FROM :
FAX NO. : 5103513585
Jul. 27 2005 04:39PM P1/1

Concentra Occupational Med Ctrs-CA
Service Date: 07/27/2005

Medical Surveillance - Asbestos

Patient: Estrada, Cristobal
SSN: 626-09-3946
DOB: 02/02/1979
Gender: M
Marital Status: S
Address: 1696 Redwood Avenue
SAN LEANDRO, CA 94579
Home Phone: (510) 614-9655
Work Phone: Ext

Job Title:
Employer: Laborers Trust Fund
Address: 220 Campus Lane
SUISUN CITY, CA 94585
Job Contact: Ruben Barba
Role:
Phone: (510) 569-4761 Ext.:
Fax: (510) 569-4763

Race: ASIAN BLACK HISPANIC INDIAN WHITE OTHER

The above individual was seen on 07/2[illegible]/2005 in accordance with: ___29 CFR 1926.1101
___40 CFR 763.121

The following was performed:

- ☑ Completion and review of the standardized medical questionnaire and work history with special emphasis directed to the pulmonary, cardiovascular, and gastrointestinal systems per Appendix D in 1926.1101.
- ☐ Review of the employer's description of this employee's duties as they relate to the employee's exposure, the employee's representative or anticipated exposure level, and personal protection equipment to be utilized by the employee.
- ☑ Review of information from previous medical examinations if available.
- ☑ A physical examination with emphasis upon the pulmonary, cardiovascular, and gastrointestinal systems.
- ☑ A pulmonary function test of forced vital capacity (FVC) and forced expiratory volume at one second (FEV 1) in accordance with NIOSH and ATS standards.
- ☑ A chest roentgenogram, posterior-anterior, 14x17 inches (or current film on file) with interpretation in accordance with 29 CFR 1926.1101 (M)(2)(ii)(C).
- ☐ NOTE: According to 29 CFR 1926.1101 (M)(2)(ii)(C), it is up to the discretion of the physician whether or not a chest X-ray is required.
- ☑ The employee was informed by the physician of the results of the exam and of any medical conditions that may result from asbestos exposure including the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure.

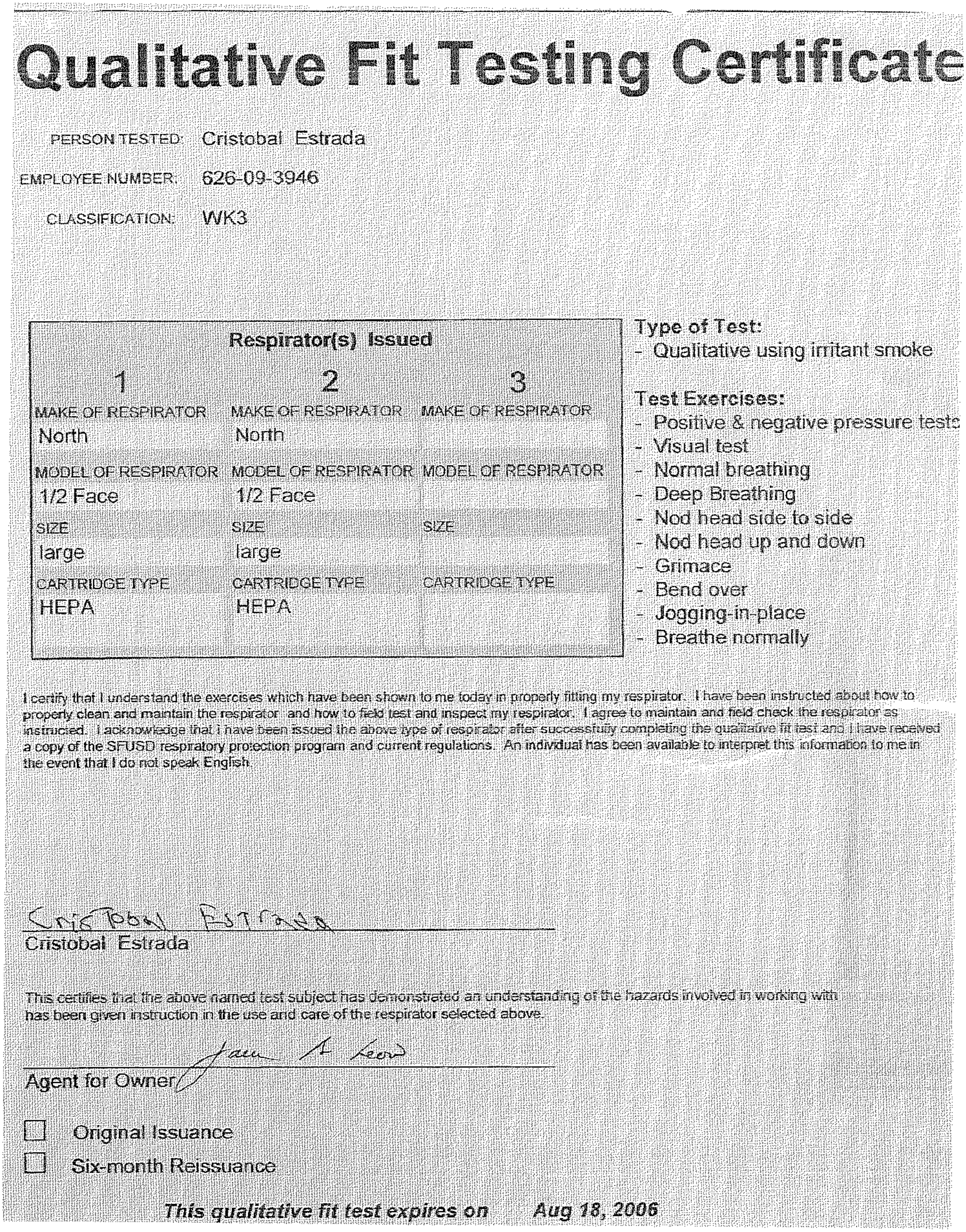
Unless otherwise noted below, this evaluation indicates that there are no detected medical conditions that would place employee at an increased risk of material health impairment from exposure to asbestos, and there are no recommended limitations on the employee concerning the use of personal protective equipment or respirator.

Comments or limitations (if any): none

Provider Signature
7/27/05
Date

Evaluation - Asbestos Medical Surveillance Page 1 of 1 Revision Date: 07/21/199

Cristobal Estrada Employee Number **3946**



Qualitative Fit Testing Certificate

PERSON TESTED: Cristobal Estrada

EMPLOYEE NUMBER: 626-09-3946

CLASSIFICATION: WK3

Respirator(s) Issued

1	2	3
MAKE OF RESPIRATOR North	MAKE OF RESPIRATOR North	MAKE OF RESPIRATOR
MODEL OF RESPIRATOR 1/2 Face	MODEL OF RESPIRATOR 1/2 Face	MODEL OF RESPIRATOR
SIZE large	SIZE large	SIZE
CARTRIDGE TYPE HEPA	CARTRIDGE TYPE HEPA	CARTRIDGE TYPE

Type of Test:
- Qualitative using irritant smoke

Test Exercises:
- Positive & negative pressure test
- Visual test
- Normal breathing
- Deep Breathing
- Nod head side to side
- Nod head up and down
- Grimace
- Bend over
- Jogging-in-place
- Breathe normally

I certify that I understand the exercises which have been shown to me today in properly fitting my respirator. I have been instructed about how to properly clean and maintain the respirator and how to field test and inspect my respirator. I agree to maintain and field check the respirator as instructed. I acknowledge that I have been issued the above type of respirator after successfully completing the qualitative fit test and I have received a copy of the SFUSD respiratory protection program and current regulations. An individual has been available to interpret this information to me in the event that I do not speak English.

Cris Tobal Estrada

Cristobal Estrada

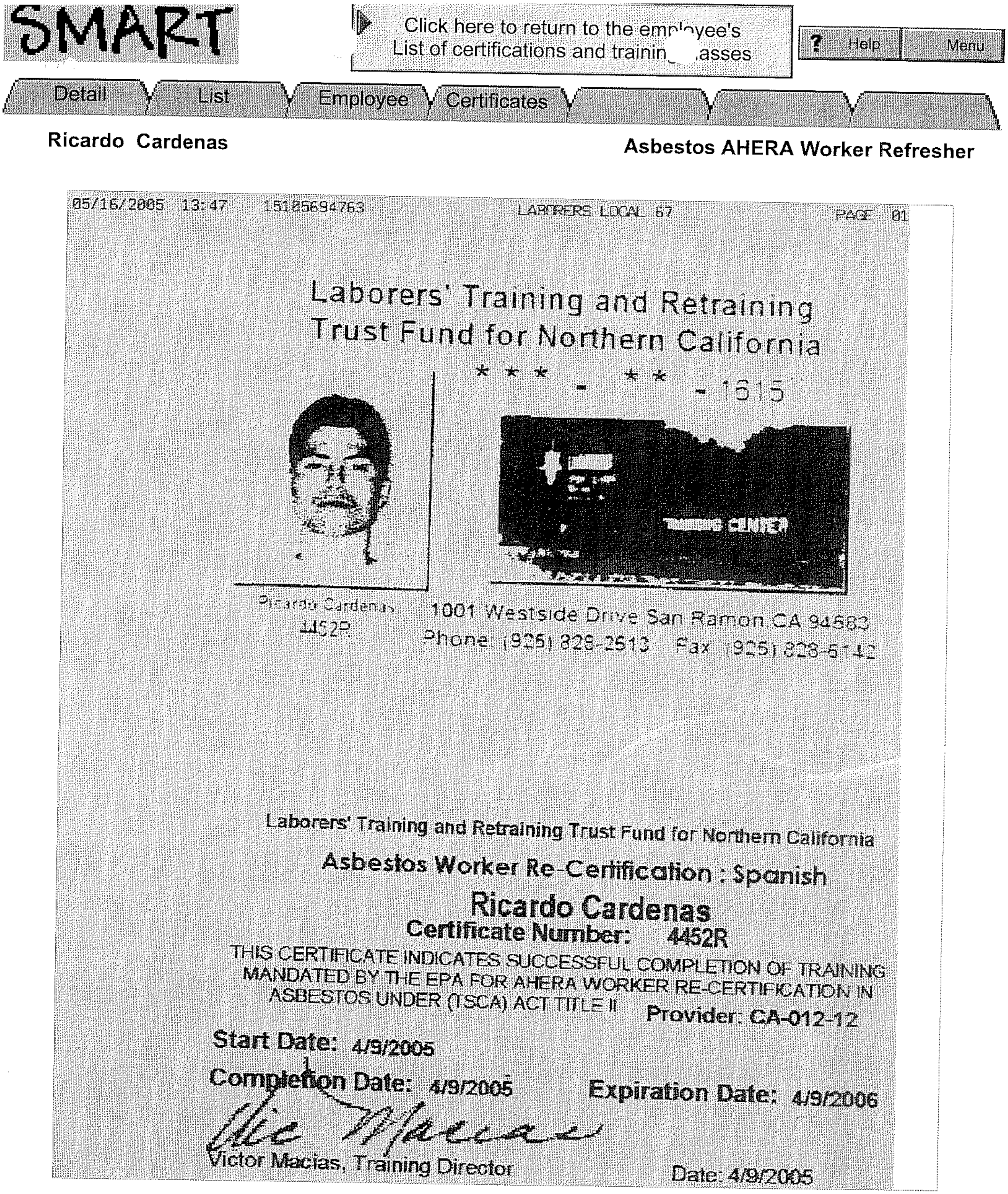
This certifies that the above named test subject has demonstrated an understanding of the hazards involved in working with has been given instruction in the use and care of the respirator selected above.

Agent for Owner

☐ Original Issuance

☐ Six-month Reissuance

This qualitative fit test expires on Aug 18, 2006



Ricardo Cardenas

Asbestos AHERA Worker Refresher

05/16/2005 13:47 15105694763 LABORERS LOCAL 67 PAGE 01

Laborers' Training and Retraining
Trust Fund for Northern California

*** - ** - 1615

Ricardo Cardenas
4452R

1001 Westside Drive San Ramon CA 94583
Phone (925) 828-2513 Fax (925) 828-6142

Laborers' Training and Retraining Trust Fund for Northern California

Asbestos Worker Re-Certification : Spanish

Ricardo Cardenas

Certificate Number: 4452R

THIS CERTIFICATE INDICATES SUCCESSFUL COMPLETION OF TRAINING MANDATED BY THE EPA FOR AHERA WORKER RE-CERTIFICATION IN ASBESTOS UNDER (TSCA) ACT TITLE II

Provider: CA-012-12

Start Date: 4/9/2005

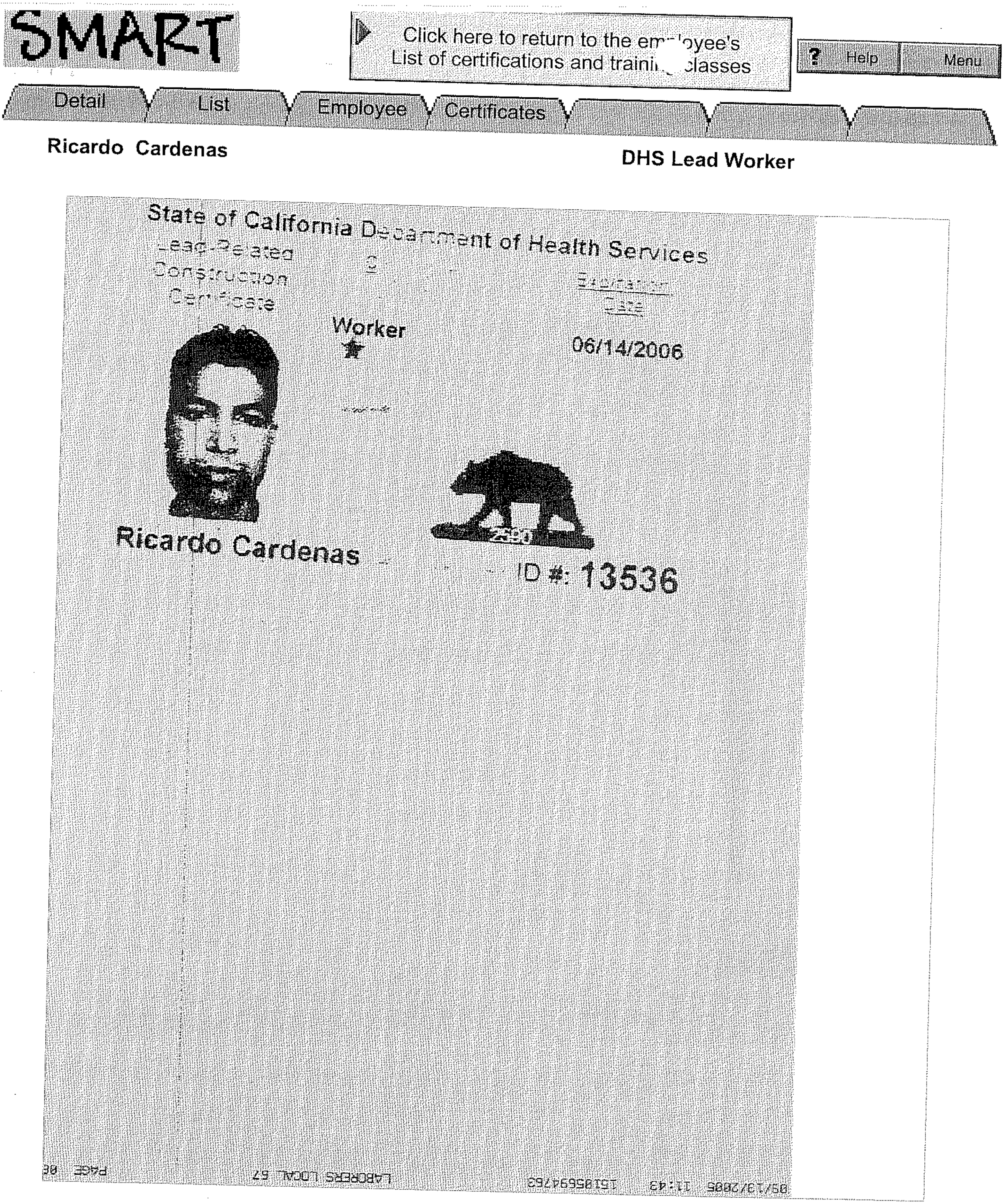
Completion Date: 4/9/2005

Expiration Date: 4/9/2006

Vic Macias

Victor Macias, Training Director

Date: 4/9/2005



Ricardo Cardenas

DHS Lead Worker

State of California Department of Health Services

Lead-Related Construction Certificate

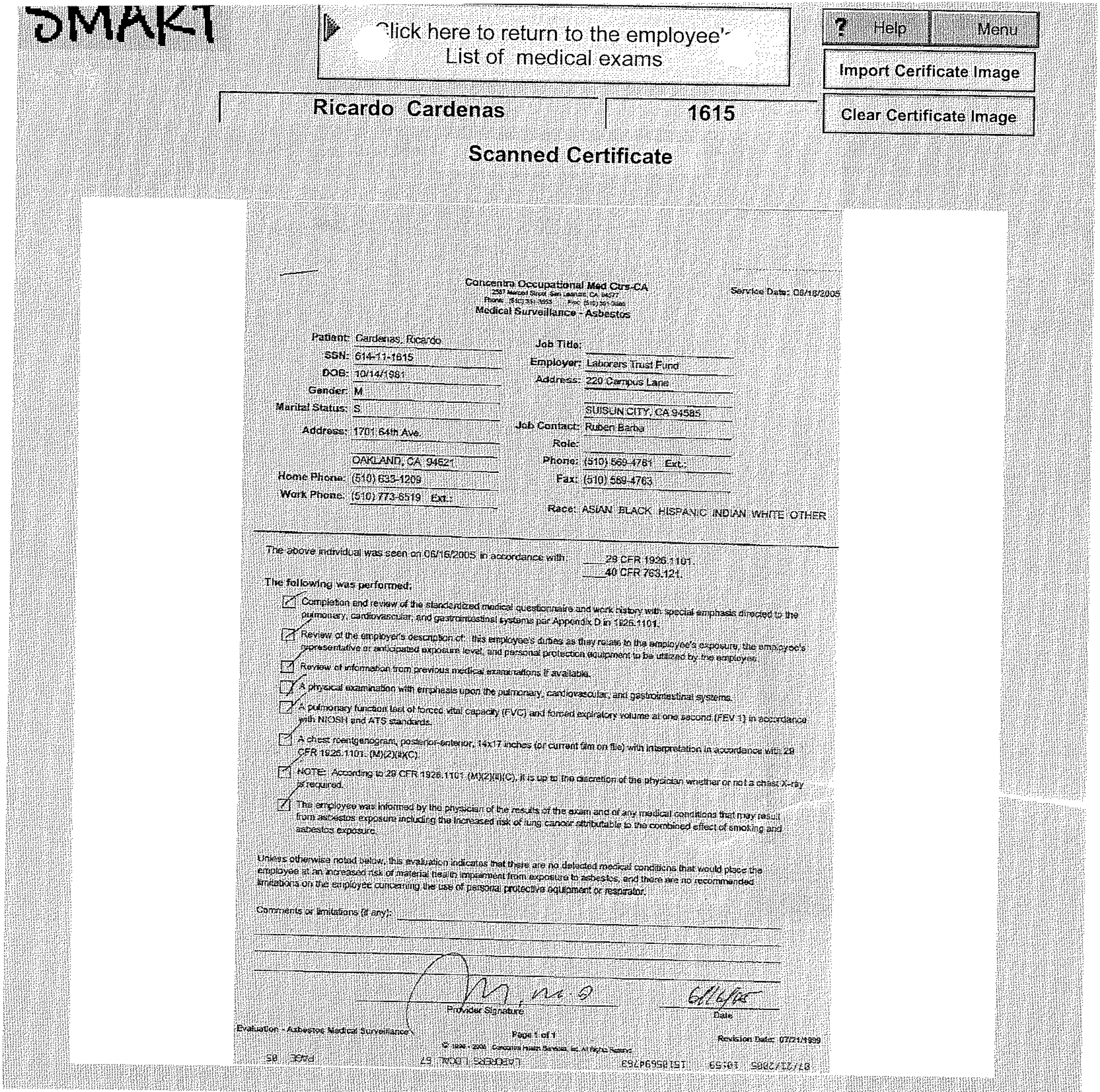
Worker

Expiration Date

06/14/2006

Ricardo Cardenas

ID #: 13536



Ricardo Cardenas **1615**

Scanned Certificate

Concentra Occupational Med Ctrs-CA
2587 Merced Street, San Leandro, CA 94577
Phone: (510) 351-3553 Fax: (510) 351-3586
Medical Surveillance - Asbestos

Service Date: 06/16/2005

Patient:	Cardenas, Ricardo	**Job Title:**	
SSN:	614-11-1615	**Employer:**	Laborers Trust Fund
DOB:	10/14/1981	**Address:**	220 Campus Lane
Gender:	M		
Marital Status:	S		SUISUN CITY, CA 94585
Address:	1701 64th Ave.	**Job Contact:**	Ruben Barba
		Role:	
	OAKLAND, CA 94621	**Phone:**	(510) 569-4761 Ext.:
Home Phone:	(510) 633-1209	**Fax:**	(510) 569-4763
Work Phone:	(510) 773-6519 Ext.:		

Race: ASIAN BLACK HISPANIC INDIAN WHITE OTHER

The above individual was seen on 06/16/2005 in accordance with: ____29 CFR 1926.1101.
____40 CFR 763.121.

The following was performed:

- ☑ Completion and review of the standardized medical questionnaire and work history with special emphasis directed to the pulmonary, cardiovascular, and gastrointestinal systems per Appendix D in 1926.1101.
- ☑ Review of the employer's description of: this employee's duties as they relate to the employee's exposure, the employee's representative or anticipated exposure level, and personal protection equipment to be utilized by the employee.
- ☑ Review of information from previous medical examinations if available.
- ☑ A physical examination with emphasis upon the pulmonary, cardiovascular, and gastrointestinal systems.
- ☑ A pulmonary function test of forced vital capacity (FVC) and forced expiratory volume at one second (FEV 1) in accordance with NIOSH and ATS standards.
- ☑ A chest roentgenogram, posterior-anterior, 14x17 inches (or current film on file) with interpretation in accordance with 29 CFR 1926.1101. (M)(2)(ii)(C).
- ☑ NOTE: According to 29 CFR 1926.1101 (M)(2)(ii)(C), it is up to the discretion of the physician whether or not a chest X-ray is required.
- ☑ The employee was informed by the physician of the results of the exam and of any medical conditions that may result from asbestos exposure including the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure.

Unless otherwise noted below, this evaluation indicates that there are no detected medical conditions that would place the employee at an increased risk of material health impairment from exposure to asbestos, and there are no recommended limitations on the employee concerning the use of personal protective equipment or respirator.

Comments or limitations (if any): ____________________

M, M.D. 6/16/05
Provider Signature Date

Evaluation - Asbestos Medical Surveillance
Page 1 of 1
Revision Date: 07/21/1999

07/21/2005 10:59 15105694763 LABORERS LOCAL 67 PAGE 05

Ricardo Cardenas

Employee Number **1615**

Qualitative Fit Testing Certificate

PERSON TESTED: Ricardo Cardenas

EMPLOYEE NUMBER: 614-11-1615

CLASSIFICATION: WK3

Respirator(s) Issued

1	2	3
MAKE OF RESPIRATOR North	MAKE OF RESPIRATOR North	MAKE OF RESPIRATOR Survivair
MODEL OF RESPIRATOR 1/2 Face	MODEL OF RESPIRATOR 1/2 Face	MODEL OF RESPIRATOR PAPR
SIZE large	SIZE large	SIZE One-Size-Fits-All
CARTRIDGE TYPE HEPA	CARTRIDGE TYPE HEPA	CARTRIDGE TYPE HEPA

Type of Test:
- Qualitative using irritant smoke

Test Exercises:
- Positive & negative pressure tests
- Visual test
- Normal breathing
- Deep Breathing
- Nod head side to side
- Nod head up and down
- Grimace
- Bend over
- Jogging-in-place
- Breathe normally

I certify that I understand the exercises which have been shown to me today in properly fitting my respirator. I have been instructed about how to properly clean and maintain the respirator and how to field test and inspect my respirator. I agree to maintain and field check the respirator as instructed. I acknowledge that I have been issued the above type of respirator after successfully completing the qualitative fit test and I have received a copy of the SFUSD respiratory protection program and current regulations. An individual has been available to interpret this information to me in the event that I do not speak English.

Ricardo Cardenas

This certifies that the above named test subject has demonstrated an understanding of the hazards involved in working with has been given instruction in the use and care of the respirator selected above.

Agent for Owner

☐ Original Issuance

☐ Six-month Reissuance

This qualitative fit test expires on Aug 18, 2006

SMART

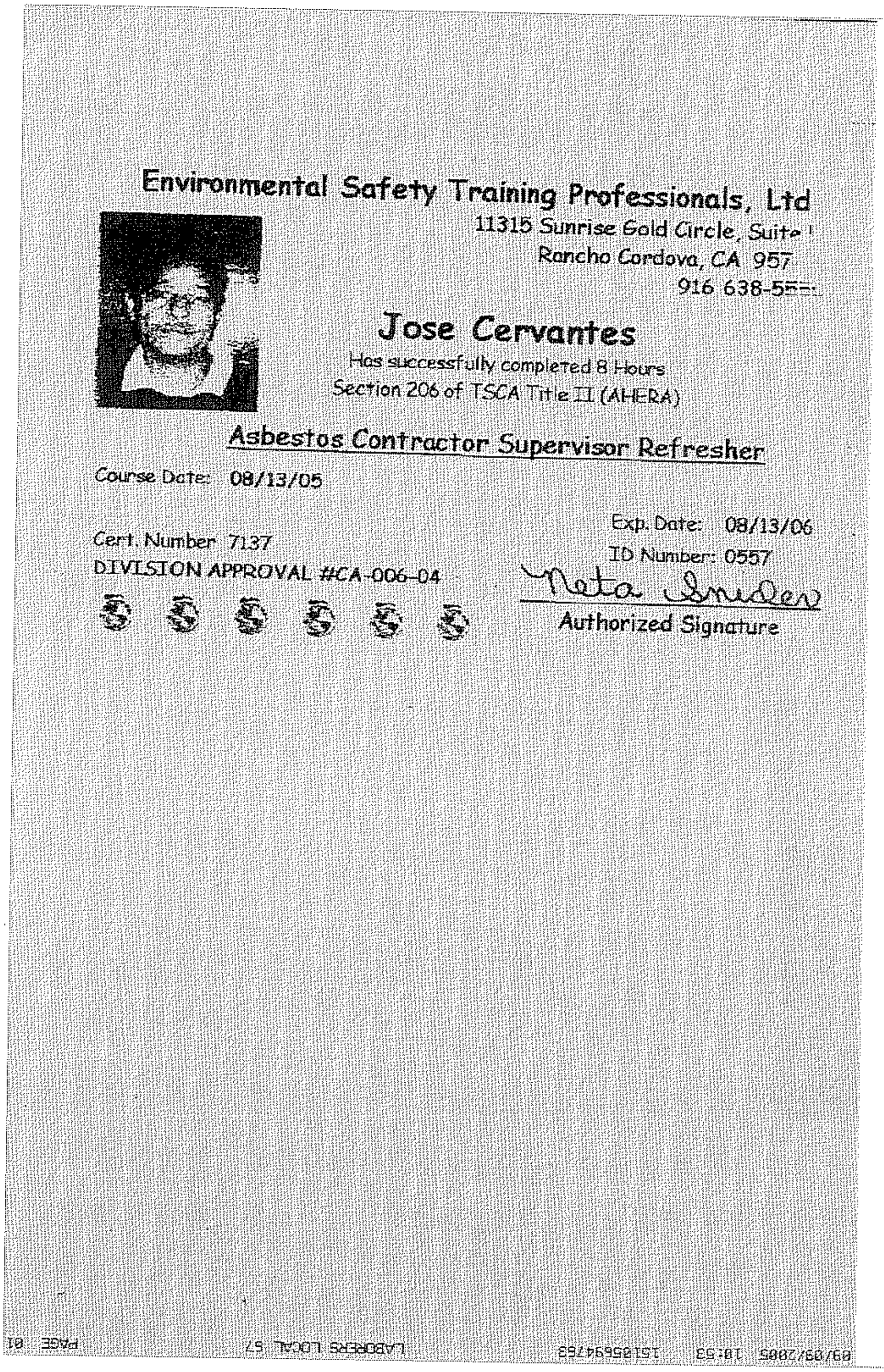
Click here to return to the empl‍oyee's List of certifications and trainin‍g classes

? Help | Menu

Detail | List | Employee | Certificates

Jose M. Cervantes

Asbestos Contractors and



Environmental Safety Training Professionals, Ltd
11315 Sunrise Gold Circle, Suite
Rancho Cordova, CA 957
916 638-5

Jose Cervantes
Has successfully completed 8 Hours
Section 206 of TSCA Title II (AHERA)

Asbestos Contractor Supervisor Refresher

Course Date: 08/13/05

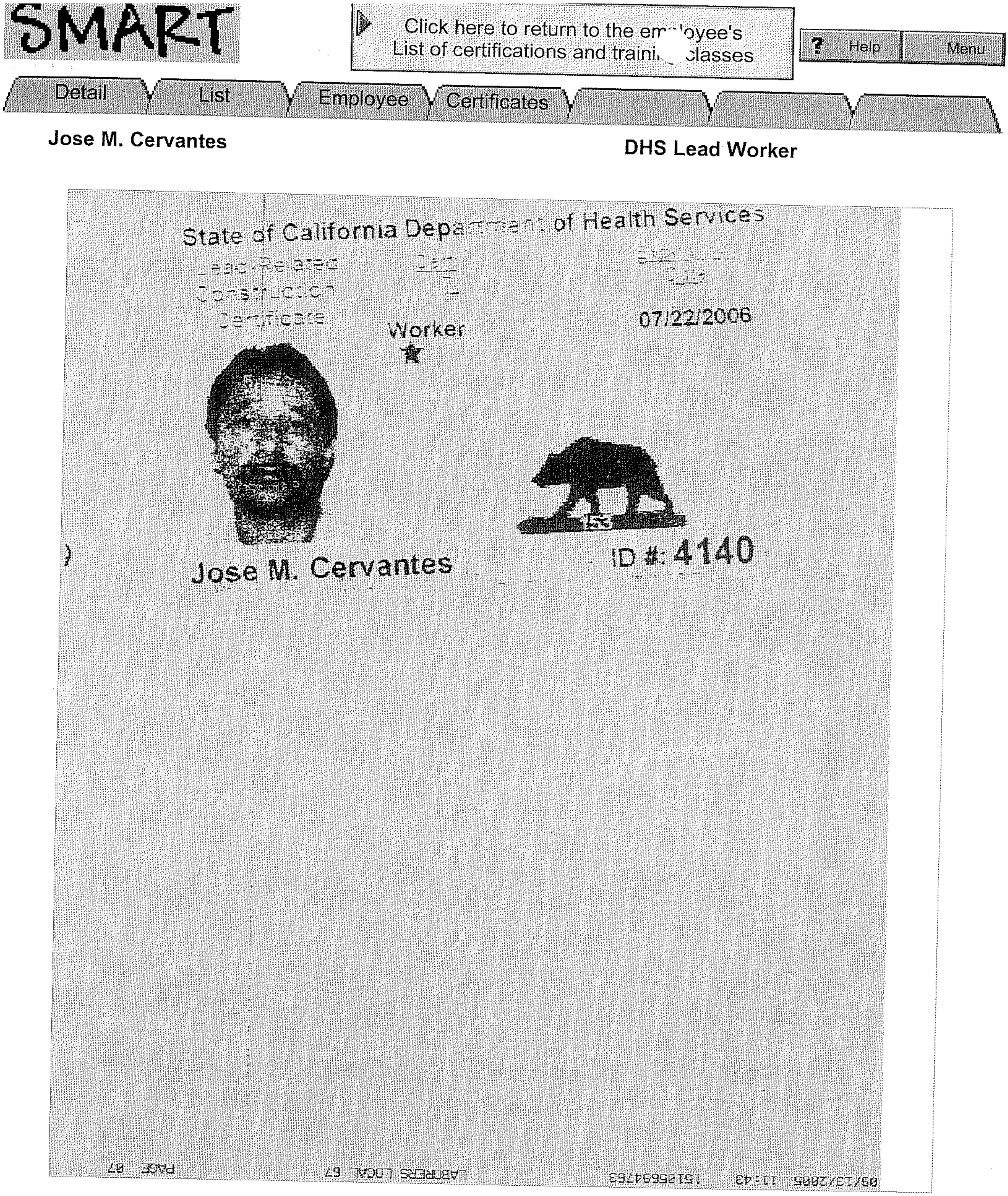
Exp. Date: 08/13/06

Cert. Number 7137

ID Number: 0557

DIVISION APPROVAL #CA-006-04

Neta Snider
Authorized Signature



Jose M. Cervantes

DHS Lead Worker

State of California Department of Health Services

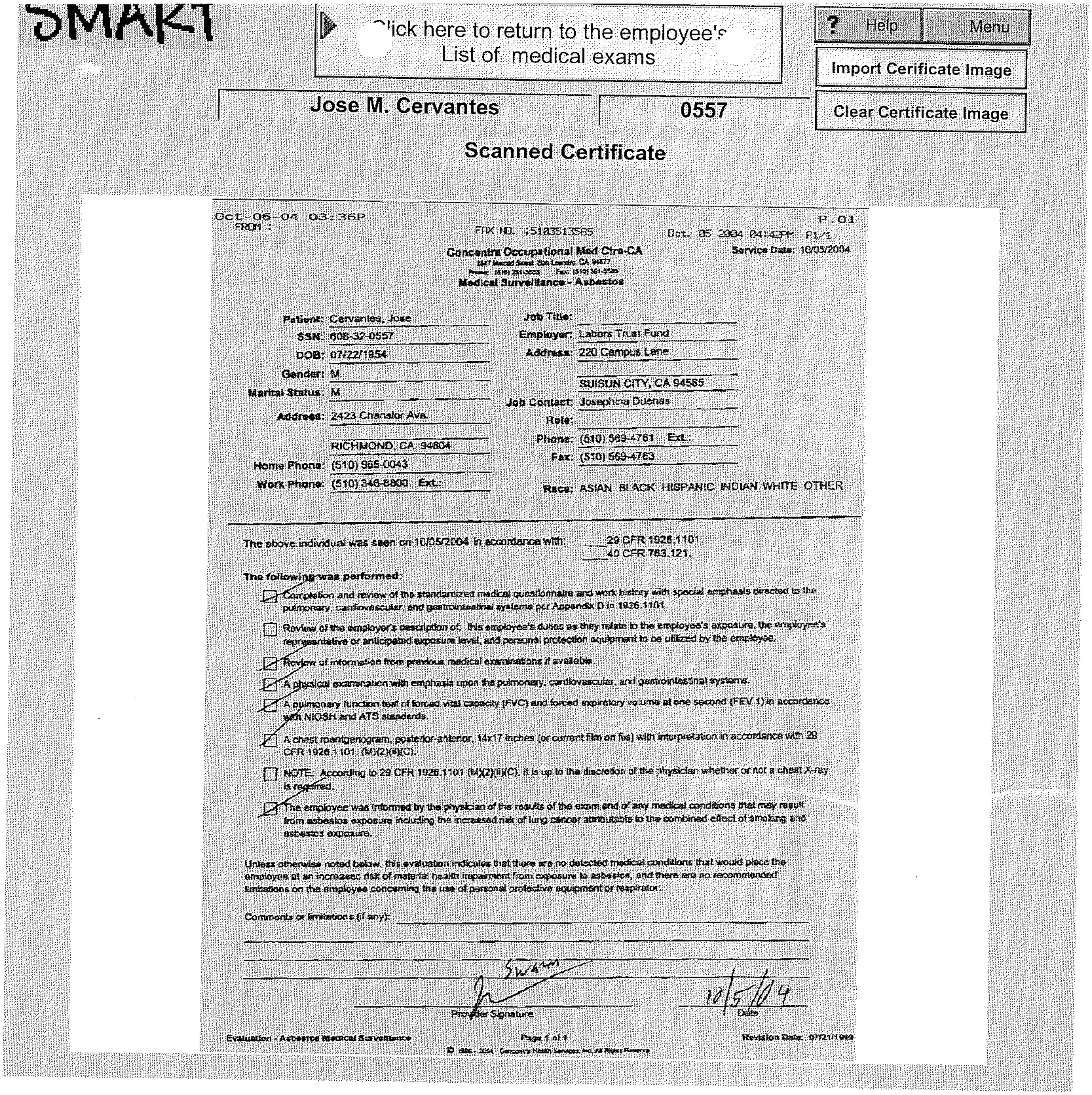
Lead-Related
Construction
Certificate

Worker

Expiration Date
07/22/2006

Jose M. Cervantes

ID #: 4140



Jose M. Cervantes | **0557**

Scanned Certificate

Oct-06-04 03:36P P.01
FROM :
FAX NO. :5103513585 Oct. 05 2004 04:42PM P1/1

Concentra Occupational Med Ctrs-CA

Service Date: 10/05/2004

Medical Surveillance - Asbestos

Patient: Cervantes, Jose
SSN: 608-32-0557
DOB: 07/22/1954
Gender: M
Marital Status: M
Address: 2423 Chanslor Ave.
RICHMOND, CA 94804
Home Phone: (510) 965-0043
Work Phone: (510) 346-8800 **Ext.:**

Job Title:
Employer: Labors Trust Fund
Address: 220 Campus Lane
SUISUN CITY, CA 94585
Job Contact: Josephina Duenas
Role:
Phone: (510) 569-4761 **Ext.:**
Fax: (510) 569-4763

Race: ASIAN BLACK HISPANIC INDIAN WHITE OTHER

The above individual was seen on 10/05/2004 in accordance with:
___ 29 CFR 1926.1101
___ 40 CFR 763.121.

The following was performed:

- ☑ Completion and review of the standardized medical questionnaire and work history with special emphasis directed to the pulmonary, cardiovascular, and gastrointestinal systems per Appendix D in 1926.1101.
- ☐ Review of the employer's description of: this employee's duties as they relate to the employee's exposure, the employee's representative or anticipated exposure level, and personal protection equipment to be utilized by the employee.
- ☑ Review of information from previous medical examinations if available.
- ☑ A physical examination with emphasis upon the pulmonary, cardiovascular, and gastrointestinal systems.
- ☑ A pulmonary function test of forced vital capacity (FVC) and forced expiratory volume at one second (FEV 1) in accordance with NIOSH and ATS standards.
- ☑ A chest roentgenogram, posterior-anterior, 14x17 inches (or current film on file) with interpretation in accordance with 29 CFR 1926.1101 (M)(2)(ii)(C).
- ☐ NOTE: According to 29 CFR 1926.1101 (M)(2)(ii)(C), it is up to the discretion of the physician whether or not a chest X-ray is required.
- ☑ The employee was informed by the physician of the results of the exam and of any medical conditions that may result from asbestos exposure including the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure.

Unless otherwise noted below, this evaluation indicates that there are no detected medical conditions that would place the employee at an increased risk of material health impairment from exposure to asbestos, and there are no recommended limitations on the employee concerning the use of personal protective equipment or respirator.

Comments or limitations (if any): __________

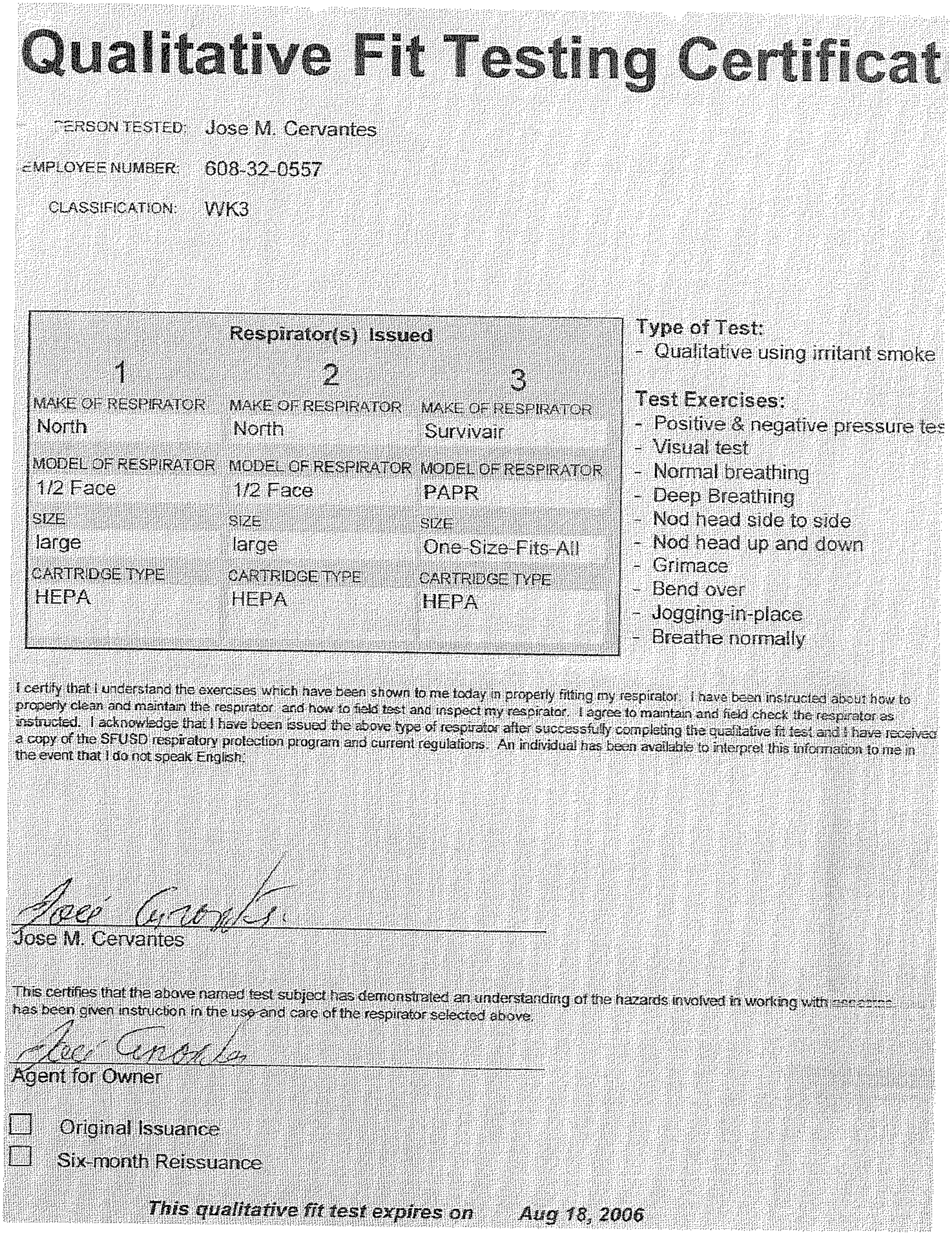
Swan
Provider Signature

10/5/04
Date

Evaluation - Asbestos Medical Surveillance Page 1 of 1 **Revision Date:** 07/21/1999

Jose M. Cervantes

Employee Number **0557**



Qualitative Fit Testing Certificat

ERSON TESTED: Jose M. Cervantes

MPLOYEE NUMBER: 608-32-0557

CLASSIFICATION: WK3

Respirator(s) Issued

1	2	3
MAKE OF RESPIRATOR North	MAKE OF RESPIRATOR North	MAKE OF RESPIRATOR Survivair
MODEL OF RESPIRATOR 1/2 Face	MODEL OF RESPIRATOR 1/2 Face	MODEL OF RESPIRATOR PAPR
SIZE large	SIZE large	SIZE One-Size-Fits-All
CARTRIDGE TYPE HEPA	CARTRIDGE TYPE HEPA	CARTRIDGE TYPE HEPA

Type of Test:

- Qualitative using irritant smoke

Test Exercises:

- Positive & negative pressure tes
- Visual test
- Normal breathing
- Deep Breathing
- Nod head side to side
- Nod head up and down
- Grimace
- Bend over
- Jogging-in-place
- Breathe normally

I certify that I understand the exercises which have been shown to me today in properly fitting my respirator. I have been instructed about how to properly clean and maintain the respirator and how to field test and inspect my respirator. I agree to maintain and field check the respirator as instructed. I acknowledge that I have been issued the above type of respirator after successfully completing the qualitative fit test and I have received a copy of the SFUSD respiratory protection program and current regulations. An individual has been available to interpret this information to me in the event that I do not speak English.

Jose M. Cervantes

This certifies that the above named test subject has demonstrated an understanding of the hazards involved in working with ~~[illegible]~~ has been given instruction in the use and care of the respirator selected above.

Agent for Owner

☐ Original Issuance

☐ Six-month Reissuance

This qualitative fit test expires on Aug 18, 2006

APPENDIX D: Worker Air Sampling Results

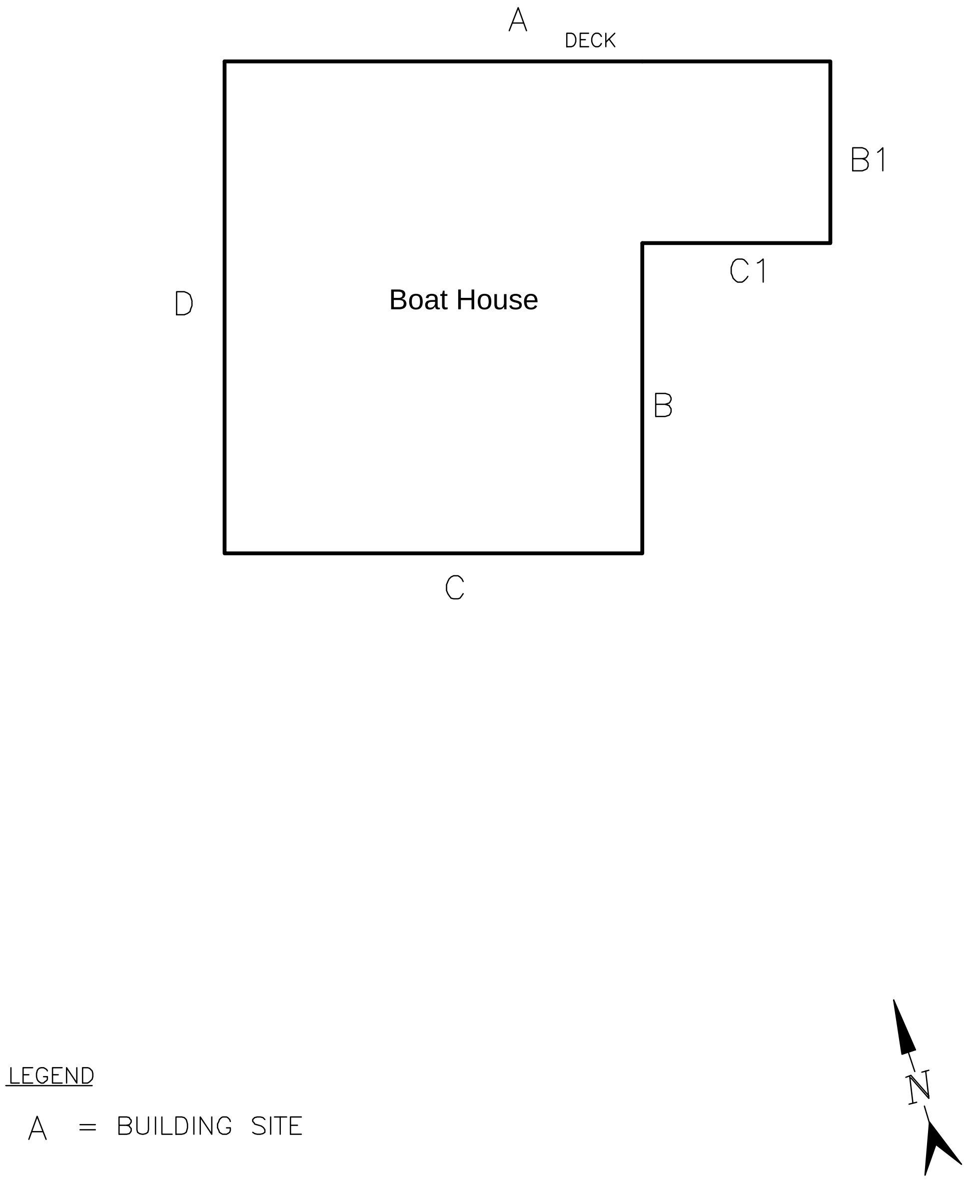
APPENDIX D: PERSONAL AIR SAMPING RESULTS DURING PAINT STABALIZATION AND SOIL REMOAL AT BURROWS ISLAND LIGHT STATION

SAMPLE DATE	LAB LOGIN #	FIELD SAMPLE ID	LOCATION / DESCRIPTION	ACTIVITY	WORKER	TOTAL LEAD $\mu g/m^3$	EXPOSURE $\mu g/m^3$	TWA $\mu g/m^3$
9/17/2005	050923I-1	17-01	IWA, Personal.	Paint scrape (duplex)	M. Benitez	73.0	250.0	
9/17/2005	050923I-2	17-02	IWA, Personal.	Paint scrape (duplex)	M. Benitez	120.0	240.0	150.0
9/17/2005	050923I-3	17-03	IWA, Personal.	Paint scrape (duplex)	S. Estrada	57.0	130.0	
9/17/2005	050923I-4	17-04	IWA, Personal.	Paint scrape (duplex)	S. Estrada	200.0	540.0	260.0
9/17/2005	050923I-5	17-B	Box Blank			<5.0		
9/18/2005	050923G-1	18-01	IWA, Personal (in breathing zone).	Paint scrape on duplex	J. Gastulum	310.0	380.0	
9/18/2005	050923G-2	18-02	IWA, Personal (in breathing zone).	Paint scrape on duplex	J. Gastulum	370.0	560.0	510.0
9/18/2005	050923G-3	18-03	IWA, Personal (in breathing zone).	Paint scrape on duplex	R. Cardenas	100.0	170.0	
9/18/2005	050923G-4	18-04	IWA, Personal (in breathing zone).	Paint scrape on duplex	R. Cardenas	210.0	440.0	320.0
9/18/2005	050923G-5	18-05	Field Blank			<5.0		
9/19/2005	050923H-1	19-01	IWA, Personal, in breathing zone	Scraping paint on storage & duplex	J. Cervantes	210.0	270.0	
9/19/2005	050923H-2	19-02	IWA, Personal, in breathing zone	Sealing soil drums & assisting with drums	J. Cervantes	<5.0	<8.0	<160.0
9/19/2005	050923H-3	19-03	IWA, Personal, in breathing zone	Scraping paint on duplex & storage	C. Estrada	49.0	83.0	
9/19/2005	050923H-4	19-04	IWA, Personal, in breathing	Digging out soil	C. Estrada	<5.0	<11.0	<55.0

SAMPLE DATE	LAB LOGIN #	FIELD SAMPLE ID	LOCATION / DESCRIPTION	ACTIVITY	WORKER	TOTAL LEAD µg/m^3	EXPOSURE µg/m^3	TWA µg/m^3
			zone					
9/19/2005	050923H-5	19-05	Field Blank			<5.0		
9/20/2005	050930G-1	20-01	IWA, Personal, in breathing zone	Soil removal around duplex	J. Torres	<5.0	<10.0	<5.0
9/20/2005	050930G-3	20-02	Field Blank			<5.0		
9/20/2005	050930G-2	20-03	IWA, Personal, in breathing zone	XRF testing in soil removal areas at duplex	R. Czarnecki	<5.0	<6.0	<5.0
9/21/2005	050930A-1	21-01	IWA, Personal, in breathing zone	Removing soil at duplex	J. Alejandro	<5.0	<14.0	<5.0
9/21/2005	050930A-2	21-02	IWA, Personal, in breathing zone	Removing soil at duplex	R. Cardenas	<5.0	<14.0	<5.0
9/21/2005	050930A-3	21-03	Field Blank			<5.0		
9/22/2005	050930H-1	22-01	IWA, Personal, in breathing zone	Digging soil (with lead) with shovels, picks, etc. at duplex	J. Magallon	<5.0	<6.0	
9/22/2005	050930H-2	22-02	IWA, Personal, in breathing zone	Digging soil (with lead) with shovels, picks, etc. at duplex	S. Estrada	<5.0	<7.0	
9/22/2005	050930H-3	22-03	IWA, Personal, in breathing zone	Digging soil (with lead) with shovels, picks, etc. at duplex	J. Magallon	<5.0	<11.0	<8.0
9/22/2005	050930H-4	22-04	IWA, Personal, in breathing zone	Digging soil (with lead) with shovels, picks, etc. at duplex	S. Estrada	<5.0	<14.0	<8.0
9/22/2005	050930H-5	22-05	Box Blank			<5.0		
9/23/2005	050930E-1	23-01	Personal, in breathing zone	Lead containing soil removal with hand toos at duplex	J. Cervantes	<5.0	<9.0	<5.0
9/23/2005	050930E-2	23-02	Personal, in	Sealing &	M. Benitez	<5.0	<7.0	<4.0

SAMPLE DATE	LAB LOGIN #	FIELD SAMPLE ID	LOCATION / DESCRIPTION	ACTIVITY	WORKER	TOTAL LEAD μg/m^3	EXPOSURE μg/m^3	TWA μg/m^3
			breathing zone	working on barrels				
9/24/2005	050930C-1	24-01	IWA, Personal, in breathing zone	Manual lead contaminated soil removal at duplex	M. Benitez	<5.0	<18.0	
9/24/2005	050930C-2	24-02	IWA, Personal, in breathing zone	Manual lead contaminated soil removal at duplex	M. Benitez	<5.0	<8.0	<9.0
9/25/2005	050930F-1	25-01	IWA, Personal, in breathing zone	Manual lead contaminated soil removal at duplex	A. Mendoza	<5.0	<7.0	
9/25/2005	050930F-2	25-02	IWA, Personal, in breathing zone	Manual lead contaminated soil removal at duplex	A. Mendoza	<5.0	<8.0	<8.0
9/26/2005	050930D-1	26-01	IWA, Personal, in breathing zone	XRF soil testing		<5.0	<20.0	<4.0
9/28/2005	050930B-1	28-01	IWA, Personal, in breathing zone	XRF soil testing at duplex	R. Czarnecki	<5.0	<8.0	<5.0

APPENDIX E: Moisture Readings



Drawing Not to Scale

KELLCO Services, Inc.
3137 Diablo Avenue Hayward, CA
(510) 786-9751
Fax (510) 786-9625

Date: August 24, 2005

Client: US Coast Guard

Job #: 0508-05

Job Site: Burrows Island, WA

Lead Test Side Identification

Figure No.: E1

K E L L C O

PG 1 of 4

MOISTURE CONTENT SAMPLING LOG

3 READING AVG AT MOST LOCATIONS

STRUCTURE	~~STG BLDG~~ BOAT HOUSE	**INSPECTOR**		**DATE**	9/19/05

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	HEIGHT	READING #	MOISTURE PERCENT	SUBSTRATE	NOTES
A	AD	1		2		12.5		
	↓			4		18.3		
	↓			6		18.4		
	↓			9		12.5		
A	A-B1	5'		EAVE UNDER SIDE		20.6		
"	"	4		10		12.0		
A	AD	5		5		17.3		
A	AD	4	TRIM AROUND ENTRY	5		14.4		
A	AD	7		8		20.6		
A	AD	8	BY DOOR RT SIDE	6"		21.1		
↓	↓	15		3'6"		12.4-15.4		HORIZONTAL TRIM 2 READINGS
↓	↓	15		8		12.5		
A	A-B1	1		1		16.9		
↓	"	2		4		14.1		2-SIDE WINDOW FRAM
↓	"	3'6"		5		27.5		WINDOW BOARD COVER
↓	AD	8		13		14.5		
↓	↓	8		15		16.4		

PG 2 -4

K E L L C O

MOISTURE CONTENT SAMPLING LOG

STRUCTURE	BOAT HOUSE ~~STG~~ PG 2	**INSPECTOR**		**DATE**	8/19/05

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	HEIGHT	READING #	MOISTURE PERCENT	SUBSTRATE	NOTES
D	AD	3'		3'6"		9.4		HORIZ. TRIM
		3'		6		15.2		
		3'		8		13.0		
		8		4'6"		21.5		WINDOW SILL
		9		6'		26.6		WINDOW BOARD COVER
		12		5'		14.5		
		15		1		12.3		
		"		3		11.5		
		"		8		10.5		
		18		9'6"		12.6		
		24		10'		15.5		
		27		5'		11.2		
		30		1'		16.0		
D	~~CD~~ AD	36		6'		12.7		
		36		9'		16.4		
		39		8'		10.4		
		39		10'		13.2		
D	CD	1'		2'6"		13.5		
		0		6'		16.9		CORNER TRIM
				10 1/2'		16.1		EAVE BOTTOM SIDE
						13.2		" FACE
						23.0		" BOTTOM FACE STRIP

PG3-4

MOISTURE CONTENT SAMPLING LOG

STRUCTURE ~~STG BLDG~~ BOAT HOUSE	**INSPECTOR**	**DATE** 9/21/05

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	HEIGHT	READING #	MOISTURE PERCENT	SUBSTRATE	NOTES
C	CD	4'		2'		15.2		
				6'		13.9		
				9'		17.2		
				12'		17.2		
				13½'		16.1		EAVE BOTTOM
		8'		6'		21.6		BOTTOM OF WINDOW SILL
				6'2"		12.8		WINDOW SILL
				8'		13.3		BOARD ON WINDOW
				10'		14.9		
				12'		14.3		UPPER WINDOW BOARD
				14'		15.5		
		12		13'4"		13.8 / 16.2		EAVE FACE/BOTTOM
				9'		16.5		
				4'6"		16.1		
				2'		20.4		EXPOSED STUD
		16		1'6"		21.4		BOTTOM SLAT
				4'		19.9		EXPOSED STUD
				5'6"		19.8		
				6'6"		22.2		

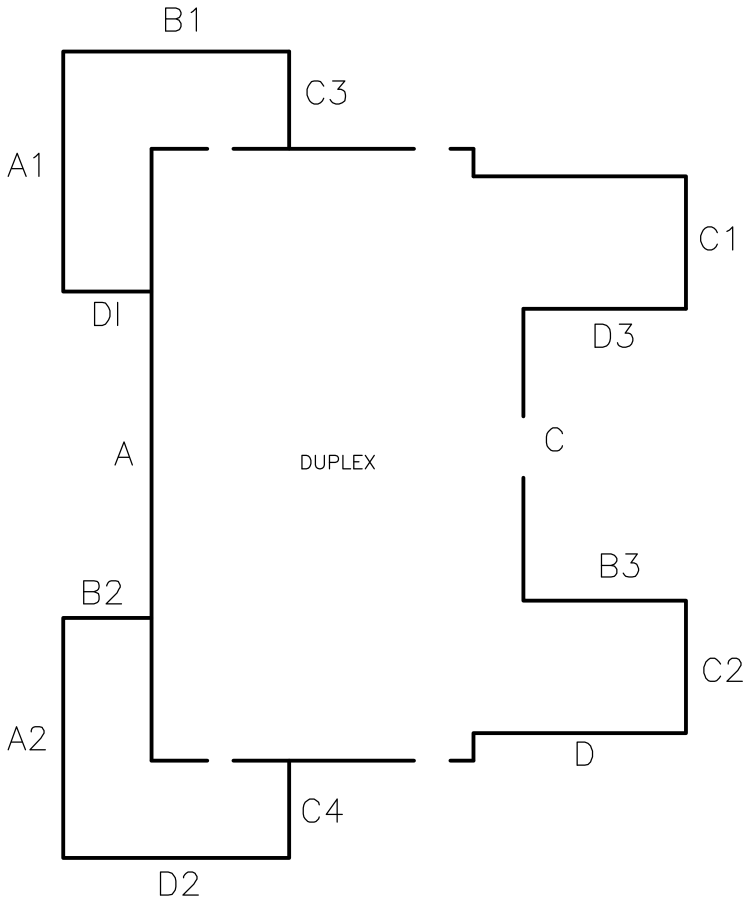
PG 4 OF 4

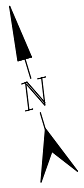
KELLCO

MOISTURE CONTENT SAMPLING LOG

STRUCTURE ~~STORAGE BLDG~~ BOAT HOUSE **INSPECTOR** **DATE** 9/21/05

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	HEIGHT	READING #	MOISTURE PERCENT	SUBSTRATE	NOTES
B	CB	7'		2'	18.8			BOTTOM TRIM
		7'		7'	12.9			
				10'6"	22.4 / >40.0	NOTE EAVE WOOD ROTTEN		EAVE BOTTOM/FACE
				10'6"	17.6			TOP WALL TRIM
		14'		4'	14.5			
				6'	21.9			
				10'	10.8			TOP WINDOW FRAME
				11'4"	19.0 / 17.1			EAVE BOTTOM/FACE MOLDING
		21'		3'7"	11.7			BOTTOM MOLDING
				5'	>40.0			
				8'	>40.0			
				10'	>40.0			
C1	C1-B	3'		3'	17.9			
		3'		4'	9.9 ~~9.9~~			BOTTOM WINDOW SILL MOLDING
		3' ~~4"~~		9'9"	~~9.9~~ 17.7			EAVE BOTTOM
		3' ~~8'6"~~		8'6"	>40.0			
B1	C1-B1	6"		2'6"	>40.0			
		6"		5'	16.0			
		6'6"		8'	208			EAVE
		8'6"		6'6"	10.0			
		12'6"		1'	19.2			
		12'6"		6'	11.8			
		12'0"		8'	14.9			





LEGEND

A = BUILDING SIDE

Drawing Not to Scale

KELLCO Services, Inc.
3137 Diablo Avenue Hayward, CA
(510) 786-9751
Fax (510) 786-9625

Date: August 24, 2005

Client: US Coast Guard

Job #: 0508-05

Job Site: Burrows Island, WA

Duplex Lead Test
Side Identification

Figure No.: E2

3 READING AVG @ MOSTS LOCATIONS

K E L L C O

MOISTURE CONTENT SAMPLING LOG

PG 1 OF 4

STRUCTURE DUPLEX **INSPECTOR** RC **DATE** 9/19/05

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	HEIGHT	READING #	MOISTURE PERCENT	SUBSTRATE	NOTES
A1	A1-B1	0		FLOOR DECK		12.1		ON DECK
⊥	⊥	0		COLUMN 6"		>40.0		COLUMN
|	⊥	0		2'6" FROM DECK		12.5		
|	|	1'		RAIL		12.2		
|	|	1'		RAIL TRIM		>40		
↓	⊥	2'		POST		11.5		
NORTH PORCH DECK	50-60 TESTS	BETWEEN 7.2 TO 19.6	WITH 4 >40 READINGS IN VARIOUS SPOTS					
A1	A1-B1	0		COLUMN 8'		12.7		
|	|	0' ~~78~~		4'		12.5		
|	⊥	18'	COLUMN	8'		>40 (3 TIMES)		
|	|	9'	COLUMN	7'		13.3		
|	⊥	7'	RAIL	RAIL TOP		>40		
⊥		1"		CEILING ~~12-13'~~		19.2		N. PORCH CEILING
A1		1'		~~CEILING~~ 13'	CE1	>40		EAVE TRIM/FACE
A	A-B	1'		5' FM PORCH		19.7		
A	A-B	6'		4' " "		14.4		2 OF 5 READING >40
|	|	12'		8 FM GROUND		16.5		
|	|	12		10 " "		10.6		
⊥	⊥	11'-7' R-L		4' FROM PORCH		8.8-19.1		BOTTOM WINDOW FRAME R TO L
B	AB	12'		8'		13.3		
⊥	⊥	6'		6" FM PORCH		13.1		

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K E L L C O

PG 2 OF 4

MOISTURE CONTENT SAMPLING LOG

STRUCTURE DUPLEX | **INSPECTOR** | **DATE** 9/19/05

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	HEIGHT	READING #	MOISTURE PERCENT	SUBSTRATE	NOTES
B1	A1-B1	14'		4'.		37.8		
		13'		3'		17.1		TOP STAIR
		13'		2'		26.3		3RD STAIR RISER
		16'		2'		18.5		LATTICE
B	B-C3	9'		3'6"		37.8		HORIZ TRIM RAIL
		9'		7'6"		16.8	9/21/05	SOIL REMOVE 12" THIS SIDE
		9'		7'6"		>40.0		WINDOW SILL
		18'		8'6"		>40		
		19'6"		5'		14.2		
		29'		13'4"		11.4		EAVE MOLDING
				13'2"		>40.0		EAVE FACE
				10'6"		11.4		WINDOW FRAME
		29'6"		12'		12.1		
		37'		7'6"		13.3		
		35'		11'6"		18.8		
C1	B-C1	1'		2'		11.9		
		5'		4'		18.8		
		9'		8'6"		12.5		
		13		12		17.3		
		7'6"		17½-18'		9.9/15.5		EAVE: MOLD/BOTTOM
		8'		17'6"		>40		TOP TRIM
		7'		17'		13.5		TOP WALL

PG 3 OF 4

MOISTURE CONTENT SAMPLING LOG

STRUCTURE	DUPLEX	**INSPECTOR**		**DATE**	9/21/25

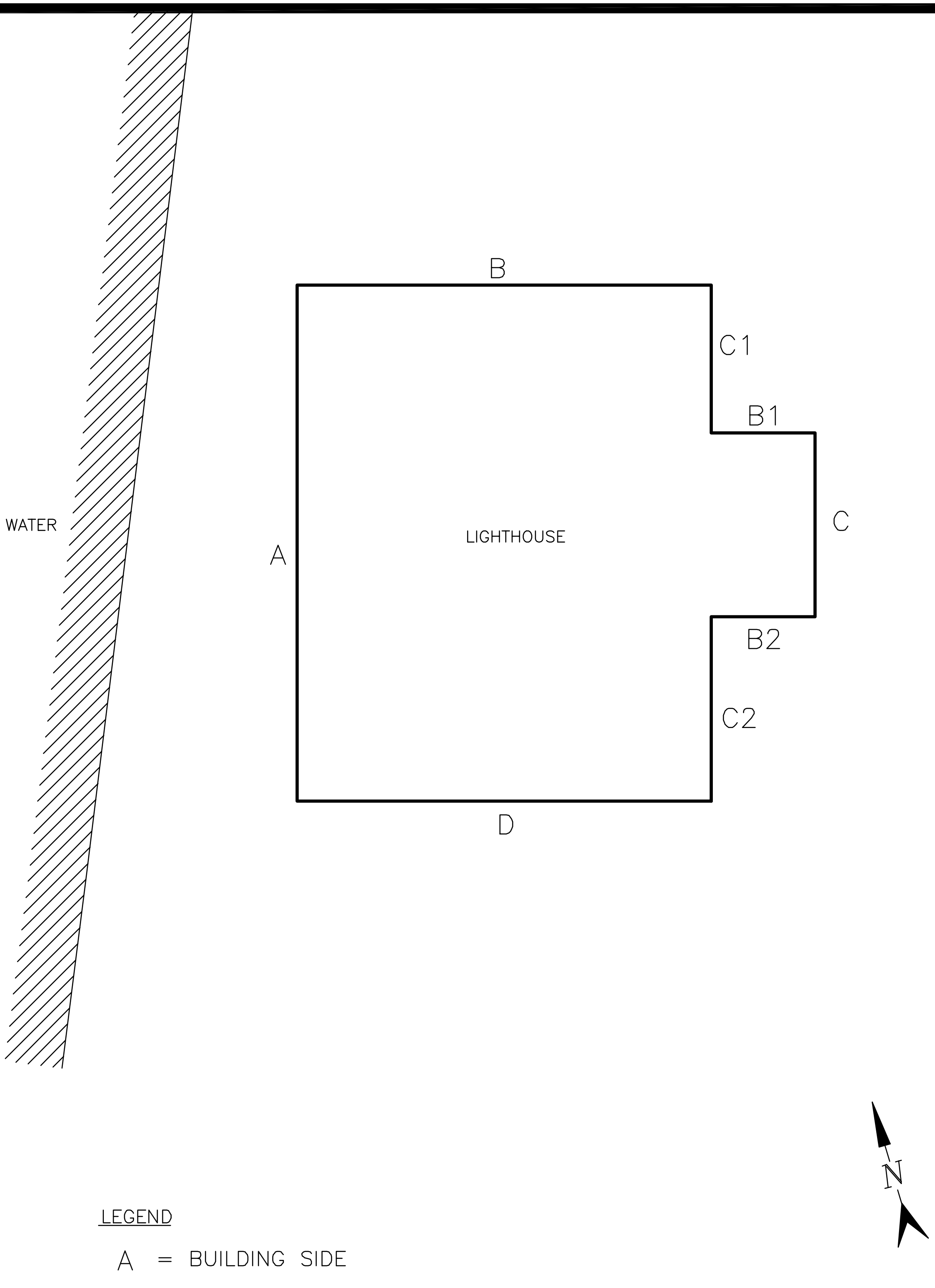
SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	HEIGHT	READING #	MOISTURE PERCENT	SUBSTRATE	NOTES
D3	D3-C1	1		3'6"		10.9		
		4'6"		6'6"		11.5		
		8'6"		11'		12.0		
		14 1/2		8'		10.1		WINDOW FRAME
		9'		3'4"		9.3		STAIR TOP DECK
		18'		3		10.9		BOTTOM TRIM
C	C-D3	7		27'		10.7		
↓	↓	10'		27'		9.7		WINDOW SILL
↓	↓	11'		26'		13.4		
↓	↓	17'		26'		11.9		
↓	↓	VARIOUS		15'		11.7		AVG. ACROSS WALL SAMPLE
↓	↓			15'		12.1		
↓	↓	15'		13'		12.6		
↓	↓	6'6"		8'		15.9		
D	D-C2	2'		6'		>40.0		
↓	↓	6'		2		13.1		
↓	↓	9'		5'		12.2		
↓	↓	13'		8'		11.8		
↓	↓	17'6"		11'		11.5		

Pg 4 of 4

MOISTURE CONTENT SAMPLING LOG

STRUCTURE DUPLEX **INSPECTOR** **DATE** 9/21/05

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	HEIGHT	READING #	MOISTURE PERCENT	SUBSTRATE	NOTES
D	D-02	21'		5'	~~11.9~~	11.9		
		25'		6'6"		10.7		WINDOW SILL
		25'		4		11.2		
		27'		8'		11.5		
		27'		2'		10.4		
		31'		12'		13.2		
		31'		8'		12.7		
		31'		5		10.3		
		35'		2'6"		11.1		BOTTOM TRIM
		35'		4		11.7		
		35'		7'		10.8		



LEGEND

A = BUILDING SIDE

Drawing Not to Scale

KELLCO Services, Inc. 3137 Diablo Avenue Hayward, CA (510) 786-9751 Fax (510) 786-9625	Date: August 24, 2005
Client: US Coast Guard	Job #: 0508-05
Job Site: Burrows Island, WA Lighthouse Lead Test Side Identification	Figure No.: E3

PG 1 OF 5

MOISTURE CONTENT SAMPLING LOG

STRUCTURE LIGHT HOUSE

INSPECTOR

DATE 9/12/05

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	HEIGHT	READING #	MOISTURE PERCENT	SUBSTRATE	NOTES
A	AD	ON TRIM CORNER		6'	~~13.3~~ 1	13.3		
	↓	"		2'	~~12.8~~ 2	12.8		
		"		8'		13.1		
		7'		4½'		20.4		
		2'		2'		18.1		
	↓			8'		13.5		
	AD SIDE WINDOW	7-11'				>40.0		BOTTOM OF WINDOW TRIM/SILL
	AD SIDE WINDOW					12.6 13.3 13.5 (3)		FACE OF WINDOW SILL
				7'		10.5		WIN. FRAME S. SIDE
						130 15.9 - 19.0 (3)		" " N. SIDE
						15.2 12.2 17.6		BOTTOM OF WINDOW COVER BOARD
				7'		6.2 2.3		MID WINDOW COVER BOARD
	AD	15'		2'		12.6		
		"		4'		16		
		"		6'		25.2		
		"		8'		17.6		
		25'		2'		16.5		
				6'		16.1		
				8'		21.3		

PG 2 OF 5

K E L L C O

MOISTURE CONTENT SAMPLING LOG

STRUCTURE LT House **INSPECTOR** **DATE** 9-1705

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	HEIGHT	READING #	MOISTURE PERCENT	SUBSTRATE	NOTES
B	AB	2'		11'	17.4			
B	AB	5'		11'	8.4			TOP WINDOW FRAME
		2		2'	12.2			Bottom trim @2
		2		4'	20.1			
				5'	14.6			
				6'	17.4			
		10'		2'	17.5			
		"		4'	19.5			
		"		6'	12.8			
		"		12'	13.0			
		17'		3'	17.4			
				5'	16.2			
				7'	19.9			
				11'	20.7			
~~B~~-C1	B-C1	1'		1'	12.3			
		1'		3'	12.5			
		1'		5'	12.4			
		1'		7'	10.8			
		1'		9'	13.7			

PG 3 of 5

MOISTURE CONTENT SAMPLING LOG

STRUCTURE L.H	**INSPECTOR**	**DATE** 9/17/05	

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	~~DISTANCE FROM STRUCTURE~~	HEIGHT	READING #	MOISTURE PERCENT	SUBSTRATE	NOTES
C1	B-C1	7'	L SIDE DOOR FRAME	BOTTOM EDGE		22.9		
"	"	"	↓	2'		9.0		
				4'		10.3		
				6'		12.7		
			DOOR FRAME EDGE	10'		16.1		
		5	HEADER	6'8"		14.0		DOORWAY HEADER
		5	WOOD PANEL OVER DOOR	8'		13		
		3		8'		8.1		
		7		8'		13.3		
B1	B1·C1	1'	[illegible]	1'		20.9		
		1'		2' 8"		12.2		
		1'		4'		14.5		
		6" TO 3'6"		4'3"		RT TO LEFT 11.2 - 9.0 - 11.9		BOTTOM OF WINDOW SILL
				4'5"		R - L 13.1 13.9 13.7		FACE OF WINDOW SILL
		4'		1'		17.6		
				3'		10.5		
				5'		14.6		
				7'		17.4 BOTTOM OF SLAT	10.5	TOP OF SLAT

PG 4 OF 5

K E L L C O

MOISTURE CONTENT SAMPLING LOG

STRUCTURE	h.H.	**INSPECTOR**		**DATE**	9/17/05

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	HEIGHT	READING #	MOISTURE PERCENT	SUBSTRATE	NOTES
B2	B2-C	1'		12'		31.9		
		3				17.8		
		5'				33.6		
		1		15'		14.3		
		3		15'		12.2		
		5				12.1		
C-2	B2-C2	1		12'		13.5		
		3		12		14.5		
		7				13.7		
		9				20.4		CORNER TRIM
C2		3'-6' WINDOW FRAME				R-L 16.8 16.3 129		TOP OF C2 WINDOW FRAME
C	B1-C	3		1		19.3		
				3		13.6		
				5		11.4		
				7		>400		BY VENT
		9		5		14.4		
		9		2		18.4		
		9		4		20.0		
		9		6		15.9		

Pg 5 of 5

K E L L C O

MOISTURE CONTENT SAMPLING LOG

STRUCTURE L.H
INSPECTOR
DATE 9/07/05

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	HEIGHT	READING #	MOISTURE PERCENT	SUBSTRATE	NOTES
BZ	BZ-C	1		1		21.2		
		3		3		>40.0		
		5		5		12.5		
		3		8		16.1		
CZ	BZ CZ	1		1		14		
		3		3		13.2		
		2'6"		5		11.0		WINDOW FRAME RT SIDE
		5'9"		7		12.2		L SIDE
		8'6"		2		17.1		
				4		11.7		
				6		11.9		
		7		7		10.4		
D	D-CZ	2		1'6"		14.6		
		2		4'		16		
		8		6'		16.5		
		12'6"		8'		>40.0		
		12'6"		3'		16.4		TRIM (BEVELED)
		19		2'6"		15.6		
		19		4		14.4		
		19		6		21.5		
		19		8		17.4		

APPENDIX F: XRF Calibration Data

APPENDIX F Soil Testing after removal of 300 barrels of Soil

Instrumentation

In situ testing of soil was performed using a Niton XL300 with a 14 millicurie cadmium source. The instrument was modified for soil sampling, and was factory calibrated on August 10, 2005.

Field Calibration

As instructed by Niton, the XL300 was allowed to warm up for 15 minutes before field calibration. A self-calibration test was successfully run, followed by a calibration reading versus the NIST "high" lead soil standard # 2710. During the course of testing the self-calibrations were run intermittent to taking the readings, and NIST calibrations were run following collection of all field data, using the NIST high standard and the NIST medium standard (#2711). The calibration readings are shown in Table F1.

Table F1
Burrows Island XL300 Calibration Readings
In Situ
9/26-10/1/05

XL Reading No	Measurement Pb ppm	Calibration Note
277	5628.8	NIST High
278	5718.4	NIST High
279	5680	NIST High
280	1120	NIST Med
281	1100	NIST Med
282	1220	NIST Med
283	<LOD	NIST Low
284	<LOD	NIST Low
285	<LOD	NIST Low
295	NA	Shutter Cal 1
330	NA	Shutter Cal 1
354	NA	Shutter Cal 1
375	NA	Shutter Cal 1
376	NA	Shutter Cal 1
377	5609.6	NIST High
378	5779.2	NIST High

Table F1
Burrows Island XL300 Calibration Readings
In Situ
9/26-10/1/05

XL Reading No	Measurement Pb ppm	Calibration Note
379	5459.2	NIST High
380	1100	NIST Med
381	1080	NIST Med
382	1149.6	NIST Med
383	<LOD	NIST Low
384	<LOD	NIST Low
483	NA	Shutter Cal 1
521	NA	Shutter Cal 1
522	NA	Shutter Cal 1
528	NA	Shutter Cal 1
529	5628.8	NIST High
530	5209.6	NIST High
531	5548.8	NIST High
532	1049.6	NIST Med
533	1109.6	NIST Med
534	1149.6	NIST Med
535	<LOD	NIST Low
536	<LOD	NIST Low
549	NA	Shutter Cal 1
617	NA	Shutter Cal 1
618	NA	Shutter Cal 1

APPENDIX G: Duplex Test Results after Soil Removal

Appendix G: Post Soil Removal Testing around Duplex

After removal of 300 barrels of soil, XRF testing was used to check lead levels around the Duplex. These measurements are shown below in Table G1: Shaded areas represent readings (Lead ppm) that, when combined with the effort factor (Lead +/-) exceed 1000 ppm

Testing was performed following EPA Method 6200 Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment, Section 11.3 for in situ analysis.

Building sides were determined by the conventional method, which has been documented in the HUD guidelines. For each building the "front" was determined to be "Side A". The building sides were then designated by proceeding in a clockwise direction. Assigned sides to the Duplex are shown in Figure E2 of Appendix E

In order to more specifically describe testing locations, each sample was given two additional positional references:

1) Distance from a reference corner
2) Distance out from the structure

Table G1
DUPLEX SOIL TESTING BY XRF
AFTER REMOVAL OF
300 BARRELS

XLNo	Building Side	Reference Corner	Distance from Reference	Distance Out from Structure	Depth Below Ground Level	Lead ppm	Lead +/-	Note
286	C	C-D3	2'6"	14'6"		779.2	75.1	North side of basement entry
287	C	C-D3	6"	6"	11-12"	1180	90.6	North side of basement entry
288	C	C-D3	3'	3'	11-12"	851.2	81.7	North side of basement entry
289	C	C-D3	6'	5'	11"	5897.6	240	North side of basement entry
290	C	C-D3	6"	6'	8"	1000	85.2	Under stairs
291	D3	C-D3	9'	2'	9-10"	102.9	48.7	Under stairs
292	D3	C-D3	12'	6"	8-9"	2529.6	230	Under stairs
293	D3	C-D3	15"	3'	8-9"	634.4	110	Under stairs
294	D3	C-D3	18'	6"	10"	1260	140	Under stairs
295	C	C-D3				NA		Shutter Cal 1
296	C-1	D3-C1	0	3'	12"	536	70.2	
297	C-1	D3-C1	3'	6"	10-12"	2779.2	230	
298	C-1	D3-C1	2'6"	6'	12"	305	58	Water tank
299	C-1	D3-C1	0	6'	12"	191.7	76.9	
300	C-1	D3-C1	2'6"	9'	12"	118.1	67.4	
301	C-1	D3-C1	3'	12'	13-14"	1649.6	140	
302	C-1	D3-C1	6'	6"	8-9"	2760	200	
303	C-1	D3-C1	9'	3'	6"	298.8	90.3	Undertank
304	C-1	D3-C1	6'	9'	8"	211.6	72.6	Under tank
305	C-1	D3-C1	8'6"	11'6"	13"	338.2	69.6	
306	C-1	D3-C1	10'	12'	8-9"	1529.6	130	
307	C-1	D3-C1	12'	1'	12-13"	101.1	58.9	Photo 925.5pg
308	C-1	D3-C1	12'	6"	10-11"	1629.6	160	On soil on drain pipe metal, runs parallel to drip line along sewer pipe
309	C-1	D3-C1	13'	9'	12"	832	86.4	
310	C-1	D3-C1	13'	4'6"	13"	692.4	90.5	
311	C-1	D3-C1	15'6"	1'	11"	924.8	82.1	
312	A-1	A1-B1	0	6"	11-12'	227.2	76	
313	A-1	A1-B1	3'	3'	10-11"	526.8	87.6	
314	A-1	A1-B1	6'	6"	11-12"	778	93.3	

Table G1
DUPLEX SOIL TESTING BY XRF
AFTER REMOVAL OF
300 BARRELS

XLNo	Building Side	Reference Corner	Distance from Reference	Distance Out from Structure	Depth Below Ground Level	Lead ppm	Lead +/-	Note
315	A-1	A1-B1	9'	3'	11-12"	398.6	77.2	
316	A-1	A1-B1	12'	6"	11-12"	283	56.8	
317	A-1	A1-B1	15'	3'	8-9"	477.2	78.1	By stump N side
318	A-1	A1-B1	18'	8"	5-6"	4108.8	290	By stump SE side
319	A-1	A1-B1	18'	3'	4"	2068.8	190	By stump SW side
320	D1	A1-D1	0	6"	12-14"	381.2	86	One ft from #318 and two ft from stump
321	D1	A1-D1	3'	3'	12-14"	2560	200	
322	D1	A1-D1	6'	6"	12-14"	344.6	74.7	
323	A	D1-A	3'	3'	12-14"	2169.6	280	Next to #321
324	A	D1-A	3'	2'	12-14"	314.6	94.5	
325	A	D1-A	6'	6"	12-14"	<LOD	67.8	
326	A	D1-A	9'	3'	12-14"	634.8	120	
327	A	D1-A	12'	6"	12-14"	212.8	76.4	
328	A	D1-A	15'	3'	12-14"	<LOD	85.05	
329	A	D1-A	18'	6"	12-14"	135.2	67.2	
330	A	D1-A				NA		Shutter Cal 1
331	A	D1-A	21'	3'	12"	<LOD	85.95	
332	A	D1-A	24'	6"	12"	612.4	100	
333	A	D1-A	27'	6"	12"	1880	160	
334	B-2	A-B2	3'	3'	12"	349	91.1	
335	B-2	A-B2	3'	6"	12"	1140	160	Same area 335 on a rock
336	B-2	A-B2	3'	6-8"	12"	1920	190	Same area 335 on a rock
337	B-2	A-B2	6'	6"	12"	244.6	79.1	
338	B-2	A-B2	7'	5'	12"	145.9	73.9	
339	A	D1-A	3'	9'	12-14"	972.8	92.1	
340	A	D1-A	6'	9'	12-14"	750	96.4	
341	A	D1-A	12'	9'	12-14"	155.5	82	
342	A	D1-A	18'	9'	12-14"	168.7	73.2	
343	A	D1-A	24'	9'	12-14"	<LOD	105.9	
344	A2	B2-A2	0	3'	12-14"	293.2	76	
345	A2	B2-A2	3'	8"	7-10"	832	92.3	At large root
346	A2	B2-A2	6'	2'10"	12-14"	422	66.8	

Table G1
DUPLEX SOIL TESTING BY XRF
AFTER REMOVAL OF
300 BARRELS

XLNo	Building Side	Reference Corner	Distance from Reference	Distance Out from Structure	Depth Below Ground Level	Lead ppm	Lead +/-	Note
347	A2	B2-A2	9'	6"	12"	560.8	67.4	
348	A2	B2-A2	12'	3'	10-12"	577.6	69.2	
349	A2	B2-A2	15'	6"	7-8"	1939.2	190	NE of stump
350	A2	B2-A2	15'	3'	8-9"	<LOD	31488	NW of stump
351	A2	B2-A2	18'	3'	8-9"	443.6	70.7	SW of stump
352	A2	B2-A2	18'	2-3"	2-4"	1309.6	150	SE of stump
355	D2	A2-D2	1"	8"	12-13"	533.2	64.8	
356	D2	A2-D2	3'	3'	16-18"	354.2	80.1	
357	D2	A2-D2	6'	6"	12-14"	370	71.2	
358	D2	A2-D2	9'	2'9"	16-18"	230.8	74.4	By sidewalk under stairs
359	D2	A2-D2	4'	4'	12-13"	161.7	64.7	45 degree from corner at side walk corner
360	D2	A2-D2	8'	4-6"	13'	1429.6	150	By sidewalk stairs
361	D2	A2-D2	7'4"	4'4"	16-18"	207.2	70.6	
362	D2	A2-D2	12'	6"	12-13"	274.6	62.9	
363	D2	A2-D2	15'	3'	11-12'	1189.6	100	E side of stairs
364	D2	A2-D2	18'	6"	8-10"	956.8	83.3	
365	D2	A2-D2	17'	4'	10-11"	884	89	By sidewalk
366	D	C4-D	2'	10'	12-13"	436	73.6	
367	D	C4-D	6"	6'	8"	554.8	92.3	Loose soil
368	D	C4-D	3'	3'	8-9"	714	78.1	
369	D	C4-D	8"	6"	6-8"	1769.6	160	Loose soil around foundation
370	D	C4-D	6'	6"	6-8"	2840	240	Loose soil around foundation
371	D	C4-D	6'	14"	9-10"	1400	240	
372	D	C4-D	6'	3'	9-10"	841.6	88	
373	D	C4-D	6'	5'	9-10"	1060	91.5	
374		C4-D	6'	7'	9-10"	1020	97.9	
485	D	C4-D	2'	10'	13-14"	<LOD	84.75	
487	D	C4-D	6"	6"	10-12"	2179.2	140	see 369
488	D	C4-D	6"	6'	10-12"	1189.6	93.1	

Table G1
DUPLEX SOIL TESTING BY XRF
AFTER REMOVAL OF
300 BARRELS

XLNo	Building Side	Reference Corner	Distance from Reference	Distance Out from Structure	Depth Below Ground Level	Lead ppm	Lead +/-	Note
489	D	C4-D	3'	3'	10-12"	970.4	87.2	
490	D	C4-D	6'	6"	10-12"	1369.6	120	
491	D	C4-D	9'	3'	10-11"	1389.6	110	
492	D	C4-D	6'	5'	11-13"	186.3	72.7	
493	D	C4-D	6'	7'	10-11"	680.8	79.8	
494	D	C4-D	6'	8'8"	10-11"	1469.6	150	By sidewalk
495	D	C4-D	12'	6"	10-12"	794.8	85.9	
496	D	C4-D	15'	3'	12"	3388.8	220	
497	D	C4-D	18'	6"	4"	3977.6	270	Under stairs W. end
498	D	C4-D	12'	7'	12-14"	859.2	81.9	
499	D	C4-D	15'	5'	12-14"	2508.8	180	
500	D	D-C2	6"	6"	8-9"	1948.8	130	
501	D	D-C2	3' 6"	18"	11-12"	1060	110	By metal sewer pipe and side walk 2'6" form bldg
502	D	D-C2	6'6"	6"	8-9"	5459.2	240	
503	D	D-C2	9'6"	3"	8-9"	1309.6	140	
504	D	D-C2	12'6"	6"	8-9"	2160	170	
505	D	D-C2	15'6"	3'	surf	5987.2	400	
506	D	D-C2	12'6"	4'6"	9-10"	2080	170	
507	D	D-C2	8'	6'8"	8"	311.4	99.7	S side of sidewalk
510	D	D-C2	9'	8' 3"	Surf	1988.8	110	S side of sidewalk
511	D	D-C2	3'	6'	8-9"	225.6	56	S Side of sidewalk
512	D	D-C2	2'	8'6"	surf	801.2	75.4	S side of sidewalk
513	D	D-C2	9'	10'	surf	1160	84	S side of sidewalk see #510 above
514	D	D-C2	9'	11'6"	surf	730.8	69.1	S side of sidewalk see #510 above
515	D	D-C2	0	7'6"	surf	827.2	77.6	S side of sidewalk
516	D	D-C2	0	6'	8-9"	814.8	77.6	S side of sidewalk
517	SE corner	SE of water tank stand	1'	7'6"	8-9"	742.8	72.2	S side of sidewalk
518	SE corner	SE of water tank stand	4'6"	7'6"	9-10"	208.8	72.3	S side of sidewalk

Table G1
DUPLEX SOIL TESTING BY XRF
AFTER REMOVAL OF
300 BARRELS

XLNo	Building Side	Reference Corner	Distance from Reference	Distance Out from Structure	Depth Below Ground Level	Lead ppm	Lead +/-	Note
519	SE corner	SE of water tank stand	9'	7'6"	8-9"	<LOD	96.9	S side of sidewalk
520	SE corner	SE of water tank	1'	10'6"	Surf	864.8	78.3	S side of sidewalk
537	C2	D-C2	0	6"	10-12"	928	77.8	
538	C2	D-C2	0	3'	10-12"	1360	130	
539	C2	D-C2	0	6'	8-9"	1868.8	160	
540	C2	D-C2	1'	9'	8-9"	1360	130	
541	C2	D-C2	1'	12'	Surf	645.2	86.2	under root lifted sidewalk
542	C2	D-C2	3'	3'	6-8"	3817.6	220	
543	C2	D-C2	6'	6"	6-8"	3600	220	
544	C2	D-C2	9'	3'	4-6"	9964.8	570	Under SE water tank
545	C2	D-C2	12'6"	6"	9-11"	1029.6	130	
546	C2	D-C2	12'	3'	10-12"	1349.6	190	
551	C2	D-C2	14'	6'	10-12"	872	78.4	#547 725-100*old #'s
552	C2	D-C2	12'	9'	8-10"	284.6	52.3	548 178-81 * old #'s
553	C2	D-C2	14'	12'	8-10"	1580	120	
554	C2	D-C2	9'	12'	4-6"	1100	120	
555	C2	D-C2	9'	9'	4-6"	1309.6	140	Under SE tank
556	C2	D-C2	6'	9'	4-6"	1440	130	Under SE tank
557	C2	D-C2	6'	11'6"	4-6"	1760	140	By stump and water tank
558	B3	C2-B3	0	3'	7-9"	255	55.7	
559	B3	C2-B3	0	8"	8-10"	283	72.6	
560	B3	C2-B3	0	9'	6-8"	267.8	69	
561	B3	C2-B3	3'	8"	8-10"	373.8	72.2	
562	B3	C2-B3	3'	6'	6-8"	487.2	82.5	
563	B3	C2-B3	6'	3'	8"	456.4	85.3	
564	B3	C2-B3	6'	9'	6"	3249.6	210	
565	B3	C2-B3	9'	8"	4-6"	284.8	69.9	Under stairs
566	B3	C2-B3	12'	3'	4-6"	1049.6	83	Under stairs
567	B3	C2-B3	15'	8"	4-6"	522.4	83.7	
568	B3	C2-B3	18'	3'	4-6"	3059.2	190	

Table G1
DUPLEX SOIL TESTING BY XRF
AFTER REMOVAL OF
300 BARRELS

XLNo	Building Side	Reference Corner	Distance from Reference	Distance Out from Structure	Depth Below Ground Level	Lead ppm	Lead +/-	Note
569	C	B3-C	6"	6"	4-6"	1708.8	120	South side of basement entry
570	C	B3-C	3'	3'	4-6"	1988.8	160	South side of basement entry
571	C	B3-C		8'	4-6"	698.8	81.7	South side of basement entry
572	C	B3-C	5'10"	4'6"	6-8"	12000	520	South side of basement entry
573	C	B3-C	3'	21'		621.2	97.7	
574	C	B3-C	3'	24'		408.8	76.9	
575	C	B3-C	3'	27'		368.6	75.5	
576	C	B3-C	6'	30'	8'-10"	302	68.5	
577	C	B3-C	6'	27'	6-8"	125.8	53.4	
578	C	B3-C	6'	24'	6-8"	551.6	77.7	
579	B	C1-B	0	8"	12-13"	4169.6	280	
580	B	C1-B	0	2'4"	10-12"	786	73.3	By sidewalk
581	B	C1-B	3'	3'	10-12"	944	67.3	
582	B	C1-B	6'	6"	10-12"	176.5	57.2	
583	B	C1-B	9'	3'	10-12"	276.4	57.7	
584	B	C1-B	12'	6"	10-12"	67.6	37.4	
585	B	C1-B	12'	5'	10-12"	440.4	72	By sidewalk
586	B	C1-B	15'	3'	10-12"	102	58	
587	B	C1-B	18'	6"	10-12"	224	62.2	
588	B	C1-B	21'	3'	10-12"	219	72.5	
590	B	C1-B	19'6"	4'	10-12"	1149.6	110	
591	B	C1-B	24'	6"	10-12"	476	66.5	
592	B	C1-B	27'	3'	10-12"	454	87.7	
593	B	C1-B	30'	6"	10-12"	331.6	74.3	
594	B	C1-B	33'	3'	12-14"	105.4	63.7	
595	B	C1-B	36'6"	1'6"	12-14"	426.8	78.6	
596	B	C1-B	21'	7'	surf	673.6	67.1	on 12'x4' wedge between sidewalk and building
597	B	C1-B	27'	7'4"	surf	660.8	59.7	on 12'x4' wedge between sidewalk and building
598	B	C1-B	30'	8'4"	surf	482.4	64.6	on 12'x4' wedge

Table G1
DUPLEX SOIL TESTING BY XRF
AFTER REMOVAL OF
300 BARRELS

XLNo	Building Side	Reference Corner	Distance from Reference	Distance Out from Structure	Depth Below Ground Level	Lead ppm	Lead +/-	Note
								between sidewalk and building
599	C3	B-C3	3'	3'	12-14"	176.3	62.7	
600	C3	B-C3	6'	6"	12-14"	129.6	58.3	
601	B1	C3-B1	0	4'2"	10-12"	275.4	71.9	By sidewalk
602	B1	C3-B1	0	6"	10-12"	237.6	64.6	
603	B1	C3-B1	3'	3'	10-12"	246.6	55.1	
604	B1	C3-B1	4'	4'6"	9-10"	89.3	48.6	
605	B1	C3-B1	6'	6"	10-12"	<LOD	70.2	
606	B1	C3-B1	9'	3'	4-6"	1200	120	
607	B1	C3-B1	12'	6"	10-12"	113.6	51	
608	B1	C3-B1	15'	3'	10-12"	396.8	80.9	
609	B1	C3-B1	18'	6"	10-12"	228	70.8	
610	B1	C3-B1	17'	8'6"	surf	736	71.6	NE of sidewalk
611	B1	C3-B1	7'	9'6"	surf	316.8	55.6	NE of sidewalk
612	B	C1-B	35'	14'	surf	300.8	63.2	NE of sidewalk
613	B	C1-B	26'	11'10"	surf	323.4	53.8	NE of sidewalk
614	B	C1-B	16'	10'4"	surf	486.8	69.8	NE of sidewalk
615	B	C1-B	3'	6'6"	surf	610	76.9	NE of sidewalk
616	B1	C3-B1	23'6"	5'6"	surf	382.4	62.8	NW of sidewalk corner

APPENDIX H: Duplex Testing Logs and Figures

Por|-'

SOIL TESTING SAMPLE LOG

STRUCTURE Duplex FINAL TESTS 9/26

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	DEPTH	READING #	READING VALUE	+/-	SAMPLE #	LAB RESULTS
C	C-D3	2'6"	14'6"		286	779	75	NORTH SIDE OF BASEMENT ENTRY	
		6"	6"	11-12"	287	1180	91		
		3'	3'	11-12"	288	451	82		
		6'	5'	11"	289	5900	240		
		6"	6'	8"	290	1000	45	UNDER STAIRS	
D3	C-D3	9'	2'	9-10"	291	103	49	UNDER STAIRS	
		12'	6"	8-9"	292	2530	230	" "	
		15'	3'	8-9"	293	634	100		
		18'	6"	10"	294	1260	140		
C	C-D3								
	9/27/03	1332	~~SELFTEST~~				+/-		
C1	D3-C1	0	3'	12"	296	536	70		
		3'	6"	10-12"	297	2780	230		
		2'6"	6'	12"	298	305	58	WATER TANK	
		0	6'	12"	299	192	77		
		2'6"	9'	12"	300	118	67		
		3'	12'	13-14"	~~1650~~ 301	1650	140		
		6'	6"	8-9"	302	2760	280		
		9'	3'	6"	303	299	90	UNDER TANK	
		6'	9'	8"	304	212	73	" "	

Pg 2

SOIL TESTING SAMPLE LOG

STRUCTURE DUP. FINALS 9/27

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	DEPTH	READING #	READING VALUE ppm	+/-	SAMPLE #	LAB RESULTS
C1	D3-C1	8'6"	11'6"	13"	305	338	70		
		10	12'	8-9"	306	1530	130		
		12'	1'	12-13" ~~10-11"~~	307	101	59	PHOTO 925.JPG	/413
		12 FT	6"	10-11"	308	1630	160	ON SOIL ON DRAIN PIPE METAL RUNS PARALLEL TO DRIP LINE ALONG C1	
		13'	9'	12"	309	832	86		SEWER PIPE
		13'	4'6"	13"	310	692	91		
	~~B D1~~	15'6"	1'	11"	311	925	82		
A1	A1-B1	0	6"	11-12"	312	227	76		
		3'	3'	10-11"	313	527	88		
		6'	6"	11-12"	314	778	93		
		9'	3'	11-12"	315	399	77		
		12'	6"	11-12	316	283	57		
		15'	3'	8-9"	317	477	78	BY STUMP N SIDE	
		18'	8"	5-6"	318	4110	290	BY STUMP SE SIDE	
		18'	3'	4"	319	2070	190	BY STUMP SW SIDE	
D1	A1-D1	0	6"	12-14"	320	381	86	ONE FT FROM #318 AND TWO FT FROM STUMP	
		3'	3'	12-14"	321	2560	200		
		6'	6"	12-14"	322	345	75		

pg 3

SOIL TESTING SAMPLE LOG

STRUCTURE DUP. FINAL 9/22

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	DEPTH	READING #	READING VALUE	SAMPLE #	LAB RESULTS
A	D1-A	3'	3'	~~40~~ 12-14"	323	2170 280	NEXT TO #321	
		3'	2'	12-14"	324	315 85		
		6'	6"		325	BDL <680		
		9'	3'		326	635 120		
		12'	6"		327	213 76		
		15'	3'		328	BDL <85.0		
		18'	6"		329	135 67		
1537		SELF CALIBRATE			330			
		21	3'	12"	331	BDL <860		
		24	6"	12"	332	612 100		
		27	6"	12"	333	1880 160		
B2	A-B2	3' ~~6"~~	3' ~~6"~~		334	349 91		
		3'	6"		335	1140 160	SAME AREA 335 ON A ROCK	
		3'	6-8"		336	1920 190		
		6'	6"		337	245 79		
		7	5'		338	146 74		
A	D1-A	3'	9'	12-14"	339	973 92		
		6'			340	750 96		
		12'			341	156 42		
		18'			342	169 73		
		24'			343	BDL <110		

PG4 -

SOIL TESTING SAMPLE LOG

STRUCTURE DUP FINALS 9/27/05

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	DEPTH	READING #	READING VALUE	SAMPLE #	LAB RESULTS
A2	B2-A2	0	3'	12-14"	344	293 76		
		3'	8"	7-10"	345	832 92	AT LARGE ROOT	
		6'	210"	12-14"	346	422 67		
		9'	6"	12"	347	561 67		
		~~12'~~	~~3'~~		~~349~~	~~1940~~		
		~~15'~~	~~6"~~		~~350~~	~~BDL <31~~		
		~~18'~~	~~3'~~	~~7-8"~~	~~351~~	~~444 71~~		
		12'	3'	10-12"	348	578 69		
		15'	6"	7-8"	349	1940 190	NE OF STUMP	
		15'	3'	8-9"	350	BDL <31	NW OF STUMP	
		18'	3'	8-9"	351	444 71	SW OF STUMP	
		18'	2-3"	2-4"	352	1310 150	SE OF STUMP	
D2	A2-D2	1'0	8"	12-13"	355	533 65	WW #353 - SELF CAL 1651	
		3'	3'	16-18"	356	354 80		
		6'	6"	12-14"	357	370 71		
		9'	2'9"	16-18"	358	231 74	BY SIDEWALK UNDER STAIRS	
		4'	4'	12-13"	359	162 65	45° FROM CORNER AT SIDEWALK CORNER	
		8'	4'6"	13"	360	1430 150	BY SIDEWALK/STAIRS	
		7'4"	4'4"	16-18"	361	207 71		

PG5-

KELLCO

PG5

SOIL TESTING SAMPLE LOG

STRUCTURE DWD. FINALS 9/27/05 + 9/28

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	DEPTH	READING #	READING VALUE	+/-	SAMPLE #	LAB RESULTS
D2	A2-D2	12'	6"	12-13"	362	275	63		
		15'	3'	11-12"	363	1190	100	E SIDE OF STAIRS	
		18'	6"	8-10"	364	957	83		
		17'	4'	10-11"	365	884	89	BX SIDEWALK	
D	C4-D	2'	10' ~~5'8"~~	12-13"	366	436	74		
		6"	6'	8"	367	555	92	LOOSE SOIL	
		3'	3'	8-9"	368	714	78		
		8"	6"	6-8"	369	1770	160	LOOSE SOIL AROUND FOUNDATION	
		6'	6"	6-8"	370	2840	240	" "	
			14"	9-10"	371	1400	240		
			3'	9-10"	372	842	88		
			5'	9-10"	373	1060	92		
			7'	9-10"	374	1020	98		

SELF CAL 1759

9/28/05 CALIBRATION SELF + NIST 0633

MULTIPLE SPOT CHECKS TO READING #484

SELF CA 0951

RETEST SIDE D AT C4-D SEE #366

PG 6

K E L L

SOIL TESTING SAMPLE LOG

9/28

STRUCTURE D UP. FINAL 9/28/05

VOID #486

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	DEPTH	READING #	READING VALUE +/-	SAMPLE #	LAB RESULTS
D	C4-D	2'	10'	13-14"	485	BDL <85		
		6"	6"	10-12"	487	2180 140	SEE ~~#370~~ 369	
		6"	6'	10-12"	488	1190 93		
		3'	3'	10-12"	489	970 87		
		6'	6"	10-12"	490	1370 120		
		9'	3'	10-12"	491	1390 110		
		6'	5'	11-13"	492	186 73		
		6'	7'	10-12"	493	681 80		
		6'	8'8	10-12"	494	1470 150	BY SIDEWALK	
		12'	6"	10-12"	495	795 86		
		15'	3'	12"	496	3390 220		
		18'	6"	4"	497	3980 270	UNDER STAIRS W. END	
		12'	7'	12-14"	498	859 82		
		15'	5'	12-14"	499	2510 180		
D	D-C2	6"	6"	8-9"	500	1950 130		
		3'6"	18"	11-12"	501	1060 110	BY METAL SEWER PIPE & SIDEWALK 2'6" FM BLDG	
		6'6"	6"	8-9"	502	5460 240		
		9'6"	3'	8-9"	503	1310 140		
		12'6"	6"	8-9"	504	2160 170		
		15'6"	3'	SURF	505	5990 400		
		12'6	4'6"	9-10"	506	2080 170		

PG 7 OF [illegible]

SOIL TESTING SAMPLE LOG

STRUCTURE DCP FINAL 9/28/05

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	DEPTH	READING #	READING VALUE +/-	SAMPLE #	LAB RESULTS
D	D-C2	8'	6' 8"	8"	507	311 100	S. SIDE OF SIDE WALK	
		9'	8' 3"	SURF	510	1990 110	(VOID #508 & 509)	S. SIDE OF SIDE WALK
		3'	6'	8-9"	511	226 56	S SIDE OF SIDEWALK	
		2' ~~X~~	8' 6"	SURF	512	801 75	" "	
		9'	10'	SURF	513	1160 84	" "	SEE #510 ABOVE
		9'	11'6"	SURF	514	731 69	" "	
		0	7'6"	SURF	515	827 78	" "	
		0	6'	8-9"	516	815 78	" "	
SE CORNER	SE WATER OF TANK STAND	~~X~~ 1'	7'6"	8-9"	517	743 72	" "	
		4'6"	7'6"	9-10"	518	209 72	" "	
		9'	7'6"	8-9	519	<970	" "	
		1'	10'6"	SURF	520	865 78	" "	
SELF CALIBRATE 1235								
		SPOT TESTS FOR USCG.						
			SEE PG 8					

Pg 8

SOIL TESTING SAMPLE LOG

STRUCTURE DUPLEX FINALS 10-1-05

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	DEPTH	READING #	READING VALUE +/-	SAMPLE #	LAB RESULTS
C2	D-C2	0	6"	10-12"	537	928 78		
		0	3'	10-12	538	1360 130		
		0	6'	8-9	539	1870 160		
		1'	9'	8-9	540	1360 130		
		1'	12'	SURF	541	645 86	UNDER ROOT LIFTED SIDEWALK	
		3'	3'	6-8"	542	3820 220		
		6'	6"	6-8"	543	3600 220		
		9'	3'	4-6"	544	9960 570	UNDER SE WATER TANK	
		12'6"	6"	9-11"	545	1030 130		
		12'	3'	10-12"	546	1350 190		
		14'	6'	10-12"	* 551	872 78	#547 725-100 *	OLD #'s
		12'	9'	8-10"	* 552	285 52	548 178-81 *	" "
		14'	12'	8-10"	* 553	1580 120		
CHANGE BATTERY – SELF CAL.				10:05	RESHOOT	* OUT OF ORDER		
		9'	12'	4-6"	~~554~~	~~1010 88~~ → 1100 +/-120		
		9'	9'	4-6"	555	1310 140	UNDER SE TANK	
		6'	9'	4-6	556	1440 130	" "	
		6'	11'6"	4-6	557	1760 140	BY STUMP + WATER TANK	

~~557~~

Pg 9

SOIL TESTING SAMPLE LOG

STRUCTURE DUP. FINALS 10-1-05

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	DEPTH	READING #	READING VALUE	+/-	SAMPLE #	LAB RESULTS
B3	CZ-B3	0	3'	7-9"	558	255	56		
		0	8"	8-10"	559	283	73		
		0	9'	6-8"	560	268	69		
		3'	8"	8-10"	561	374	72		
		3'	6'	6-8"	562	487	83		
		6'	3'	8"	563	456	85		
		6'	9	6"	564	3250	210		
		9'	8"	4-6"	565	285	70	UNDERSTAIRS	
		12'	3'		566	1050	83	" "	
		15'	8"		567	522	84		
		18'	3'		568	3060	190		
C	B3-C	6"	6"	4-6"	569	1710	120	SOUTH SIDE OF BASEMENT ENTRY	
		3'	3'		570	1990	160		
		5'10"	8"		571	699	82		
		5'10"	4'6"	6-8"	572	12,000	520		
		3'	21'		573	621	98		
		3'	24'		574	409	77		
		3'	27'		575	369	76		
		6'	30' ~~27'~~	8-10"	576	302	69		
		6'	27' ~~24'~~	6-8"	577	126	53		
		6'	24'	6-8"	578	552	78		

10'

K E L L C O

SOIL TESTING SAMPLE LOG

STRUCTURE DUP. FINAL 10-1-05

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	DEPTH	READING #	READING VALUE	+/-	SAMPLE #	LAB RESULTS
B	C1-B	0	8"	12-13	579	4170	280		
		0	2'4"	10-12"	580	796	73	BY SIDEWALK	
		3'	3'		581	944	67		
		6'	6"		582	177	57		
		9'	3'		583	276	58		
		12'	6"		584	67.6	37		
		12'	5'	10-12	585	440	72	BY SIDEWALK	
		15'	3'		586	105	58		
		18'	6"		587	224	62		
		21	3'		588	219	73		
			~~6"~~		~~589~~	VOID 589			
		19'6"	4'		590	1150	110		
		24'	6"		591				
		27'	3'		592				
		30'	6"		593				
		33'	3'	12-14	594				
		36'6"	1'6"	12-14	595	427	79		
		21'	7'	SURF	596	674	67	ON 12'X4' WEDGE BETWEEN SIDEWALK + BLDG	
		27'	7'4"	SURF	597	661	60		
		30'	8'4"	SURF	598	482	65		

RG Howell

K E L L C O

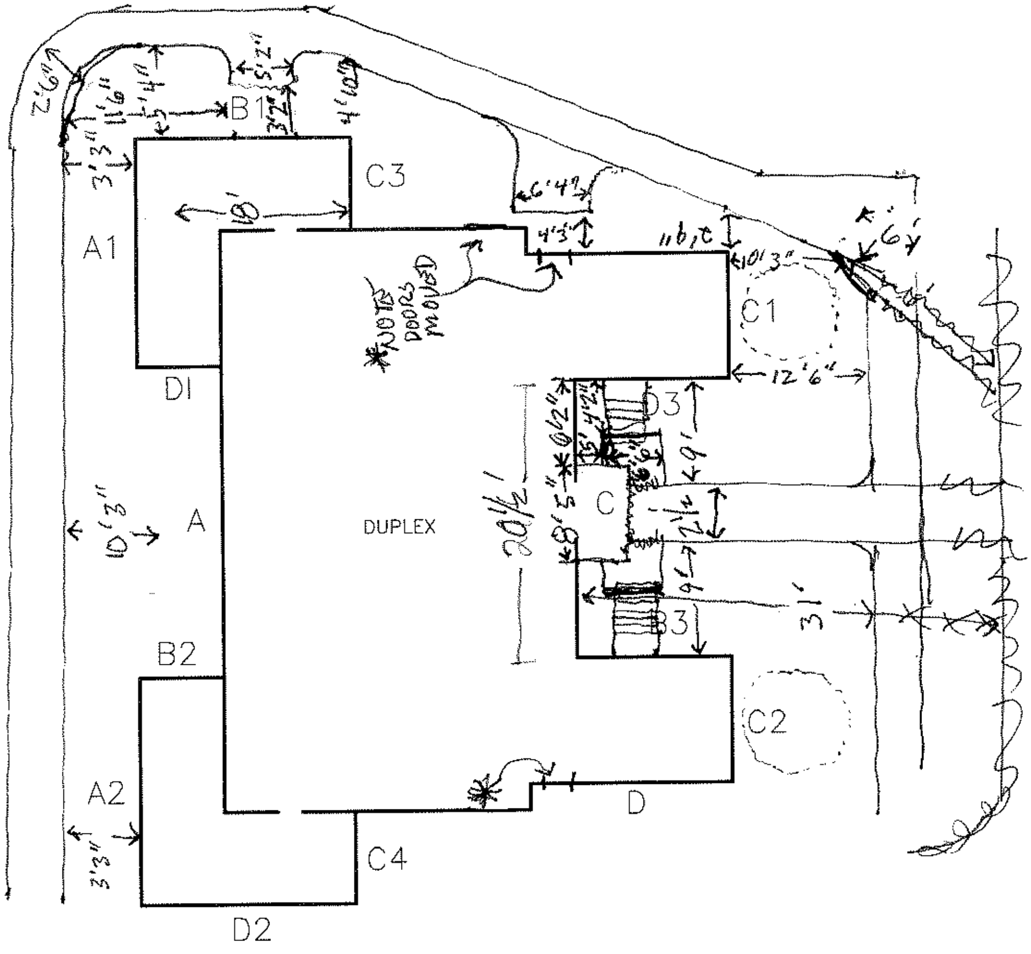
SOIL TESTING SAMPLE LOG

STRUCTURE DWP FINAL 10-1-05

SIDE	REFERENCE CORNER	DISTANCE FROM REFERENCE CORNER	DISTANCE FROM STRUCTURE	DEPTH	READING #	READING VALUE	SAMPLE #	LAB RESULTS
C3	B-C3	3'	3'	12-14"	599	176 63		
		6'	6"	12-14	600	130 58		
B1	C3-B1	0	4'2"	10-12	601	275 72	BY SIDEWALK	
		0	6"	10-12	602	238 65		
		3'	3'	10-12	603	247 55		
		4	4'6"	9-10	604	49.3 49		
		6'	6"	10-12	605	BDL < 70		
		9'	3'	4-6"	606	1200 120		
		12'	6"	10-12	607	114 51		
		15'	3'	10-12	608	397 81		
		18'	6"	10-12	609	228 71		
		17'	8'6"	SURF	610	736 72	N. OF SIDEWALK	
		7'	9'6"	"	611	317 56		
B	C1-B	35'	14	"	612	301 63		
		26	11'10"	"	613	323 54		
		16	10'4"	"	614	487 70		
		3	6'6"	"	615	610 77		
B1	C3-B1	23'6"	5'6"	"	616	382 63	NW OF SIDEWALK CORNER	

DONE !!

1409 SELF CAL



LEGEND

A = BUILDING SIDE

Drawing Not to Scale

KELLCO Services, Inc.
3137 Diablo Avenue Hayward, CA
(510) 786-9751
Fax (510) 786-9625

Date: August 24, 2005

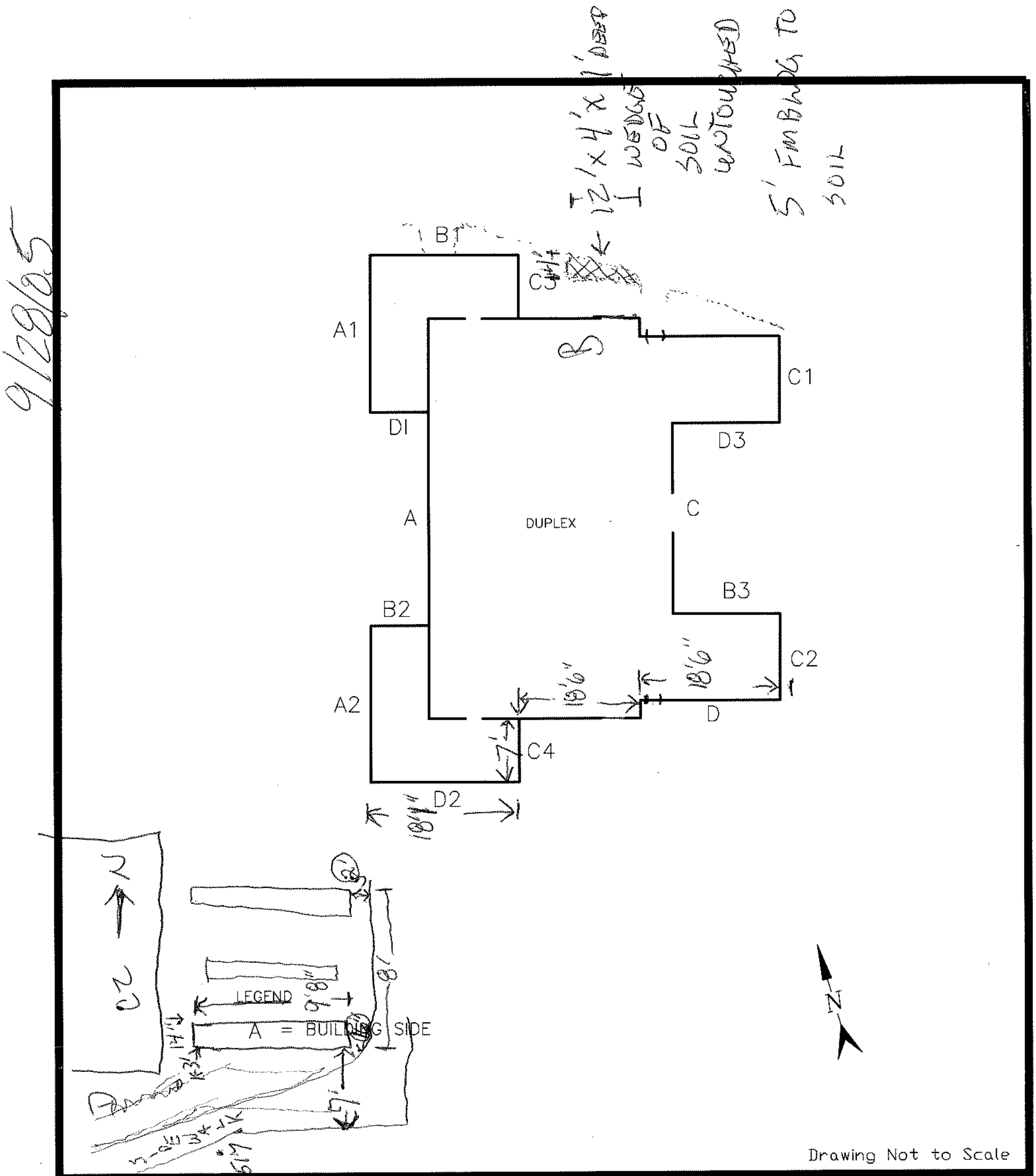
Client: US Coast Guard

Job #: 0508-05

Job Site: Burrows Island, WA

Duplex Lead Test
Side Identification

Figure No.: 4



KELLCO Services, Inc. 3137 Diablo Avenue Hayward, CA (510) 786-9751 Fax (510) 786-9625	Date: August 24, 2005
Client: US Coast Guard	Job #: 0508-05
Job Site: Burrows Island, WA — Duplex Lead Test Side Identification	Figure No.: 4

APPENDIX I: Certified Weight Tickets

#92305

Donna's
3104 116th St. NE
Marysville, WA 98271
(360) 653-3000

I-5 and Exit 200
Marysville, WA. 98271

STEER AXLE 10080 lb
DRIVE AXLE 33480 lb
TRAILER AXLE 27860 lb
TOTAL WEIGHT 71420 lb

COMPANY Clean Harbors TRACTOR # 1234 TRAILER # ____

WEIGHERS SIGNATURE: ____ FEE: 5.00 FULL WEIGH TICKET # ____ (IF RE-WEIGH)

ONLY CERTIFIED WEIGHTS APPEAR BELOW THIS LINE

CERTIFIED WEIGHTS
(imprint seal)

GROSS

TARE

NET

180814
TICKET NUMBER

WEIGHMASTER CERTIFICATE

This is to certify that the following described commodity was weighed, measured, or counted by a Weighmaster, whose signature is on this Certificate, who is a recognized authority of accuracy, as prescribed by State Law.

COMMODITY WEIGHED: ____
REMARKS: ____
TRACTOR LICENSE # ____ TRACTOR # ____
TRAILER LICENSE # ____ TRAILER # ____
TRAILER LICENSE # ____ TRAILER # ____

NAME OF WEIGHMASTER (print): ____
WEIGHMASTER SIGNATURE: ____

92305

Donna's
3104 116th St. NE
Marysville, WA 98271
(360) 653-3000

[illegible]
Marysville, WA 98271

STEER AXLE	10040	lb
DRIVE AXLE	13660	lb
TRAILER AXLE	9320	lb
TOTAL WEIGHT	33040	lb

COMPANY ______ TRACTOR # 1234 TRAILER # ______

WEIGHERS SIGNATURE: ______ FEE: 8.00 FULL WEIGH TICKET # ______
(IF RE-WEIGH)

ONLY CERTIFIED WEIGHTS APPEAR BELOW THIS LINE

CERTIFIED WEIGHTS
(imprint seal)

GROSS

TARE

NET

180780
TICKET NUMBER

WEIGHMASTER CERTIFICATE

This is to certify that the following described commodity was weighed, measured, or counted by a Weighmaster, whose signature is on this Certificate, who is a recognized authority of accuracy, as prescribed by State Law.

COMMODITY WEIGHED: ______

REMARKS: ______

TRACTOR LICENSE # ______ TRACTOR # ______

TRAILER LICENSE # ______ TRAILER # ______

TRAILER LICENSE # ______ TRAILER # ______

NAME OF WEIGHMASTER (print): ______

WEIGHMASTER SIGNATURE: ______

DONNA'S

CERTIFIED PUBLIC SCALE

07:14:45 27 Sep 2005

Donna's
3104 116th St. NE
Marysville, WA 98271
(360) 653-3000

I-5 and Exit 202
Marysville,WA. 98271

STEER AXLE	10200 lb
DRIVE AXLE	13240 lb
TRAILER AXLE	10720 lb
TOTAL WEIGHT	34160 lb

COMPANY Clean Harbors TRACTOR # 0234 TRAILER # ______

WEIGHERS SIGNATURE: ______ FEE: 8.00

FULL WEIGH TICKET # ______
(IF RE-WEIGH)

ONLY CERTIFIED WEIGHTS APPEAR BELOW THIS LINE

CERTIFIED WEIGHTS
(imprint seal)

GROSS

WEIGHMASTER CERTIFICATE
This is to certify that the following described commodity was weighed, measured, or counted by a Weighmaster, whose signature is on this Certificate, who is a recognized authority of accuracy, as prescribed by State Law.

#92605

DONNA'S

CERTIFIED PUBLIC SCALE

13:06:12 27 Sep 2005

Donna's
3104 116th St. NE
Marysville, WA 98271
(360) 653-3000

I-5 and Exit 202
Marysville,WA 98271

STEER AXLE	11320 lb
DRIVE AXLE	34620 lb
TRAILER AXLE	20460 lb
TOTAL WEIGHT	66400 lb

COMPANY Clean Harbors TRACTOR # 1234 TRAILER # ____

WEIGHERS SIGNATURE: ____ FEE: 5.00

FULL WEIGH TICKET # ____ (IF RE-WEIGH)

ONLY CERTIFIED WEIGHTS APPEAR BELOW THIS LINE

CERTIFIED WEIGHTS
(imprint seal)

GROSS

WEIGHMASTER CERTIFICATE

This is to certify that the following described commodity was weighed, measured, or counted by a Weighmaster, whose signature is on this Certificate, who is a recognized authority of accuracy, as prescribed by State Law.

92605

P 92905

STEER AXLE 10240 lb
DRIVE AXLE 14380 lb
TRAILER AXLE 12100 lb
TOTAL WEIGHT 36720 lb

Donna's
3104 116th St. NE
Marysville, WA 98271
(360) 653-3000

[illegible] 20[illegible]
Mar[illegible]ille, WA [illegible]8271

COMPANY Clean Harbors TRACTOR # 1234 TRAILER # ______

WEIGHERS SIGNATURE: L Butley FEE: 8.00 FULL WEIGH TICKET # ______
(IF RE-WEIGH)

ONLY CERTIFIED WEIGHTS APPEAR BELOW THIS LINE

CERTIFIED WEIGHTS
(imprint seal)

GROSS

TARE

NET

180987
TICKET NUMBER

WEIGHMASTER CERTIFICATE

This is to certify that the following described commodity was weighed, measured, or counted by a Weighmaster, whose signature is on this Certificate, who is a recognized authority of accuracy, as prescribed by State Law.

COMMODITY WEIGHED: ______
REMARKS: ______
TRACTOR LICENSE # ______ TRACTOR # ______
TRAILER LICENSE # ______ TRAILER # ______
TRAILER LICENSE # ______ TRAILER # ______

NAME OF WEIGHMASTER (print): ______
WEIGHMASTER SIGNATURE: ______

#92905

[illegible] 03 Oct 2005

10280 lb

STEER AXLE 33900 lb

DRIVE AXLE 33860 lb

TRAILER AXLE 78040 lb

TOTAL WEIGHT

Donna's
3104 116th St. NE
Marysville, WA 98271
(360) 653-3000

I-5 and Exit 206
Marysville, WA. 98271

COMPANY Clean Harbors TRACTOR # 1234 TRAILER # ______

WEIGHERS SIGNATURE: Trina FEE: ______ FULL WEIGH TICKET # ______ (IF RE-WEIGH)

ONLY CERTIFIED WEIGHTS APPEAR BELOW THIS LINE

CERTIFIED WEIGHTS
(imprint seal)

GROSS

TARE

NET

181018
TICKET NUMBER

WEIGHMASTER CERTIFICATE

This is to certify that the following described commodity was weighed, measured, or counted by a Weighmaster, whose signature is on this Certificate, who is a recognized authority of accuracy, as prescribed by State Law.

COMMODITY WEIGHED: ______

REMARKS: ______

TRACTOR LICENSE # ______ TRACTOR # ______

TRAILER LICENSE # ______ TRAILER # ______

TRAILER LICENSE # ______ TRAILER # ______

NAME OF WEIGHMASTER (print): ______

DONNA'S

CERTIFIED PUBLIC SCALE

16:10:04 04 Oct 2005

STEER AXLE 10140 lb

DRIVE AXLE 33500 lb

TRAILER AXLE 33[illegible] lb

TOTAL WEIGHT 76640 lb

Donna's
3104 116th St. NE
Marysville, WA 98271
(360) 653-3000

I 5 and Exit 206
Marysville,WA. 98271

COMPANY Clean Harbors TRACTOR # 1234 TRAILER # ____

WEIGHERS SIGNATURE Trina FEE: 8.00 FULL WEIGH TICKET # (IF RE-WEIGH) ____

ONLY CERTIFIED WEIGHTS APPEAR BELOW THIS LINE

CERTIFIED WEIGHTS
(imprint seal)

GROSS

TARE

WEIGHMASTER CERTIFICATE

This is to certify that the following described commodity was weighed, measured, or counted by a Weighmaster, whose signature is on this Certificate, who is a recognized authority of accuracy, as prescribed by State Law

#72606

DONNA'S

CERTIFIED PUBLIC SCALE

03:39:51 04 Oct 2005

Donna's
3104 116th St. NE
Marysville, WA 98271
(360) 653-3000

Marysville WA 98271

STEER AXLE 10380 lb
DRIVE AXLE 13260 lb
TRAILER AXLE 11140 lb
TOTAL WEIGHT 34780 lb

COMPANY Clean Harbors TRACTOR # 1734 TRAILER # ______

WEIGHERS SIGNATURE L Bentley FEE: 9.00

FULL WEIGH TICKET # ______
(IF RE-WEIGH)

ONLY CERTIFIED WEIGHTS APPEAR BELOW THIS LINE

CERTIFIED WEIGHTS
(imprint seal)

GROSS

TARE

WEIGHMASTER CERTIFICATE

This is to certify that the following described commodity was weighed, measured, or counted by a Weighmaster, whose signature is on this Certificate, who is a recognized authority of accuracy, as prescribed by State Law

COMMODITY WEIGHED ______

92606

APPENDIX J: Waste Manifest

216 27182 DI1033147 26
PPW 08/25/2005

Please print or type. (Form designed for use on elite (12-pitch) typewriter.)
Form Approved. OMB No. 2050-0039.

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. WAH000027147
Manifest Document No. 92605
2. Page 1 of 2
Information in the shaded areas is not required by Federal law.

3. Generator's Name and Mailing Address
US Coast Guard-Burrow Island Light Station
ATTN: Chris Sage
1519 Alaskan Way
Seattle, WA 98134
4. Generator's Phone (206) 217-6915

A. State Manifest Document Number 92605
B. State Generator's ID

5. Transporter 2 Company Name Clean Harbors Env Services Inc
6. US EPA ID Number MAD039322250
C. State Transporter's ID
D. Transporter's Phone (781) 849-1800

7. Transporter 1 Company Name ~~T W Company~~ see box 15
8. US EPA ID Number ~~UTD980007471 2~~
E. State Transporter's ID
F. Transporter's Phone ~~(801) 299-1800~~

9. Designated Facility Name and Site Address
Clean Harbors Grassy Mountain
3 Miles East 7 Miles North of Knolls
Clive, UT, 84029
10. US EPA ID Number UTD991301748
G. State Facility's ID
H. Facility's Phone (801) 323-8900

	HM	11. US DOT Description (Including Proper Shipping Name, Hazard Class and ID Number)	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
a.	X	WASTE ENVIRONMENTALLY HAZARDOUS SUBSTANCES, SOLID, N.O.S., (LEAD), 9, UN3077, PG III	065	DM	39195	P	D008
b.							
c.			CR				
			FS	PM			
d.			OFFC				

J. Additional Descriptions for Materials Listed Above
11a.ERG#171 (S),(E) 65 x 55g
SOIL CONTAMINATED WITH LEAD

K. Handling Codes for Wastes Listed Above
03

15. Special Handling Instructions and Additional Information
EMERGENCY PHONE #: (800) 483-3718
11a: CH120914 — BARRELS ARE FIFTY GALLON BARRELS/METAL DRUMS ON A BARGE TRL# 216
BARRELS ON 9/26/05 72 TRANSPORTED FIRST BY; ISLAND TRANSPORT FERRY SERVICE, INC
US EPA ID# 060205001034N (REG. No.) PRINT SIGN Ed McNamee 9-26-05 43,200 LB APPROX BARGE WT
TRANSPORTERS PHONE (360) 293-6060

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; **OR**, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name CHRIS SAGE (CPO) R.E. CZARNECKI FOR: USCG
Signature FOR: CHRIS SAGE (CPO) USCG
Month Day Year 09 26 05

17. Transporter 1 Acknowledgement of Receipt of Materials
Printed/Typed Name
Signature
Month Day Year

18. Transporter 2 Acknowledgement of Receipt of Materials 200505351
Printed/Typed Name Scott Tyson
Signature Scott Tyson
Month Day Year 09 27 05

19. Discrepancy Indication Space completed by Scott Tyson
line 5, 7, 15 Transporter # 1 signed and filled in incorrect line,
line 11a and 15 manifest was split due to excessive weight extra drums shipped on mf# 92606

20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.
Printed/Typed Name Pam Melancon
Signature Pam Melancon
Month Day Year 10 05 05

Style CF 17 LABELMASTER® (800) 621-5808 www.labelmaster.com
EPA Form 8700-22 (Rev. 9-88) Previous editions are obsolete.

Clean Harbors has the appropriate permits for and will accept the waste the generator is shipping.

ORIGINAL-RETURN TO GENERATOR

PRINTED ON RECYCLED PAPER USING SOYBEAN INK
PRINTED WITH SOY INK

EMERGENCY CONTACT TELEPHONE NUMBER

UNIFORM HAZARDOUS WASTE MANIFEST
(Continuation Sheet)

21. Generator's US EPA ID No. WAH000027147 Manifest Document No. 42605

22. Page 2 of 2

Information in the shaded areas is not required by Federal law.

23. Generator's Name
US Coast Guard - Burrow Island light station
1519 Alaskan Way
Seattle WA 98134

L. State Manifest Document Number

M. State Generator's ID

24. Transporter 3 Company Name TW Company

25. US EPA ID Number UTD988074712

N. State Transporter's ID

O. Transporter's Phone (801) 299-1900

26. Transporter 4 Company Name CHES

27. US EPA ID Number MAD039322250

P. State Transporter's ID

Q. Transporter's Phone 801-323-8102

GENERATOR

28. US DOT Description *(Including Proper Shipping Name, Hazard Class, and ID Number)*	HM		29. Containers No	29. Containers Type	30. Total Quantity	31. Unit Wt/Vol	R. Waste No.
a.							
b.							
c.							
d.							
e.		TPD					
f.							
g.							
h.							
i.							

S. Additional Descriptions for Materials Listed Above

T. Handling Codes for Wastes Listed Above

32. Special Handling Instructions and Additional Information

TRANSPORTER

33. Transporter 3 Acknowledgement of Receipt of Materials

Printed/Typed Name Mike Hansen

Signature

Date Month Date Year 09 27 05

34. Transporter 4 Acknowledgement of Receipt of Materials

Printed/Typed Name Ellene DeZeeuw for CHES

Signature Ellene DeZeeuw

Date Month Date Year 09 29 05

FACILITY

35. Discrepancy Indication Space

ORIGINAL RETURN TO GENERATOR

DI 1033147
PPW 08/25/2005

Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

Form Approved. OMB No. 2050-0039.

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. W A H 0 0 0 0 2 7 1 4 7 Manifest Document No. 92305

2. Page 1 of 1

Information in the shaded areas is not required by Federal law.

3. Generator's Name and Mailing Address
US Coast Guard-Burrow Island Light Station
ATTN: Chris Sage
1519 Alaskan Way
Seattle, WA 98134

4. Generator's Phone (206) 217-6915

A. State Manifest Document Number 92305

B. State Generator's ID

5. Transporter 2 Company Name Clean Harbors Env Services Inc

6. US EPA ID Number M A D 0 3 9 3 2 2 2 5 0

C. State Transporter's ID

D. Transporter's Phone (781) 849-1800

7. Transporter 1 Company Name ~~T W Company~~ SEE BOX 15

8. US EPA ID Number ~~U T D 9 8 8 0 7 4 7 1 2~~

E. State Transporter's ID

F. Transporter's Phone ~~(801) 299-1900~~

9. Designated Facility Name and Site Address
Clean Harbors Grassy Mountain
3 Miles East 7 Miles North of Knolls
Clive, UT, 84029

10. US EPA ID Number U T D 9 9 1 3 0 1 7 4 8

G. State Facility's ID

H. Facility's Phone (801) 323-8900

	11. US DOT Description (Including Proper Shipping Name, Hazard Class and ID Number)	HM	12. Containers No.	12. Containers Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
a.	WASTE ENVIRONMENTALLY HAZARDOUS SUBSTANCES, SOLID, N.O.S., (LEAD), 9, UN3077, PG III	X	075	DM	40000	P	D008
b.							
c.							
d.							

CR
FS pm
OFFC

J. Additional Descriptions for Materials Listed Above
11a.ERG#171 (S),(E) 70x 55g ; 5x85g
SOIL CONTAMINATED WITH LEAD

K. Handling Codes for Wastes Listed Above
14
03

15. Special Handling Instructions and Additional Information ON 9-23-05 EMERGENCY PHONE #: (800) 483-3718
11a: CH120914— 108 METAL DRUMS (50 GAL) TRANSPORTED VIA BARGE BY: ISLAND TRANSPORT FERRY SERVICE INC., REG. NO. 0602050061034N - TRANSPORTER PHONE (360) 293-6060
PRINT:
SIGN: Ed McNamee 9-23-05 (93) APPROX BARGE WT 64,800 LB

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; **OR**, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name FOR: CHRIS SAGE (CPO) R.E. CZARNECKI USCG.
Signature R.E. Czarnecki FOR: CHRIS SAGE (CPO) USCG
Month Day Year 09 23 05

17. Transporter 1 Acknowledgement of Receipt of Materials
Printed/Typed Name Scott Tys
Signature
Month Day Year

2005005357

18. Transporter 2 Acknowledgement of Receipt of Materials
Printed/Typed Name Scott Tyson
Signature Scott
Month Day Year 09 29 05

19. Discrepancy Indication Space
LINE 5, 7, 15 TRANSPORTER #1 SIGNED AND FILLED IN INCORRECT LINE
LINE 11a AND 15 MANIFEST WAS SPLIT DUE TO EXCESSIVE WEIGHT, EXTRA DRUMS SHIPPED ON MANIFEST # 92606

20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.
Printed/Typed Name ~~Stacey Chadwick~~ SC
Signature ~~Stacey Chadwick~~
Month Day Year ~~10 03 05~~
Pam Mclean
10-05-05

Style CF17 LABELMASTER ® (800) 621-5808 www.labelmaster.com EPA Form 8700-22 (Rev. 9-88) Previous editions are obsolete.

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ORIGINAL-RETURN TO GENERATOR

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EMERGENCY CONTACT TELEPHONE NUMBER

UNIFORM HAZARDOUS WASTE MANIFEST
(Continuation Sheet)

21. Generator's US EPA ID No. WAH000027147 Manifest Document No. 92305

22. Page 2 of 2

Information in the shaded areas is not required by Federal law.

23. Generator's Name
U.S. Coast Gaurd - Burrow Island light station
1519 Alaskan Way
Seattle, WA 98134

L. State Manifest Document Number

M. State Generator's ID

24. Transporter 3 Company Name TW COMPANY

25. US EPA ID Number INTD988074712

N. State Transporter's ID

O. Transporter's Phone 801-299-1900

26. Transporter 4 Company Name CLEAN HARBORS

27. US EPA ID Number MAD039322250

P. State Transporter's ID

Q. Transporter's Phone

GENERATOR

	HM	28. US DOT Description *(Including Proper Shipping Name, Hazard Class, and ID Number)*	29. Containers No	29. Containers Type	30. Total Quantity	31. Unit Wt/Vol	R. Waste No.
a.							
b.							
c.							
d.							
e.							
f.							
g.							
h.							
i.							

S. Additional Descriptions for Materials Listed Above

T. Handling Codes for Wastes Listed Above

32. Special Handling Instructions and Additional Information

(FOR TRANSPORT ONLY)

TRANSPORTER

33. Transporter 3 Acknowledgement of Receipt of Materials

Printed/Typed Name Lawrence Averill

Signature L. Averill

Date: Month 09 Date 30 Year 05

34. Transporter 4 Acknowledgement of Receipt of Materials

Printed/Typed Name THOMAS S MARSHALL

Signature Thomas S Marshall

Date: Month 10 Date 05 Year 05

FACILITY

35. Discrepancy Indication Space

ORIGINAL RETURN TO GENERATOR

26 27298

DI1033147
PPW 08/25/2005

Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

Form Approved. OMB No. 2050-0039.

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. W A H 0 0 0 0 2 7 1 4 7 Manifest Document No. 92905

2. Page 1 of 1

Information in the shaded areas is not required by Federal law.

3. Generator's Name and Mailing Address
US Coast Guard-Burrow Island Light Station
ATTN: Chris Sage
1519 Alaskan Way
Seattle, WA 98134

4. Generator's Phone (206) 217-6915

A. State Manifest Document Number 92905

B. State Generator's ID

5. Transporter 2 Company Name Clean Harbors Env Services Inc

6. US EPA ID Number M A D 0 3 9 3 2 2 2 5 0

C. State Transporter's ID

D. Transporter's Phone (781) 849-1800

7. Transporter 1 Company Name ISLAND ~~T W Company~~ TRANSPORT FERRY SERVICE

8. US EPA ID Number 060205001034N ~~U T D 9 8 8 0 7 4 7 1 2~~

E. State Transporter's ID

F. Transporter's Phone ~~(801) 299-1800~~ (360) 293-6060

9. Designated Facility Name and Site Address
Clean Harbors Grassy Mountain
3 Miles East 7 Miles North of Knolls
Clive, UT, 84029

10. US EPA ID Number U T D 9 9 1 3 0 1 7 4 8

G. State Facility's ID

H. Facility's Phone (801) 323-8900

	HM	11. US DOT Description (Including Proper Shipping Name, Hazard Class and ID Number)	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
a.	X	WASTE ENVIRONMENTALLY HAZARDOUS SUBSTANCES, SOLID, N.O.S., (LEAD), 9, UN3077, PG III	080	DM	41,000	P	D008
b.							
c.							
d.							

J. Additional Descriptions for Materials Listed Above
11a.ERG#171 (S),(E) 80X 55g
SOIL CONTAMINATED WITH LEAD
#209
#75

K. Handling Codes for Wastes Listed Above

CR	VS
FS	
OFFC	

15. Special Handling Instructions and Additional Information
EMERGENCY PHONE #: (800) 483-3718
11a: CH120914 — ISLAND TRANSPORT FERRY SERVICE HAULED 120 METAL DRUMS VIA BARGE ON 9-29-05, APPROX WEIGHT 72,880 POUNDS

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

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Printed/Typed Name FOR: CHRIS SAGE (CPO) R.E.CZARNECKI USCG
Signature
Month Day Year 09 29 05

17. Transporter 1 Acknowledgement of Receipt of Materials
Printed/Typed Name Ed McNamee
Signature
Month Day Year 09 29 05

18. Transporter 2 Acknowledgement of Receipt of Materials
Printed/Typed Name Scott Tyson
Signature
Month Day Year 10 03 05

19. Discrepancy Indication Space
LINE 5 AND 7 FILLED IN INCORRECT, ALSO 6,8, F INCORRECT FILL-IN
200500 5489
LINE 11A AND 15 MANIFEST WAS SPLIT DUE TO EXCESSIVE WEIGHT EXTRA DRUMS SHIPPED ON M# 92606

20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.
Printed/Typed Name ~~FRAN~~ Les R. Ashwood
Signature
Month Day Year 10 13 05

Style CF 17 LABELMASTER® (800) 621-5808 www.labelmaster.com

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ORIGINAL-RETURN TO GENERATOR

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PRINTED WITH SOY INK

EMERGENCY CONTACT TELEPHONE NUMBER

UNIFORM HAZARDOUS WASTE MANIFEST
(Continuation Sheet)

21. Generator's US EPA ID No. / Manifest Document No.: WAH000027147192905

22. Page: 2 of 2

Information in the shaded areas is not required by Federal law.

23. Generator's Name:
US COAST GUARD - BURROW IS. LT. STATION
1519 ALASKAN WAY
SEATTLE, WA 98134

L. State Manifest Document Number

M. State Generator's ID

24. Transporter 3 Company Name: TW COMPANY

25. US EPA ID Number: IN.TD988074712

N. State Transporter's ID

O. Transporter's Phone: 801-299-2900

26. Transporter 4 Company Name: CHES

27. US EPA ID Number: MA0039322250

P. State Transporter's ID

Q. Transporter's Phone: 801 323 8100

28. US DOT Description *(Including Proper Shipping Name, Hazard Class, and ID Number)*	HM		29. Containers No	29. Containers Type	30. Total Quantity	31. Unit Wt/Vol	R. Waste No.
a.							
b.							
c.							
d.							
e.							
f.							
g.							
h.							
i.							

TPO

S. Additional Descriptions for Materials Listed Above

T. Handling Codes for Wastes Listed Above

32. Special Handling Instructions and Additional Information

(FOR TRANSFER ONLY)

33. Transporter 3 Acknowledgement of Receipt of Materials
Printed/Typed Name: IAN S. CHRISTENSEN
Signature: Ian S. Christensen
Date: Month 10 Date 09 Year 05

34. Transporter ____ Acknowledgement of Receipt of Materials
Printed/Typed Name: TRAVIS L. SMITH FOR CHES
Signature
Date: Month 10 Date 10 Year 05

35. Discrepancy Indication Space

ORIGINAL RETURN TO GENERATOR

DI1033147
PPW 08/25/2005

Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

Form Approved. OMB No. 2050-0039.

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. WAH000027147 Manifest Document No. 92606
2. Page 1 of 1
Information in the shaded areas is not required by Federal law.

3. Generator's Name and Mailing Address
US Coast Guard-Burrow Island Light Station
ATTN: Chris Sage
1519 Alaskan Way
Seattle, WA 98134
4. Generator's Phone (206) 217-6915

A. State Manifest Document Number 92606
B. State Generator's ID

5. Transporter 1 Company Name ~~Clean Harbors Env Services Inc~~ ISLAND TRANSPORT FERRY SERVICE INC
6. US EPA ID Number ~~MAD039322250~~ 60205001034N
C. State Transporter's ID
D. Transporter's Phone ~~(781) 849-1800~~ (360) 293-6060

7. Transporter 2 Company Name ~~T W Company~~ CLEAN HARBOR ENV SERVICES INC
8. US EPA ID Number ~~UTD888074712~~ MAD039322250
E. State Transporter's ID
F. Transporter's Phone ~~(801) 298-1900~~ (781) 849-1800

9. Designated Facility Name and Site Address
Clean Harbors Grassy Mountain
3 Miles East 7 Miles North of Knolls
Clive, UT, 84029
10. US EPA ID Number UTD991301748
G. State Facility's ID
H. Facility's Phone (801) 323-8900

11. US DOT Description (Including Proper Shipping Name, Hazard Class and ID Number)	HM	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
a. WASTE ENVIRONMENTALLY HAZARDOUS SUBSTANCES, SOLID, N.O.S., (LEAD), 9, UN3077, PG III	X	080	DM	39,000	P	D008
b.						
c.						
d.						

CR	
FS	pm
OFFC	

J. Additional Descriptions for Materials Listed Above
11a.ERG#171 (S),(E)
SOIL CONTAMINATED WITH LEAD 77x55g
3x85g

K. Handling Codes for Wastes Listed Above

CR	✓S	03
FS		
OFFC		

EMERGENCY PHONE #: (800) 483-3718

15. Special Handling Instructions and Additional Information
11a: CH120914

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

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Printed/Typed Name FOR: CHRIS SAGE CPO USCG R.E CZARNECKI
Signature R.E. FOR CHRIS SAGE CPO USCG
Month Day Year 10 04 05

17. Transporter 1 Acknowledgement of Receipt of Materials
Printed/Typed Name ISLAND TRANSPORT
Signature IS. TRANSPORT.
Month Day Year 10 04 05

18. Transporter 2 Acknowledgement of Receipt of Materials
Printed/Typed Name Scott Tyson
Signature
Month Day Year 10 04 05

19. Discrepancy Indication Space LINE 5,7 FILLED IN INCORRECT ALSO 6,8,D,F INCORRECT FILL-IN line 17 refer to ~~[illegible]~~ M# 92305, 92605, 92905
2005005492

20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.
Printed/Typed Name Sam Melancon
Signature Sam Melancon
Month Day Year 10 13 05

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ORIGINAL RETURN TO GENERATOR

EMERGENCY CONTACT TELEPHONE NUMBER

UNIFORM HAZARDOUS WASTE MANIFEST
(Continuation Sheet)

21. Generator's US EPA ID No. WAH000027147
Manifest Document No. 92606
22. Page 2 OF 2

Information in the shaded areas is not required by Federal law.

23. Generator's Name
US COAST GUARD-BURROWS IS. LT. STATION
1519 ALASKAN WAY
SEATTLE, WA 98134

L. State Manifest Document Number
M. State Generator's ID

24. Transporter 3 Company Name SLT EXPRESS
25. US EPA ID Number UTD981552425
N. State Transporter's ID
O. Transporter's Phone 800-627-3047

26. Transporter ______ Company Name CLEAN HARBORS ENV SERVICES
27. US EPA ID Number MAD039322250
P. State Transporter's ID
Q. Transporter's Phone 801-323-8100

28. US DOT Description *(Including Proper Shipping Name, Hazard Class, and ID Number)*	HM		29. Containers No	29. Containers Type	30. Total Quantity	31. Unit Wt/Vol	R. Waste No.
a.							
b.							
c.							
d.							
e.							
f.							
g.							
h.							
i.							

S. Additional Descriptions for Materials Listed Above

T. Handling Codes for Wastes Listed Above

32. Special Handling Instructions and Additional Information

(FOR TRANSPORT ONLY)

GENERATOR

33. Transporter 3 Acknowledgement of Receipt of Materials
Printed/Typed Name Mark L Draper
Signature Mark L Draper
Date Month 10 Date 10 Year 05

34. Transporter ______ Acknowledgement of Receipt of Materials
Printed/Typed Name TRAVIS L. SMITH FOR CHGS
Signature
Date Month 10 Date 12 Year 05

TRANSPORTER

35. Discrepancy Indication Space

FACILITY

ORIGINAL RETURN TO GENERATOR

Final
Site Investigation Report
Burrows Island Light Station
Skagit County, Washington

August 2009

Project No. 28-137

Prepared for:

United States Coast Guard
Civil Engineering Unit Oakland
2000 Embarcadero, Suite 200
Oakland, California 94606

Prepared by:

ERRG

Engineering/Remediation Resources Group, Inc.
1700 Westlake Avenue North, Suite 200A
Seattle, WA 98109
(206) 282-4749

Final
Site Investigation Report
Burrows Island Light Station
Skagit County, Washington

August 2009

Submitted by:

Signature	8/17/2009 Date
Bernie Wong, LEG Name	Senior Project Manager Title
Signature	08/17/2009 Date
Bradley S. Hall, PG Name	Program Manager Title

Table of Contents

Acronyms and Abbreviations

bgs	below ground surface
CCI	CCI Analytical Laboratory
COPC	chemical of potential concern
Ecology	Washington State Department of Ecology
EDDA	environmental due diligence audit
EPA	U.S. Environmental Protection Agency
ERRG	Engineering/Remediation Resources Group, Inc.
LBP	lead-based paint
mg/kg	milligram(s) per kilogram
MTCA	Model Toxics Control Act
SAP	sampling and analysis plan
USCG	United States Coast Guard
WAC	Washington Administrative Code
XRF	X-ray fluorescence

Section 2. Site Background

2.1. SITE DESCRIPTION

Burrows Island is located approximately ¼ mile west of the city of Anacortes, Washington (Figure 1). The island is less than a square mile in size, with approximately 4 miles of shoreline. The majority of the island is densely forested and the shoreline is jagged and rocky. The USCG established a lighthouse facility (Light Station) at the northwestern-most corner of the island and was operational in 1906. The scope of this study is limited to the three Coast Guard structures at the facility that were previously sampled for lead contamination in their surrounding soil: Duplex, Lighthouse, and Boathouse (Figure 2).

2.2. PREVIOUS INVESTIGATIONS

KELLCO conducted a Phase II Environmental Due Diligence Audit (EDDA) at Burrows Island Light Station in 2005 (KELLCO, 2005a). The Phase II EDDA included a lead-based paint (LBP) survey and soil sampling for potential chemicals of concern based on historic operation at the Light Station. LBP on existing buildings along with lead in the soil were identified as the only environmental concerns in the Phase II EDDA, and follow-up remedial actions were recommended (KELLCO, 2005a). In 2005, KELLCO was contracted by the USCG for the remedial actions (KELLCO, 2005b). These actions consisted of (1) All building surfaces identified with LBP were treated (sprayed) with various lead encasement paints/topcoats for LBP encapsulation; and (2) limited quantities of soil which was lead-impacted was removed from around the Duplex. The soil was excavated, placed in metal drums, and barged to the mainland for off-site disposal as hazardous waste. A total of 153,920 pounds of lead-contaminated soil was excavated and disposed of before the removal action was stopped (KELLCO, 2005b). KELLCO reported that site soil exceeding 1,000 milligrams per kilogram (mg/kg) of lead still remained in the vicinity of the Duplex and other buildings. The excavated area was not backfilled, and native grasses have covered the trench-like surface depression that remains around the Duplex (KELLCO, 2005b).

2.3. GEOLOGY

Throughout the San Juan Islands archipelago (including Burrows Island) the majority of rocks are remnants of large fragments of oceanic crusts (terranes) uplifted and deformed by various thrust faulting events, and intruded by igneous rocks. Burrows Island is within the Decatur Terrane, and is composed largely of the Fidalgo Complex (Alt and Hyndman, 1984). Extensive outcrops of thick sections of

Section 3. Field Sampling Activities Summary

The soil sampling task described in the SAP (ERRG, 2008) was fully implemented as part of this Site Investigation. Minor task modifications were made in the field due to varied site conditions and are summarized below:

- Surface soil sampling with the use of a XRF analyzer for lead around all 3 buildings (Duplex, Lighthouse, and Boathouse)

  Modifications: (1) A few sampling locations were slightly shifted from their original locations due to obstacles and terrain. The north side of the boathouse was not sampled because of steep slope and bedrock outcrop. (2) Additional step out samples were collected for XRF analysis at 3 sample locations that had lead concentrations between 700 and 1,000ppm. This was done to ensure locations with lead concentrations near 1,000 ppm were properly characterized.

3.1. SURFACE SOIL XRF SCREENING AND SAMPLING

Surface soil samples were collected and analyzed to further delineate the horizontal and vertical extent of lead contamination at the Burrows Island Light Station. As described in the SAP, soil samples were collected 10 feet from all sides of the buildings, and the sampling locations were spaced at 10 feet apart. The SAP estimated 62 initial XRF samples: 27 surrounding the Duplex, 19 surrounding the Lighthouse, and 16 surrounding the Boathouse. At each sampling location, the vegetative cover was removed, and surface soil up to 6 inches below ground surface (bgs) was removed by a decontaminated stainless steel trowel, and placed in a Zip Loc® plastic bag for homogenization. The XRF was then used to take a reading thru the bag. The number of actual initial samples collected was 61 based on site conditions: 32 from the Duplex, 15 from the Lighthouse, and 14 from the Boathouse. Figures 3, 4, and 5 illustrate the XRF sampling locations and locations with screening level exceedences. As stated in the SAP, at least 10 percent of XRF samples were also collected for laboratory confirmation analysis, a total of 9 initial confirmation samples (15 percent of all XRF samples) were sent to CCI Analytical Laboratories (CCI) in Everett, WA.

During surface sampling around the Duplex, a depressed area averaging two feet deep was found between the concrete sidewalk and building footing and was found to be around the entire building. The depressed area was overgrown with vegetation, and represented the extent of the limited removal action conducted in 2005. A total of 10 samples were collected from this depressed area: D-003, D-004, D-005, D-006, D-007, D-008, D-009, D-010, D-022, and D-023. The lead concentrations found at these sample locations represent lead levels remaining in the soil after the 2005 limited soil removal action.

Section 4. Site Investigation Findings

4.1. SURFACE SOIL XRF AND CONFIRMATION SAMPLING RESULTS

A total of 61 initial and 12 step-out surface soil samples were tested in the field for lead concentrations using a portable XRF analyzer. The initial sampling locations were located 10 feet away from the sides of the Duplex, Lighthouse, and Boathouse. The limits (step-out) of the XRF sampling points were reached when the lead concentration at the farthest location was less than 1,000 mg/kg, or if paved surfaces, steep slopes, or dense brush was encountered.

The XRF soil sampling results are listed in Table 1. Figures 3, 4, and 5 illustrate the XRF sampling locations and lead exceedences around the three existing buildings.

4.1.1. XRF Sampling Results

XRF soil sampling results for lead ranged from 40 mg/kg (BI-BH-005) at a drip-line sample collected from the southeastern-most corner of the Boathouse, to 2,334 mg/kg (BI-LH-012) approximately 10 feet from the northeastern side of the Lighthouse. Of the 61 samples analyzed for lead, 7 samples (12 percent) exceeded the lead screening level of 1,000 mg/kg: five at the Lighthouse and two at the Duplex. The sampling locations and exceedences for lead are illustrated on Figures 3, 4, and 5. Two lead exceedences occurred on the north side of the Lighthouse, while two exceedences were found on the east side and one on the south side. Two XRF sampling locations on the south side of the Duplex along the drip-line were higher than 1,000 mg/kg screening level. The following is the number of initial samples around each structure that had concentrations exceeding the screening level of 1,000 mg/kg:

- 0 of the 14 samples (0 percent) collected around the Boathouse;
- 2 of the 32 samples (6 percent) collected around the Duplex;
- 5 of the 15 samples (33 percent) collected around the Lighthouse

Step-out samples collected around the Duplex (BI-D-001A, BI-D-004A, BI-D-030A, BI-D-032A) and Lighthouse (BI-LH-006A, BI-LH-007A, BI-LH-010A, BI-LH-012A, BI-LH-013A/B/C, BI-LH-015A) were used to delineate the horizontal extent of lead. All step-out readings were significantly less than the screening level except for one from the Lighthouse (BI-LH-013A) which had a lead concentration of 953 mg/kg. Two additional step-outs sampling/reading were taken at 5 foot intervals (one to the north, the other perpendicular and to the east) from the one elevated step-out location at the Lighthouse. Both of these second readings were less than the lead screening level (295 mg/kg and 270 mg/kg respectively).

1,000 mg/kg and any XRF result less than 1,085 mg/kg has better than 5 percent probability of being less than the 1,000 mg/kg limit. Based on the statistical analysis, lead results by XRF between 915 mg/kg and 1,085 should be confirmed by laboratory analysis during future investigation at the site to ensure the results are less than the 1,000 mg/kg site screening level.

samples contained lead at concentrations that exceeded the lead screening level. Four laboratory confirmation samples were collected from the Duplex, 3 from surface level and 1 at shallow-depth, and only one surface sample contained lead at a concentration that exceeded the lead screening level.

5.1.3. Boathouse

Sixteen soil samples were collected for XRF (14) and laboratory confirmation sampling (2) for lead around the Boathouse. All samples were collected approximately 10 feet away from the Boathouse exterior walls, and none of the XRF readings and confirmation samples contained lead at concentrations that exceeded the screening level (Figure 5). No step-out samples were collected around the Boathouse.

5.2. COMPARISON OF LEAD XRF AND LABORATORY CONFIRMATION SAMPLING RESULTS

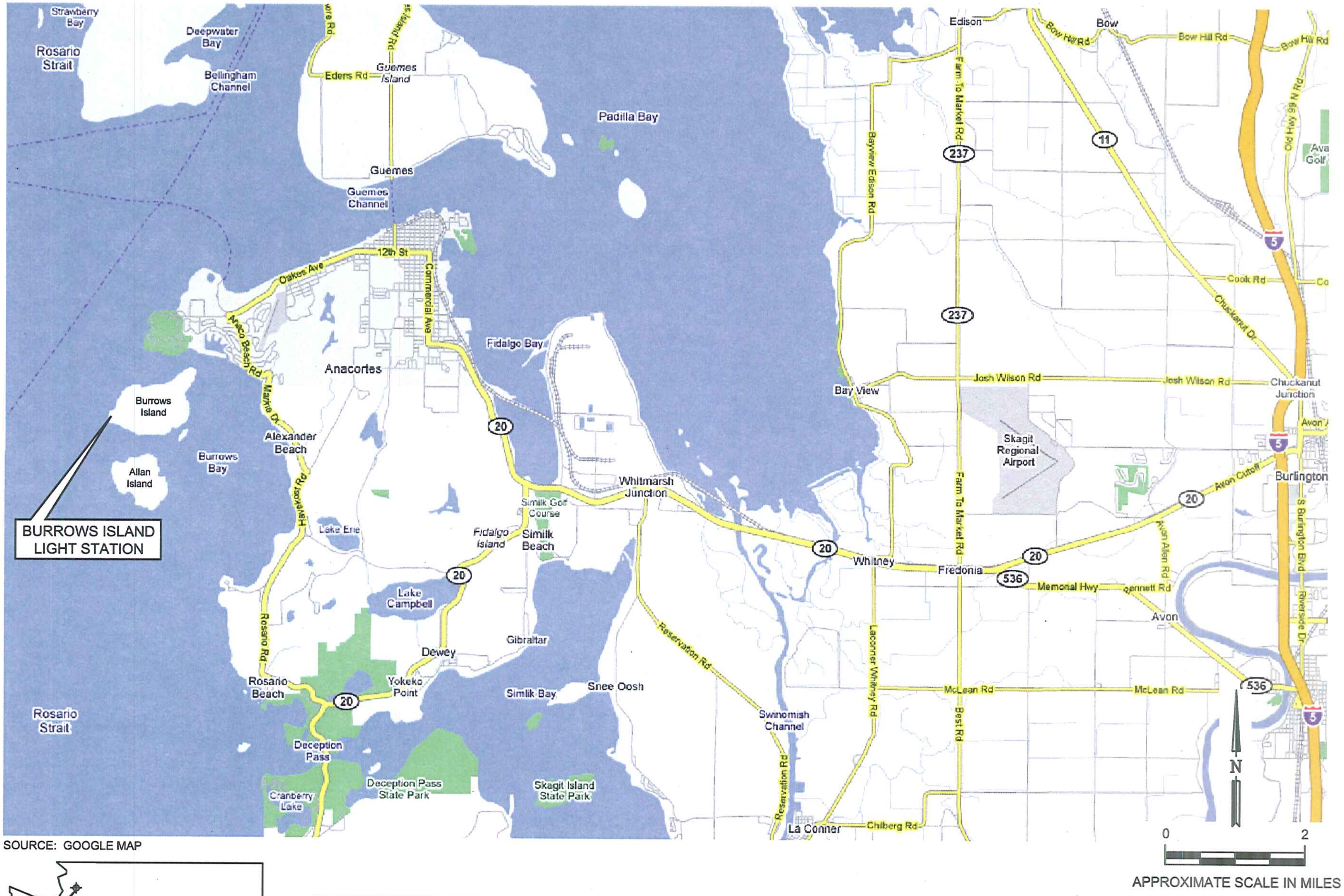
Although field and analytical results indicate a great range of percentage difference between the XRF readings and the confirmation soil sampling results, especially for those samples having high (>1,000 mg/kg) concentrations, the majority (55 percent) of the confirmation samples were within 20 percent of the XRF readings.

It is not clear why there were discrepancies between the XRF and confirmation values, however, XRF readings on soil are known to be affected by numerous outside factors, such as soil matrix, moisture contents, and distribution of LBP chips in the soil samples. Despite the variations, the XRF and confirmation soil sampling results for lead match up well on their position relative to the screening level (1,000 mg/kg).

The results of a simple statistical analysis predicted that there would be a 95 percent confidence level that the XRF result at 915 mg/kg would have a confirmation result less than the 1,000 mg/kg site screening level; and the XRF results at 1,085 mg/kg would have a 95 percent confidence level that the confirmation result would be greater than the 1,000 mg/kg site screening level. Based on this analysis, lead results by XRF field analysis between 915 mg/kg and 1,085 mg/kg should be confirmed by laboratory analysis during future investigation at the site for quantitative comparison to the 1,000 mg/kg site screening level.

The current XRF and analytical results, put in the context of the trend and statistical analyses, is deemed reliable for estimating areas of lead-impacted soil greater than the site screening level.

Figures

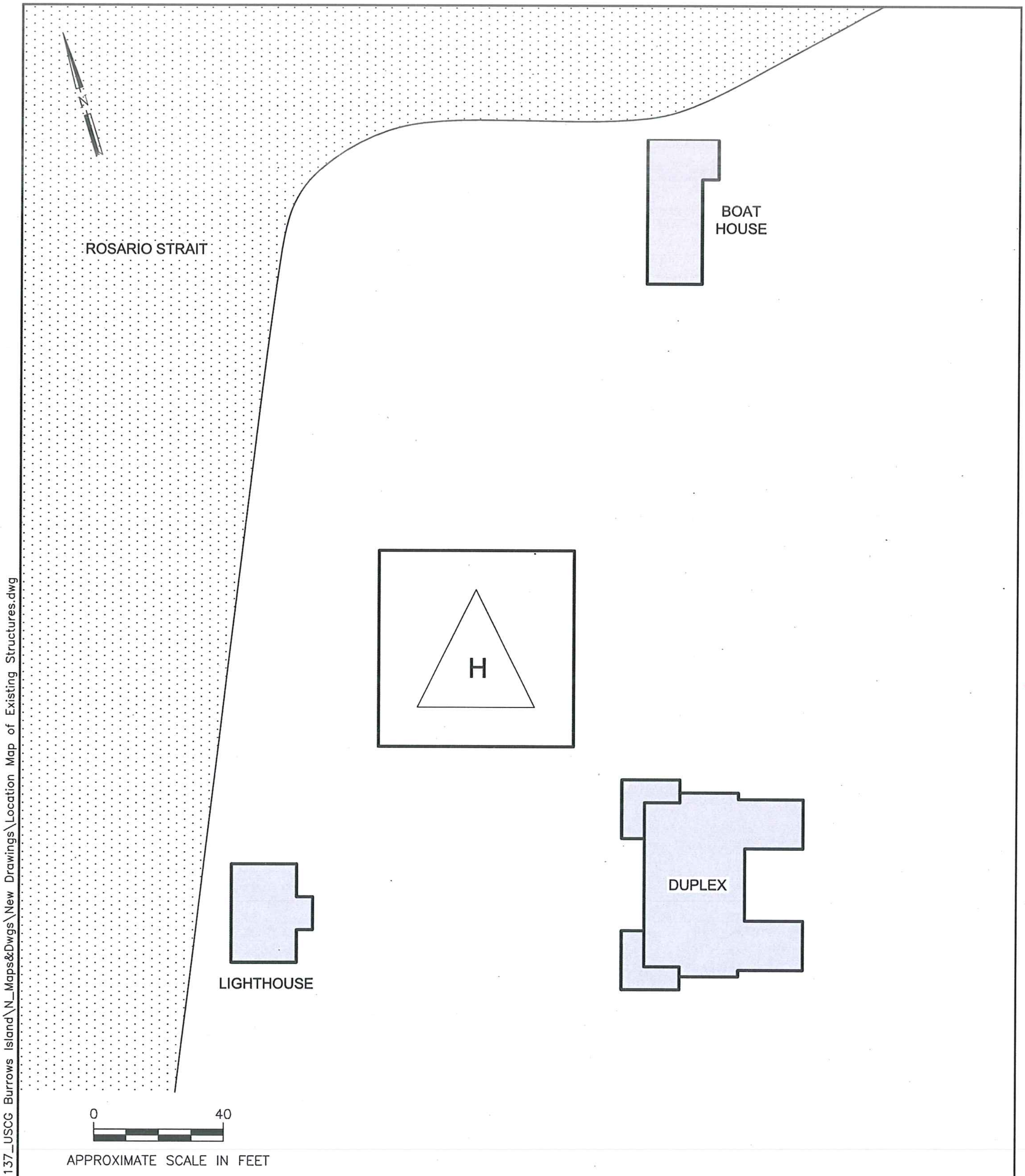


SOURCE: GOOGLE MAP

Engineering/Remediation Resources Group, Inc.
1700 Westlake Ave. N, Suite 200A
Seattle, Washington 98109
(206) 282-4749

CLIENT: UNITED STATES COAST GUARD	DESIGNED BY: RDB 9-23-08	SITE LOCATION MAP			
LOCATION: BURROWS ISLAND LIGHT STATION SKAGIT COUNTY,WA	CHECKED BY: KAL 9-25-08				
	P.E/P.G.: BBW 9-26-08	ERRG PROJECT NO. 28-137	REVISION NO. 0	SHEET 1 OF 1	FIG NO. 1

P:\2008_Projects\28-137 USCG Burrows Island\N_Maps_Drawings\Site Location Map.dwg



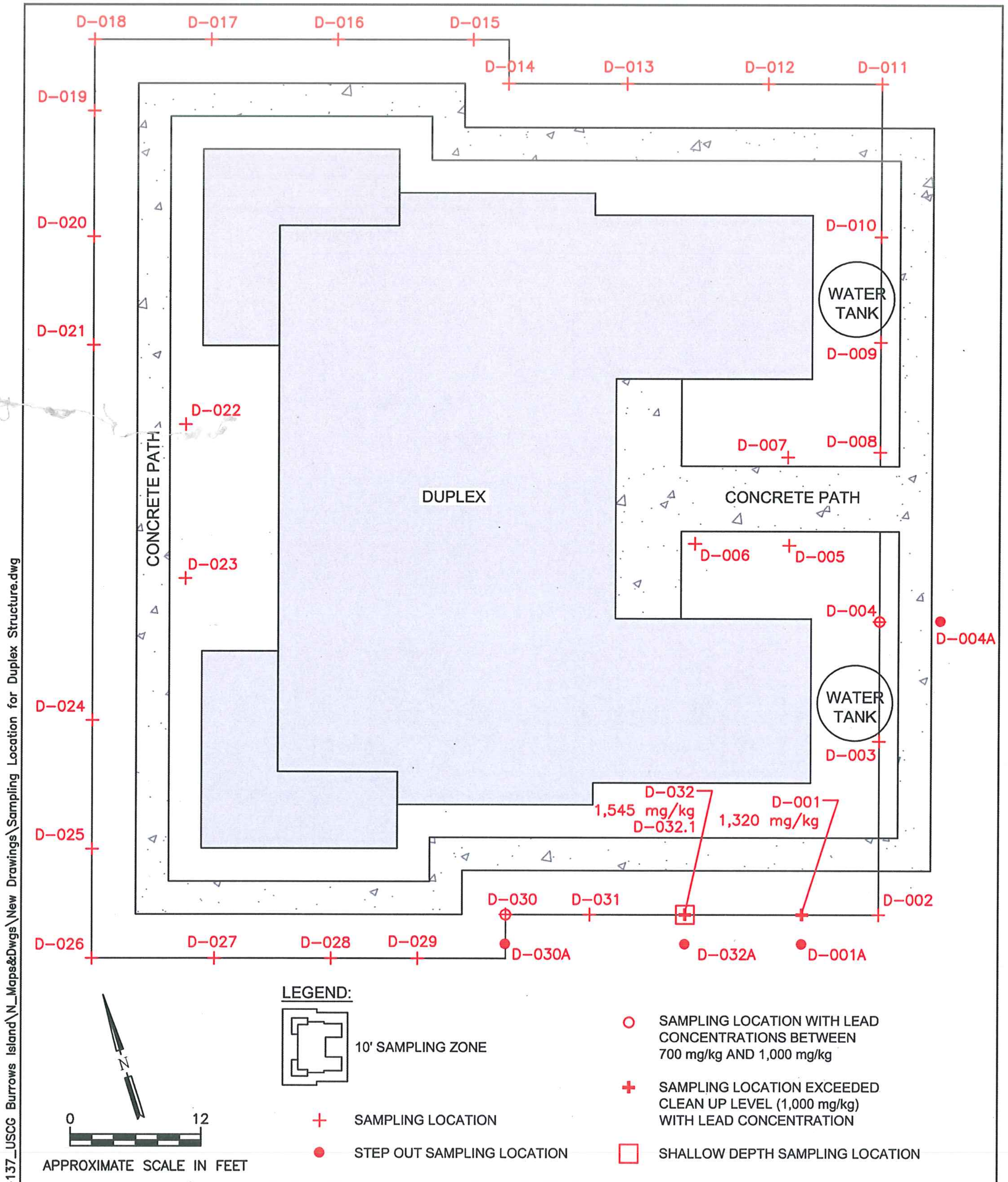
Engineering/Remediation Resources Group, Inc.
1700 Westlake Ave. N, Suite 200A
Seattle, Washington 98109
(206) 282-4749
ERRG

CLIENT:	UNITED STATES COAST GUARD
LOCATION:	BURROWS ISLAND LIGHT STATION SKAGIT COUNTY, WA
DESIGNED BY:	VZC 4-7-09
CHECKED BY:	KAL 4-7-09
P.E/P.G.:	BBW 4-7-09

LOCATION MAP OF EXISTING STRUCTURES

ERRG PROJECT NO.	REVISION NO.	SHEET	OF	FIG NO.
28-137	0	1	1	2

P:\2008_Projects\28-137_USCG Burrows Island\N_Maps&Dwgs\New Drawings\Location Map of Existing Structures.dwg



P:\2008_Projects\28-137_USCG Burrows Island\N_Maps&Dwgs\New Drawings\Sampling Location for Duplex Structure.dwg

Engineering/Remediation
Resources Group, Inc.
1700 Westlake Ave. N, Suite 200A
Seattle, Washington 98109
(206) 282-4749
ERRG

CLIENT:
UNITED STATES
COAST GUARD

LOCATION:
BURROWS ISLAND
LIGHT STATION
SKAGIT COUNTY, WA

DESIGNED BY:
VZC 8-3-09

CHECKED BY:
KAL 8-4-09

P.E/P.G.:
BBW 8-4-09

SAMPLING LOCATIONS
AND EXCEEDENCES FOR
DUPLEX STRUCTURE

ERRG PROJECT NO.	REVISION NO.	SHEET	OF	FIG NO.
28-137	0	1	1	3

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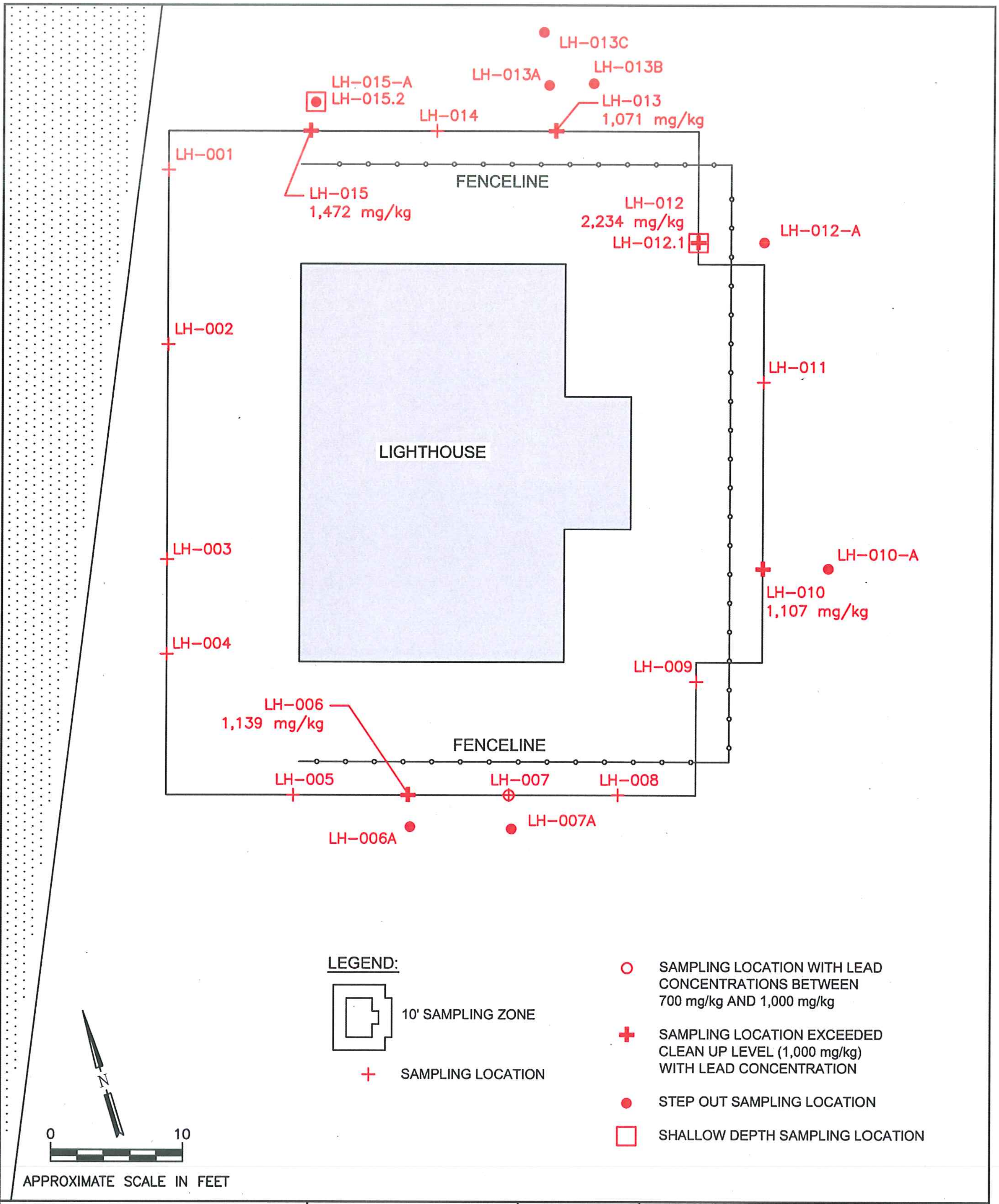
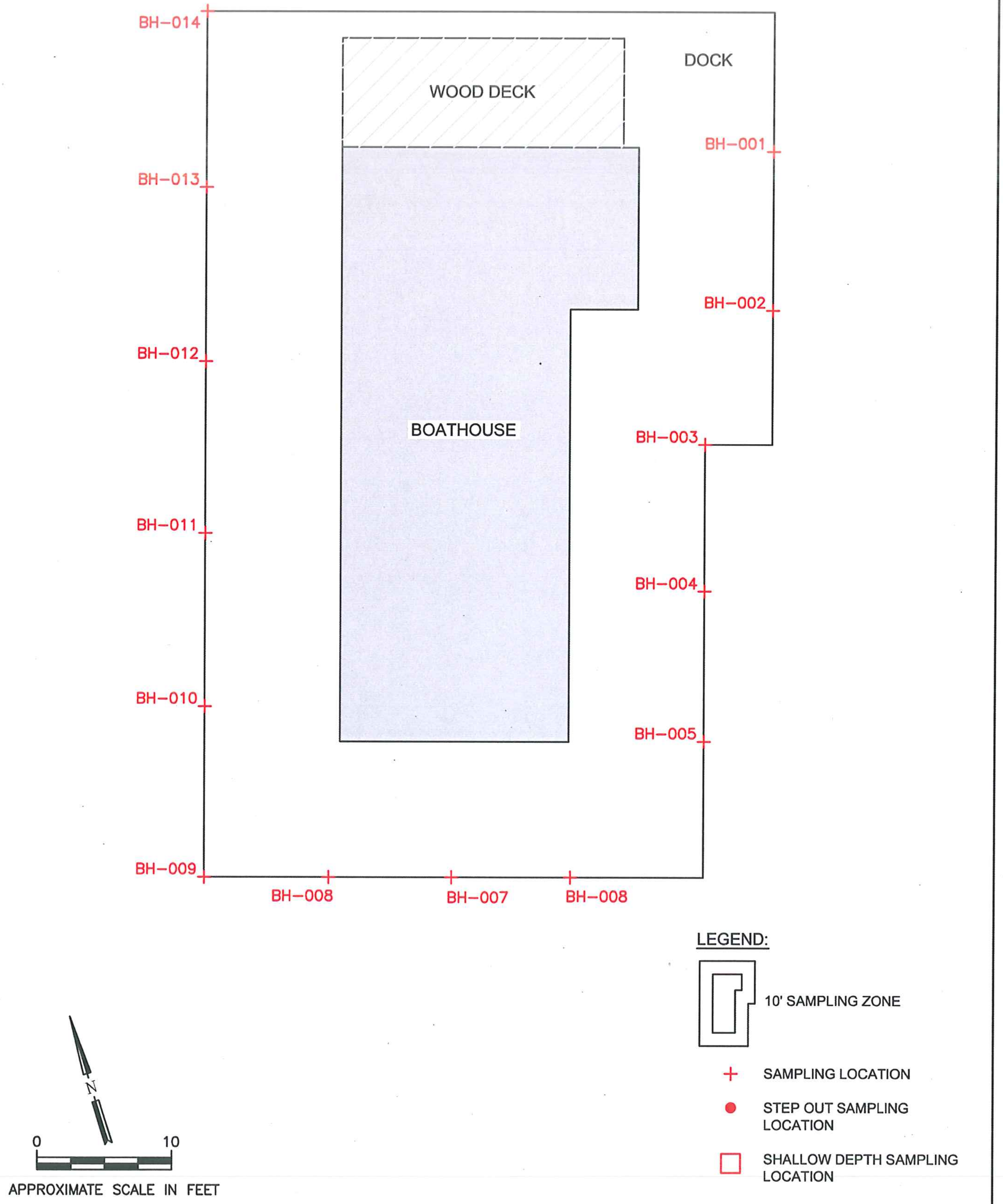


ERRG

Engineering/Remediation Resources Group, Inc.
1700 Westlake Ave. N, Suite 200A
Seattle, Washington 98109
(206) 282-4749

CLIENT: UNITED STATES COAST GUARD	DESIGNED BY: VZC 8-3-09	SAMPLING LOCATIONS AND EXCEEDENCES FOR LIGHTHOUSE STRUCTURE				
	CHECKED BY: KAL 8-4-09					
LOCATION: BURROWS ISLAND LIGHT STATION SKAGIT COUNTY, WA	P.E/P.G.: BBW 8-4-09	ERRG PROJECT NO. 28-137	REVISION NO. 0	SHEET 1	OF 1	FIG NO. 4



Engineering/Remediation Resources Group, Inc.
1700 Westlake Ave. N, Suite 200A
Seattle, Washington 98109
(206) 282-4749
ERRG

CLIENT: UNITED STATES COAST GUARD	DESIGNED BY: VZC 8-3-09	SAMPLING LOCATIONS AND EXCEEDENCES FOR BOATHOUSE STRUCTURE
	CHECKED BY: KAL 8-4-09	
LOCATION: BURROWS ISLAND LIGHT STATION SKAGIT COUNTY, WA	P.E/P.G.: BBW 8-4-09	

ERRG PROJECT NO.	REVISION NO.	SHEET	OF	FIG NO.
28-137	0	1	1	5

P:\2008_Projects\28-137_USCG Burrows Island\N_Maps&Dwgs\New Drawings\Sampling Locations for Boathouse Structure.dwg

Tables

Table 1. XRF and Confirmation Lead Sampling Results
Site Investigation
Burrows Island Light Station, Skagit County, Washington

Sample ID	Sample Date	Sample Location	XRF Lead (ppm)	Laboratory Confirmation Sample Results
BI-BH-001	1/28/2009	10 ft from Boathouse	135	
BI-BH-002	1/28/2009	10 ft from Boathouse	<LOD	
BI-BH-003	1/28/2009	10 ft from Boathouse	105	
BI-BH-004	1/28/2009	10 ft from Boathouse	94	
BI-BH-005	1/28/2009	10 ft from Boathouse	40	
BI-BH-006	1/28/2009	10 ft from Boathouse	60	
BI-BH-007	1/28/2009	10 ft from Boathouse	64	
BI-BH-008	1/28/2009	10 ft from Boathouse	262	59
BI-BH-009	1/28/2009	10 ft from Boathouse	50	
BI-BH-010	1/28/2009	10 ft from Boathouse	59	
BI-BH-011	1/28/2009	10 ft from Boathouse	168	
BI-BH-012	1/28/2009	10 ft from Boathouse	169	
BI-BH-013	1/28/2009	10 ft from Boathouse	222	
BI-BH-014	1/28/2009	10 ft from Boathouse	330	340
BI-D-001	1/28/2009	10 ft from Duplex	**1320**	
BI-D-001A	1/28/2009	15 ft from Duplex	351	
BI-D-002	1/28/2009	10 ft from Duplex	453	
BI-D-003	1/28/2009	10 ft from Duplex	670	
BI-D-004	1/28/2009	10 ft from Duplex	863	770
BI-D-004A	1/28/2009	15 ft from Duplex	234	
BI-D-005	1/28/2009	10 ft from Duplex	32	
BI-D-006	1/28/2009	10 ft from Duplex	578	
BI-D-007	1/28/2009	10 ft from Duplex	384	
BI-D-008	1/28/2009	10 ft from Duplex	<LOD	
BI-D-009	1/28/2009	10 ft from Duplex	104	
BI-D-010	1/28/2009	10 ft from Duplex	473	260
BI-D-011	1/28/2009	10 ft from Duplex	169	
BI-D-012	1/28/2009	10 ft from Duplex	256	
BI-D-013	1/28/2009	10 ft from Duplex	290	
BI-D-014	1/28/2009	10 ft from Duplex	577	
BI-D-015	1/28/2009	10 ft from Duplex	595	
BI-D-016	1/28/2009	10 ft from Duplex	185	
BI-D-017	1/28/2009	10 ft from Duplex	250	
BI-D-018	1/28/2009	10 ft from Duplex	253	
BI-D-019	1/28/2009	10 ft from Duplex	109	
BI-D-020	1/28/2009	10 ft from Duplex	262	210

Table 1. XRF and Confirmation Lead Sampling Results
Site Investigation
Burrows Island Light Station, Skagit County, Washington *(cointinued)*

Sample ID	Sample Date	Sample Location	XRF Lead (ppm)	Laboratory Confirmation Sample Results
BI-D-032.1	1/29/2009	10 ft from Duplex	554	140
BI-LH-012.1	1/29/2009	10 ft from Lighthouse	395	310
BI-LH-015.2 (1.5ft bgs)	1/29/2009	15 ft from Lighthouse	128	

Notes:
MTCA Method A Screening Level for lead for industrial properties is 1,000 mg/kg.
Soil samples collected 1/28/2009 throught 1/29/2009
EPA - U.S. Environmental Protection Agency
LOD - Limit of Detection
mg/kg - milligrams per kilogram
ppm - parts per million

Appendix A. Laboratory Reports

CCI
ANALYTICAL
LABORATORIES
A Division of DataChem Laboratories, Inc.

CERTIFICATE OF ANALYSIS

CLIENT: ERRG
1700 WESTLAKE AVE. NORTH SUITE 200A
SEATTLE, WA 98109

DATE:	2/9/2009
CCIL JOB #:	0901130
DATE RECEIVED:	1/29/2009
WDOE ACCREDITATION #:	C1336

CLIENT CONTACT:	BERNIE WONG
CLIENT PROJECT ID:	28-137 BURROWS ISLAND
CLIENT SAMPLE ID:	1/28/2009 8:51 BI-BH-008
CCIL SAMPLE #:	-01

DATA RESULTS

ANALYTE	METHOD	RESULTS*	UNITS**	ANALYSIS DATE	ANALYSIS BY
Lead	EPA-6010	59	MG/KG	2/3/2009	BAM

* "ND" INDICATES ANALYTE ANALYZED FOR BUT NOT DETECTED AT LEVEL ABOVE REPORTING LIMIT. REPORTING LIMIT IS GIVEN IN PARENTHESES.

** UNITS FOR ALL NON LIQUID SAMPLES ARE REPORTED ON A DRY WEIGHT BASIS

APPROVED BY:

CCI
ANALYTICAL
LABORATORIES
A Division of DataChem Laboratories, Inc.

CERTIFICATE OF ANALYSIS

CLIENT: ERRG
1700 WESTLAKE AVE. NORTH SUITE 200A
SEATTLE, WA 98109

DATE: 2/9/2009
CCIL JOB #: 0901130
DATE RECEIVED: 1/29/2009
WDOE ACCREDITATION #: C1336

CLIENT CONTACT: BERNIE WONG
CLIENT PROJECT ID: 28-137 BURROWS ISLAND
CLIENT SAMPLE ID: 1/28/2009 10:50 BI-D-032
CCIL SAMPLE #: -03

DATA RESULTS

ANALYTE	METHOD	RESULTS*	UNITS**	ANALYSIS DATE	ANALYSIS BY
Lead	EPA-6010	2300	MG/KG	2/3/2009	BAM

* "ND" INDICATES ANALYTE ANALYZED FOR BUT NOT DETECTED AT LEVEL ABOVE REPORTING LIMIT. REPORTING LIMIT IS GIVEN IN PARENTHESES.

** UNITS FOR ALL NON LIQUID SAMPLES ARE REPORTED ON A DRY WEIGHT BASIS

APPROVED BY:

CERTIFICATE OF ANALYSIS

CLIENT: ERRG
1700 WESTLAKE AVE. NORTH SUITE 200A
SEATTLE, WA 98109

DATE: 2/9/2009
CCIL JOB #: 0901130
DATE RECEIVED: 1/29/2009
WDOE ACCREDITATION #: C1336

CLIENT CONTACT: BERNIE WONG
CLIENT PROJECT ID: 28-137 BURROWS ISLAND
CLIENT SAMPLE ID: 1/28/2009 10:58 BI-D-010
CCIL SAMPLE #: -05

DATA RESULTS

ANALYTE	METHOD	RESULTS*	UNITS**	ANALYSIS DATE	ANALYSIS BY
Lead	EPA-6010	260	MG/KG	2/3/2009	BAM

* "ND" INDICATES ANALYTE ANALYZED FOR BUT NOT DETECTED AT LEVEL ABOVE REPORTING LIMIT. REPORTING LIMIT IS GIVEN IN PARENTHESES.

** UNITS FOR ALL NON LIQUID SAMPLES ARE REPORTED ON A DRY WEIGHT BASIS

APPROVED BY:

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A Division of DataChem Laboratories, Inc

CERTIFICATE OF ANALYSIS

CLIENT: ERRG
1700 WESTLAKE AVE. NORTH SUITE 200A
SEATTLE, WA 98109

DATE: 2/9/2009
CCIL JOB #: 0901130
DATE RECEIVED: 1/29/2009
WDOE ACCREDITATION #: C1336

CLIENT CONTACT: BERNIE WONG
CLIENT PROJECT ID: 28-137 BURROWS ISLAND
CLIENT SAMPLE ID: 1/28/2009 13:20 BI-LH-015
CCIL SAMPLE #: -07

DATA RESULTS

ANALYTE	METHOD	RESULTS*	UNITS**	ANALYSIS DATE	ANALYSIS BY
Lead	EPA-6010	1700	MG/KG	2/3/2009	BAM

* "ND" INDICATES ANALYTE ANALYZED FOR BUT NOT DETECTED AT LEVEL ABOVE REPORTING LIMIT. REPORTING LIMIT IS GIVEN IN PARENTHESES.

** UNITS FOR ALL NON LIQUID SAMPLES ARE REPORTED ON A DRY WEIGHT BASIS

APPROVED BY:

CCI
ANALYTICAL
LABORATORIES
A Division of DataChem Laboratories, Inc.

CERTIFICATE OF ANALYSIS

CLIENT: ERRG
1700 WESTLAKE AVE. NORTH SUITE 200A
SEATTLE, WA 98109

DATE: 2/9/2009
CCIL JOB #: 0901130
DATE RECEIVED: 1/29/2009
WDOE ACCREDITATION #: C1336

CLIENT CONTACT: BERNIE WONG
CLIENT PROJECT ID: 28-137 BURROWS ISLAND
CLIENT SAMPLE ID: 1/28/2009 13:27 BI-LH-012
CCIL SAMPLE #: -09

DATA RESULTS

ANALYTE	METHOD	RESULTS*	UNITS**	ANALYSIS DATE	ANALYSIS BY
Lead	EPA-6010	2600	MG/KG	2/3/2009	BAM

* "ND" INDICATES ANALYTE ANALYZED FOR BUT NOT DETECTED AT LEVEL ABOVE REPORTING LIMIT. REPORTING LIMIT IS GIVEN IN PARENTHESES.

** UNITS FOR ALL NON LIQUID SAMPLES ARE REPORTED ON A DRY WEIGHT BASIS

APPROVED BY:

CERTIFICATE OF ANALYSIS

CLIENT: ERRG
1700 WESTLAKE AVE. NORTH SUITE 200A
SEATTLE, WA 98109

DATE: 2/9/2009
CCIL JOB #: 0901130
DATE RECEIVED: 1/29/2009
WDOE ACCREDITATION #: C1336

CLIENT CONTACT: BERNIE WONG
CLIENT PROJECT ID: 28-137 BURROWS ISLAND
CLIENT SAMPLE ID: 1/28/2009 14:05 SB-01
CCIL SAMPLE #: -11

DATA RESULTS

ANALYTE	METHOD	RESULTS*	UNITS**	ANALYSIS DATE	ANALYSIS BY
Lead	EPA-200.8	ND(<3)	UG/L	2/5/2009	ARI

* "ND" INDICATES ANALYTE ANALYZED FOR BUT NOT DETECTED AT LEVEL ABOVE REPORTING LIMIT. REPORTING LIMIT IS GIVEN IN PARENTHESES.

** UNITS FOR ALL NON LIQUID SAMPLES ARE REPORTED ON A DRY WEIGHT BASIS

APPROVED BY:

CCI
ANALYTICAL
LABORATORIES
A Division of DataChem Laboratories, Inc

ALS

CERTIFICATE OF ANALYSIS

CLIENT: ERRG
1700 WESTLAKE AVE. NORTH SUITE 200A
SEATTLE, WA 98109

DATE:	2/9/2009
CCIL JOB #:	0901130
DATE RECEIVED:	1/29/2009
WDOE ACCREDITATION #:	C1336

CLIENT CONTACT: BERNIE WONG

CLIENT PROJECT ID: 28-137 BURROWS ISLAND
CLIENT SAMPLE ID: 1/29/2009 12:01 BI-D-032.1
CCIL SAMPLE #: -13

DATA RESULTS

ANALYTE	METHOD	RESULTS*	UNITS**	ANALYSIS DATE	ANALYSIS BY
Lead	EPA-6010	140	MG/KG	2/3/2009	BAM

* "ND" INDICATES ANALYTE ANALYZED FOR BUT NOT DETECTED AT LEVEL ABOVE REPORTING LIMIT. REPORTING LIMIT IS GIVEN IN PARENTHESES.

** UNITS FOR ALL NON LIQUID SAMPLES ARE REPORTED ON A DRY WEIGHT BASIS

APPROVED BY:

CERTIFICATE OF ANALYSIS

CLIENT: ERRG
1700 WESTLAKE AVE. NORTH SUITE 200A
SEATTLE, WA 98109

DATE: 2/9/2009
CCIL JOB #: 0901130
DATE RECEIVED: 1/29/2009
WDOE ACCREDITATION #: C1336

CLIENT CONTACT: BERNIE WONG
CLIENT PROJECT ID: 28-137 BURROWS ISLAND

QUALITY CONTROL RESULTS

BLANK SPIKE/BLANK SPIKE DUPLICATE RESULTS

METHOD	MATRIX	QC BATCH ID	ASSOCIATED SAMPLES	ANALYTE	BLANK SPIKE RECOVERY	BLANK SPIKE DUP RECOVERY	RPD
EPA-6010	Soil	ICPS020309-3	0901130-1-9, 12,13	Lead	97 %	91 %	6
EPA-200.8	Water	ICPMS020509-1	0901130-10, 11	Lead	111 %	NA	NA

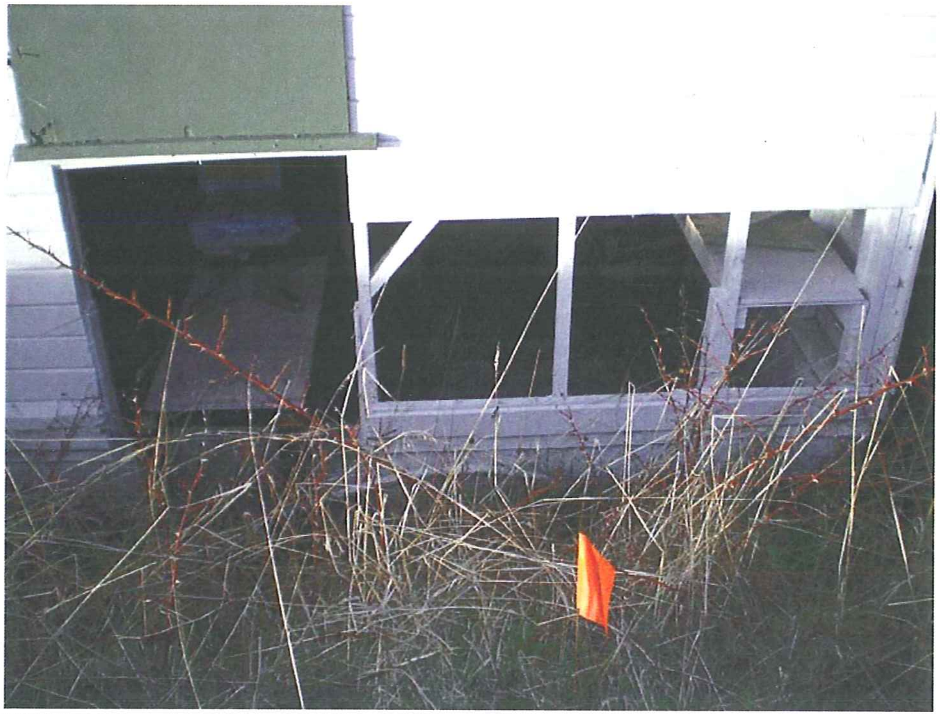
APPROVED BY:

Appendix B. Field Activities Photo Log

USCG – Burrows Island Light Station: *Photo 1* – View of X-ray Fluorescence (XL3t 600 Environmental Analyzer) equipment analyzing a soil sample through a Ziploc bag.

USCG – Burrows Island Light Station: *Photo 2* – View of soil being collected from a surface sampling location for laboratory confirmation analysis.

USCG – Burrows Island Light Station: *Photo 3* –View of Boathouse, facing eastward, with pin flags marking the 10ft interval spacing for sampling.



USCG – Burrows Island Light Station: *Photo 4* –View of the south side of the Boathouse through the opening to the "crawl space" with miscellaneous debris.

USCG – Burrows Island Light Station: *Photo 5* – Facing north, inside of Boathouse "crawl space" showing miscellaneous debris.

USCG – Burrows Island Light Station: *Photo 6* – View of north side of Boathouse with wooden deck. Also, shows stairway down to the dock behind the deck and steep shoreline bluff going down to the dock.

USCG – Burrows Island Light Station: *Photo 7* – View from north shoreline. Boathouse is located in upper right-hand corner. Wooden debris located on steep shoreline next to loading dock. No surface samples were collected on the steep bluff for the north side of the Boathouse.

USCG – Burrows Island Light Station: *Photo 8* – Northeastern facing, view of Lighthouse (on left) and Duplex (on right).

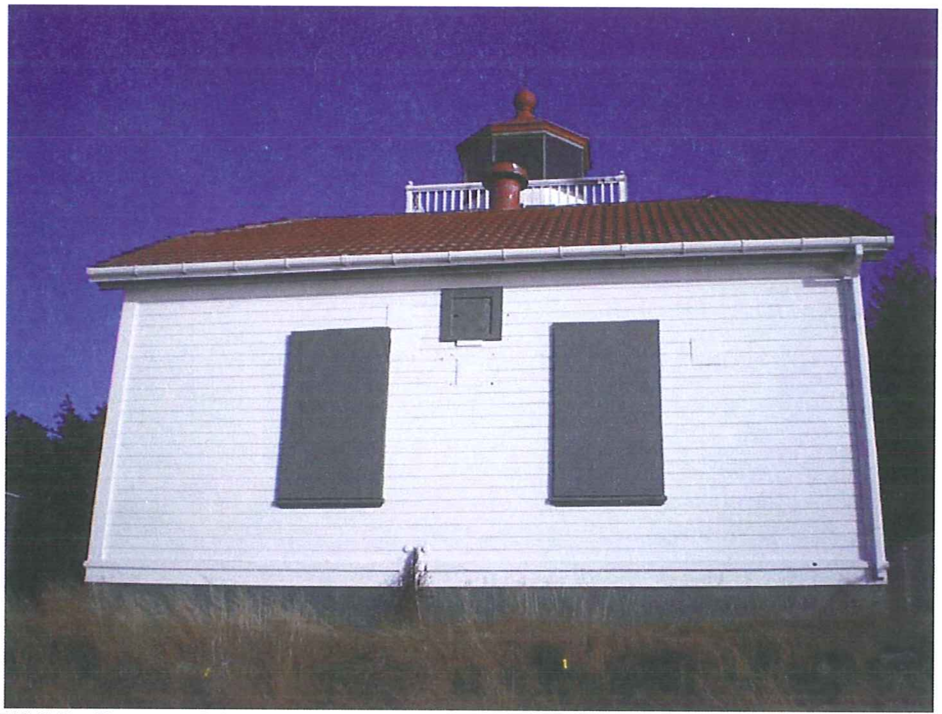
USCG – Burrows Island Light Station: *Photo 9* – View of east side of the Duplex showing two former water tanks on either side of building.

USCG – Burrows Island Light Station: *Photo 10* – View of backside side of Duplex showing deteriorating stairs, opened doors and scattered debris.

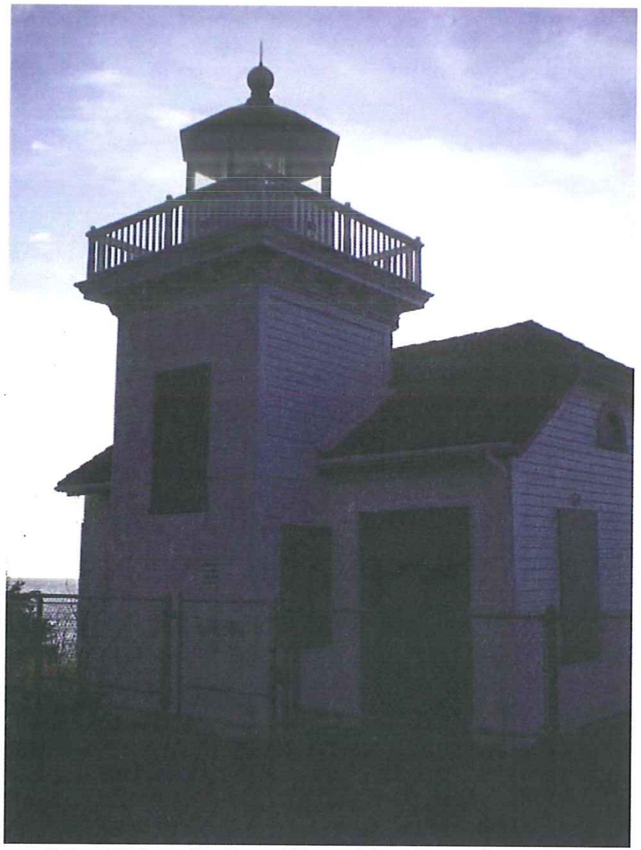
USCG – Burrows Island Light Station: *Photo 11* – View of front of Duplex facing eastward.

USCG – Burrows Island Light Station: *Photo 12* – View of depression inside the concrete foot path of Duplex where previous removal action has taken place. The excavated area has since been overgrown with grass and shrubs.

USCG – Burrows Island Light Station: *Photo 13*- Another view of depression inside the foot path of Duplex where previous removal action has taken place. Depth of excavation is estimated to be 2 feet.



USCG – Burrows Island Light Station: *Photo 14* – View of west side of Lighthouse.



USCG – Burrows Island Light Station: *Photo 15* – View of east side of Lighthouse.

Terrestrial Ecological Evaluation

Burrows Island Light Station
Skagit County, WA

September, 2013

Washington State Department of Ecology
Toxics Cleanup Program
300 Desmond Drive
Lacey, WA 98504-7106

For More Information Contact:
Washington State Department of Ecology
Land and Aquatic Lands Cleanup
(360) 407-7180

Terrestrial Ecological Evaluation

History and Location:

Burrows Island Light Station is located on Burrows Island, located one quarter mile off the coast of the town of Anacortes, Washington (Figure 1). It is a small complex of buildings, which include the lighthouse, a boathouse and a duplex residence. Coordinates for the lighthouse (proper) are 48° 28' 40" N and 122° 42' 48" W. The remainder of the island is densely forested. There are no permanent or part time residents at the Light Station.

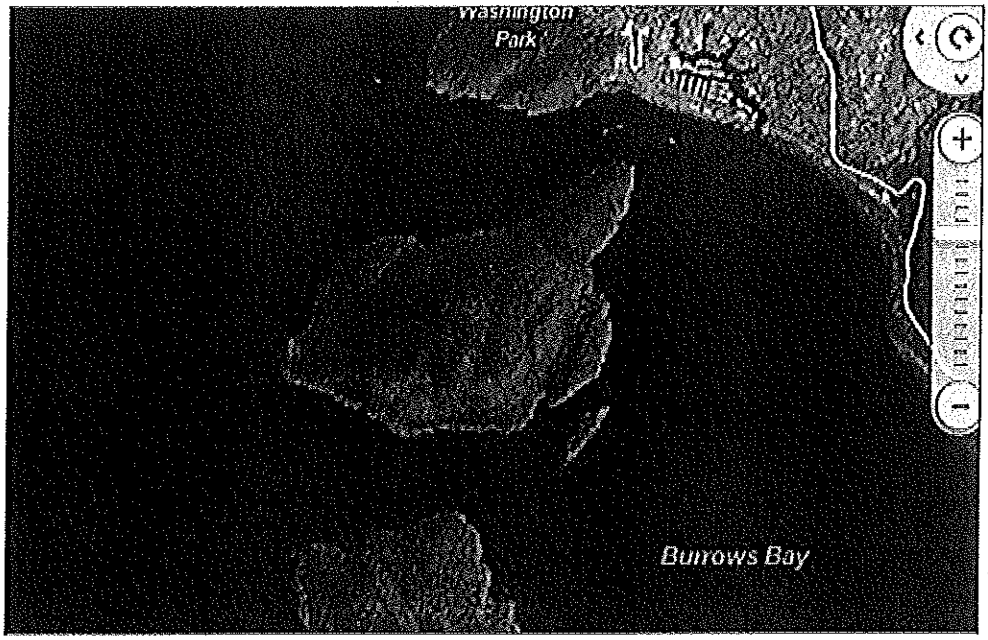


Figure 1: Location of Burrows Island.

Remediation to Date:

There is lead contaminated soil around the lighthouse and the duplex residence. There are two small areas of slightly elevated lead contaminated soil located on two corners of the boathouse. This soil contamination is a result of weathering of the lead based paint exterior surfaces of the structures over the years. In 2005, the Coast Guard began remediation of the lead contamination at the site. The remediation consisted of encapsulation of the exterior surfaces of the structures and excavation and removal of lead contaminated soil around the structures. Much of the excavation and removal of the contaminated soil was done by hand due to the remote location of the site and difficulty in accessing the site with construction equipment and means of transport.

Previous environmental work at the Light Station includes:

- 1980 - PCB spill; remediation consisted of removal of 140 cubic yards of PCB contaminated soil.
- 2000 - UST removal; 300 gallon diesel tank removed from area close to residence.
- 2005 - LBP encapsulation on structures and 150,000 pounds of lead contaminated soil removal in areas around the duplex residence.

Site Characterization:

A site investigation report was completed in August of 2009 (Final Site Investigation Report Burrows Island Light Station Skagit County, Washington) (EERG, 2009). The investigation report includes site diagrams that indicate sampling locations. Those sampling locations have been summarized in Figures (2a through 2d) (EERG, 2009). Results for the samples can be found in (Table 1).

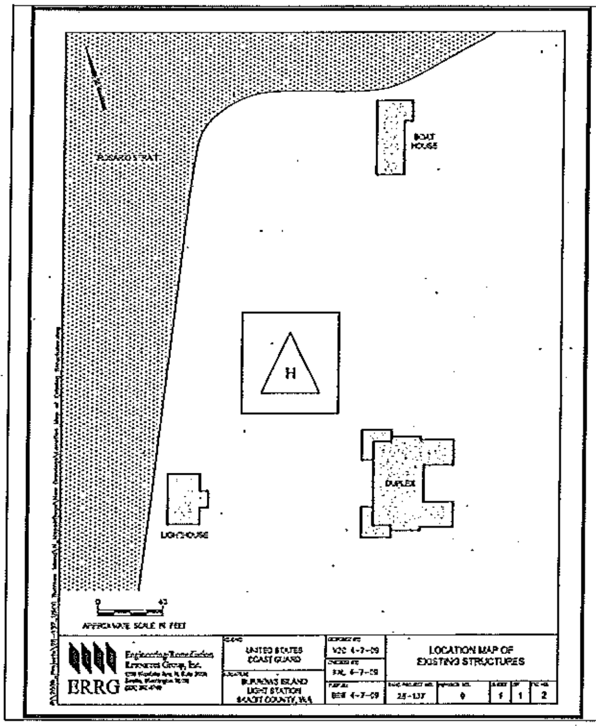


Figure 2(a): Diagram of facilities on Burrows Island

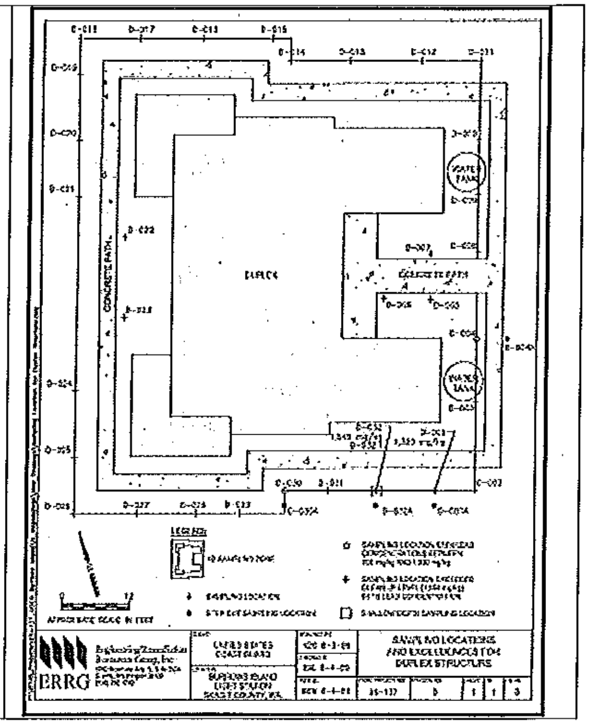


Figure 2(b): Diagram of Duplex and Sampling locations

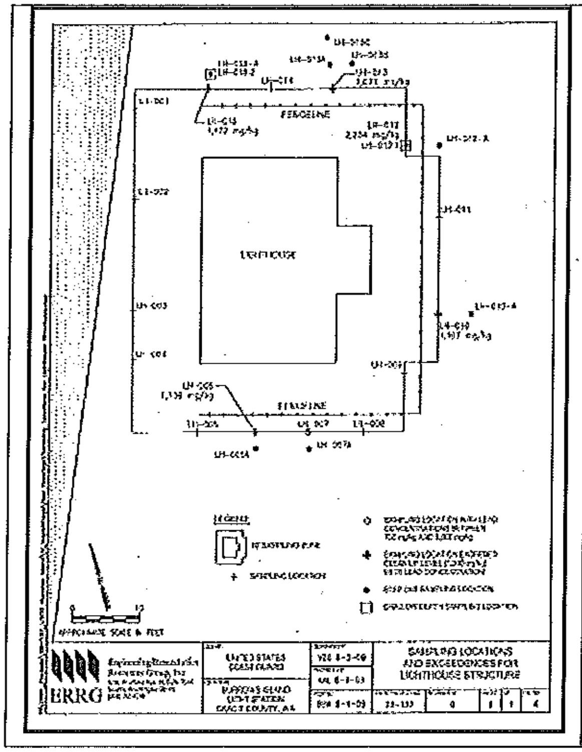


Figure 2(c): Diagram of Lighthouse and sampling locations

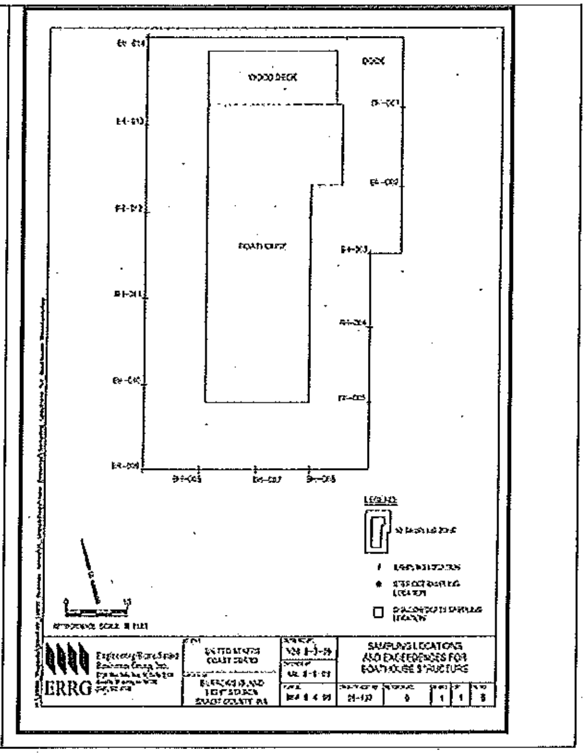


Figure 2(d): Diagram of Boathouse and sampling locations

Terrestrial Ecological Evaluation Process

Washington State's Model Toxics Control Act (MTCA) (Ecology, 2007), Washington Administrative Code (WAC) 173-340, applies to all facilities where there has been a release or threatened release of a hazardous substance that may pose a threat to human health or the environment. Soil contamination shall be evaluated for both human health and ecological threats, and those remedies selected to address soil contamination shall be protective of both human health and ecological receptors. The Terrestrial Ecological Evaluation (TEE) is a process that evaluates threats posed by contaminants to ecological receptors and is included in MTCA, specifically, WAC 173-340-7490 through 7494. The goals and procedures of the Terrestrial Ecological Evaluation are to:

- Determining whether a release of hazardous substances to soil may pose a threat to the terrestrial environment.
- Characterizing existing or potential threats to soil biota and terrestrial plants and animals exposed to hazardous substances in soil.
- Establishing soil concentrations that are protective of soil biota and terrestrial plants and animals, and;
- Developing and evaluating cleanup action alternatives and selecting a cleanup action protective of soil biota and terrestrial plants and animals.

A summary of the TEE process includes the following steps:

- Characterization of the site
- Exclusion evaluation, if no exclusion applies, then;
    - Selection of the appropriate evaluation method (simplified or site-specific TEE)
    - Conduct TEE, and then if required:
        - Selection of clean-up actions.
        - Implementation of cleanup actions, and;
        - Compliance monitoring requirements.

If the site may be excluded from the TEE process, then no further evaluation of ecological risk is necessary as long as the specific exclusion and its application to the site under investigation have been addressed. If the site cannot be excluded from the TEE process, a simplified or site-specific TEE is required. If cleanup actions/alternatives are required to meet requirements, the selection, implementation, and the compliance requirements of those cleanup actions shall also be included.

The TEE process is required at all MTCA sites where there has been a release or threatened release of a hazardous substance that may pose a threat to human health or the environment. This applies to sites that have formal Ecology oversight and also to those sites requiring a No Further Action (NFA) determination under the Voluntary Cleanup Program (VCP).

Exclusion Evaluation:

There are four primary criteria for excluding a contaminated site from further evaluation under the TEE process. As discussed earlier in this document, the site may be excluded from the TEE process and no further evaluation of ecological risk is necessary as long as the specific exclusion and its' application to the site under investigation have been addressed. If the specifics of the site have met one of the exclusionary criteria, neither a simplified nor site – specific TEE would be required.

The four TEE exclusionary criteria are:

- Contamination below the point of compliance.
- Incomplete exposure pathway.
- Type of contamination and proximity to ecological receptors, and;
- Concentrations below background levels.

Contamination below the Point of Compliance:

To qualify for an exclusion based on "contamination below the point of compliance," all soil contaminated with hazardous substances is (or will be) located below the established point of compliance. This means all soil contamination shall be below the standard point of compliance (ground surface to a depth of 15 feet), or below the conditional point of compliance (ground level to a depth of 6 feet). In making this demonstration, the following shall be considered:

- Depth to which soil macro-invertebrates are likely to occur.
- Depth to which soil turnover is likely to occur due to the activities of soil invertebrates.
- Depth to which animals likely to occur at the site are expected to burrow.
- Depth to which plant roots are likely to extend, and;
- The presence of a manmade subsurface biological barrier (such as a geomembrane cap or cobble barrier designed to limit penetration by plant roots and burrowing animals).

It has been determined that the contamination is found mainly at the surface and that the receptors of interest (plants, soil biota, and wildlife) could come in contact with the contaminant. Therefore, the site is not excluded under this condition.

Incomplete Exposure Pathway:

To qualify for an exclusion based on "incomplete exposure pathway," all soil contaminated with hazardous substances is (or will be) covered by buildings, paved roads, pavement, or other physical barriers that will prevent plants or wildlife from being exposed to the soil contamination. These barriers may include engineered caps with geo-textile membranes or other engineered barriers which break the exposure pathway between the ecological receptors and the soil contaminants.

It has been determined that no institutional controls or future use will be implemented that would create an incomplete exposure pathway that that the receptors of interest (plants, soil biota, wildlife) could come in contact with the contaminant. Therefore, the site is not excluded under this condition.

Type of Contamination and Proximity to Ecological Receptors:

To qualify for an exclusion based on "type of contamination and proximity to ecological receptors," the site must be located on or near a limited amount of undeveloped land. This exclusion would be based on one of the following two points:

- For sites contaminated with hazardous substances other than those specified below; there must be less than 1.5 acres of contiguous undeveloped land on the site or within 500 feet of any area located on the site, or;
- For sites contaminated with one of the below substances; there must be less than one-quarter acre of contiguous undeveloped land on the site or within 500 feet of any area located on the site:
  - aldrin
  - benzene hexachloride
  - chlordane
  - chlorinated dioxins or furans
  - DDT, DDE, or DDD
  - dieldrin
  - endosulfan
  - endrin
  - heptachlor or heptachlor epoxide
  - hexachlorobenzene
  - PCB mixtures
  - pentachlorobenzene
  - pentachlorophenol
  - toxaphene

It has been determined that the contaminant of concern is lead, and that there is more than 1.5 acres of contiguous undeveloped land on or within 500 feet of the site (Figure 3). As a result, the receptors of interest (plants, soil biota, and wildlife) could come in contact with the contaminant. Therefore, the site is not excluded under this condition.

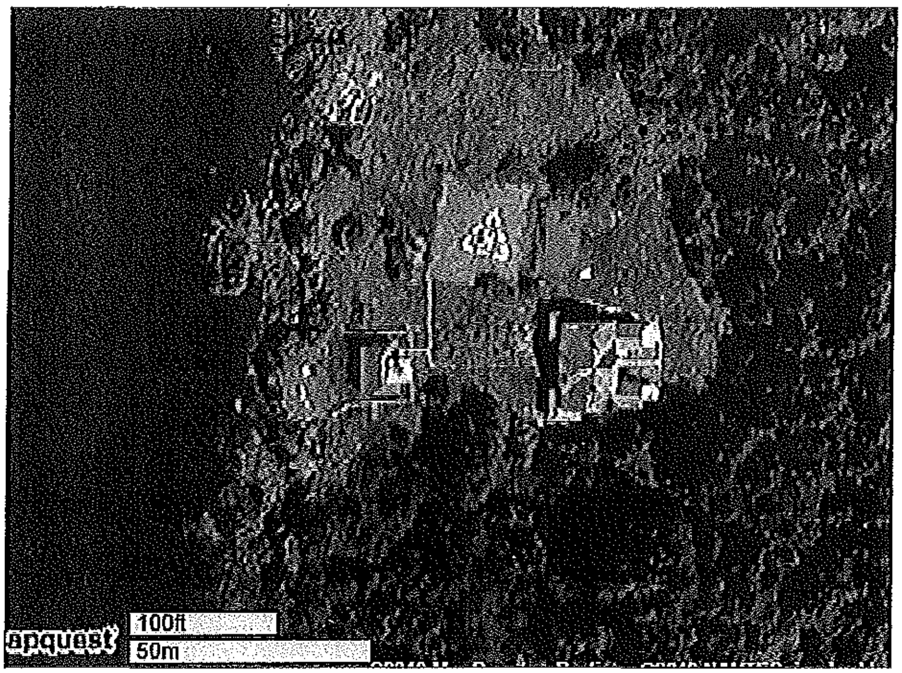


Figure 3: Location of Lighthouse and immediate surrounding area.

Concentrations below Background Levels:

To qualify for an exclusion based on "concentrations below background levels," concentrations of all hazardous substances in soil should not exceed natural background levels based on the determining compliance methodology found in MTCA.

The statewide and regional 90th percentile (natural background level) for lead is:

Statewide	17 ppm
Puget Sound	24 ppm

The sampling indicates concentrations of lead in the soil are above both statewide and regional 90th percentile levels. Therefore, the site is not excluded under this condition.

Summary: It has been determined that the site does not qualify for exclusion

Selection of an Appropriate Evaluation Method:

Since it was determined that none of the above-mentioned exclusionary criteria apply, either a simplified or site-specific terrestrial ecological evaluation is required. MTCA specifically refers to the process of determining the type of evaluation that is required (simplified or site-specific) as "Applicability of a Simplified Terrestrial Ecological Evaluation." The specific regulation that refers to this process can be found in WAC 173-340-7492; Applicability of a Simplified Terrestrial Ecological Evaluation. WAC 173-340-7492 lists four criteria that are to be used in that determination. If any of the below criteria apply to the site, then a site-specific terrestrial ecological evaluation is necessary. Those criteria are:

- Natural areas.
- Vulnerable species.
- Extensive habitat, and;
- Risk to significant wildlife populations.

Natural Areas:

If the site is located on, or directly adjacent to an area where management or land use plans will maintain or restore native or semi-native vegetation, then a site-specific terrestrial ecological evaluation is necessary. Examples of these areas include:

- Green-belts.
- Protected wetlands.

- Forestlands.
- Riparian areas.
- Locally designated environmentally sensitive areas.
- Open space areas managed for wildlife, and;
- Some parks and outdoor recreation areas.

Native Vegetation: Means any plant community native to the state of Washington. The following sources shall be used in making this determination: *Natural Vegetation of Oregon and Washington,* J.F. Franklin and C.T. Dyrness, Oregon State University Press, 1988; and *Vascular Plants of the Pacific Northwest* (5 Volumes), A. Cronquist, 1955-1969.

Semi-native Vegetation: Means a plant community that includes at least some vascular plant species native to the state of Washington. The following shall not be considered semi-native vegetation:

- Areas planted for ornamental or landscaping purposes.
- Areas planted for cultivated crops, and;
- Areas significantly disturbed and predominantly covered by noxious, introduced plant species or weeds (e.g., Scotch broom, Himalayan blackberry or knap-weed).

It does not appear that management or land use plans have been established that would maintain or restore native or semi-native vegetation at this site. Therefore, a site-specific TEE is not necessary doe to these criteria.

Vulnerable Species:

If the site is used by vulnerable species, a site-specific terrestrial ecological evaluation is necessary. Examples of listed vulnerable species are:

- A threatened or endangered species protected under the Federal Endangered Species Act.
- A wildlife species classified by the Washington State Department of Fish and Wildlife as a "priority species" or "species of concern" under Title 77 RCW, and;
- A plant species classified by the Washington State Department of Natural Resources Natural Heritage Program as "endangered," "threatened," or "sensitive" under Title 79 RCW.

Note: For plants, "used" means that a plant species grows at the site or has been found growing at the site. For animals, "used" means that individuals of a species have been observed to live, feed or breed at the site.

The Washington State Department of Fish and Wildlife has classified the following priority species to use this specific area:

- Bald Eagle (*H. leucocephalus*)
- Pinto Abalone (*H. kamtschatkana*)
- Red Sea Urchin (*S. franciscanus*)
- Peregrine Falcon (*F. peregrinus*)

The above information can be found on the Washington Department of Fish and Wildlife Priority Habitats and Species on the Web at:

www.wdfw.wa.gov/mapping/phs/

Under the above criteria, a site-specific TEE is required because individuals of the species have been observed to live, feed, or breed at the site.

Extensive Habitat:

If there is at least ten acres of native vegetation on or within 500 feet of any area of contaminated soil, a site-specific TEE is necessary. This total (ten acres) is applicable whether or not the native vegetation has been fragmented into smaller areas. "Any area of contaminated soil" means that the ten acres "on or within 500 feet of any area of contaminated soil" is not limited to the property that the source of the contamination is located on. It appears a site-specific TEE is required because there are more than 10 acres of native vegetation on or within 500 of contaminated soil (Figure 4).

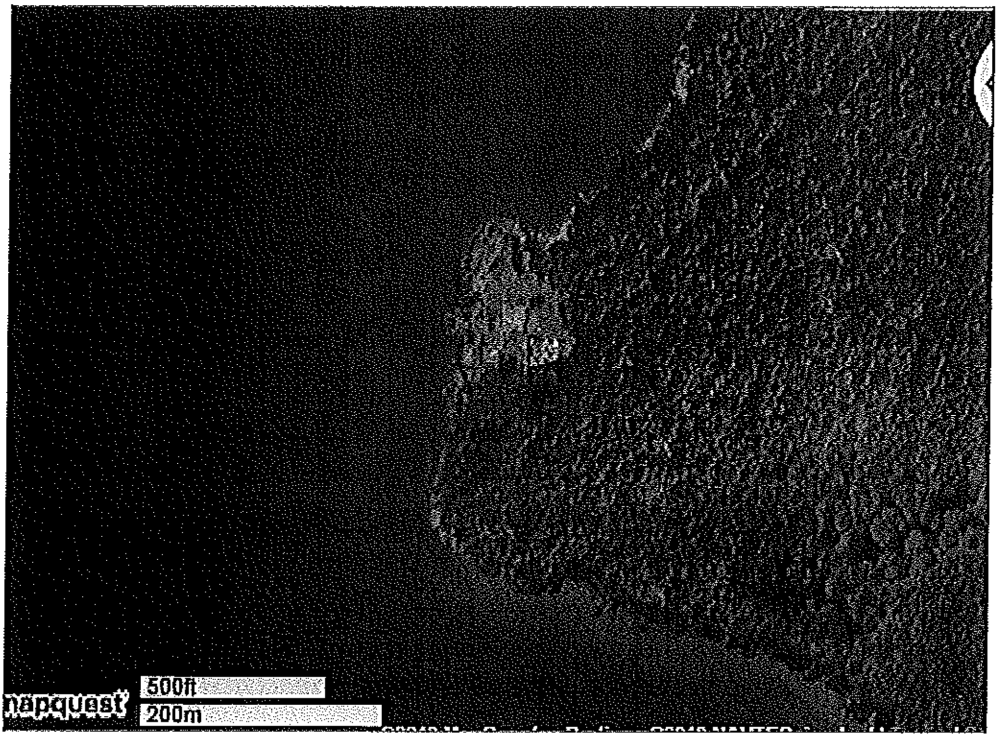


Figure 4: Lighthouse and surrounding vegetation.

Risk to Significant Wildlife Populations:

If the department determines the contamination may present a risk to significant wildlife populations, a site – specific terrestrial ecological evaluation is necessary. The department did not determine the contamination may present a risk to significant wildlife populations. Therefore, a site-specific TEE is not required under these criteria.

Summary: It has been determined that a site-specific TEE is required due to the vulnerable species and extensive habitat criteria.

The Site-Specific Terrestrial Ecological Evaluation:

It has been established that a site-specific TEE is required at this site. A site-specific TEE shall include the following steps:

- Problem formulation
- Selection of appropriate evaluation method(s)
- Conducting the evaluation
- Establish ecologically protective soil concentrations

Problem Formulation Step:

Contaminants of Ecological Concern:

The contaminants of ecological concern at the site are: Lead (Pb). The concentrations of Pb exceed the screening levels found in Table 5.1 (MTCA Table 749-3). The site Ecological Indicator Soil Concentration for Protection of Terrestrial Plants and Animals for lead are:

Contaminant	Plants (ppm)	Soil Biota (ppm)	Wildlife (ppm)
Lead	50	500	118

Exposure Pathways:

It appears there are only complete potential exposure pathways for exposure of plants or animals to the contaminants of concern (Pb). It does not appear that there are any man-made physical barriers, either currently existing or for future use within a timeframe acceptable to the department that would create an incomplete exposure pathway.

Terrestrial Ecological Receptors of Concern:

The identified current and potential terrestrial ecological receptor groups reasonably likely to live or feed at the site are the suggested receptor groups in WAC 173-340. The groupings represent taxonomically related species with similar exposure characteristics. These include:

- Soil-associated invertebrates (earthworms)
- Vascular plants
- Ground-feeding birds (robin)
- Ground-feeding small mammal predators (shrew)
- Herbivorous small mammals (vole)

Toxicological Assessment:

Lead in soil is relatively immobile and persistent whether added to the soil as halides, hydroxides, oxides, carbonates, or sulfates. When released to the soil, lead is normally converted from soluble lead compounds to relatively insoluble sulfate or phosphate derivatives. It also forms complexes with organic matter and clay minerals which limits its mobility. The efficient fixation of lead in soils limits the transfer of lead to aquatic systems. However, leaching of lead can be relatively rapid from some soils, especially at highly contaminated sites or landfills. Lead is most available from acidic sandy soils which contain little material capable of binding lead. Concentrations of lead in soil solution reach a minimum between pH 5 and 6 because metal-organic complexes form in this pH range. Only a small fraction of lead in lead-contaminated soil appears to be in water-soluble form (0.2-1%) (USEPA, 2005).

Plants: Lead is not considered to be an essential element for plant growth and development. Lead inhibits growth, reduces photosynthesis (by inhibiting enzymes unique to photosynthesis), interferes with cell division and respiration, reduces water absorption and transpiration, accelerates abscission or defoliation and pigmentation, and reduces chlorophyll and ATP synthesis (USEPA, 1979). The uptake of lead by plants depends on factors including cation exchange capacity, soil composition (e.g., organic matter content, calcium content), metal concentrations, precipitation, light, and temperature. Lead uptake by plants is favored at lower pH values and in soils with low organic carbon content (DeMayo et al. 1982) (USEPA, 2005).

Soil Invertebrates: Earthworms accumulate lead and are thus a useful bioindicator of lead pollution in soil. Total lead concentrations in soils almost always exceed concentrations in earthworms except where unique conditions, such as high levels of lead in soils combined with low pH and low calcium, cause earthworms to accumulate greater amounts of lead from the soil. BCFs (ratio of lead in worms to lead in the soil) range from 0.01 to 2.73, but are usually well below 1.0, indicating that there is no constant relationship between the concentration of lead in soil and that found in earthworms (CSG, 1999) (Canada, 1999).

Birds and Mammals: Lead is not considered an essential element for birds or mammals. Lead can interfere with the synthesis of heme, thereby altering the urinary or blood concentration of enzymes and intermediates in heme synthesis or their derivatives. Thus, lead poisoning can lead to accumulation of non-heme iron and protoporphyrin-IX in red cell, an increase in delta-aminolevulinic acid (ALA) in blood and urine, an increase in urinary coproporphyrin, proporphyrin, and porphobilinogen, inhibition of blood ALA-dehydratase (ALA-D), and an increased proportion of immature red cell in the blood (reticulocytes and basophilic stippled cells) (USEPA, 2005).

Selection of Appropriate Evaluation Method:

It was determined during the problem formulation that further evaluation is necessary. As a result, the following methods are options for conducting the site-specific TEE:

- Table Values
- Soil Bioassays
- Wildlife exposure model
- Biomarkers
- Site – specific field studies
- Weight of evidence
- Literature surveys

It has been determined that the Table Values from WAC 173-340 (Table 749-3), should be used to evaluate risk associated with Pb exposure at this site.

Table Values:

At the discretion of the person conducting the evaluation, the screening values in Table 5.1 (MTCA Table 749-3) may be used as the cleanup level when terrestrial ecological risk drives the cleanup level.

Ecological Indicator Soil Concentration for Protection of Terrestrial Plants and Animals for lead are:

Contaminant	Plants (ppm)	Soil Biota (ppm)	Wildlife (ppm)
Lead	50	500	118

Confirmation samples appear to indicate the potential for unacceptable exposure to Pb plants, soil biota, and wildlife at surface locations (Table 1) (EERG, 2009):

Table 1: Sampling results of Lighthouse and surrounding area

Sample ID	Sample Date	Sample Locations	XRF Lead (ppm)	Laboratory Confirmation Sample Results (ppm)
BI-BH-001	1/28/2009	10 ft from Boathouse	135	
BI-BH-002	1/28/2009	10 ft from Boathouse	<LOD	
BI-BH-003	1/28/2009	10 ft from Boathouse	105	
BI-BH-004	1/28/2009	10 ft from Boathouse	94	
BI-BH-005	1/28/2009	10 ft from Boathouse	40	
BI-BH-006	1/28/2009	10 ft from Boathouse	60	
BI-BH-007	1/28/2009	10 ft from Boathouse	64	
BI-BH-008	1/28/2009	10 ft from Boathouse	262	59
BI-BH-009	1/28/2009	10 ft from Boathouse	50	
BI-BH-010	1/28/2009	10 ft from Boathouse	59	
BI-BH-011	1/28/2009	10 ft from Boathouse	168	
BI-BH-012	1/28/2009	10 ft from Boathouse	169	
BI-BH-013	1/28/2009	10 ft from Boathouse	222	
BI-BH-014	1/28/2009	10 ft from Boathouse	330	340
BI-D-001	1/28/2009	10 ft from Duplex	1320	
BI-D-001A	1/28/2009	15 ft from Duplex	351	
BI-D-002	1/28/2009	10 ft from Duplex	453	
BI-D-003	1/28/2009	10 ft from Duplex	670	
BI-D-004	1/28/2009	10 ft from Duplex	863	770
BI-D-004A	1/28/2009	15 ft from Duplex	234	
BI-D-005	1/28/2009	10 ft from Duplex	32	
BI-D-006	1/28/2009	10 ft from Duplex	578	
BI-D-007	1/28/2009	10 ft from Duplex	384	
BI-D-008	1/28/2009	10 ft from Duplex	<LOD	
BI-D-009	1/28/2009	10 ft from Duplex	104	
BI-D-010	1/28/2009	10 ft from Duplex	473	260
BI-D-011	1/28/2009	10 ft from Duplex	169	
BI-D-012	1/28/2009	10 ft from Duplex	256	
BI-D-013	1/28/2009	10 ft from Duplex	290	
BI-D-014	1/28/2009	10 ft from Duplex	577	
BI-D-015	1/28/2009	10 ft from Duplex	595	
BI-D-016	1/28/2009	10 ft from Duplex	185	
BI-D-017	1/28/2009	10 ft from Duplex	250	
BI-D-018	1/28/2009	10 ft from Duplex	253	
BI-D-019	1/28/2009	10 ft from Duplex	109	
BI-D-020	1/28/2009	10 ft from Duplex	262	210
BI-D-021	1/28/2009	10 ft from Duplex	135	
BI-D-022	1/28/2009	10 ft from Duplex	97	
BI-D-023	1/28/2009	10 ft from Duplex	54	
BI-D-024	1/28/2009	10 ft from Duplex	210	
BI-D-025	1/28/2009	10 ft from Duplex	213	
BI-D-026	1/28/2009	10 ft from Duplex	221	
BI-D-027	1/28/2009	10 ft from Duplex	572	
BI-D028	1/28/2009	10 ft from Duplex	357	
BI-D-029	1/28/2009	10 ft from Duplex	600	
BI-D-030	1/28/2009	10 ft from Duplex	744	
BI-D-030A	1/28/2009	15 ft from Duplex	404	
BI-D-031	1/28/2009	10 ft from Duplex	475	
BI-D-032	1/28/2009	10 ft from Duplex	1545	2300
BI-D-032A	1/28/2009	15 ft from Duplex	434	
BI-LH-001	1/28/2009	10 ft from Lighthouse	473	
BI-LH-002	1/28/2009	10 ft from Lighthouse	559	
BI-LH-003	1/28/2009	10 ft from Lighthouse	429	
BI-LH-004	1/28/2009	10 ft from Lighthouse	402	
BI-LH-005	1/28/2009	10 ft from Lighthouse	388	
BI-LH-006	1/28/2009	10 ft from Lighthouse	1139	

BI-LH-006A	1/28/2009	15 ft from Lighthouse	566	
BI-LH-007	1/28/2009	10 ft from Lighthouse	992	860
BI-LH-007A	1/28/2009	15 ft from Lighthouse	512	
BI-LH-008	1/28/2009	10 ft from Lighthouse	306	
BI-LH-009	1/28/2009	10 ft from Lighthouse	592	
BI-LH-010	1/28/2009	10 ft from Lighthouse	1107	
BI-LH-010A	1/28/2009	15 ft from Lighthouse	356	
BI-LH-011	1/28/2009	10 ft from Lighthouse	342	
BI-LH-012	1/28/2009	10 ft from Lighthouse	2334	2600
BI-LH-012A	1/28/2009	15 ft from Lighthouse	184	
BI-LH-013	1/28/2009	10 ft from Lighthouse	1071	
BI-LH-013A	1/28/2009	15 ft from Lighthouse	953	
BI-LH-013B	1/28/2009	15 ft from Lighthouse	270	
BI-LH-013C	1/28/2009	20 ft from Lighthouse	295	
BI-LH-014	1/28/2009	10 ft from Lighthouse	288	
BI-LH-015	1/28/2009	10 ft from Lighthouse	1472	1700
BI-LH-015A	1/28/2009	15 ft from Lighthouse	187	
BI-D-032.1	1/29/2009	10 ft from Duplex	554	
BI-LH-012.1	1/29/2009	10 ft from Lighthouse	395	
BI-LH-015.2 (1.5ft bgs)	1/29/2009	15 ft from Lighthouse	128	

Selection of Cleanup Actions:

The remaining cleanup action selected for this site (including the previous soil removal) is to treat the remaining lead in the soil. This alternative method would use processed fish bones (commercial name Apatite II) as a soil amendment to the lead contaminated soil. The Apatite II would become a source of calcium phosphate to the lead in the soil. Based on the results of another project where this method has been used, there is the anticipation that the lead would react chemically with the Apatite II and be chemically bound into the phosphate mineral called pyromorphite. This chemical reaction would transform the lead into a mineral that will not leach out of the soil. Reaction time is very rapid and the treatment should be effective immediately based on previous project results. A PBET (lead based bioaccessibility extraction test) will be performed to calculate bioavailability of the contaminant.

A contractor will be transported to the project site along with the necessary materials and equipment to perform the soil stabilization. The Apatite II material will be transported to Burrows Island by barge or helicopter, along with tilling equipment. Areas to be treated shall be based on this site investigation report and reports completed by the Coast Guard in 2008. Tilling equipment will till the lead affected soil to a depth of six inches, blending in the Apatite II at the recommended application rate. Composite samples of the treated soil will be sent to a certified lab for TCLP or SPLP testing to demonstrate the effectiveness of the treatment. When the test results have demonstrated that the soil has been rendered non-hazardous, the soil surface will be graded and seeded with native grass to provide a surface cap to the treated soil.

Site work has been discussed with the State of Washington Fish and Wildlife biologist. Based on his direction, site work would be conducted after August 1st and prior to the following spring. Routing helicopters around the north side of the island would minimize impacts to fledgling eagles. Based on these recommendations the Coast Guard work should have no adverse effect on natural resources in the area.

Compliance Monitoring Requirements:

Following the selected cleanup action, composite samples of the treated soil will be sent to a certified lab for TCLP or SPLP testing to demonstrate the effectiveness of the treatment.

Soil Bioassays and the Wildlife Exposure Model:

Effectiveness of the cleanup action should normally be demonstrated with soil bioassays for plants and soil biota and the wildlife exposure model for wildlife. Ecology Publication No. 96-324 (Early Seedling Growth Protocol for Soil Toxicity Screening) (Ecology, 1996a) and Ecology Publication No. 96-327 (Earthworm Bioassay Protocol for Soil Toxicity Screening) (Ecology, 1996b) are the recommended resources for bioassay protocol. Bioaccumulation of the contaminants should be recorded at the same time so adjustments can be made (if needed) to BAF_{worm} and K_{Plant} to be used with the wildlife exposure model. However, it appears that because of the sensitive species that use this site a Net Environmental Benefit Analysis would be more appropriate.

Net Environmental Benefit Analysis:

It is recommended that a Net Environmental Benefit Analysis is conducted at this site in conjunction with the proposed cleanup action.

It appears that this site could constitute especially valuable habitat, whereas excessive soil removal could cause more harm than net benefit. A Net Environmental Benefit Analysis (NEBA) is the procedure of weighing the advantages of active cleanup (remediation) versus the impact that cleanup might have on potentially valuable ecological receptor habitat (Ecology, 2012). Terrestrial ecological evaluation procedures should not create an incentive to cause harm through the destruction of habitat. As a result, WAC 173-340-7490 (5): "Additional measures. The department may require additional measures to evaluate potential threats to terrestrial ecological receptors notwithstanding the provisions in this and the following sections (when based upon a site – specific review), the department determines that such measures are necessary to protect the environment." (Ecology, 2007).

Prior to performing a NEBA, the proposed area needs to be defined as "especially valuable habitat." (Ecology, 2012). "Especially valuable habitat" can be designated through the use of one of the below proposed methods:

Method 1: Site can be designated "especially valuable habitat" through several verifications:

- The site is used by a threatened or endangered species protected under the Federal Endangered Species Act, or;
- The site is used by a "priority species" or "species of concern" designated under Title 77 RCW, or;

- The site <u>is used</u> by a plant species classified as "endangered," "threatened," or "sensitive" under Title 79 RCW, or;
- Wetlands and Fish and Wildlife habitat conservation areas designated as critical areas under Chapter 36.70A.170 RCW. Other critical areas that might be found on the property, such as recharge areas, frequently flooded areas, geologically hazardous areas, steep slopes, and aquatic areas, are not immediately designated as "especially valuable habitat" unless they meet one of the previous criteria. These other types of critical areas must follow the Method 2 process.

Note: For animals, "used" means that individuals of a species have been observed to live, feed or breed at the site. For plants, "used" means that a plant species grows at the site or has been found growing at the site (Ecology, 2007).

<u>Method 2</u>: Site can be designated "<u>especially valuable habitat</u>" through several verifications:

- An experienced field biologist must visit the site and document that:
    - The site <u>can be potentially used</u> by a threatened or endangered species protected under the Federal Endangered Species Act, or;
    - The site <u>can be potentially used</u> by a "priority species" or "species of concern" designated under Title 77 RCW, or;
    - The site <u>can be potentially used</u> by a plant species classified as "endangered," "threatened," or "sensitive" under Title 79 RCW
- Additionally, the field biologist must document types of flora and fauna and signs of excessive uptake of the specific contaminants. This will help establish sustainability and whether or not native species occupy the habitat.
    - Document the species of plant, soil biota, and wildlife found at the specific site
        1. Differentiate between those that are native and those that are invasive
    - Document if native plant life is well-established (i.e. primary or secondary growth)
    - Document if plant life show signs of Pb uptake including (but not limited to) signs of:
        1. Wilting
        2. Chlorosis (pale, yellow or white plant tissue)
        3. Browning
        4. Excess mortality
        5. Reduced growth, photosynthesis, mitosis, or water absorption (dehydration)
    - Document any signs of Pb uptake in soil biota including (but not limited to):
        1. Limited numbers

- Document any signs of Pb uptake in wildlife including (but not limited to):
    1. Muscular incoordination
    2. Debility
    3. Slowness
    4. Jerkiness
    5. Falling
    6. Hyperactivity
    7. Fluffed feathers
    8. Drooped eyelids
    9. Seizures

If one of the above methods has been met, the Ecology Site Manager (or designee) should then visit the site to make a final determination as to whether or not the area appears to be established, sustainable, and native habitat. In granting the request of the proposed cleanup action (application of fish bones [Apatite II] as a soil amendment to the lead contaminated soil), the Ecology Site Manager (or designee) should consider the following factors prior to making the final decision (Ecology, 2012) that the proposed cleanup action sufficiently addresses ecological risk:

- The rarity of the habitat for the geographic area in which the site is located.
- The size of the habitat.
- Whether the habitat functions as a wildlife corridor.
- Whether the habitat functions as a refuge or feeding area for migratory species.
- The structural diversity of the habitat.
- Surrounding habitat and land uses.
- Whether the habitat is manmade or natural.
- Whether the cleanup would significantly disturb the ecological functions of the habitat.
- The level of human activity in the area.
- The length of time for recovery of the habitat after cleanup.

In summary, the proposed remaining cleanup action is an in-situ treatment involving the application of Apatite II to the remaining contaminated soil on site. Post application of the Apatite II, composite samples of the treated soil will be sent to a certified lab for TCLP or SPLP testing to demonstrate the effectiveness of the treatment (limiting the bioavailability of the lead). In addition, under WAC 173-340-7490(5) – Additional Measures, Ecology is requiring that a Net Environmental Benefit Analysis is performed to show that further removal of that contaminated soil could create an incentive to cause harm through the destruction of habitat (designated as "especially valuable" through either Method 1 or Method 2 as described above). A follow-up report documenting the findings of the NEBA is required prior to making a final determination.

Results of the Net Environmental Benefit Analysis:

Method 1 was chosen to designate the site as "especially valuable habitat" because the site is used by a "priority species" designated under Title 77 RCW. Those species include:

- Bald Eagle (*H. leucocephalus*)
- Pinto Abalone (*H. kamtschatkana*)
- Red Sea Urchin (*S. franciscanus*)
- Peregrine Falcon (*F. peregrinus*)

Because the site met the requirements of Method 1, the final determination regarding the proposed remaining cleanup action (treatment of contamination in place by tilling Apatite II to a depth of 6 ") was based on a site visit by a designee from the Ecology Site Manager. Those points that were factors in the final decision were:

- The rarity of the habitat for the geographic area in which the site is located.
- The size of the habitat.
- Whether the habitat functions as a wildlife corridor.
- Whether the habitat functions as a refuge or feeding area for migratory species.
- The structural diversity of the habitat.
- Surrounding habitat and land uses.
- Whether the habitat is manmade or natural.
- Whether the cleanup would significantly disturb the ecological functions of the habitat.
- The level of human activity in the area.
- The length of time for recovery of the habitat after cleanup.

Methods:

The site was evaluated (site visit) on 08/28/2013. Method used to evaluate contamination was soil sampling 4" bgs at seven [7] locations (see Figure 5 through 13) with a Thermo Niton XL3t 700 XRF gun and identification of both native and non-native plant species with field guides; *Wild Plants of the San Juan Islands* (Atkinson and Sharpe, 1993), *Northwest Weeds* (Taylor, 1990), *Trees of Washington* (Mosher and Lunnum, 2003), and *Burke Image Collection* (WTU Image Collection, 2013).

Soil Sampling:

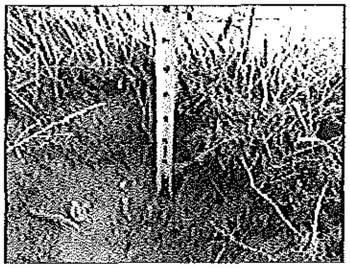


Figure 5: Soil Sampling at 4" bgs

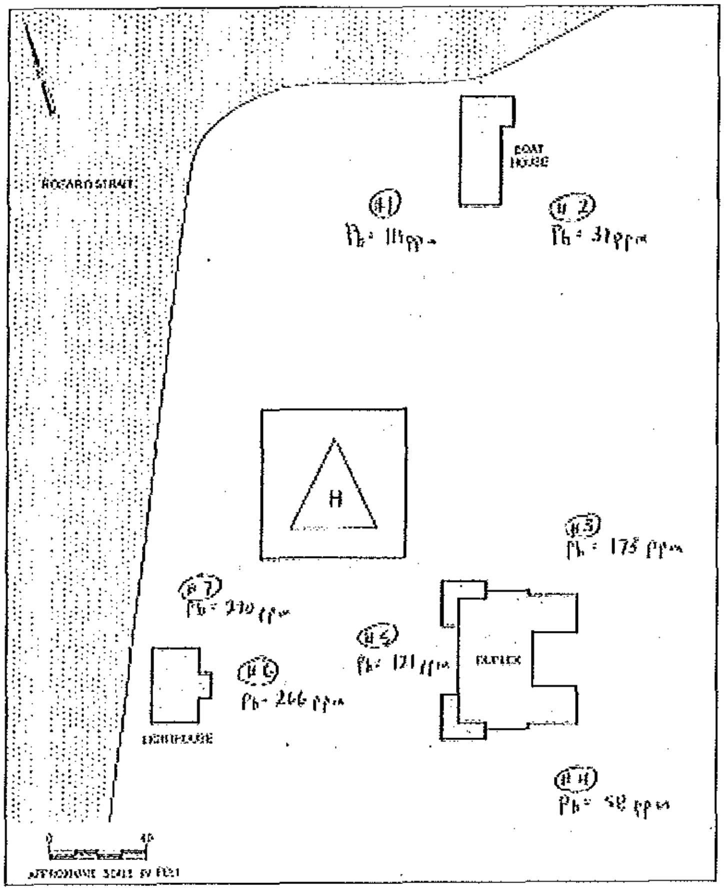


Figure 6: Locations of samples and Pb contaminant levels.

The seven locations chosen to test soil samples for lead were:

- SW and SE corner of Boat house app. 20' from the structure

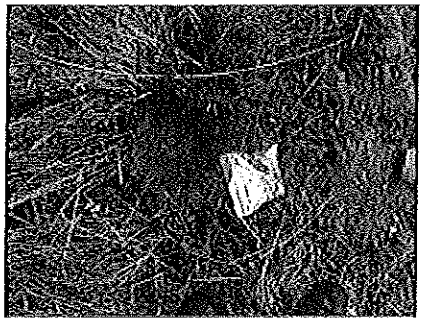


Figure 7: Pb = 111 ppm

Figure 8: Pb = 31 ppm

- NE and SE end corner of Duplex app. 20' from the structure

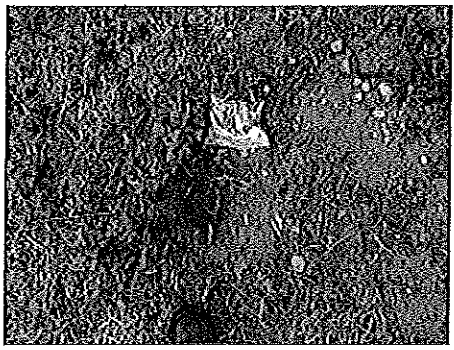


Figure 9: Pb = 173 ppm

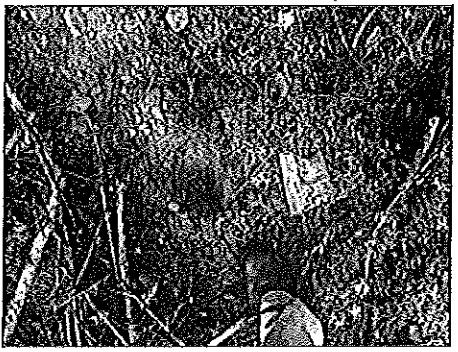


Figure 10: Pb = 58 ppm

- W end of Duplex app. 20’ from the structure

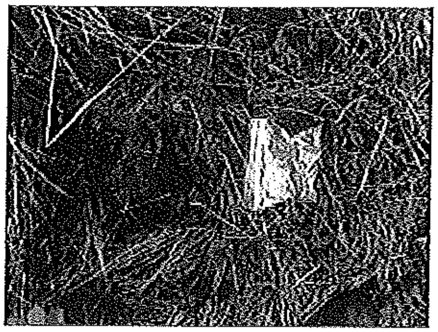


Figure 11: Pb = 124 ppm

- E end of Lighthouse app. 10’ from structure

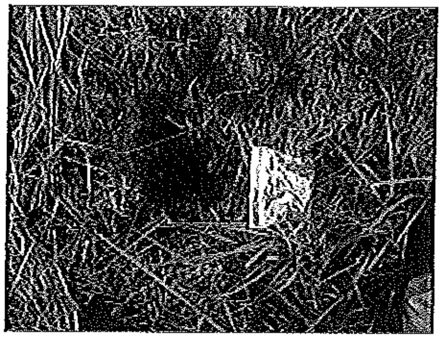


Figure 12: Pb = 266 ppm

- NE end of Lighthouse app. 10’ from structure

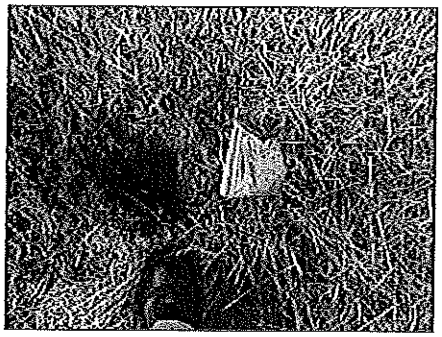


Figure 13: Pb = 270 ppm

Identification of both native and non-native plant species:

Native species identified to use the site were:

- Yarrow (*Achillea millefolium*)
- Sword fern (*Polystichum munitum*)
- Douglas fir (*Pseudotsuga menziesii*)
- Trailing Blackberry (*Rubus ursinus*)
- Oceanspray (*Holodiscus discolor*)
- Low Oregon grape (*Berberis nervosa*)
- Nootka rose (*Rosa nutkana*)
- Red Alder (*Alnus rubra*)
- Pacific Madrone (*Arbutus menziesii*)
- Rocky Mountain Juniper (*Juniperus scopulorum*)

Non-native species identified to use the site were:

- Canada Thistle (*Cirsium arvense*)
- Gumweed (*Grindelia spp.*)
- Himalayan Blackberry (*Rubus procerus*)
- Quackgrass (*Agropyron repens*)
- Cheatgrass (*Bromus tectorum*)
- Evening Primrose (*Oenothera biennis*)
- Common Dandelion (*Taraxacum officinale*)

Ecology Representative Evaluation:

- The rarity of the habitat for the geographic area in which the site is located:
    - This is an island with many native species found. In Washington State, this appears to be relatively rare habitat.
- The size of the habitat:
    - The contamination covers approximately 240' x 320'.
- Whether the habitat functions as a wildlife corridor.
    - Wildlife are known to use this area including invertebrates, vertebrates, mammals, and birds.
- Whether the habitat functions as a refuge or feeding area for migratory species.
    - It is not know if this habitat functions as a refuge or feeding area for migratory species.
- The structural diversity of the habitat.

    - The structural diversity of the habitat is illustrated in the number of native plant species found.
- Surrounding habitat and land uses.
    - Surrounding habitat is a dense coniferous and deciduous forest.
- Whether the habitat is manmade or natural.
    - Much of the habitat is man-made. It is recommended that the Apatite II is tilled into the soil in the man-made/non-native species areas.
- Whether the cleanup would significantly disturb the ecological functions of the habitat.
    - It is recommended that the continued removal of soil would significantly disturb the ecological functions of the habitat. Tillage of Apatite II in the areas described in the Terrestrial Ecological Risk Assessment should significantly mitigate that disruption.
- The level of human activity in the area.
    - There is minimal human activity in the area. It is recommended that an Environmental Covenant be placed on this site to prevent future development.
- The length of time for recovery of the habitat after cleanup.
    - The length of time for recovery of the habitat after treatment and tillage of Apatite II to the recommended areas is minimal (< 1 yr) because the recommended areas for treatment are disturbed at present.

Final Recommendation

The final recommendation to be protective of ecological receptors at this site, will be to till (non-contaminated-i.e. make sure it is clean) Apatite II into the soil to a depth of at least 6" in all disturbed areas within 25 ft of all structures located within the complex. Areas that are, and will remain inaccessible (i.e. pavement walkways, rocky outcrops) and native vegetation will not be required to undergo this proposed treatment.

Native Vegetation includes:

- Yarrow (*Achillea millefolium*)
- Sword fern (*Polystichum munitum*)
- Douglas fir (*Pseudotsuga menziesii*)
- Trailing Blackberry (*Rubus ursinus*)
- Oceanspray (*Holodiscus discolor*)
- Low Oregon grape (*Berberis nervosa*)

- Nootka rose (*Rosa nutkana*)
- Red Alder (*Alnus rubra*)
- Pacific Madrone (*Arbutus menziesii*)
- Rocky Mountain Juniper (*Juniperus scopulor*)

Native Vegetation does not include:

- Canada Thistle (*Cirsium arvense*)
- Gumweed (*Grindelia spp.*)
- Himalayan Blackberry (*Rubus procerus*)
- Quackgrass (*Agropyron repens*)
- Cheatgrass (*Bromus tectorum*)
- Evening Primrose (*Oenothera biennis*)
- Common Dandelion (*Taraxacum officinale*)

In addition, if the helicopter pad (pad) is removed (prior to, or after treatment with Apatite II), it is recommended that any suspected contaminated soil is placed at the east end of the graded area of the pad and capped with at least 6" of soil from the site (that does not contain native species) of which the source of the soil is greater than 25 ft from any structure located on the site.

Following the selected cleanup action, composite samples of the treated soil will be sent to a certified lab for TCLP or SPLP testing to demonstrate the effectiveness of the treatment.

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Washington State Department of Ecology. (2007). *Model Toxics Control Act Statute and Regulation*. Publication No. 94-06.

Washington State Department of Ecology. (2012). Draft Technical Document, "Terrestrial Ecological Evaluations under the Model Toxics Control Act." Internal Review. No Publication No.

MEMO

SUBJECT
Lead Stabilization Treatability Testing Memo Addendum for Burrows Island Light Station

DATE
October 15, 2015

LOCATION
2999 Oak Road, Suite 300
Walnut Creek, CA 94597

FROM
Josh Gravenmier, Arcadis
Adam Griffin, Arcadis

DEPARTMENT
Environment

TO
Mr. Don Marini, U.S. Coast Guard

PROJECT NUMBER
B0003110.0000

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COPIES TO
Mr. Dave Stalters, U.S. Coast Guard

Introduction

This Lead Stabilization Treatability Testing Memo Addendum was prepared by Arcadis U.S., Inc. (Arcadis) on behalf of the United State Coast Guard (USCG) for the Burrows Island Light Station located in Skagit County near Anacortes, Washington (Site). This addendum memo summarizes the evaluation of triple superphosphate (TSP; primarily $Ca(H_2PO4)_2$) as specified in the Soil Stabilization Work Plan (Arcadis 2015) under Task Order HSCB88-15-J-PXA001. This addendum summarizes the results of the laboratory scope which occurred subsequent to the surface soil sample collection and treatability results from three additional phosphate reagents presented in the previous memo report dated July 2, 2015 (Arcadis 2015).

Treatability Testing Addendum Objective

The objective and scope of this treatability testing was to evaluate the TSP phosphate reagent at different ratios to chemically stabilize lead contamination present in the surface soils in the vicinity of Site buildings (Lighthouse, Boat House, and Duplex) and thus prevent lead from leaching to groundwater.
In order to meet this objective, ARCADIS evaluated three TSP ratios on surficial soil samples collected from the Site. Leaching behavior was evaluated using the Synthetic Precipitation Leaching Procedure (SPLP, USEPA Method 1312). Under Washington Administration Code (WAC) 173-340-747(7), the SPLP method can be used to establish soil leaching conditions that are protective of groundwater and will not cause contamination that exceeds Model Toxics Control Act (MTCA) Method A groundwater cleanup levels. WAC 173-340-747(7)(c)(i) states that the SPLP test effluent shall be equal to or less than ten (10) times the applicable ground water standard. This establishes a screening level for SPLP lead of up to 0.15 milligrams per liter (mg/L) as being protective of the Method A groundwater cleanup level for lead.

Materials and Methods

Sample Selection

As detailed in the previous memo report (Arcadis 2015), five surface soil samples were collected on March 15, 2015 and sent to the Arcadis Treatability Laboratory in Durham, NC for bench scale testing.

Four potential sampling locations were pre-selected using results presented in the *Final Site Investigation Report* (ERRG, 2009), with a fifth location identified away from the buildings to represent a background or an un-impacted location.

Sample Receipt, Homogenization, and Baseline Sampling

The soil samples from each location were homogenized by hand individually in their original containers until visually homogenous upon arrival at the Arcadis Treatability Laboratory. Analytical samples were collected from each of the homogenized soil matrices and shipped to Southeast Accutest Laboratories in Orlando, Florida (Accutest; Washington Certification C918) for baseline lead characterization, consisting of total lead by United States Environmental Protection Agency (USEPA) Method 6010C and SPLP leachable lead by USEPA Method 1312/6010C. Analytical results from the baseline characterization are presented on Table 1.

Preparation of Homogenate and Moisture Content Measurement

Soil samples BI-02 and BI-03 had the highest total lead baseline concentrations and were combined to generate the homogenate BI-02/03 used for the treatability testing. In addition, BI-01 was also selected for use in TSP testing since it contained the third highest total lead and second highest leachable lead concentrations according to the baseline analytical data shown in Table 1. Average baseline moisture content of the homogenates were measured using Method 2540B, with the results presented in the Results and Conclusions section.

Reagent Sourcing

Three phosphate-based chemical reagents were utilized in the previous memo report dated July 2, 2015 (Arcadis 2015):

- EnviroBlend, supplied by Premier Magnesia
- Apatite-II, supplied by PIMS NW, Inc.
- Trisodium phosphate (anhydrous), supplied by Innophos

This memo describes a fourth phosphate-based chemical reagent that was used as a soil amendment in the treatability testing:

- Triple Superphosphate, supplied by Hi-Yield, which contained 45% available phosphate as P_2O_5 (specification sheet and safety data sheet provided in Attachment A)

Triple superphosphate was identified as one of the soil reagents in the Soil Stabilization Work Plan (Arcadis, 2015). TSP is an acidic chemical commonly used as a fertilizer.

Test Mix Design

Three TSP reagent mixes were prepared using three different dosing rates of 1, 2, and 3 percent as TSP, consistent with the previous testing (Arcadis 2015). The soil reagent was delivered and applied in a powder/granular form. Dosing rates were determined and applied on a soil dry weight basis.
BI-01 homogenate was used to create the 1 percent mix. The BI-02/03 homogenate was used to create the 2 and 3 percent mixes. A control for each individual homogenate was created to further determine variability in each homogenate. The BI-01 soil was used for the lowest TSP dosing rate of 1% since this was expected to be the lowest performing mix. A total of three TSP mixes were created along with two unamended controls with no reagent addition.

Test Mix Creation

On August 19, 2015, two subsamples of the BI-02/03 homogenate were separated and mixed with TSP reagent. One other subsample was created using the BI-01 homogenate. For each treatability testing homogenate, a sample was separated out and left un-amended for the control samples consistent with the previous test mix creation (Arcadis 2015). For each mix, 1,000 grams (g) of the homogenate soil sample was weighed into a 1-gallon plastic bucket with a water tight lid. The appropriate soil reagent mass was then measured using a three-place balance and poured onto the surface of the soil sample. The chemical reagent was thoroughly mixed into the soil for approximately 2 minutes by shaking and turning the soil by hand until visibly homogenized.

TSP was mixed with the BI-01 homogenate at a concentration of 1% and with the BI-02/03 homogenate at concentrations of 2% and 3% based on a soil dry weight basis. Mass addition and mix ratios are provided on Table 2. Once each mix was fully homogenized with its respective reagent addition, the buckets were sealed with water tight plastic lids.

Amended soil mixes and the controls were stored in closed containers under ambient indoor conditions at the Arcadis Treatability Lab for the duration of the test. When analytical samples were collected, the mixes were shaken and approximately 200 g of soil were removed from each mix. Samples were jarred and shipped overnight to Accutest for leachable lead analysis by USEPA Method 1312/6010C (SPLP). The samples were analyzed by Accutest within 48 hours of receipt. All samples were analyzed using the SPLP extraction solution designed for use with samples collected in the western United States (specifically, SPLP solution pH of 5 for sites west of the Mississippi River).

Results and Conclusion

Baseline Characterization Results

Total lead concentrations in baseline samples ranged between 926 and 3,470 milligrams/kilogram (mg/kg) in the samples collected in the vicinity of the Duplex and the Lighthouse, and were consistent with previous Site investigation results (Table 2; ERRG 2009). Based on the previous horizontal delineation, locations of maximum concentrations are limited to small areas in the vicinity of the Lighthouse and Duplex (ERRG 2009). Baseline SPLP lead concentrations were equal to, or greater than the screening level of 0.15 mg/L in samples BI-01, BI-02 and BI-03. Sample BI-04, which was collected from the north side of the Lighthouse, and BI-05, which was the background sample collected northeast of the helicopter pad, had SPLP lead concentrations less than 0.15 mg/L. Baseline analytical results are presented in Table 1. Analytical reports from Accutest are provided in Attachment B.

Based on these results and available soil volume, soil samples BI-02 and BI-03 were selected and homogenized together for subsequent lead stabilization testing for the 2 and 3 percent mixes and BI-01 was selected for the 1 percent mix to evaluate the technology for treatment of the soils with the highest lead concentrations at the Site. Average gravimetric moisture content of the BI-02/03 homogenate was measured as 39.8%. Average gravimetric moisture content of the BI-01 homogenate was 34.48% as shown in Table 3.

Lead Stabilization Testing Results

SPLP lead concentrations were between 0.080 and 0.12 mg/L for the three TSP mixes. The un-amended control samples were analyzed for SPLP lead initially after setup in Week 0 for this round of treatability testing. The BI-02/03 control Week 0 sample showed a low result of 0.058 mg/L, while the BI-01 control was 0.20 mg/L leachable lead. Due to suspicions that the Week 0 BI-02/03 control result was an outlier, an extra sample was analyzed again at Week 3. Leachable lead concentrations for the BI-02/03 control for Week 3 and 4 were 0.16 and 0.14 mg/L, respectively. The week 4 BI-01 Control results were 0.18 mg/L which are similar to the Week 0 result of 0.20 mg/L.

Each of the Week 4 results for each TSP mix showed a higher concentration of leachable lead than any of the previous week’s data and each control, shown in Table 4. Table 4 also shows the previous treatability testing results (Arcadis 2015) for the other three phosphate-based chemical reagents (EnviroBlend, Apatite-II, and Trisodium phosphate) for comparison.

Conclusions Following Triple Superphosphate Evaluation

The site-specific TEE conducted by the Washington State Department of Ecology recommended that lead impacts be chemically stabilized by tilling Apatite-II into the top 6 inches of soils within 25 feet of the Boat House, Duplex and Lighthouse. In addition to the previous treatability testing (Arcadis 2015), TSP soil reagent was blended into soil samples collected from the Site at different dosing rates to evaluate performance of the treatment proposed in the TEE. Despite the fact that the TSP data set contained some data values that were below the site specific clean-up criteria of 0.15 mg/L in SPLP leachate, the SPLP concentrations increased over time.

A chemically functional phosphate stabilization for lead is expected to virtually eliminate lead leaching from soils. Instead, the TSP evaluated during this addendum study failed to generate lead SPLP data with a clear downward trend in any of the amended samples and there was no inverse correlation between increased TSP dosage and decreases in lead leachability. These data suggest that the variable lead leaching values are more likely a function of variability in lead concentration in the soil grab samples submitted for analysis. Therefore, Arcadis concludes that the TSP reagent did not effectively chemically stabilize the available lead in soil or reduce lead leaching.

Recommendations

Based on the results of the combined treatability testing from the previous testing (Arcadis 2015) and the results described in this addendum, in-situ soil stabilization using phosphate soil amendments will not meet the treatment goals outlined in the TEE and Work Plan under current Site conditions with the reagents tested. The following approach remains the same moving forward:

- Treat the lead paint remaining on the buildings through encapsulation or removal
- Engage Ecology to address the NEBA based on the results of the treatability testing
- Conduct a limited soil excavation coupled with horizontal impact delineation of impacted soils in the vicinity of the Duplex and Lighthouse structures.

Therefore, Arcadis does not recommend implementation of in-situ stabilization and suggests that the USCG reconsider other approaches for closure of the Site in order to obtain the most cost effective solution for remediation of the soil impacted with lead.

Tables

Table 1 Baseline Soil Sample Total and SPLP Lead Concentrations

Table 2 Mix Ratios and Reagent Mass Addition Rates

Table 3 Baseline Soil Moisture Content

Table 4 Treatability Testing Analytical Results

Attachments

A TSP Product Specifications and Safety Data Sheets

B Accutest Analytical Reports

References

ARCADIS. 2015. *DRAFT Soil Stabilization Work Plan, Burrows Island Light Station, Skagit County, Washington.* February 2015.

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Washington State Department of Ecology. 2013. *Terrestrial Ecological Evaluation of Burrows Island Light Station, Skagit County, WA.* September, 2013.

Tables

Table 1
Baseline Soil Sample Total and SPLP Lead Concentrations
Lead Stabiliation Treatability Testing Memo Addendum
Burrows Island Light Station

Sample	Location	Total Lead[b] (mg/kg)	SPLP Lead[c] (mg/L)
BI-01	S Side of Duplex	1,510	0.21
BI-02[a]	S Side of Duplex	3,470	0.47
BI-03[a]	NE Side of Lighthouse	2,670	0.15
BI-04	N Side of Lighthouse	926	0.096
BI-05	ENE of Helipad	63.6	0.021
Control BI-02/BI-03	--	2,600	0.058
Control BI-01	--	1,990	0.20

Notes:

[a] Samples combined to form homogenate for amendment testing

[b] Total lead by USEPA Method 6010C

[c] SPLP lead by USEPA Method 1312/6010C

Table 2
Mix Ratios and Reagent Mass Addition Rates
Lead Stabiliation Treatability Testing Memo Addendum
Burrows Island Light Station

Sample	Amendment	Mass Added[1] (g)	Dosing Rate[2]
Mix 1	Enviroblend CR20	24.1	4%
Mix 2	Enviroblend CR20	18.1	3%
Mix 3	Enviroblend CR20	12.1	2%
Mix 4	Apatite-II	18.1	3%
Mix 5	Apatite-II	12.1	2%
Mix 6	Apatite-II	6.0	1%
Mix 7	Trisodium Phosphate	18.1	3%
Mix 8	Trisodium Phosphate	12.1	2%
Mix 9	Trisodium Phosphate	6.0	1%
Mix 10	Triple Superphosphate	18.1	3%
Mix 11	Triple Superphosphate	12.1	2%
Mix 12	Triple Superphosphate	6.6	1%

Notes:

[1] Total mass of soil samples was 1000 g, with dry mass of 602.5 g for all samples

[2] Dosing rate based on dry mass of soil

Table 3
Baseline Soil Moisture Content
Lead Stabiliation Treatability Testing Memo Addendum
Burrows Island Light Station

Sample	Sample Media	Moisture Content[a]
Mix 1	BI-02/BI-03 Homogenate	39.75%
Mix 2	BI-02/BI-03 Homogenate	39.75%
Mix 3	BI-02/BI-03 Homogenate	39.75%
Mix 4	BI-02/BI-03 Homogenate	39.75%
Mix 5	BI-02/BI-03 Homogenate	39.75%
Mix 6	BI-02/BI-03 Homogenate	39.75%
Mix 7	BI-02/BI-03 Homogenate	39.75%
Mix 8	BI-02/BI-03 Homogenate	39.75%
Mix 9	BI-02/BI-03 Homogenate	39.75%
Mix 10	BI-02/BI-03 Homogenate	39.80%
Mix 11	BI-02/BI-03 Homogenate	39.80%
Mix 12	BI-01	34.48%

Notes:

[a] Moisture content percentage on an average gravimetric basis

Table 4
Treatability Testing Analytical Results
Lead Stabiliation Treatability Testing Memo Addendum
Burrows Island Light Station

Sample	Amendment	SPLP Lead (mg/L)[a]										
		Treatability Testing						Treatability Testing Addendum				
		Week 1	Week 2	Week 3		Week 8		Week 0	Week 1	Week 2	Week 3	Week 4
Model Toxics Control Act (MTCA) Method A Screening Level for Lead SPLP (CLs) in mg/L		**0.15**										
Mix 1	4% Enviroblend CR20	0.31	0.35	0.25	0.16[b]	0.36	0.11[c]	--	--	--	--	--
Mix 2	3% Enviroblend CR20	0.32	0.39	0.23	0.13[b]	--	0.18[c]	--	--	--	--	--
Mix 3	2% Enviroblend CR20	0.36	0.40	--	--	--	0.16[c]	--	--	--	--	--
Mix 4	3% Apatite-II	0.43	0.60	0.51	0.090[b]	--	0.19[c]	--	--	--	--	--
Mix 5	2% Apatite-II	0.42	0.59	0.48	0.074[b]	--	0.21[c]	--	--	--	--	--
Mix 6	1% Apatite-II	0.38	0.54	--	--	0.17	0.15[c]	--	--	--	--	--
Mix 7	3% Trisodium Phosphate	3.0	3.7	--	--	--	--	--	--	--	--	--
Mix 8	2% Trisodium Phosphate	2.9	3.4	--	--	--	--	--	--	--	--	--
Mix 9	1% Trisodium Phosphate	1.8	1.9	--	--	--	--	--	--	--	--	--
Mix 10	3% Triple Superphosphate	--	--	--	--	--	--	--	0.08	0.11	0.072	0.16
Mix 11	2% Triple Superphosphate	--	--	--	--	--	--	--	0.12	0.15	0.13	0.17
Mix 12[d]	1% Triple Superphosphate	--	--	--	--	--	--	--	0.096	0.11	0.11	0.2
Control (BI-02/BI-03)	None	0.24	--	0.22	0.026[b]	0.18	--	0.058	--	--	0.16	0.14
Control (BI-01)	None	--	--	--	--	--	--	0.2	--	--	--	0.18

Notes:

[a] SPLP Lead by USEPA Method 1312/6010C

[b] SPLP leachate was filtered through a 0.2µm membrane filter

[c] Soil sample pH was adjusted using H_3PO_4 as shown in Table 4

[d] BI-01 sample used with Mix 12, BI-02/BI-03 sample used with all other mixes

-- Mix not tested during this phase of treatability testing

Attachment A

TSP Product
Specifications and
Safety Data Sheets

MATERIAL SAFETY DATA SHEET

In the event or a medical or chemical emergency contact ChemTel, Inc. North American 1-800-255-3924 or worldwide Intl. + 01-813-248-0585

Voluntary Purchasing Groups, Inc.
230 FM 87
Bonham, Texas 75418

Effective Date: May 23, 2012

Hi-Yield® Triple Superphosphate

1. PRODUCT AND COMPANY IDENTIFICATION:

PRODUCT: Hi-Yield® Triple Superphosphate
FORMULA: Mixture

COMPANY IDENTIFICATION:
Voluntary Purchasing Groups, Inc.
230 FM 87
Bonham, TX. 75418

2. COMPOSITION/INFORMATION ON INGREDIENTS:

CHEMICAL COMPONENT	% (TYPICAL)
Available phosphate (P2O5)	45%

3. PHYSICAL DATA:

BOILING POINT (°F) Does not apply	SPECIFIC GRAVITY (H_2O=1) 0.5	VAPOR PRESSURE (mm Hg) Does not apply
PERCENT VOLATILE BY VOLUME (%) <1%	VAPOR DENSITY (AIR=1) Does not apply	EVAPORATION RATE (ethyl ether=1) Does not apply
SOLUBILITY IN WATER Appreciable	REACTIVITY IN WATER Will not evolve flammable or toxic gases	
APPEARANCE AND ODOR Solid; light odor		

4. FIRE AND EXPLOSION DATA:

FLASH POINT (°F) Does not apply	FLAMMABLE LIMITS IN AIR (% by volume) Lower: Not determined Upper: Not determined
EXTINGUISHING MEDIA Water, foam, dry chemical or carbon dioxide	AUTO IGNITION TEMPERATURE Not determined
UNUSUAL FIRE AND EXPLOSION HAZARDS Thermal decomposition will evolve ammonia. May form an explosive mixture when dispersed in air. An explosion hazard will exist if mixed with oxidizers such as potassium chlorate, potassium nitrate, or potassium nitrite..	
SPECIAL FIRE FIGHTING PROCEDURES Wear pressure-demand, self-contained breathing apparatus, MSHA/NIOSH approved or equivalent, and full protective gear. Avoid inhalations of fumes and dusts.	

5. HEALTH INFORMATION:

PRIMARY ROUTES OF EXPOSURE AND TARGET ORGANS Skin and eye contact, inhalation, ingestion.
SIGNS AND SYMPTOMS OF EXPOSURE
(1) ACUTE OVEREXPOSURE Ingestion of large quantities may cause symptoms of non-specific irritation of the gastrointestinal tract; nausea, vomiting, cramps, and diarrhea. Eye and skin contact may result in local irritation. Inhalation of high concentrations may result in upper respiratory tract irritation.

(2) CHRONIC OVEREXPOSURE
Inhalation of dust may permanently damage the lungs and result in the development of pneumoconiosis, silicosis, or other respiratory disorders.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
Disorders of respiratory system, dermatitis, or other skin disorders.

CHEMICAL/COMPONENT LISTED AS CARCINOGEN OR POTENTIAL CARCINOGEN
None

NTP ☐ YES ☒ NO	IARC ☐ YES ☒ NO	OSHA ☐ YES ☒ NO

OTHER EXPOSURE LIMITS
PEL (amorphous silica): 80 milligrams per cubic meter/%SiO2-OSHA; TLV (nuisance dust):10 mg/m3-ACGIH.

EMERGENCY AND FIRST AID PROCEDURES
INGESTION: Induce vomiting immediately by giving two glasses of water and sticking finger down throat. Never give anything by mouth to an unconscious person. Call a physician. EYE CONTACT: Immediately flush eyes with water for at least 15 minutes, holding eyelids apart to ensure flushing of the entire surface of the eye and lids with water. Obtain medical attention if irritation persists. Oils or ointments should not be used unless directed by a physician. SKIN CONTACT: Immediately wash skin with soap and water. Wash clothing before reuse. INHALATION: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

6. REACTIVITY DATA:

STABILITY ☐ Unstable ☒ Stable	CONDITIONS TO AVOID Decomposes upon heating.

INCOMPATIBILITY (Materials to Avoid)
Strong oxidizers and alkalis, potassium chlorate, potassium nitrate, and potassium nitrite.

HAZARDOUS DECOMPOSITION PRODUCTS
Ammonia, sulfur trioxide, phosphorous oxides, cyanuric acid, cyanic acid and carbon dioxide.

HAZARDOUS POLYMERIZATION ☒May Occur ☐ Will Not occur	CONDITIONS TO AVOID Avoid heating or direct exposure to sunlight.

7. SPILL OR LEAK PROCEDURES:

STEPS TO BE TAKEN IN CASE MATERIAL IS LEAKED OR SPILLED
Clean up of spills may require personal protective equipment. Sweep-up or vacuum the material to the original container, or to a sealed, labeled container. Keep spill out of sewers and open bodies of water.

WASTE DISPOSAL METHOD
Components of this product are toxic to aquatic life. Dispose of in accordance with Federal, State, and local regulations.

8. PERSONAL PROTECTION INFORMATION:

RESPIRATORY PROTECTION
NIOSH/MSHA approved for protective against toxic dusts containing quartz. If ammonia vapors are encountered, NIOSH/MSHA approved respirators for protection against ammonia vapors.

VENTILATION
Local or general exhaust to maintain exposure below TLV/PEL.

PROTECTIVE GLOVES
PVC or Neoprene

EYE PROTECTION
Safety goggles (ANSI Z87.1 1979)

OTHER PROTECTIVE CLOTHING OR EQUIPMENT
Apron, boots, long sleeve shirt and full-length pants (or overalls) may be worn when necessary to prevent skin contact. Eye wash and shower facilities should be available.

9. PHYSICAL AND CHEMICAL PROPERTIES:

PRECAUTIONS TO BE TAKEN IN HANDLING & STORING
Corrosive to cast iron and aluminum. Store in dry, cool, ventilated area, out of direct sunlight. Separate from strong oxidizers.

OTHER PRECAUTIONS
Not determined.

10. TRANSPORT INFORMATION:

Not regulated by DOT or IMDG.

11. OTHER INFORMATION:

The information contained within was obtained from authoritative sources and is believed to be accurate for the manner in which the product is intended to be used. Other uses could result in ramifications, which are not included within this document.

Univar USA Inc Safety Data Sheet

SDS No:

Version No: 004 2015-06-08

Order No:

3075 Highland Pkwy, Ste 200, Downers Grove, IL 60515
(425) 889 3400

Emergency Assistance

For emergency assistance involving chemicals call
Chemtrec - (800) 424-9300

Triple Superphosphate 0-45-0

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product form : Mixture
Product name : Triple Superphosphate 0-45-0
Product code : M12030

1.2. Relevant identified uses of the substance or mixture and uses advised against

1.3. Details of the supplier of the safety data sheet

JR Simplot Company
Boise, ID 83707
T 1-208-336-2110

1.4. Emergency telephone number

Emergency number : CHEMTREC 1-800-424-9300

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

GHS-US classification

Skin Irrit. 2 H315
Eye Irrit. 2B H320
STOT SE 3 H335

Full text of H-phrases: see section 16

2.2. Label elements

GHS-US labelling

Hazard pictograms (GHS-US) :

GHS07

Signal word (GHS-US) : Warning

Hazard statements (GHS-US) : H315 - Causes skin irritation
H320 - Causes eye irritation
H335 - May cause respiratory irritation

Precautionary statements (GHS-US) : P261 - Avoid breathing dust/fume/gas/mist/vapours/spray
P264 - Wash ... thoroughly after handling
P271 - Use only outdoors or in a well-ventilated area
P280 - Wear protective gloves/protective clothing/eye protection/face protection
P302+P352 - If on skin: Wash with plenty of water/…
P304+P340 - If inhaled: Remove person to fresh air and keep comfortable for breathing
P305+P351+P338 - If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P312 - Call a poison center/doctor/… if you feel unwell
P321 - Specific treatment (see ... on this label)
P332+P313 - If skin irritation occurs: Get medical advice/attention
P337+P313 - If eye irritation persists: Get medical advice/attention
P362 - Take off contaminated clothing and wash before reuse
P403+P233 - Store in a well-ventilated place. Keep container tightly closed
P405 - Store locked up
P501 - Dispose of contents/container to ...

2.3. Other hazards

No additional information available

2.4. Unknown acute toxicity (GHS-US)

No data available

SECTION 3: Composition/information on ingredients

3.1. Substance

Not applicable

3.2. Mixture

Name	Product identifier	%	GHS-US classification
Calcium Phosphate	(CAS No) 7758-23-8		Skin Irrit. 2, H315 Eye Irrit. 2B, H320 STOT SE 3, H335
Dicalcium Phosphate	(CAS No) 7757-93-9		Eye Irrit. 2B, H320

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general : Never give anything by mouth to an unconscious person. If you feel unwell, seek medical advice (show the label where possible).

First-aid measures after inhalation : Remove to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER/doctor/physician if you feel unwell.

First-aid measures after skin contact : Wash with plenty of soap and water. Wash contaminated clothing before reuse. If skin irritation occurs: Get medical advice/attention. Specific treatment (see ... on this label).

First-aid measures after eye contact : IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

First-aid measures after ingestion : Rinse mouth. Do NOT induce vomiting. Obtain emergency medical attention.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/injuries after inhalation : May cause respiratory irritation.

Symptoms/injuries after skin contact : Causes skin irritation.

Symptoms/injuries after eye contact : Causes eye irritation.

4.3. Indication of any immediate medical attention and special treatment needed

No additional information available

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Foam. Dry powder. Carbon dioxide. Water spray. Sand.

Unsuitable extinguishing media : Do not use a heavy water stream.

5.2. Special hazards arising from the substance or mixture

Reactivity : Stable.

5.3. Advice for firefighters

Firefighting instructions : Use water spray or fog for cooling exposed containers. Exercise caution when fighting any chemical fire. Prevent fire-fighting water from entering environment.

Protection during firefighting : Do not enter fire area without proper protective equipment, including respiratory protection.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

Emergency procedures : Evacuate unnecessary personnel.

6.1.2. For emergency responders

Protective equipment : Equip cleanup crew with proper protection.

Emergency procedures : Ventilate area.

6.2. Environmental precautions

Prevent entry to sewers and public waters. Notify authorities if liquid enters sewers or public waters.

6.3. Methods and material for containment and cleaning up

Methods for cleaning up : On land, sweep or shovel into suitable containers. Minimize generation of dust. Store away from other materials.

6.4. Reference to other sections

See Heading 8. Exposure controls and personal protection.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling	:	Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Provide good ventilation in process area to prevent formation of vapour. Avoid breathing dust/fume/gas/mist/vapours/spray. Use only outdoors or in a well-ventilated area.
Hygiene measures	:	Wash ... thoroughly after handling.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions	:	Keep only in the original container in a cool, well ventilated place away from : Keep container tightly closed.
Incompatible products	:	Strong bases. Strong acids.
Incompatible materials	:	Sources of ignition. Direct sunlight.

7.3. Specific end use(s)

No additional information available

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

No additional information available

8.2. Exposure controls

Personal protective equipment	:	Avoid all unnecessary exposure.
Hand protection	:	Wear protective gloves.
Eye protection	:	Chemical goggles or safety glasses.
Skin and body protection	:	Wear suitable protective clothing.
Respiratory protection	:	Wear appropriate mask.
Other information	:	Do not eat, drink or smoke during use.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	:	Solid
Appearance	:	Granules.
Colour	:	Off-white
Odour	:	characteristic
Odour threshold	:	No data available
pH	:	No data available
pH solution	:	1 g to 10 g H_2O: 2.3-3
Relative evaporation rate (butylacetate=1)	:	No data available
Melting point	:	No data available
Freezing point	:	No data available
Boiling point	:	No data available
Flash point	:	No data available
Auto-ignition temperature	:	No data available
Decomposition temperature	:	No data available
Flammability (solid, gas)	:	Non-flammable
Vapour pressure	:	No data available
Relative vapour density at 20 °C	:	No data available
Relative density	:	No data available
Solubility	:	Soluble. Water: Solubility in water of component(s) of the mixture : • Calcium Phosphate: 1.8 g/100ml (30 °C) • Dicalcium Phosphate: 0.010 g/100ml
Log Pow	:	No data available
Log Kow	:	No data available
Viscosity, kinematic	:	No data available
Viscosity, dynamic	:	No data available

Explosive properties : No data available
Oxidising properties : No data available
Explosive limits : No data available

9.2. Other information

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

Stable.

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

Not established.

10.4. Conditions to avoid

Direct sunlight. Extremely high or low temperatures.

10.5. Incompatible materials

Oxidizers. Strong acids. Strong bases. May be corrosive to metals.

10.6. Hazardous decomposition products

NH_3, CN, SO_x, PO_x. fume. Carbon dioxide. Carbon monoxide.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity : Not classified

Calcium Phosphate (7758-23-8)	
LD50 oral rat	17500 mg/kg (Rat; Literature)
LD50 dermal rabbit	> 2000 mg/kg (Rabbit; Literature)
ATE US (oral)	17500.00000000 mg/kg bodyweight

Dicalcium Phosphate (7757-93-9)	
LD50 oral rat	10000 mg/kg (Rat)
LD50 dermal rat	7940 mg/kg (Rat)
ATE US (oral)	10000.00000000 mg/kg bodyweight
ATE US (dermal)	7940.00000000 mg/kg bodyweight

Skin corrosion/irritation : Causes skin irritation.
Serious eye damage/irritation : Causes eye irritation.
Respiratory or skin sensitisation : Not classified
Germ cell mutagenicity : Not classified
Carcinogenicity : Not classified

Reproductive toxicity : Not classified
Specific target organ toxicity (single exposure) : May cause respiratory irritation.

Specific target organ toxicity (repeated exposure) : Not classified

Aspiration hazard : Not classified
Potential adverse human health effects and symptoms : Based on available data, the classification criteria are not met.
Symptoms/injuries after inhalation : May cause respiratory irritation.
Symptoms/injuries after skin contact : Causes skin irritation.
Symptoms/injuries after eye contact : Causes eye irritation.

SECTION 12: Ecological information

12.1. Toxicity

No additional information available

12.2. Persistence and degradability

Triple Superphosphate 0-45-0	
Persistence and degradability	Not established.

Calcium Phosphate (7758-23-8)	
Persistence and degradability	Biodegradability: not applicable. Not established.
Biochemical oxygen demand (BOD)	Not applicable
Chemical oxygen demand (COD)	Not applicable
ThOD	Not applicable
BOD (% of ThOD)	Not applicable

Dicalcium Phosphate (7757-93-9)	
Persistence and degradability	Biodegradability: not applicable. Not established.
Biochemical oxygen demand (BOD)	Not applicable
Chemical oxygen demand (COD)	Not applicable
ThOD	Not applicable
BOD (% of ThOD)	Not applicable

12.3. Bioaccumulative potential

Triple Superphosphate 0-45-0	
Bioaccumulative potential	Not established.

Calcium Phosphate (7758-23-8)	
Bioaccumulative potential	No bioaccumulation data available. Not established.

Dicalcium Phosphate (7757-93-9)	
Bioaccumulative potential	Not bioaccumulative. Not established.

12.4. Mobility in soil

No additional information available

12.5. Other adverse effects

Effect on ozone layer : No additional information available

Effect on the global warming : No known ecological damage caused by this product.

Other information : Avoid release to the environment.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste disposal recommendations : Dispose in a safe manner in accordance with local/national regulations.
Ecology - waste materials : Avoid release to the environment.

SECTION 14: Transport information

In accordance with DOT
Not regulated for transport

Additional information

Other information : No supplementary information available.

ADR

Transport document description :

Transport by sea

No additional information available

Air transport

No additional information available

Triple Superphosphate 0-45-0

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

SECTION 15: Regulatory information

15.1. US Federal regulations

All components of this product are listed, or excluded from listing, on the United States Environmental Protection Agency Toxic Substances Control Act (TSCA) inventory

This product or mixture does not contain a toxic chemical or chemicals in excess of the applicable de minimis concentration as specified in 40 CFR §372.38(a) subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

15.2. International regulations

CANADA

No additional information available

EU-Regulations

No additional information available

Classification according to Regulation (EC) No. 1272/2008 [CLP]

Classification according to Directive 67/548/EEC or 1999/45/EC

Not classified

15.2.2. National regulations

No additional information available

15.3. US State regulations

California Proposition 65 - This product does not contain any substances known to the state of California to cause cancer and/or reproductive harm

SECTION 16: Other information

:

Other information : None.

Full text of H-phrases: see section 16:

Eye Irrit. 2B	Serious eye damage/eye irritation, Category 2B
Skin Irrit. 2	Skin corrosion/irritation, Category 2
STOT SE 3	Specific target organ toxicity — Single exposure, Category 3, Respiratory tract irritation
H315	Causes skin irritation
H320	Causes eye irritation
H335	May cause respiratory irritation

SDS US (GHS HazCom 2012)

Disclaimer: This information relates to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. Such information is to the best of our knowledge and belief, accurate and reliable as of the date compiled. However, no representation, warranty or guarantee is made as to its accuracy, reliability or completeness. NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED, IS MADE CONCERNING THE INFORMATION HEREIN PROVIDED. It is the user's responsibility to satisfy himself as to the suitability and completeness of such information for his own particular use. We do not accept liability for any loss or damage that may occur from the use of this information nor do we offer warranty against patent infringement.

Univar USA Inc Safety Data Sheet

For Additional Information contact SDS Coordinator during business hours, Pacific time: (425) 889-3400

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Attachment B

Accutest Analytical Reports

e-Hardcopy 2.0
Automated Report

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08/25/15

Technical Report for

ARCADIS

Burrows Island, WA

B0003110.0000.00001

Accutest Job Number: FA26939

Sampling Date: 08/19/15

Report to:

ARCADIS Geraghty & Miller
801 Corporate Center Dr Suite 300
Raleigh, NC 27607
david.liles@arcadis-us.com; ricky.sams@arcadis-us.com

ATTN: David Liles

Total number of pages in report: **19**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Norm Farmer

Norm Farmer
Technical Director

Client Service contact: Heather Wandrey 407-425-6700

Certifications: FL (E83510), LA (03051), KS (E-10327), IA (366), IL (200063), NC (573), NJ (FL002), SC (96038001)
DoD ELAP (L-A-B L2229), CA (2937), TX (T104704404), PA (68-03573), VA (460177),
AK, AR, GA, KY, MA, NV, OK, UT, WA
This report shall not be reproduced, except in its entirety, without the written approval of Accutest Laboratories.
Test results relate only to samples analyzed.

Table of Contents

-1-

Sample Summary

ARCADIS

Job No: FA26939

Burrows Island, WA
Project No: B0003110.0000.00001

Sample Number	Collected Date	Time	By	Received	Matrix Code	Matrix Type	Client Sample ID
FA26939-1	08/19/15	12:00	RS	08/20/15	SO	Soil	CONTROL 02/03
FA26939-2	08/19/15	12:00	RS	08/20/15	SO	Soil	CONTROL 01

Soil samples reported on a dry weight basis unless otherwise indicated on result page.

Summary of Hits

Job Number: FA26939
Account: ARCADIS
Project: Burrows Island, WA
Collected: 08/19/15

Lab Sample ID Analyte	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
FA26939-1	**CONTROL 02/03**					
pH, SPLP Leachate [a]		6.94			su	SW846 1312
Lead		0.058	0.0050		mg/l	SW846 6010C
FA26939-2	**CONTROL 01**					
pH, SPLP Leachate [b]		8.11			su	SW846 1312
Lead		0.20	0.0050		mg/l	SW846 6010C

(a) Sample pH prior to leaching was 5.61.
(b) Sample pH prior to leaching was 6.05.

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Sample Results

Report of Analysis

Report of Analysis

Client Sample ID:	CONTROL 02/03		
Lab Sample ID:	FA26939-1	**Date Sampled:**	08/19/15
Matrix:	SO - Soil	**Date Received:**	08/20/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

Metals Analysis, SPLP Leachate SW846 1312

Analyte	Result	MCL	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	0.058		0.0050	mg/l	1	08/21/15	08/21/15	LM	SW846 6010C [1]	SW846 3010A [2]

(1) Instrument QC Batch: MA12598
(2) Prep QC Batch: MP29290

RL = Reporting Limit
MCL = Maximum Contamination Level (not available)

Report of Analysis

Client Sample ID:	CONTROL 02/03		
Lab Sample ID:	FA26939-1	**Date Sampled:**	08/19/15
Matrix:	SO - Soil	**Date Received:**	08/20/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
pH, SPLP Leachate [a]	6.94		su	1	08/20/15	CP	SW846 1312

(a) Sample pH prior to leaching was 5.61.

RL = Reporting Limit

Report of Analysis

Client Sample ID:	CONTROL 01		
Lab Sample ID:	FA26939-2	**Date Sampled:**	08/19/15
Matrix:	SO - Soil	**Date Received:**	08/20/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

Metals Analysis, SPLP Leachate SW846 1312

Analyte	Result	MCL	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	0.20		0.0050	mg/l	1	08/21/15	08/21/15	LM	SW846 6010C [1]	SW846 3010A [2]

(1) Instrument QC Batch: MA12598
(2) Prep QC Batch: MP29290

RL = Reporting Limit
MCL = Maximum Contamination Level (not available)

Report of Analysis

Client Sample ID:	CONTROL 01		
Lab Sample ID:	FA26939-2	**Date Sampled:**	08/19/15
Matrix:	SO - Soil	**Date Received:**	08/20/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
pH, SPLP Leachate [a]	8.11		su	1	08/20/15	CP	SW846 1312

(a) Sample pH prior to leaching was 6.05.

RL = Reporting Limit

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Misc. Forms

Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody

ARCADIS
Infrastructure · Water · Environment · Buildings

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

FA 26939

Page 1 of 1

Lab Work Order #

Send Results to:

Contact & Company Name: Dave Liles / ARCADIS
Telephone: 919-544-4535
Address:
Fax:
City State Zip
E-mail Address:
Project Name/Location (City, State): Burrows Island
Project #:
Sampler's Printed Name: Ricky Sams
Sampler's Signature: R. Sams

Preservative	E										
Filtered (✓)											
# of Containers	1										
Container Information	8										

PARAMETER ANALYSIS & METHOD

	Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix	SPLP						
1	Control 02/03	8/19/15	1208	X		SO	X						
2	Control 01	8/19/15	1200	X		SO	X						

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: ______
G. Other: ______
H. Other: ______

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: ______
10. Other: ______

Matrix Key:

SO - Soil	SE - Sediment	NL - NAPL/Oil
W - Water	SL - Sludge	SW - Sample Wipe
T - Tissue	A - Air	Other: ______

REMARKS

3 Day TAT if possible

* For Leachate please report ~~##~~ pH before and after extraction

Special Instructions/Comments: 3 Day TAT if possible

☐ Special QA/QC Instructions(✓):

Laboratory Information and Receipt

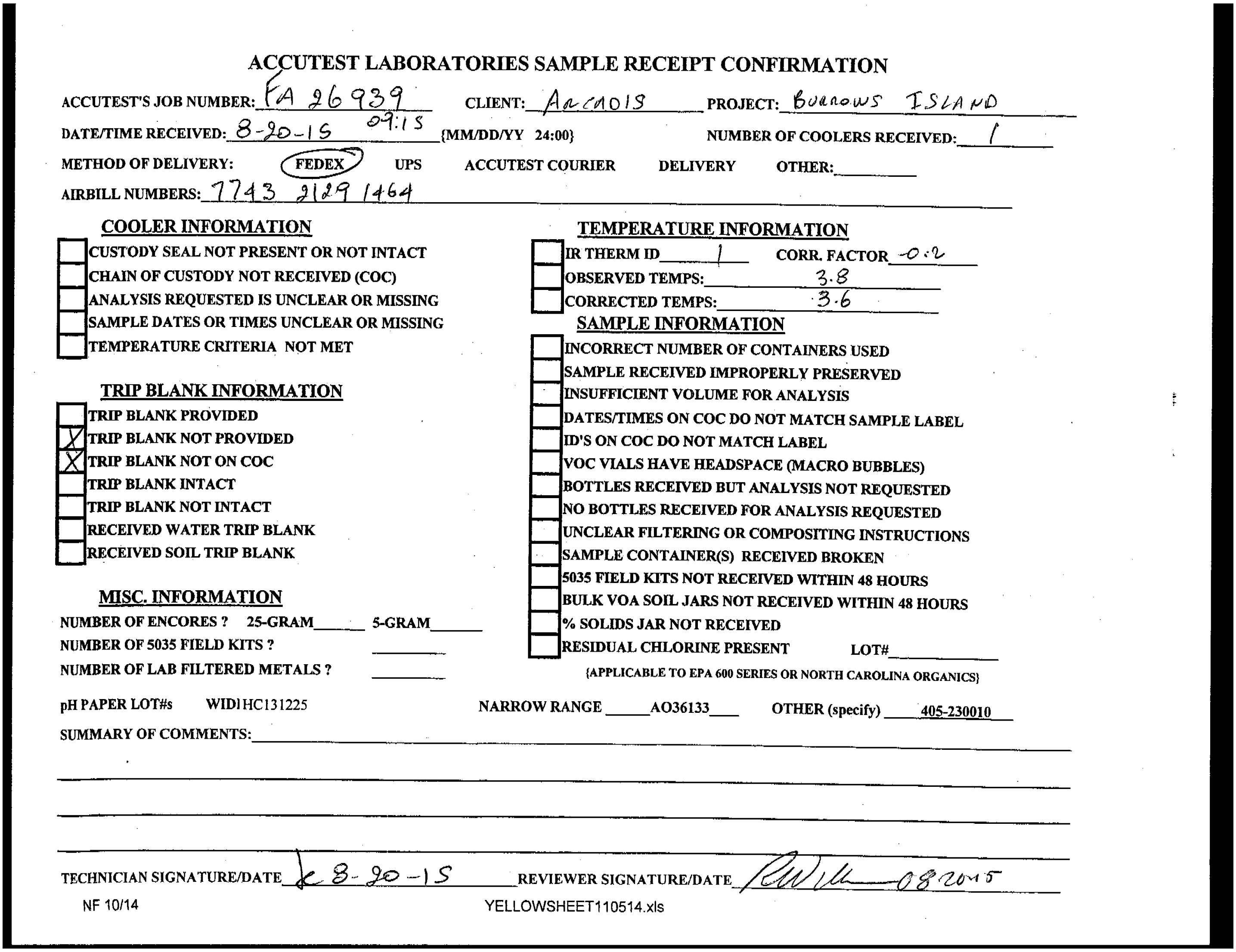
Lab Name:
☐ Cooler packed with ice (✓)
Specify Turnaround Requirements:
Shipping Tracking #:
Cooler Custody Seal (✓)
☐ Intact ☐ Not Intact
Sample Receipt:
Condition/Cooler Temp: ______

	Relinquished By	Received By	Relinquished By	Laboratory Received By
Printed Name:	Ricky Sams			
Signature:	R. Sams	FX	FX	J. Coppola (ASE)
Firm:	ARCADIS			
Firm/Courier:				
Date/Time:	8/19/15			8.20.15 09:15

20730826 CofC AR Form 01.12.2007

Distribution: WHITE – Laboratory returns with results YELLOW – Lab copy PINK – Retained by ARCADIS

3.6



ACCUTEST LABORATORIES SAMPLE RECEIPT CONFIRMATION

ACCUTEST'S JOB NUMBER: FA 26939 CLIENT: ARCADIS PROJECT: BURROWS ISLAND

DATE/TIME RECEIVED: 8-20-15 09:15 {MM/DD/YY 24:00} NUMBER OF COOLERS RECEIVED: 1

METHOD OF DELIVERY: [✓ FEDEX] UPS ACCUTEST COURIER DELIVERY OTHER:

AIRBILL NUMBERS: 7743 2129 1464

COOLER INFORMATION

☐ CUSTODY SEAL NOT PRESENT OR NOT INTACT
☐ CHAIN OF CUSTODY NOT RECEIVED (COC)
☐ ANALYSIS REQUESTED IS UNCLEAR OR MISSING
☐ SAMPLE DATES OR TIMES UNCLEAR OR MISSING
☐ TEMPERATURE CRITERIA NOT MET

TRIP BLANK INFORMATION

☐ TRIP BLANK PROVIDED
☒ TRIP BLANK NOT PROVIDED
☒ TRIP BLANK NOT ON COC
☐ TRIP BLANK INTACT
☐ TRIP BLANK NOT INTACT
☐ RECEIVED WATER TRIP BLANK
☐ RECEIVED SOIL TRIP BLANK

MISC. INFORMATION

NUMBER OF ENCORES ? 25-GRAM_____ 5-GRAM_____
NUMBER OF 5035 FIELD KITS ? _____
NUMBER OF LAB FILTERED METALS ? _____

TEMPERATURE INFORMATION

☐ IR THERM ID 1 CORR. FACTOR -0.2
☐ OBSERVED TEMPS: 3.8
☐ CORRECTED TEMPS: 3.6

SAMPLE INFORMATION

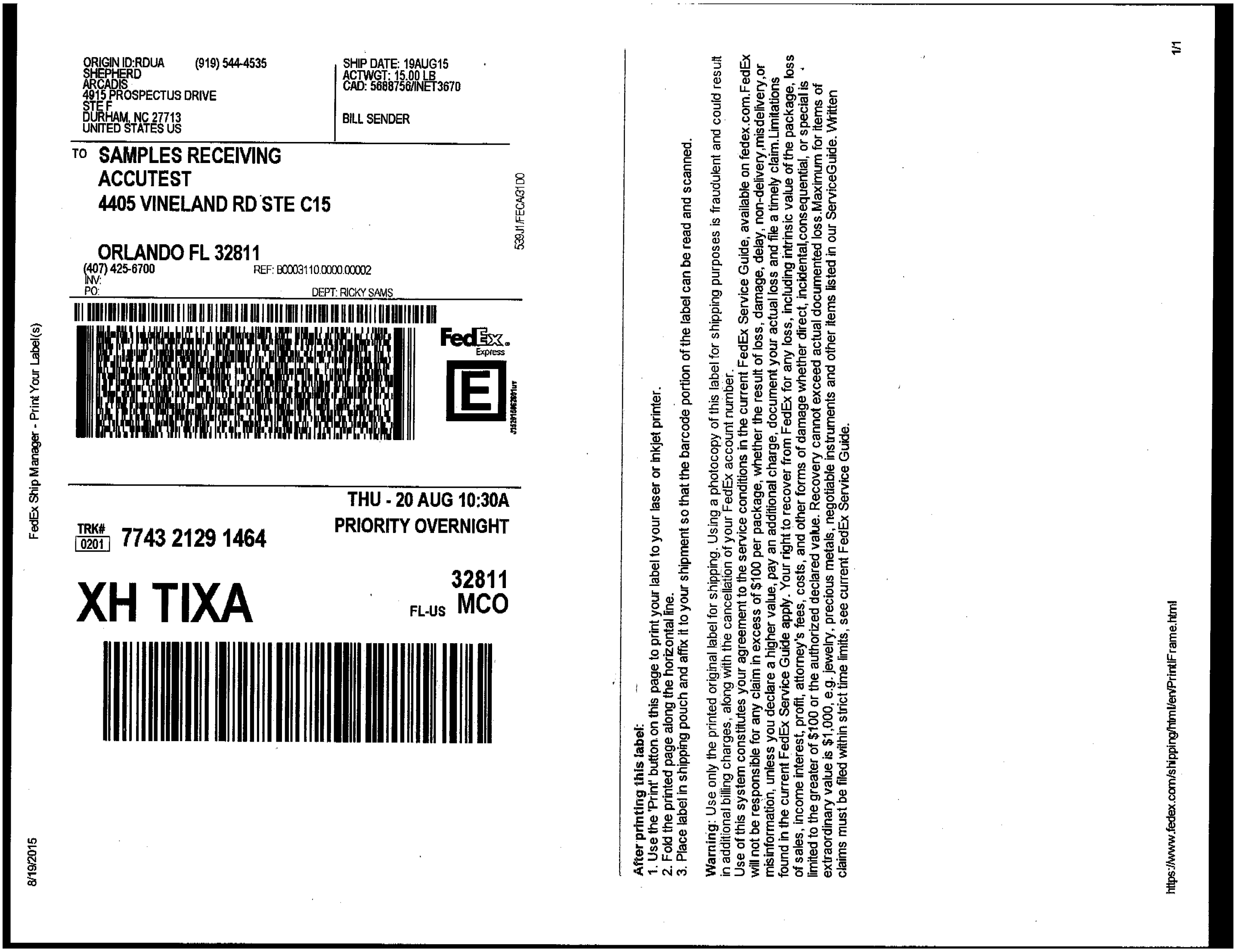
☐ INCORRECT NUMBER OF CONTAINERS USED
☐ SAMPLE RECEIVED IMPROPERLY PRESERVED
☐ INSUFFICIENT VOLUME FOR ANALYSIS
☐ DATES/TIMES ON COC DO NOT MATCH SAMPLE LABEL
☐ ID'S ON COC DO NOT MATCH LABEL
☐ VOC VIALS HAVE HEADSPACE (MACRO BUBBLES)
☐ BOTTLES RECEIVED BUT ANALYSIS NOT REQUESTED
☐ NO BOTTLES RECEIVED FOR ANALYSIS REQUESTED
☐ UNCLEAR FILTERING OR COMPOSITING INSTRUCTIONS
☐ SAMPLE CONTAINER(S) RECEIVED BROKEN
☐ 5035 FIELD KITS NOT RECEIVED WITHIN 48 HOURS
☐ BULK VOA SOIL JARS NOT RECEIVED WITHIN 48 HOURS
☐ % SOLIDS JAR NOT RECEIVED
☐ RESIDUAL CHLORINE PRESENT LOT#_____
{APPLICABLE TO EPA 600 SERIES OR NORTH CAROLINA ORGANICS}

pH PAPER LOT#s WIDI HC131225 NARROW RANGE _____AO36133____ OTHER (specify) ____405-230010___

SUMMARY OF COMMENTS:

TECHNICIAN SIGNATURE/DATE 8-20-15 REVIEWER SIGNATURE/DATE 082015

NF 10/14 YELLOWSHEET110514.xls



FedEx Ship Manager - Print Your Label(s)

8/19/2015

ORIGIN ID:RDUA (919) 544-4535
SHEPHERD
ARCADIS
4915 PROSPECTUS DRIVE
STE F
DURHAM, NC 27713
UNITED STATES US

SHIP DATE: 19AUG15
ACTWGT: 15.00 LB
CAD: 5688756/INET3670

BILL SENDER

TO **SAMPLES RECEIVING**
ACCUTEST
4405 VINELAND RD STE C15

ORLANDO FL 32811
(407) 425-6700 REF: B0003110.0000.00002
INV:
PO: DEPT: RICKY SAMS

539J1/FECA/31D0

FedEx Express

E

J152615062801uv

THU - 20 AUG 10:30A
PRIORITY OVERNIGHT

TRK# 0201 **7743 2129 1464**

XH TIXA

32811
FL-US **MCO**

After printing this label:
1. Use the 'Print' button on this page to print your label to your laser or inkjet printer.
2. Fold the printed page along the horizontal line.
3. Place label in shipping pouch and affix it to your shipment so that the barcode portion of the label can be read and scanned.

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1/1

FA26939: Chain of Custody
Page 3 of 3

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Metals Analysis

QC Data Summaries

Includes the following where applicable:

- Method Blank Summaries
- Matrix Spike and Duplicate Summaries
- Blank Spike and Lab Control Sample Summaries
- Serial Dilution Summaries

BLANK RESULTS SUMMARY
Part 2 - Method Blanks

Login Number: FA26939
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29290
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

Metal	RL	IDL	MDL	MB raw	final	MB raw	final
Prep Date:					08/21/15		08/21/15
Aluminum	0.20	.014	.014				
Antimony	0.0060	.001	.001				
Arsenic	0.010	.0013	.0013				
Barium	0.20	.001	.005				
Beryllium	0.0040	.0002	.0002				
Cadmium	0.0050	.0002	.0002				
Calcium	1.0	.05	.05				
Chromium	0.010	.001	.001				
Cobalt	0.050	.0002	.0002				
Copper	0.025	.001	.001				
Iron	0.30	.017	.017				
Lead	0.0050	.001	.0011	0.00010	<0.0050	0.00050	<0.0050
Magnesium	5.0	.035	.035				
Manganese	0.015	.0005	.001				
Molybdenum	0.050	.0003	.0003				
Nickel	0.040	.0004	.0004				
Potassium	10	.2	.2				
Selenium	0.010	.0024	.0029				
Silver	0.010	.0007	.0007				
Sodium	10	.5	.5				
Strontium	0.010	.0005	.0005				
Thallium	0.010	.0011	.0014				
Tin	0.050	.0009	.001				
Titanium	0.010	.0005	.001				
Vanadium	0.050	.0005	.0006				
Zinc	0.020	.003	.01				

Associated samples MP29290: FA26939-1, FA26939-2

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(anr) Analyte not requested

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: FA26939
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29290
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

Metal	FA26939-1 Original	DUP	RPD	QC Limits	FA26939-1 Original	MS	Spikelot MPFLICP2	% Rec	QC Limits
Prep Date:			08/21/15					08/21/15	
Aluminum									
Antimony									
Arsenic									
Barium									
Beryllium									
Cadmium									
Calcium									
Chromium									
Cobalt									
Copper									
Iron									
Lead	0.058	0.058	0.0	0-20	0.058	0.59	0.50	106.4	80-120
Magnesium									
Manganese									
Molybdenum									
Nickel									
Potassium									
Selenium									
Silver									
Sodium									
Strontium									
Thallium									
Tin									
Titanium									
Vanadium									
Zinc									

Associated samples MP29290: FA26939-1, FA26939-2

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(N) Matrix Spike Rec. outside of QC limits
(anr) Analyte not requested

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: FA26939
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29290
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

Metal	FA26939-1 Original	MSD	Spikelot MPFLICP2	% Rec	MSD RPD	QC Limit	FA26939-1 Original	DUP	RPD	QC Limits
Prep Date:					08/21/15				08/21/15	
Aluminum										
Antimony										
Arsenic										
Barium										
Beryllium										
Cadmium										
Calcium										
Chromium										
Cobalt										
Copper										
Iron										
Lead	0.058	0.58	0.50	104.4	1.7	20	0.058	0.063	8.3	0-20
Magnesium										
Manganese										
Molybdenum										
Nickel										
Potassium										
Selenium										
Silver										
Sodium										
Strontium										
Thallium										
Tin										
Titanium										
Vanadium										
Zinc										

Associated samples MP29290: FA26939-1, FA26939-2

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(N) Matrix Spike Rec. outside of QC limits
(anr) Analyte not requested

SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: FA26939
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29290
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

Metal	BSP Result	Spikelot MPFLICP2	% Rec	QC Limits	BSP Result	Spikelot MPFLICP2	% Rec	QC Limits
Prep Date:			08/21/15				08/21/15	
Aluminum								
Antimony								
Arsenic								
Barium								
Beryllium								
Cadmium								
Calcium								
Chromium								
Cobalt								
Copper								
Iron								
Lead	0.52	0.50	104.0	80-120	0.53	0.50	106.0	80-120
Magnesium								
Manganese								
Molybdenum								
Nickel								
Potassium								
Selenium								
Silver								
Sodium								
Strontium								
Thallium								
Tin								
Titanium								
Vanadium								
Zinc								

Associated samples MP29290: FA26939-1, FA26939-2

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(anr) Analyte not requested

SERIAL DILUTION RESULTS SUMMARY

Login Number: FA26939
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29290
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: ug/l

Prep Date: 08/21/15

Metal	FA26939-1 Original	SDL 1:5	%DIF	QC Limits
Aluminum				
Antimony				
Arsenic				
Barium				
Beryllium				
Cadmium				
Calcium				
Chromium				
Cobalt				
Copper				
Iron				
Lead	58.2	59.0	1.4	0-10
Magnesium				
Manganese				
Molybdenum				
Nickel				
Potassium				
Selenium				
Silver				
Sodium				
Strontium				
Thallium				
Tin				
Titanium				
Vanadium				
Zinc				

Associated samples MP29290: FA26939-1, FA26939-2

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(anr) Analyte not requested

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Automated Report

Southeast
ACCUTEST
LABORATORIES

08/31/15

Technical Report for

ARCADIS

Burrows Island, WA

B0003110.0000.00001

Accutest Job Number: FA27111

Sampling Date: 08/26/15

Report to:

ARCADIS Geraghty & Miller
801 Corporate Center Dr Suite 300
Raleigh, NC 27607
david.liles@arcadis-us.com; ricky.sams@arcadis-us.com

ATTN: David Liles

Total number of pages in report: **21**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Norm Farmer

Norm Farmer
Technical Director

Client Service contact: Heather Wandrey 407-425-6700

Certifications: FL (E83510), LA (03051), KS (E-10327), IA (366), IL (200063), NC (573), NJ (FL002), SC (96038001)
DoD ELAP (L-A-B L2229), CA (2937), TX (T104704404), PA (68-03573), VA (460177),
AK, AR, GA, KY, MA, NV, OK, UT, WA

This report shall not be reproduced, except in its entirety, without the written approval of Accutest Laboratories.
Test results relate only to samples analyzed.

Table of Contents

-1-

Sample Summary

ARCADIS

Job No: FA27111

Burrows Island, WA
Project No: B0003110.0000.00001

Sample Number	Collected Date	Time	By	Received	Matrix Code	Type	Client Sample ID
FA27111-1	08/26/15	12:00	RS	08/27/15	SO	Soil	TSP-1 (WEEK 1)
FA27111-2	08/26/15	12:00	RS	08/27/15	SO	Soil	TSP-2 (WEEK 1)
FA27111-3	08/26/15	12:00	RS	08/27/15	SO	Soil	TSP-3 (WEEK 1)

Soil samples reported on a dry weight basis unless otherwise indicated on result page.

Summary of Hits

Job Number: FA27111
Account: ARCADIS
Project: Burrows Island, WA
Collected: 08/26/15

Lab Sample ID Analyte	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
FA27111-1	**TSP-1 (WEEK 1)**					
pH, SPLP Leachate [a]		6.37			su	SW846 1312
Lead		0.096	0.0050		mg/l	SW846 6010C
FA27111-2	**TSP-2 (WEEK 1)**					
pH, SPLP Leachate [b]		6.03			su	SW846 1312
Lead		0.12	0.0050		mg/l	SW846 6010C
FA27111-3	**TSP-3 (WEEK 1)**					
pH, SPLP Leachate [c]		5.95			su	SW846 1312
Lead		0.080	0.0050		mg/l	SW846 6010C

(a) Sample pH was 5.72 prior to leaching.
(b) Sample pH was 5.36 prior to leaching.
(c) Sample pH was 5.50 prior to leaching.

Southeast
ACCUTEST
LABORATORIES

Sample Results

Report of Analysis

Report of Analysis

Client Sample ID:	TSP-1 (WEEK 1)		
Lab Sample ID:	FA27111-1	**Date Sampled:**	08/26/15
Matrix:	SO - Soil	**Date Received:**	08/27/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

Metals Analysis, SPLP Leachate SW846 1312

Analyte	Result	MCL	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	0.096		0.0050	mg/l	1	08/28/15	08/28/15	LM	SW846 6010C (1)	SW846 3010A (2)

(1) Instrument QC Batch: MA12612
(2) Prep QC Batch: MP29315

RL = Reporting Limit
MCL = Maximum Contamination Level (not available)

Report of Analysis

Client Sample ID: TSP-1 (WEEK 1)
Lab Sample ID: FA27111-1
Matrix: SO - Soil
Date Sampled: 08/26/15
Date Received: 08/27/15
Percent Solids: n/a
Project: Burrows Island, WA

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
pH, SPLP Leachate [a]	6.37		su	1	08/28/15	CP	SW846 1312

(a) Sample pH was 5.72 prior to leaching.

RL = Reporting Limit

Report of Analysis

Client Sample ID:	TSP-2 (WEEK 1)		
Lab Sample ID:	FA27111-2	**Date Sampled:**	08/26/15
Matrix:	SO - Soil	**Date Received:**	08/27/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

Metals Analysis, SPLP Leachate SW846 1312

Analyte	Result	MCL	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	0.12		0.0050	mg/l	1	08/28/15	08/28/15	LM	SW846 6010C [1]	SW846 3010A [2]

(1) Instrument QC Batch: MA12612
(2) Prep QC Batch: MP29315

RL = Reporting Limit
MCL = Maximum Contamination Level (not available)

Report of Analysis

Client Sample ID:	TSP-2 (WEEK 1)		
Lab Sample ID:	FA27111-2	**Date Sampled:**	08/26/15
Matrix:	SO - Soil	**Date Received:**	08/27/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
pH, SPLP Leachate [a]	6.03		su	1	08/28/15	CP	SW846 1312

(a) Sample pH was 5.36 prior to leaching.

RL = Reporting Limit

Report of Analysis

Client Sample ID:	TSP-3 (WEEK 1)			
Lab Sample ID:	FA27111-3		**Date Sampled:**	08/26/15
Matrix:	SO - Soil		**Date Received:**	08/27/15
			Percent Solids:	n/a
Project:	Burrows Island, WA			

Metals Analysis, SPLP Leachate SW846 1312

Analyte	Result	MCL	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	0.080		0.0050	mg/l	1	08/28/15	08/28/15	LM	SW846 6010C [1]	SW846 3010A [2]

(1) Instrument QC Batch: MA12612
(2) Prep QC Batch: MP29315

RL = Reporting Limit
MCL = Maximum Contamination Level (not available)

Report of Analysis

Client Sample ID:	TSP-3 (WEEK 1)		
Lab Sample ID:	FA27111-3	**Date Sampled:**	08/26/15
Matrix:	SO - Soil	**Date Received:**	08/27/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
pH, SPLP Leachate [a]	5.95		su	1	08/28/15	CP	SW846 1312

(a) Sample pH was 5.50 prior to leaching.

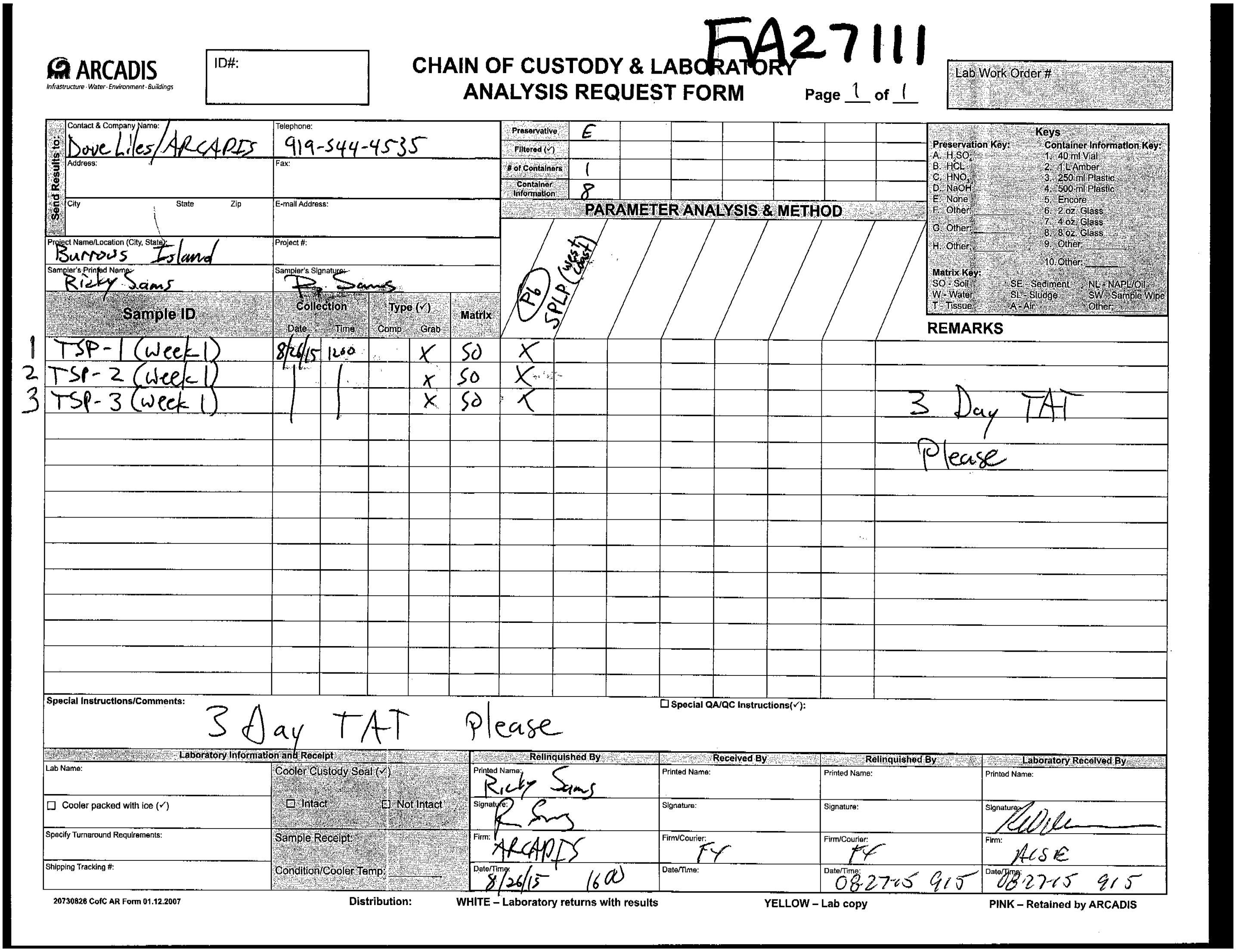
RL = Reporting Limit

Misc. Forms

Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody



FA27111

ARCADIS
Infrastructure · Water · Environment · Buildings

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page 1 of 1

Lab Work Order #

Send Results to:

Contact & Company Name: Dove Liles/ARCADIS
Telephone: 919-544-4535
Address:
Fax:
City
State
Zip
E-mail Address:

Project Name/Location (City, State): Burrous Island
Project #:
Sampler's Printed Name: Ricky Sams
Sampler's Signature: R. Sams

Preservative	E
Filtered (✓)	
# of Containers	1
Container Information	8

PARAMETER ANALYSIS & METHOD

	Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix	Pb SPLP (west coast)							REMARKS
1	TSP-1 (Week 1)	8/26/15	1200		X	SO	X							
2	TSP-2 (Week 1)	|	|		X	SO	X							
3	TSP-3 (Week 1)	|	|		X	SO	X							3 Day TAT Please

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: ______
G. Other: ______
H. Other: ______

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: ______
10. Other: ______

Matrix Key:
SO - Soil
W - Water
T - Tissue
SE - Sediment
SL - Sludge
A - Air
NL - NAPL/Oil
SW - Sample Wipe
Other: ______

Special Instructions/Comments: 3 Day TAT Please

☐ Special QA/QC Instructions(✓):

Laboratory Information and Receipt

Lab Name:
☐ Cooler packed with ice (✓)
Specify Turnaround Requirements:
Shipping Tracking #:
Cooler Custody Seal (✓)
☐ Intact ☐ Not Intact
Sample Receipt:
Condition/Cooler Temp: ______

	Relinquished By	Received By	Relinquished By	Laboratory Received By
Printed Name:	Ricky Sams			
Signature:	R Sams			
Firm:	ARCADIS	FY	FY	ALSE
Date/Time:	8/26/15 16@		08-27-15 915	08-27-15 915

20730826 CofC AR Form 01.12.2007

Distribution: WHITE – Laboratory returns with results YELLOW – Lab copy PINK – Retained by ARCADIS

ACCUTEST LABORATORIES SAMPLE RECEIPT CONFIRMATION

ACCUTEST'S JOB NUMBER: FA27111 CLIENT: Arcadis PROJECT: Burrows Island
DATE/TIME RECEIVED: 08-27-15 915 {MM/DD/YY 24:00} NUMBER OF COOLERS RECEIVED: 1
METHOD OF DELIVERY: [✓ FEDEX] UPS ACCUTEST COURIER DELIVERY OTHER:________
AIRBILL NUMBERS: 7743 7085 4810

COOLER INFORMATION

- ☐ CUSTODY SEAL NOT PRESENT OR NOT INTACT
- ☐ CHAIN OF CUSTODY NOT RECEIVED (COC)
- ☐ ANALYSIS REQUESTED IS UNCLEAR OR MISSING
- ☐ SAMPLE DATES OR TIMES UNCLEAR OR MISSING
- ☐ TEMPERATURE CRITERIA NOT MET

TRIP BLANK INFORMATION

- ☐ TRIP BLANK PROVIDED
- ☒ TRIP BLANK NOT PROVIDED
- ☒ TRIP BLANK NOT ON COC
- ☐ TRIP BLANK INTACT
- ☐ TRIP BLANK NOT INTACT
- ☐ RECEIVED WATER TRIP BLANK
- ☐ RECEIVED SOIL TRIP BLANK

MISC. INFORMATION

NUMBER OF ENCORES ? 25-GRAM______ 5-GRAM______
NUMBER OF 5035 FIELD KITS ? ______
NUMBER OF LAB FILTERED METALS ? ______

TEMPERATURE INFORMATION

- ☐ IR THERM ID 1 CORR. FACTOR -0.2
- ☐ OBSERVED TEMPS: 2 8
- ☐ CORRECTED TEMPS: 2 6

SAMPLE INFORMATION

- ☐ INCORRECT NUMBER OF CONTAINERS USED
- ☐ SAMPLE RECEIVED IMPROPERLY PRESERVED
- ☐ INSUFFICIENT VOLUME FOR ANALYSIS
- ☐ DATES/TIMES ON COC DO NOT MATCH SAMPLE LABEL
- ☐ ID'S ON COC DO NOT MATCH LABEL
- ☐ VOC VIALS HAVE HEADSPACE (MACRO BUBBLES)
- ☐ BOTTLES RECEIVED BUT ANALYSIS NOT REQUESTED
- ☐ NO BOTTLES RECEIVED FOR ANALYSIS REQUESTED
- ☐ UNCLEAR FILTERING OR COMPOSITING INSTRUCTIONS
- ☐ SAMPLE CONTAINER(S) RECEIVED BROKEN
- ☐ 5035 FIELD KITS NOT RECEIVED WITHIN 48 HOURS
- ☐ BULK VOA SOIL JARS NOT RECEIVED WITHIN 48 HOURS
- ☐ % SOLIDS JAR NOT RECEIVED
- ☐ RESIDUAL CHLORINE PRESENT LOT#______

{APPLICABLE TO EPA 600 SERIES OR NORTH CAROLINA ORGANICS}

pH PAPER LOT#s WIDI HC131225 NARROW RANGE AO36133 OTHER (specify) 405-230010

SUMMARY OF COMMENTS:______

TECHNICIAN SIGNATURE/DATE 08-27-15 REVIEWER SIGNATURE/DATE C 8-27-15

NF 10/14 YELLOWSHEET110514.xls

FedEx Ship Manager - Print Your Label(s)

8/26/2015

ORIGIN ID:RDUA (919) 544-4535
SHEPHERD
ARCADIS
4915 PROSPECTUS DRIVE
STE F
DURHAM, NC 27713
UNITED STATES US

SHIP DATE: 26AUG15
ACTWGT: 10.00 LB
CAD: 5688756/INET3670

BILL SENDER

TO **SAMPLES RECEIVING**
ACCUTEST
4405 VINELAND RD STE C15

ORLANDO FL 32811
(407) 425-6700 REF: B0003110.0000.00002
INV:
PO: DEPT: RICKY SAMS

539J1/FECA/31D0

FedEx Express

E

THU - 27 AUG 10:30A
PRIORITY OVERNIGHT

TRK# 0201 **7743 7085 4810**

XH TIXA

32811
FL-US **MCO**

After printing this label:
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FA27111: Chain of Custody
Page 3 of 3

Southeast
ACCUTEST
LABORATORIES

Metals Analysis

QC Data Summaries

Includes the following where applicable:

- Method Blank Summaries
- Matrix Spike and Duplicate Summaries
- Blank Spike and Lab Control Sample Summaries
- Serial Dilution Summaries

BLANK RESULTS SUMMARY
Part 2 - Method Blanks

Login Number: FA27111
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29315
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

Metal	RL	IDL	MDL	MB raw	final	MB raw	final
Prep Date:					08/28/15		08/28/15
Aluminum	0.20	.014	.014				
Antimony	0.0060	.001	.001				
Arsenic	0.010	.0013	.0013				
Barium	0.20	.001	.005				
Beryllium	0.0040	.0002	.0002				
Cadmium	0.0050	.0002	.0002				
Calcium	1.0	.05	.05				
Chromium	0.010	.001	.001				
Cobalt	0.050	.0002	.0002				
Copper	0.025	.001	.001				
Iron	0.30	.017	.017				
Lead	0.0050	.001	.0011	0.00040	<0.0050	-0.0014	<0.0050
Magnesium	5.0	.035	.035				
Manganese	0.015	.0005	.001				
Molybdenum	0.050	.0003	.0003				
Nickel	0.040	.0004	.0004				
Potassium	10	.2	.2				
Selenium	0.010	.0024	.0029				
Silver	0.010	.0007	.0007				
Sodium	10	.5	.5				
Strontium	0.010	.0005	.0005				
Thallium	0.010	.0011	.0014				
Tin	0.050	.0009	.001				
Titanium	0.010	.0005	.001				
Vanadium	0.050	.0005	.0006				
Zinc	0.020	.003	.01				

Associated samples MP29315: FA27111-1, FA27111-2, FA27111-3

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(anr) Analyte not requested

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: FA27111
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29315
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

Metal	FA27111-1 Original	DUP	RPD	QC Limits	FA27111-1 Original	MS	Spikelot MPFLICP2	% Rec	QC Limits
Prep Date:			08/28/15					08/28/15	
Aluminum									
Antimony									
Arsenic									
Barium									
Beryllium									
Cadmium									
Calcium									
Chromium									
Cobalt									
Copper									
Iron									
Lead	0.096	0.096	0.0	0-20	0.096	0.60	0.50	100.8	80-120
Magnesium									
Manganese									
Molybdenum									
Nickel									
Potassium									
Selenium									
Silver									
Sodium									
Strontium									
Thallium									
Tin									
Titanium									
Vanadium									
Zinc									

Associated samples MP29315: FA27111-1, FA27111-2, FA27111-3

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(N) Matrix Spike Rec. outside of QC limits
(anr) Analyte not requested

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: FA27111
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29315
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

Metal	FA27111-1 Original	MSD	Spikelot MPFLICP2	% Rec	MSD RPD	QC Limit
Prep Date:					08/28/15	
Aluminum						
Antimony						
Arsenic						
Barium						
Beryllium						
Cadmium						
Calcium						
Chromium						
Cobalt						
Copper						
Iron						
Lead	0.096	0.60	0.50	100.8	0.0	20
Magnesium						
Manganese						
Molybdenum						
Nickel						
Potassium						
Selenium						
Silver						
Sodium						
Strontium						
Thallium						
Tin						
Titanium						
Vanadium						
Zinc						

Associated samples MP29315: FA27111-1, FA27111-2, FA27111-3

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(N) Matrix Spike Rec. outside of QC limits
(anr) Analyte not requested

SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: FA27111
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29315
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

Prep Date: 08/28/15 08/28/15

Metal	BSP Result	Spikelot MPFLICP2	% Rec	QC Limits	BSP Result	Spikelot MPFLICP2	% Rec	QC Limits
Aluminum								
Antimony								
Arsenic								
Barium								
Beryllium								
Cadmium								
Calcium								
Chromium								
Cobalt								
Copper								
Iron								
Lead	0.50	0.50	100.0	80-120	0.50	0.50	100.0	80-120
Magnesium								
Manganese								
Molybdenum								
Nickel								
Potassium								
Selenium								
Silver								
Sodium								
Strontium								
Thallium								
Tin								
Titanium								
Vanadium								
Zinc								

Associated samples MP29315: FA27111-1, FA27111-2, FA27111-3

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(anr) Analyte not requested

SERIAL DILUTION RESULTS SUMMARY

Login Number: FA27111
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29315
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: ug/l

Prep Date: 08/28/15

Metal	FA27111-1 Original	SDL 1:5	%DIF	QC Limits
Aluminum				
Antimony				
Arsenic				
Barium				
Beryllium				
Cadmium				
Calcium				
Chromium				
Cobalt				
Copper				
Iron				
Lead	95.7	92.5	3.3	0-10
Magnesium				
Manganese				
Molybdenum				
Nickel				
Potassium				
Selenium				
Silver				
Sodium				
Strontium				
Thallium				
Tin				
Titanium				
Vanadium				
Zinc				

Associated samples MP29315: FA27111-1, FA27111-2, FA27111-3

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(anr) Analyte not requested

Southeast
ACCUTEST
LABORATORIES

09/09/15

Technical Report for

ARCADIS

Burrows Island, WA

B0003110.0000.00001

Accutest Job Number: FA27290

Sampling Date: 09/02/15

Report to:

ARCADIS Geraghty & Miller
801 Corporate Center Dr Suite 300
Raleigh, NC 27607
david.liles@arcadis-us.com; ricky.sams@arcadis-us.com

ATTN: David Liles

Total number of pages in report: **21**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Norm Farmer

Norm Farmer
Technical Director

Client Service contact: Heather Wandrey 407-425-6700

Certifications: FL (E83510), LA (03051), KS (E-10327), IA (366), IL (200063), NC (573), NJ (FL002), SC (96038001)
DoD ELAP (L-A-B L2229), CA (2937), TX (T104704404), PA (68-03573), VA (460177),
AK, AR, GA, KY, MA, NV, OK, UT, WA

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Test results relate only to samples analyzed.

Table of Contents

-1-

Sample Summary

ARCADIS

Job No: FA27290

Burrows Island, WA
Project No: B0003110.0000.00001

Sample Number	Collected Date	Time	By	Received	Matrix Code	Type	Client Sample ID
FA27290-1	09/02/15	16:00	RS	09/03/15	SO	Soil	TSP-1 (WEEK 2)
FA27290-2	09/02/15	16:00	RS	09/03/15	SO	Soil	TSP-2 (WEEK 2)
FA27290-3	09/02/15	16:00	RS	09/03/15	SO	Soil	TSP-3 (WEEK 2)

Soil samples reported on a dry weight basis unless otherwise indicated on result page.

Summary of Hits

Job Number: FA27290
Account: ARCADIS
Project: Burrows Island, WA
Collected: 09/02/15

Lab Sample ID Analyte	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
FA27290-1	**TSP-1 (WEEK 2)**					
pH, SPLP Leachate [a]		6.22			su	SW846 1312
Lead		0.11	0.0050		mg/l	SW846 6010C
FA27290-2	**TSP-2 (WEEK 2)**					
pH, SPLP Leachate [b]		6.05			su	SW846 1312
Lead		0.15	0.0050		mg/l	SW846 6010C
FA27290-3	**TSP-3 (WEEK 2)**					
pH, SPLP Leachate [c]		6.00			su	SW846 1312
Lead		0.11	0.0050		mg/l	SW846 6010C

(a) Sample pH was 5.86 before leaching.
(b) Sample pH was 5.59 before leaching.
(c) Sample pH was 5.37 before leaching.

Sample Results

Report of Analysis

Report of Analysis

Client Sample ID:	TSP-1 (WEEK 2)		
Lab Sample ID:	FA27290-1	**Date Sampled:**	09/02/15
Matrix:	SO - Soil	**Date Received:**	09/03/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

Metals Analysis, SPLP Leachate SW846 1312

Analyte	Result	MCL	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	0.11		0.0050	mg/l	1	09/04/15	09/04/15	LM	SW846 6010C [1]	SW846 3010A [2]

(1) Instrument QC Batch: MA12627
(2) Prep QC Batch: MP29346

RL = Reporting Limit
MCL = Maximum Contamination Level (not available)

Report of Analysis

Client Sample ID:	TSP-1 (WEEK 2)		
Lab Sample ID:	FA27290-1	**Date Sampled:**	09/02/15
Matrix:	SO - Soil	**Date Received:**	09/03/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
pH, SPLP Leachate [a]	6.22		su	1	09/04/15	CP	SW846 1312

(a) Sample pH was 5.86 before leaching.

RL = Reporting Limit

Report of Analysis

Client Sample ID:	TSP-2 (WEEK 2)		
Lab Sample ID:	FA27290-2	**Date Sampled:**	09/02/15
Matrix:	SO - Soil	**Date Received:**	09/03/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

Metals Analysis, SPLP Leachate SW846 1312

Analyte	Result	MCL	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	0.15		0.0050	mg/l	1	09/04/15	09/04/15	LM	SW846 6010C (1)	SW846 3010A (2)

(1) Instrument QC Batch: MA12627
(2) Prep QC Batch: MP29346

RL = Reporting Limit
MCL = Maximum Contamination Level (not available)

Report of Analysis

Client Sample ID:	TSP-2 (WEEK 2)		
Lab Sample ID:	FA27290-2	**Date Sampled:**	09/02/15
Matrix:	SO - Soil	**Date Received:**	09/03/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
pH, SPLP Leachate [a]	6.05		su	1	09/04/15	CP	SW846 1312

(a) Sample pH was 5.59 before leaching.

RL = Reporting Limit

Report of Analysis

Client Sample ID:	TSP-3 (WEEK 2)		
Lab Sample ID:	FA27290-3	**Date Sampled:**	09/02/15
Matrix:	SO - Soil	**Date Received:**	09/03/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

Metals Analysis, SPLP Leachate SW846 1312

Analyte	Result	MCL	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	0.11		0.0050	mg/l	1	09/04/15	09/04/15	LM	SW846 6010C [1]	SW846 3010A [2]

(1) Instrument QC Batch: MA12627
(2) Prep QC Batch: MP29346

RL = Reporting Limit
MCL = Maximum Contamination Level (not available)

Report of Analysis

Client Sample ID:	TSP-3 (WEEK 2)		
Lab Sample ID:	FA27290-3	**Date Sampled:**	09/02/15
Matrix:	SO - Soil	**Date Received:**	09/03/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
pH, SPLP Leachate [a]	6.00		su	1	09/04/15	CP	SW846 1312

(a) Sample pH was 5.37 before leaching.

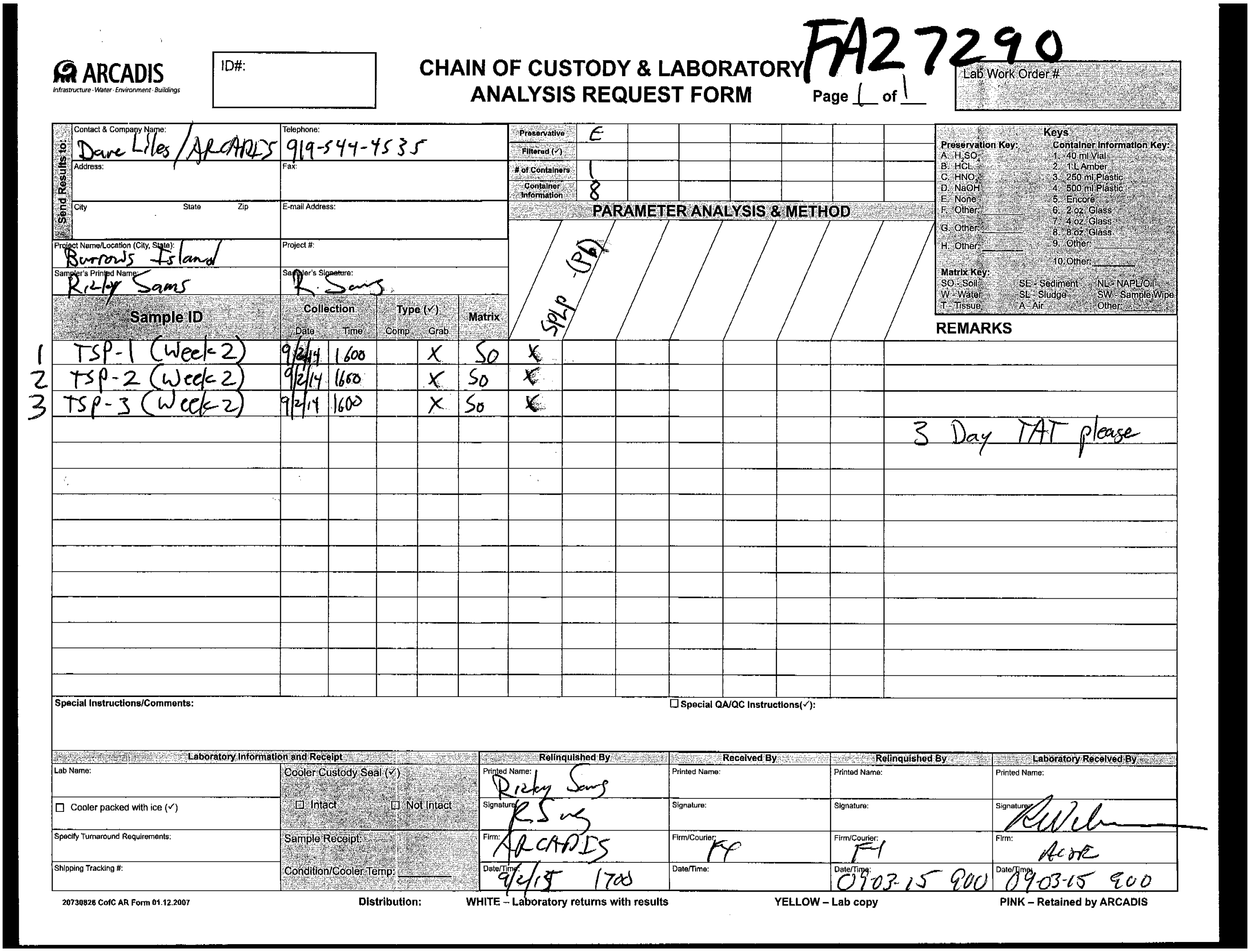
RL = Reporting Limit

Misc. Forms

Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody



ARCADIS
Infrastructure · Water · Environment · Buildings

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

FA27290

Page 1 of 1

Lab Work Order #

Send Results to:

Contact & Company Name: Dave Liles / ARCADIS
Telephone: 919-544-4535
Address:
Fax:
City State Zip
E-mail Address:
Project Name/Location (City, State): Burrows Island
Project #:
Sampler's Printed Name: Ricky Sams
Sampler's Signature: R. Sams

Preservative	E						
Filtered (✓)							
# of Containers	1						
Container Information	8						

PARAMETER ANALYSIS & METHOD

	Sample ID	**Collection** Date	**Collection** Time	**Type (✓)** Comp	**Type (✓)** Grab	**Matrix**	SPLP - (Pb)							**REMARKS**
1	TSP-1 (Week 2)	9/2/14	1600		X	So	X							
2	TSP-2 (Week 2)	9/2/14	1600		X	So	X							
3	TSP-3 (Week 2)	9/2/14	1600		X	So	X							
														3 Day TAT please

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: ______
G. Other: ______
H. Other: ______

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: ______
10. Other: ______

Matrix Key:

SO - Soil	SE - Sediment	NL - NAPL/Oil
W - Water	SL - Sludge	SW - Sample Wipe
T - Tissue	A - Air	Other: ______

Special Instructions/Comments:

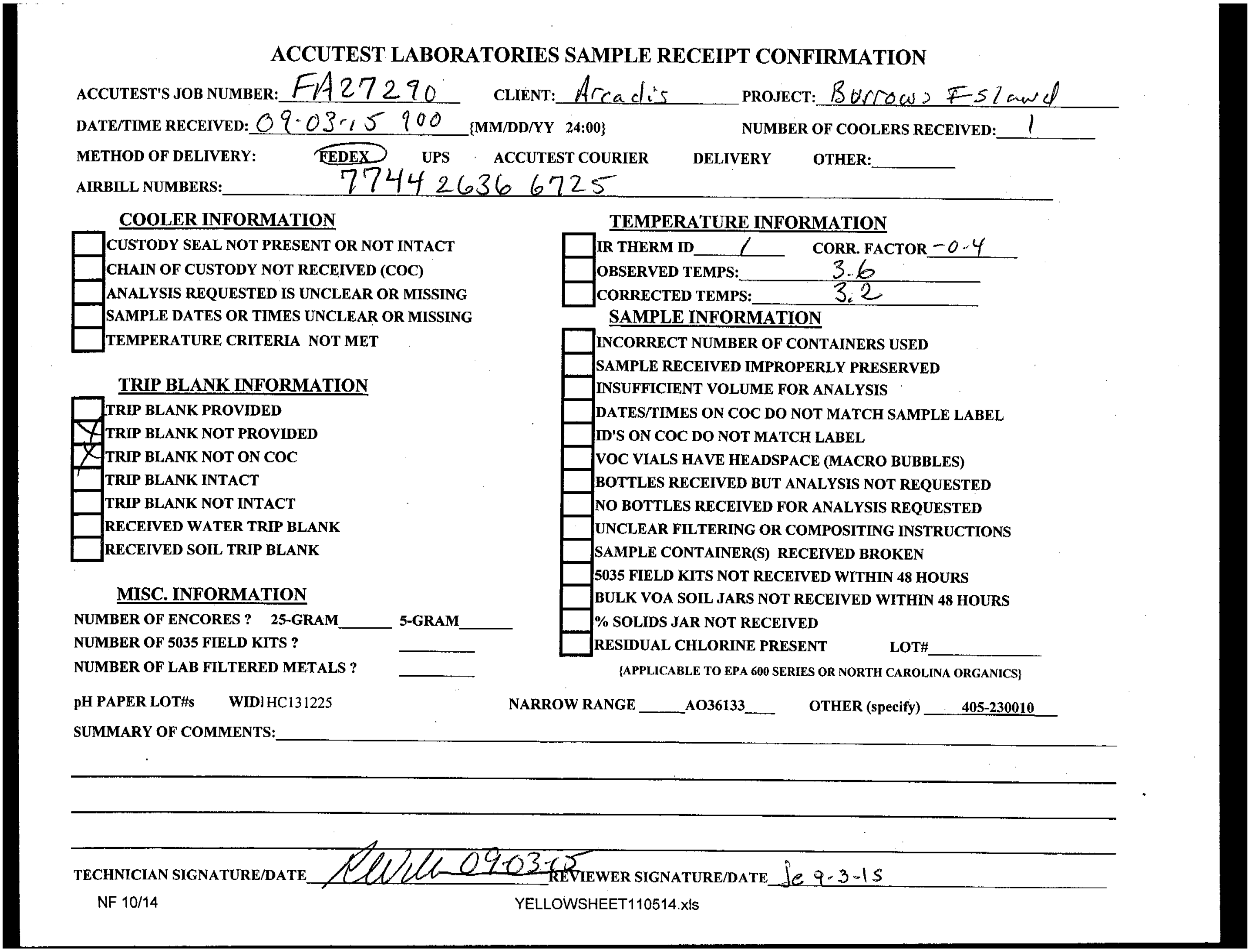
☐ **Special QA/QC Instructions(✓):**

Laboratory Information and Receipt		**Relinquished By**	**Received By**	**Relinquished By**	**Laboratory Received By**
Lab Name:	Cooler Custody Seal (✓)	Printed Name: Ricky Sams	Printed Name:	Printed Name:	Printed Name:
☐ Cooler packed with ice (✓)	☐ Intact ☐ Not Intact	Signature: R Sams	Signature:	Signature:	Signature:
Specify Turnaround Requirements:	Sample Receipt:	Firm: ARCADIS	Firm/Courier: FX	Firm/Courier: FX	Firm: Acute
Shipping Tracking #:	Condition/Cooler Temp: ______	Date/Time: 9/2/15 1700	Date/Time:	Date/Time: 09-03-15 900	Date/Time: 09-03-15 900

20730826 CofC AR Form 01.12.2007

Distribution: WHITE – Laboratory returns with results YELLOW – Lab copy PINK – Retained by ARCADIS

FA27290: Chain of Custody
Page 1 of 3



ACCUTEST LABORATORIES SAMPLE RECEIPT CONFIRMATION

ACCUTEST'S JOB NUMBER: FA27290 CLIENT: Arcadis PROJECT: Burrows Island

DATE/TIME RECEIVED: 09-03-15 900 {MM/DD/YY 24:00} NUMBER OF COOLERS RECEIVED: 1

METHOD OF DELIVERY: [✓ FEDEX] UPS ACCUTEST COURIER DELIVERY OTHER:

AIRBILL NUMBERS: 7744 2636 6725

COOLER INFORMATION

☐ CUSTODY SEAL NOT PRESENT OR NOT INTACT
☐ CHAIN OF CUSTODY NOT RECEIVED (COC)
☐ ANALYSIS REQUESTED IS UNCLEAR OR MISSING
☐ SAMPLE DATES OR TIMES UNCLEAR OR MISSING
☐ TEMPERATURE CRITERIA NOT MET

TRIP BLANK INFORMATION

☐ TRIP BLANK PROVIDED
☒ TRIP BLANK NOT PROVIDED
☒ TRIP BLANK NOT ON COC
☐ TRIP BLANK INTACT
☐ TRIP BLANK NOT INTACT
☐ RECEIVED WATER TRIP BLANK
☐ RECEIVED SOIL TRIP BLANK

MISC. INFORMATION

NUMBER OF ENCORES ? 25-GRAM______ 5-GRAM______
NUMBER OF 5035 FIELD KITS ? ______
NUMBER OF LAB FILTERED METALS ? ______

TEMPERATURE INFORMATION

☐ IR THERM ID 1 CORR. FACTOR -0.4
☐ OBSERVED TEMPS: 3.6
☐ CORRECTED TEMPS: 3.2

SAMPLE INFORMATION

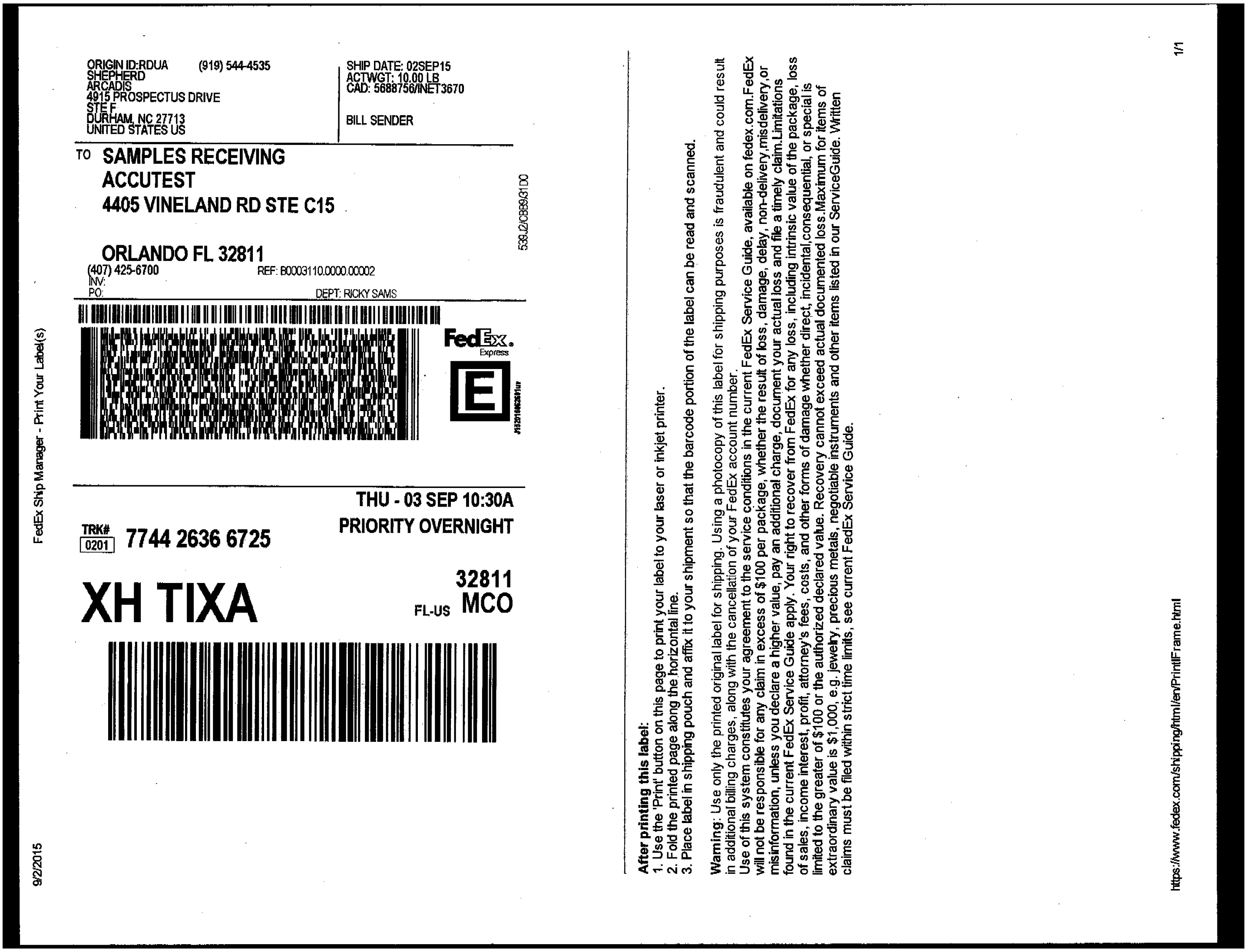
☐ INCORRECT NUMBER OF CONTAINERS USED
☐ SAMPLE RECEIVED IMPROPERLY PRESERVED
☐ INSUFFICIENT VOLUME FOR ANALYSIS
☐ DATES/TIMES ON COC DO NOT MATCH SAMPLE LABEL
☐ ID'S ON COC DO NOT MATCH LABEL
☐ VOC VIALS HAVE HEADSPACE (MACRO BUBBLES)
☐ BOTTLES RECEIVED BUT ANALYSIS NOT REQUESTED
☐ NO BOTTLES RECEIVED FOR ANALYSIS REQUESTED
☐ UNCLEAR FILTERING OR COMPOSITING INSTRUCTIONS
☐ SAMPLE CONTAINER(S) RECEIVED BROKEN
☐ 5035 FIELD KITS NOT RECEIVED WITHIN 48 HOURS
☐ BULK VOA SOIL JARS NOT RECEIVED WITHIN 48 HOURS
☐ % SOLIDS JAR NOT RECEIVED
☐ RESIDUAL CHLORINE PRESENT LOT#______
{APPLICABLE TO EPA 600 SERIES OR NORTH CAROLINA ORGANICS}

pH PAPER LOT#s WID HC131225 NARROW RANGE AO36133 OTHER (specify) 405-230010

SUMMARY OF COMMENTS:

TECHNICIAN SIGNATURE/DATE 09-03-15 REVIEWER SIGNATURE/DATE Je 9-3-15

NF 10/14 YELLOWSHEET110514.xls



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9/2/2015

ORIGIN ID:RDUA (919) 544-4535
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ARCADIS
4915 PROSPECTUS DRIVE
STE F
DURHAM, NC 27713
UNITED STATES US

SHIP DATE: 02SEP15
ACTWGT: 10.00 LB
CAD: 5688756/INET3670

BILL SENDER

TO SAMPLES RECEIVING
ACCUTEST
4405 VINELAND RD STE C15

ORLANDO FL 32811
(407) 425-6700 REF: B0003110.0000.00002
INV:
PO: DEPT: RICKY SAMS

539J2/CBB9/31D0

FedEx Express

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FA27290: Chain of Custody
Page 3 of 3

Southeast
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LABORATORIES

Metals Analysis

QC Data Summaries

Includes the following where applicable:

- Method Blank Summaries
- Matrix Spike and Duplicate Summaries
- Blank Spike and Lab Control Sample Summaries
- Serial Dilution Summaries

BLANK RESULTS SUMMARY
Part 2 - Method Blanks

Login Number: FA27290
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29346
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

Prep Date:					09/04/15		09/04/15
Metal	RL	IDL	MDL	MB raw	final	MB raw	final
Aluminum	0.20	.014	.014				
Antimony	0.0060	.001	.001				
Arsenic	0.010	.0013	.0013				
Barium	0.20	.001	.005				
Beryllium	0.0040	.0002	.0002				
Cadmium	0.0050	.0002	.0002				
Calcium	1.0	.05	.05				
Chromium	0.010	.001	.001				
Cobalt	0.050	.0002	.0002				
Copper	0.025	.001	.001				
Iron	0.30	.017	.017				
Lead	0.0050	.001	.0011	-0.00060	<0.0050	-0.00040	<0.0050
Magnesium	5.0	.035	.035				
Manganese	0.015	.0005	.001				
Molybdenum	0.050	.0003	.0003				
Nickel	0.040	.0004	.0004				
Potassium	10	.2	.2				
Selenium	0.010	.0024	.0029				
Silver	0.010	.0007	.0007				
Sodium	10	.5	.5				
Strontium	0.010	.0005	.0005				
Thallium	0.010	.0011	.0014				
Tin	0.050	.0009	.001				
Titanium	0.010	.0005	.001				
Vanadium	0.050	.0005	.0006				
Zinc	0.020	.003	.01				

Associated samples MP29346: FA27290-1, FA27290-2, FA27290-3

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(anr) Analyte not requested

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: FA27290
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29346
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

Prep Date: 09/04/15 09/04/15

	FA27290-2			QC	FA27290-2		Spikelot		QC
Metal	Original	DUP	RPD	Limits	Original	MS	MPFLICP2	% Rec	Limits
Aluminum									
Antimony									
Arsenic									
Barium									
Beryllium									
Cadmium									
Calcium									
Chromium									
Cobalt									
Copper									
Iron									
Lead	0.15	0.15	0.0	0-20	0.15	0.64	0.50	98.0	80-120
Magnesium									
Manganese									
Molybdenum									
Nickel									
Potassium									
Selenium									
Silver									
Sodium									
Strontium									
Thallium									
Tin									
Titanium									
Vanadium									
Zinc									

Associated samples MP29346: FA27290-1, FA27290-2, FA27290-3

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(N) Matrix Spike Rec. outside of QC limits
(anr) Analyte not requested

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: FA27290
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29346
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

Prep Date:					09/04/15				09/04/15	
Metal	FA27290-2 Original	MSD	Spikelot MPFLICP2	% Rec	MSD RPD	QC Limit	FA27290-1 Original	DUP	RPD	QC Limits
Aluminum										
Antimony										
Arsenic										
Barium										
Beryllium										
Cadmium										
Calcium										
Chromium										
Cobalt										
Copper										
Iron										
Lead	0.15	0.64	0.50	98.0	0.0	20	0.11	0.11	0.0	0-20
Magnesium										
Manganese										
Molybdenum										
Nickel										
Potassium										
Selenium										
Silver										
Sodium										
Strontium										
Thallium										
Tin										
Titanium										
Vanadium										
Zinc										

Associated samples MP29346: FA27290-1, FA27290-2, FA27290-3

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(N) Matrix Spike Rec. outside of QC limits
(anr) Analyte not requested

SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: FA27290
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29346
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

Prep Date: 09/04/15 09/04/15

Metal	BSP Result	Spikelot MPFLICP2	% Rec	QC Limits	BSP Result	Spikelot MPFLICP2	% Rec	QC Limits
Aluminum								
Antimony								
Arsenic								
Barium								
Beryllium								
Cadmium								
Calcium								
Chromium								
Cobalt								
Copper								
Iron								
Lead	0.49	0.50	98.0	80-120	0.49	0.50	98.0	80-120
Magnesium								
Manganese								
Molybdenum								
Nickel								
Potassium								
Selenium								
Silver								
Sodium								
Strontium								
Thallium								
Tin								
Titanium								
Vanadium								
Zinc								

Associated samples MP29346: FA27290-1, FA27290-2, FA27290-3

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(anr) Analyte not requested

SERIAL DILUTION RESULTS SUMMARY

Login Number: FA27290
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29346
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: ug/l

Prep Date: 09/04/15

Metal	FA27290-2 Original	SDL 1:5	%DIF	QC Limits
Aluminum				
Antimony				
Arsenic				
Barium				
Beryllium				
Cadmium				
Calcium				
Chromium				
Cobalt				
Copper				
Iron				
Lead	150	141	5.5	0-10
Magnesium				
Manganese				
Molybdenum				
Nickel				
Potassium				
Selenium				
Silver				
Sodium				
Strontium				
Thallium				
Tin				
Titanium				
Vanadium				
Zinc				

Associated samples MP29346: FA27290-1, FA27290-2, FA27290-3

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(anr) Analyte not requested

e-Hardcopy 2.0
Automated Report

Southeast
ACCUTEST
LABORATORIES

09/15/15

Technical Report for

ARCADIS

Burrows Island, WA

B0003110.0000.00001

Accutest Job Number: FA27431

Sampling Date: 09/09/15

Report to:

ARCADIS Geraghty & Miller
801 Corporate Center Dr Suite 300
Raleigh, NC 27607
david.liles@arcadis-us.com; ricky.sams@arcadis-us.com

ATTN: David Liles

Total number of pages in report: **21**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Norm Farmer

Norm Farmer
Technical Director

Client Service contact: Heather Wandrey 407-425-6700

Certifications: FL (E83510), LA (03051), KS (E-10327), IA (366), IL (200063), NC (573), NJ (FL002), SC (96038001)
DoD ELAP (L-A-B L2229), CA (2937), TX (T104704404), PA (68-03573), VA (460177),
AK, AR, GA, KY, MA, NV, OK, UT, WA
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Test results relate only to samples analyzed.

Table of Contents

-1-

Sample Summary

ARCADIS

Job No: FA27431

Burrows Island, WA
Project No: B0003110.0000.00001

Sample Number	Collected Date	Time	By	Received	Matrix Code	Type	Client Sample ID
FA27431-1	09/09/15	12:00	BS	09/10/15	SO	Soil	TSP-1 (WEEK 3)
FA27431-2	09/09/15	12:00	BS	09/10/15	SO	Soil	TSP-2 (WEEK 3)
FA27431-3	09/09/15	12:00	BS	09/10/15	SO	Soil	TSP-3 (WEEK 3)

Soil samples reported on a dry weight basis unless otherwise indicated on result page.

Summary of Hits

Job Number: FA27431
Account: ARCADIS
Project: Burrows Island, WA
Collected: 09/09/15

Lab Sample ID Analyte	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
FA27431-1	**TSP-1 (WEEK 3)**					
pH, SPLP Leachate [a]		7.00			su	SW846 1312
Lead		0.11	0.0050		mg/l	SW846 6010C
FA27431-2	**TSP-2 (WEEK 3)**					
pH, SPLP Leachate [b]		6.47			su	SW846 1312
Lead		0.13	0.0050		mg/l	SW846 6010C
FA27431-3	**TSP-3 (WEEK 3)**					
pH, SPLP Leachate [c]		6.23			su	SW846 1312
Lead		0.072	0.0050		mg/l	SW846 6010C

(a) Sample pH was 6.39 prior to leaching.
(b) Sample pH was 5.58 prior to leaching.
(c) Sample pH was 5.75 prior to leaching.

Southeast ACCUTEST LABORATORIES

Sample Results

Report of Analysis

Report of Analysis

Client Sample ID:	TSP-1 (WEEK 3)		
Lab Sample ID:	FA27431-1	**Date Sampled:**	09/09/15
Matrix:	SO - Soil	**Date Received:**	09/10/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

Metals Analysis, SPLP Leachate SW846 1312

Analyte	Result	MCL	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	0.11		0.0050	mg/l	1	09/14/15	09/14/15	LM	SW846 6010C [1]	SW846 3010A [2]

(1) Instrument QC Batch: MA12644
(2) Prep QC Batch: MP29375

RL = Reporting Limit
MCL = Maximum Contamination Level (not available)

Report of Analysis

Client Sample ID:	TSP-1 (WEEK 3)		
Lab Sample ID:	FA27431-1	**Date Sampled:**	09/09/15
Matrix:	SO - Soil	**Date Received:**	09/10/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
pH, SPLP Leachate [a]	7.00		su	1	09/11/15	CP	SW846 1312

(a) Sample pH was 6.39 prior to leaching.

RL = Reporting Limit

Report of Analysis

Client Sample ID:	TSP-2 (WEEK 3)		
Lab Sample ID:	FA27431-2	**Date Sampled:**	09/09/15
Matrix:	SO - Soil	**Date Received:**	09/10/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

Metals Analysis, SPLP Leachate SW846 1312

Analyte	Result	MCL	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	0.13		0.0050	mg/l	1	09/14/15	09/14/15	LM	SW846 6010C [1]	SW846 3010A [2]

(1) Instrument QC Batch: MA12644
(2) Prep QC Batch: MP29375

RL = Reporting Limit
MCL = Maximum Contamination Level (not available)

Report of Analysis

Client Sample ID:	TSP-2 (WEEK 3)		
Lab Sample ID:	FA27431-2	**Date Sampled:**	09/09/15
Matrix:	SO - Soil	**Date Received:**	09/10/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
pH, SPLP Leachate [a]	6.47		su	1	09/11/15	CP	SW846 1312

(a) Sample pH was 5.58 prior to leaching.

RL = Reporting Limit

Report of Analysis

Client Sample ID:	TSP-3 (WEEK 3)		
Lab Sample ID:	FA27431-3	**Date Sampled:**	09/09/15
Matrix:	SO - Soil	**Date Received:**	09/10/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

Metals Analysis, SPLP Leachate SW846 1312

Analyte	Result	MCL	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	0.072		0.0050	mg/l	1	09/14/15	09/14/15	LM	SW846 6010C [1]	SW846 3010A [2]

(1) Instrument QC Batch: MA12644
(2) Prep QC Batch: MP29375

RL = Reporting Limit
MCL = Maximum Contamination Level (not available)

Report of Analysis

Client Sample ID:	TSP-3 (WEEK 3)		
Lab Sample ID:	FA27431-3	**Date Sampled:**	09/09/15
Matrix:	SO - Soil	**Date Received:**	09/10/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
pH, SPLP Leachate [a]	6.23		su	1	09/11/15	CP	SW846 1312

(a) Sample pH was 5.75 prior to leaching.

RL = Reporting Limit

Southeast

Misc. Forms

Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody

ARCADIS
Infrastructure · Water · Environment · Buildings

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

FA27431

Page 1 of 1

Lab Work Order #

Send Results to:
Contact & Company Name: Dave Liles/ARCADIS
Telephone: 919-544-4535
Address:
Fax:
City State Zip
E-mail Address:
Project Name/Location (City, State): Burrows Island
Project #:
Sampler's Printed Name: Ricky Sams
Sampler's Signature: R Sams

Preservative	E
Filtered (✓)	
# of Containers	1
Container Information	8

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: ______
G. Other: ______
H. Other: ______

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: ______
10. Other: ______

Matrix Key:
SO - Soil
W - Water
T - Tissue
SE - Sediment
SL - Sludge
A - Air
NL - NAPL/Oil
SW - Sample Wipe
Other: ______

PARAMETER ANALYSIS & METHOD

Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix	SPLP (Pb)	REMARKS
1 TSP-1 (Week3)	9/9/15	1200		X	So	X	
2 TSP-2 (Week3)	9/9/15	|		X	So	X	* 3 Day TAT
3 TSP-3 (Week3)	9/9/15	|		X	So	X	Please
							Please report leachate pH before and after extraction

Special Instructions/Comments: 3 Day TAT Please

☐ Special QA/QC Instructions(✓):

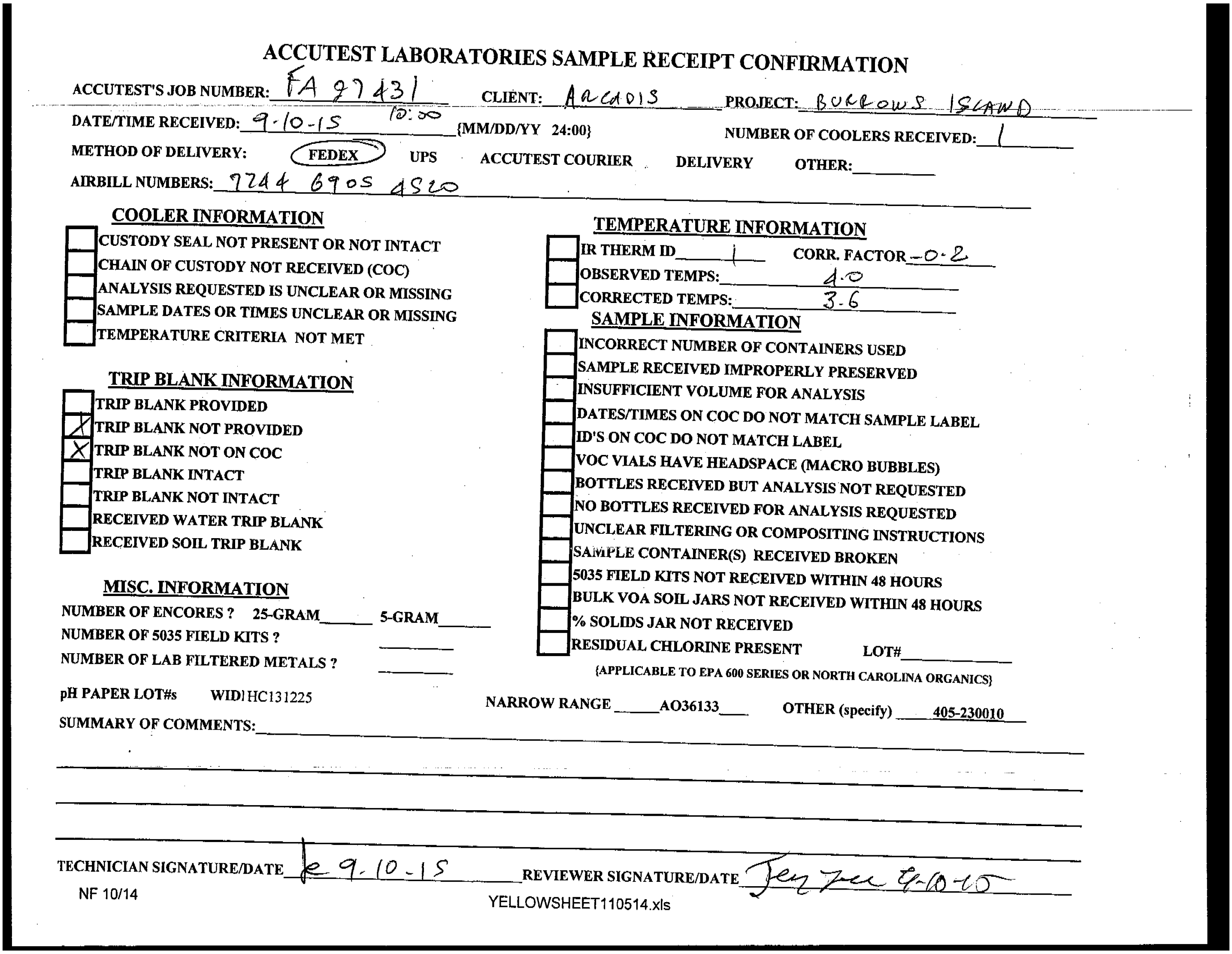
Laboratory Information and Receipt
Lab Name:
☐ Cooler packed with ice (✓)
Specify Turnaround Requirements:
Shipping Tracking #:
Cooler Custody Seal (✓) ☐ Intact ☐ Not Intact
Sample Receipt:
Condition/Cooler Temp: ______

	Relinquished By	Received By	Relinquished By	Laboratory Received By
Printed Name:	Ricky Sams			
Signature:	R Sams	FX	FX	J. Corre
Firm:	ARCADIS			Alstk
Date/Time:	9/9/15			9-10-15 10:00

20730826 CofC AR Form 01.12.2007

Distribution: WHITE – Laboratory returns with results YELLOW – Lab copy PINK – Retained by ARCADIS

3.6



ACCUTEST LABORATORIES SAMPLE RECEIPT CONFIRMATION

ACCUTEST'S JOB NUMBER: FA 27431 CLIENT: ARCADIS PROJECT: BURROWS ISLAND

DATE/TIME RECEIVED: 9-10-15 10:00 {MM/DD/YY 24:00} NUMBER OF COOLERS RECEIVED: 1

METHOD OF DELIVERY: [✓ FEDEX] UPS ACCUTEST COURIER DELIVERY OTHER:

AIRBILL NUMBERS: 7724 6905 4520

COOLER INFORMATION

☐ CUSTODY SEAL NOT PRESENT OR NOT INTACT
☐ CHAIN OF CUSTODY NOT RECEIVED (COC)
☐ ANALYSIS REQUESTED IS UNCLEAR OR MISSING
☐ SAMPLE DATES OR TIMES UNCLEAR OR MISSING
☐ TEMPERATURE CRITERIA NOT MET

TRIP BLANK INFORMATION

☐ TRIP BLANK PROVIDED
☒ TRIP BLANK NOT PROVIDED
☒ TRIP BLANK NOT ON COC
☐ TRIP BLANK INTACT
☐ TRIP BLANK NOT INTACT
☐ RECEIVED WATER TRIP BLANK
☐ RECEIVED SOIL TRIP BLANK

MISC. INFORMATION

NUMBER OF ENCORES ? 25-GRAM______ 5-GRAM______
NUMBER OF 5035 FIELD KITS ? ______
NUMBER OF LAB FILTERED METALS ? ______

TEMPERATURE INFORMATION

☐ IR THERM ID 1 CORR. FACTOR -0.2
☐ OBSERVED TEMPS: 4.0
☐ CORRECTED TEMPS: 3.6

SAMPLE INFORMATION

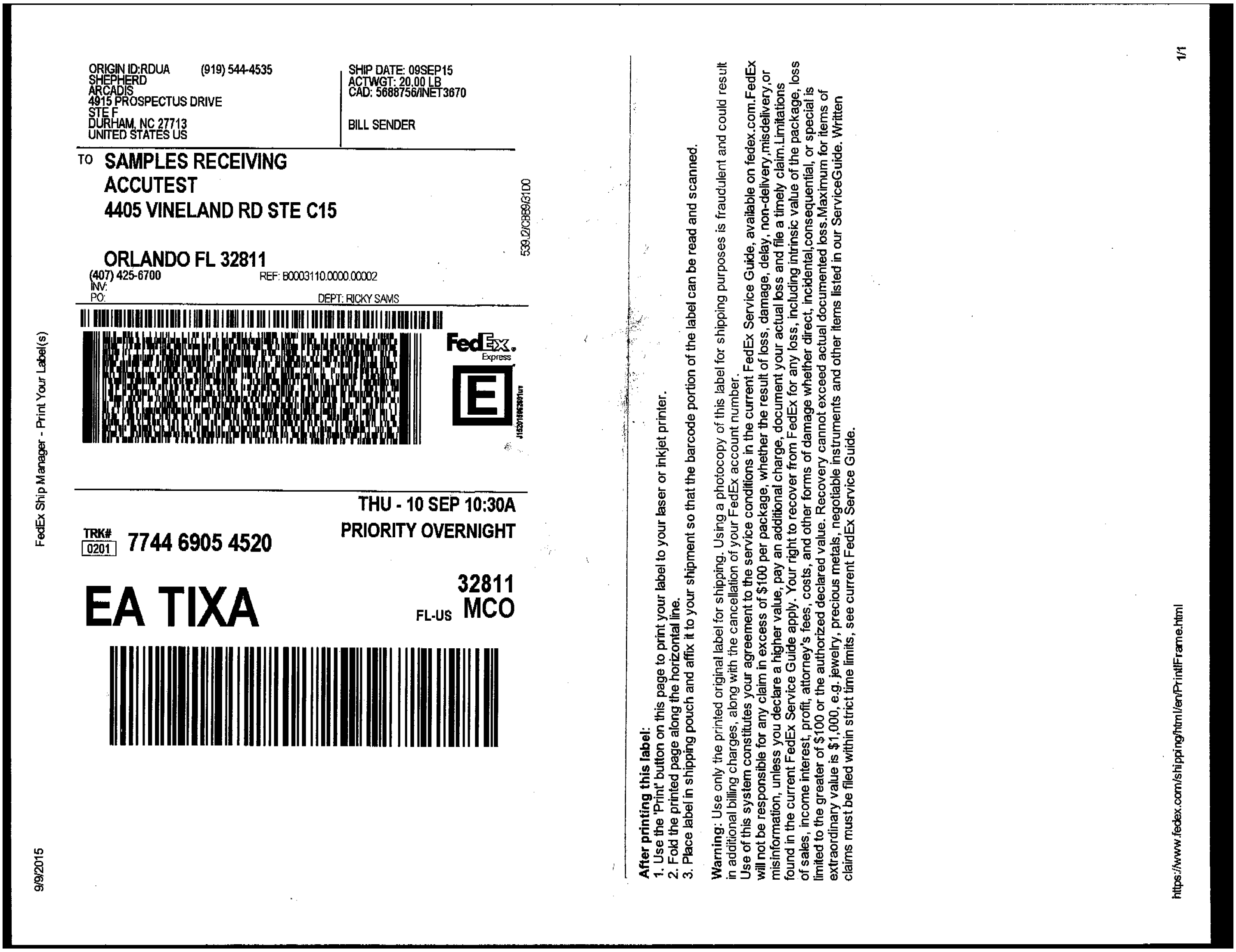
☐ INCORRECT NUMBER OF CONTAINERS USED
☐ SAMPLE RECEIVED IMPROPERLY PRESERVED
☐ INSUFFICIENT VOLUME FOR ANALYSIS
☐ DATES/TIMES ON COC DO NOT MATCH SAMPLE LABEL
☐ ID'S ON COC DO NOT MATCH LABEL
☐ VOC VIALS HAVE HEADSPACE (MACRO BUBBLES)
☐ BOTTLES RECEIVED BUT ANALYSIS NOT REQUESTED
☐ NO BOTTLES RECEIVED FOR ANALYSIS REQUESTED
☐ UNCLEAR FILTERING OR COMPOSITING INSTRUCTIONS
☐ SAMPLE CONTAINER(S) RECEIVED BROKEN
☐ 5035 FIELD KITS NOT RECEIVED WITHIN 48 HOURS
☐ BULK VOA SOIL JARS NOT RECEIVED WITHIN 48 HOURS
☐ % SOLIDS JAR NOT RECEIVED
☐ RESIDUAL CHLORINE PRESENT LOT#______
{APPLICABLE TO EPA 600 SERIES OR NORTH CAROLINA ORGANICS}

pH PAPER LOT#s WIDI HC131225 NARROW RANGE AO36133 OTHER (specify) 405-230010

SUMMARY OF COMMENTS:

TECHNICIAN SIGNATURE/DATE 9-10-15 REVIEWER SIGNATURE/DATE 9-10-15

NF 10/14 YELLOWSHEET110514.xls



ORIGIN ID:RDUA (919) 544-4535
SHEPHERD
ARCADIS
4915 PROSPECTUS DRIVE
STE F
DURHAM, NC 27713
UNITED STATES US

SHIP DATE: 09SEP15
ACTWGT: 20.00 LB
CAD: 5688756/INET3670

BILL SENDER

TO **SAMPLES RECEIVING**
ACCUTEST
4405 VINELAND RD STE C15

ORLANDO FL 32811
(407) 425-6700 REF: B0003110.0000.00002
INV:
PO: DEPT: RICKY SAMS

539J2/CBB9/31D0

FedEx Express

E

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THU - 10 SEP 10:30A
PRIORITY OVERNIGHT

TRK# 0201 **7744 6905 4520**

EA TIXA

32811
FL-US **MCO**

FedEx Ship Manager - Print Your Label(s)

9/9/2015

After printing this label:
1. Use the 'Print' button on this page to print your label to your laser or inkjet printer.
2. Fold the printed page along the horizontal line.
3. Place label in shipping pouch and affix it to your shipment so that the barcode portion of the label can be read and scanned.

Warning: Use only the printed original label for shipping. Using a photocopy of this label for shipping purposes is fraudulent and could result in additional billing charges, along with the cancellation of your FedEx account number.
Use of this system constitutes your agreement to the service conditions in the current FedEx Service Guide, available on fedex.com.FedEx will not be responsible for any claim in excess of $100 per package, whether the result of loss, damage, delay, non-delivery,misdelivery,or misinformation, unless you declare a higher value, pay an additional charge, document your actual loss and file a timely claim.Limitations found in the current FedEx Service Guide apply. Your right to recover from FedEx for any loss, including intrinsic value of the package, loss of sales, income interest, profit, attorney's fees, costs, and other forms of damage whether direct, incidental,consequential, or special is limited to the greater of $100 or the authorized declared value. Recovery cannot exceed actual documented loss.Maximum for items of extraordinary value is $1,000, e.g. jewelry, precious metals, negotiable instruments and other items listed in our ServiceGuide. Written claims must be filed within strict time limits, see current FedEx Service Guide.

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1/1

Southeast
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LABORATORIES

Metals Analysis

QC Data Summaries

Includes the following where applicable:

- Method Blank Summaries
- Matrix Spike and Duplicate Summaries
- Blank Spike and Lab Control Sample Summaries
- Serial Dilution Summaries

BLANK RESULTS SUMMARY
Part 2 - Method Blanks

Login Number: FA27431
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29375
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

Prep Date: 09/14/15 09/14/15

Metal	RL	IDL	MDL	MB raw	final	MB raw	final
Aluminum	0.20	.014	.014				
Antimony	0.0060	.001	.001				
Arsenic	0.010	.0013	.0013				
Barium	0.20	.001	.005				
Beryllium	0.0040	.0002	.0002				
Cadmium	0.0050	.0002	.0002				
Calcium	1.0	.05	.05				
Chromium	0.010	.001	.001				
Cobalt	0.050	.0002	.0002				
Copper	0.025	.001	.001				
Iron	0.30	.017	.017				
Lead	0.0050	.001	.0011	-0.00020	<0.0050	-0.00020	<0.0050
Magnesium	5.0	.035	.035				
Manganese	0.015	.0005	.001				
Molybdenum	0.050	.0003	.0003				
Nickel	0.040	.0004	.0004				
Potassium	10	.2	.2				
Selenium	0.010	.0024	.0029				
Silver	0.010	.0007	.0007				
Sodium	10	.5	.5				
Strontium	0.010	.0005	.0005				
Thallium	0.010	.0011	.0014				
Tin	0.050	.0009	.001				
Titanium	0.010	.0005	.001				
Vanadium	0.050	.0005	.0006				
Zinc	0.020	.003	.01				

Associated samples MP29375: FA27431-1, FA27431-2, FA27431-3

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(anr) Analyte not requested

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: FA27431
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29375
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

Prep Date: 09/14/15 09/14/15

Metal	FA27431-3 Original	DUP	RPD	QC Limits	FA27431-3 Original	MS	Spikelot MPFLICP2	% Rec	QC Limits
Aluminum									
Antimony									
Arsenic									
Barium									
Beryllium									
Cadmium									
Calcium									
Chromium									
Cobalt									
Copper									
Iron									
Lead	0.072	0.072	0.0	0-20	0.072	0.57	0.50	99.6	80-120
Magnesium									
Manganese									
Molybdenum									
Nickel									
Potassium									
Selenium									
Silver									
Sodium									
Strontium									
Thallium									
Tin									
Titanium									
Vanadium									
Zinc									

Associated samples MP29375: FA27431-1, FA27431-2, FA27431-3

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(N) Matrix Spike Rec. outside of QC limits
(anr) Analyte not requested

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: FA27431
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29375
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

Prep Date:					09/14/15				09/14/15	
Metal	FA27431-3 Original	MSD	Spikelot MPFLICP2	% Rec	MSD RPD	QC Limit	FA27431-1 Original	DUP	RPD	QC Limits
Aluminum										
Antimony										
Arsenic										
Barium										
Beryllium										
Cadmium										
Calcium										
Chromium										
Cobalt										
Copper										
Iron										
Lead	0.072	0.58	0.50	101.6	1.7	20	0.11	0.11	0.0	0-20
Magnesium										
Manganese										
Molybdenum										
Nickel										
Potassium										
Selenium										
Silver										
Sodium										
Strontium										
Thallium										
Tin										
Titanium										
Vanadium										
Zinc										

Associated samples MP29375: FA27431-1, FA27431-2, FA27431-3

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(N) Matrix Spike Rec. outside of QC limits
(anr) Analyte not requested

SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: FA27431
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29375
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

Prep Date: 09/14/15 09/14/15

Metal	BSP Result	Spikelot MPFLICP2	% Rec	QC Limits	BSP Result	Spikelot MPFLICP2	% Rec	QC Limits
Aluminum								
Antimony								
Arsenic								
Barium								
Beryllium								
Cadmium								
Calcium								
Chromium								
Cobalt								
Copper								
Iron								
Lead	0.50	0.50	100.0	80-120	0.50	0.50	100.0	80-120
Magnesium								
Manganese								
Molybdenum								
Nickel								
Potassium								
Selenium								
Silver								
Sodium								
Strontium								
Thallium								
Tin								
Titanium								
Vanadium								
Zinc								

Associated samples MP29375: FA27431-1, FA27431-2, FA27431-3

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(anr) Analyte not requested

SERIAL DILUTION RESULTS SUMMARY

Login Number: FA27431
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29375
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: ug/l

Prep Date: 09/14/15

Metal	FA27431-3 Original	SDL 1:5	%DIF	QC Limits
Aluminum				
Antimony				
Arsenic				
Barium				
Beryllium				
Cadmium				
Calcium				
Chromium				
Cobalt				
Copper				
Iron				
Lead	71.8	71.0	1.1	0-10
Magnesium				
Manganese				
Molybdenum				
Nickel				
Potassium				
Selenium				
Silver				
Sodium				
Strontium				
Thallium				
Tin				
Titanium				
Vanadium				
Zinc				

Associated samples MP29375: FA27431-1, FA27431-2, FA27431-3

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(anr) Analyte not requested

Southeast
ACCUTEST
LABORATORIES

09/30/15

Technical Report for

ARCADIS

Burrows Island, WA

B0003110.0000.00001

Accutest Job Number: FA27723

Sampling Date: 09/18/15

Report to:

ARCADIS Geraghty & Miller
801 Corporate Center Dr Suite 300
Raleigh, NC 27607
david.liles@arcadis-us.com; ricky.sams@arcadis-us.com

ATTN: David Liles

Total number of pages in report: **47**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Norm Farmer

Norm Farmer
Technical Director

Client Service contact: Heather Wandrey 407-425-6700

Certifications: FL (E83510), LA (03051), KS (E-10327), IA (366), IL (200063), NC (573), NJ (FL002), SC (96038001)
DoD ELAP (L-A-B L2229), CA (2937), TX (T104704404), PA (68-03573), VA (460177),
AK, AR, GA, KY, MA, NV, OK, UT, WA

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Test results relate only to samples analyzed.

Table of Contents

-1-

Sample Summary

ARCADIS

Job No: FA27723

Burrows Island, WA
Project No: B0003110.0000.00001

Sample Number	Collected Date	Time	By	Received	Matrix Code	Type	Client Sample ID
FA27723-1	09/18/15	12:00	RS	09/19/15	SO	Soil	CONTROL-02/03 WEEK 4
FA27723-1A	09/18/15	12:00	RS	09/19/15	SO	Soil	CONTROL-02/03 WEEK 4
FA27723-2	09/18/15	12:00	RS	09/19/15	SO	Soil	CONTROL-01 WEEK 4
FA27723-2A	09/18/15	12:00	RS	09/19/15	SO	Soil	CONTROL-01 WEEK 4
FA27723-3	09/18/15	12:00	RS	09/19/15	SO	Soil	TSP-1 WEEK 4
FA27723-3A	09/18/15	12:00	RS	09/19/15	SO	Soil	TSP-1 WEEK 4
FA27723-4	09/18/15	12:00	RS	09/19/15	SO	Soil	TSP-2 WEEK 4
FA27723-4A	09/18/15	12:00	RS	09/19/15	SO	Soil	TSP-2 WEEK 4
FA27723-5	09/18/15	12:00	RS	09/19/15	SO	Soil	TSP-3 WEEK 4
FA27723-5A	09/18/15	12:00	RS	09/19/15	SO	Soil	TSP-3 WEEK 4

Soil samples reported on a dry weight basis unless otherwise indicated on result page.

Summary of Hits

Job Number: FA27723
Account: ARCADIS
Project: Burrows Island, WA
Collected: 09/18/15

Lab Sample ID Analyte	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
FA27723-1	**CONTROL-02/03 WEEK 4**					
pH, SPLP Leachate [a]		7.22			su	SW846 1312
Lead		0.14	0.0050		mg/l	SW846 6010C
FA27723-1A	**CONTROL-02/03 WEEK 4**					
Lead		2600	13		mg/kg	SW846 6010C
Phosphate, Ortho		5.2	1.5		mg/kg	EPA 365.3 M
FA27723-2	**CONTROL-01 WEEK 4**					
pH, SPLP Leachate [b]		7.42			su	SW846 1312
Lead		0.18	0.0050		mg/l	SW846 6010C
FA27723-2A	**CONTROL-01 WEEK 4**					
Lead		1990	5.6		mg/kg	SW846 6010C
Phosphate, Ortho		3.4	1.5		mg/kg	EPA 365.3 M
FA27723-3	**TSP-1 WEEK 4**					
pH, SPLP Leachate [c]		7.52			su	SW846 1312
Lead		0.20	0.0050		mg/l	SW846 6010C
FA27723-3A	**TSP-1 WEEK 4**					
Lead		2180	6.4		mg/kg	SW846 6010C
Phosphate, Ortho		162	77		mg/kg	EPA 365.3 M
FA27723-4	**TSP-2 WEEK 4**					
pH, SPLP Leachate [d]		6.56			su	SW846 1312
Lead		0.17	0.0050		mg/l	SW846 6010C
FA27723-4A	**TSP-2 WEEK 4**					
Lead		3360	14		mg/kg	SW846 6010C
Phosphate, Ortho		476	160		mg/kg	EPA 365.3 M
FA27723-5	**TSP-3 WEEK 4**					
pH, SPLP Leachate [e]		6.22			su	SW846 1312
Lead		0.16	0.0050		mg/l	SW846 6010C

Summary of Hits

Job Number: FA27723
Account: ARCADIS
Project: Burrows Island, WA
Collected: 09/18/15

Lab Sample ID Analyte	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
FA27723-5A	**TSP-3 WEEK 4**					
Lead		2080	7.4		mg/kg	SW846 6010C
Phosphate, Ortho		854	400		mg/kg	EPA 365.3 M

(a) Sample pH was 5.62 prior to leaching.
(b) Sample pH was 6.23 prior to leaching.
(c) Sample pH was 5.92 prior to leaching.
(d) Sample pH was 5.89 prior to leaching.
(e) Sample pH was 5.79 prior to leaching.

Sample Results

Report of Analysis

Report of Analysis

Client Sample ID:	CONTROL-02/03 WEEK 4		
Lab Sample ID:	FA27723-1	**Date Sampled:**	09/18/15
Matrix:	SO - Soil	**Date Received:**	09/19/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

Metals Analysis, SPLP Leachate SW846 1312

Analyte	Result	MCL	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	0.14		0.0050	mg/l	1	09/22/15	09/22/15	LM	SW846 6010C [1]	SW846 3010A [2]

(1) Instrument QC Batch: MA12668
(2) Prep QC Batch: MP29420

RL = Reporting Limit
MCL = Maximum Contamination Level (not available)

Report of Analysis

Client Sample ID:	CONTROL-02/03 WEEK 4		
Lab Sample ID:	FA27723-1	**Date Sampled:**	09/18/15
Matrix:	SO - Soil	**Date Received:**	09/19/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
pH, SPLP Leachate [a]	7.22		su	1	09/21/15	CP	SW846 1312

(a) Sample pH was 5.62 prior to leaching.

RL = Reporting Limit

Report of Analysis

Client Sample ID:	CONTROL-02/03 WEEK 4		
Lab Sample ID:	FA27723-1A	**Date Sampled:**	09/18/15
Matrix:	SO - Soil	**Date Received:**	09/19/15
		Percent Solids:	66.5
Project:	Burrows Island, WA		

Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	2600	13	mg/kg	10	09/22/15	09/23/15	LM	SW846 6010C [1]	SW846 3050B [2]

(1) Instrument QC Batch: MA12669
(2) Prep QC Batch: MP29418

RL = Reporting Limit

Report of Analysis

Client Sample ID:	CONTROL-02/03 WEEK 4		
Lab Sample ID:	FA27723-1A	**Date Sampled:**	09/18/15
Matrix:	SO - Soil	**Date Received:**	09/19/15
		Percent Solids:	66.5
Project:	Burrows Island, WA		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Phosphate, Ortho	5.2	1.5	mg/kg	1	09/22/15 19:20	FN	EPA 365.3 M
Solids, Percent	66.5		%	1	09/22/15 13:40	JL	SM19 2540G

RL = Reporting Limit

Report of Analysis

Client Sample ID:	CONTROL-01 WEEK 4		
Lab Sample ID:	FA27723-2	**Date Sampled:**	09/18/15
Matrix:	SO - Soil	**Date Received:**	09/19/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

Metals Analysis, SPLP Leachate SW846 1312

Analyte	Result	MCL	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	0.18		0.0050	mg/l	1	09/22/15	09/22/15	LM	SW846 6010C [1]	SW846 3010A [2]

(1) Instrument QC Batch: MA12668
(2) Prep QC Batch: MP29420

RL = Reporting Limit
MCL = Maximum Contamination Level (not available)

Report of Analysis

Client Sample ID:	CONTROL-01 WEEK 4		
Lab Sample ID:	FA27723-2	**Date Sampled:**	09/18/15
Matrix:	SO - Soil	**Date Received:**	09/19/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
pH, SPLP Leachate [a]	7.42		su	1	09/21/15	CP	SW846 1312

(a) Sample pH was 6.23 prior to leaching.

RL = Reporting Limit

Report of Analysis

Client Sample ID:	CONTROL-01 WEEK 4		
Lab Sample ID:	FA27723-2A	**Date Sampled:**	09/18/15
Matrix:	SO - Soil	**Date Received:**	09/19/15
		Percent Solids:	65.7
Project:	Burrows Island, WA		

Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	1990	5.6	mg/kg	5	09/22/15	09/23/15	LM	SW846 6010C [1]	SW846 3050B [2]

(1) Instrument QC Batch: MA12669
(2) Prep QC Batch: MP29418

RL = Reporting Limit

Report of Analysis

Client Sample ID:	CONTROL-01 WEEK 4		
Lab Sample ID:	FA27723-2A	**Date Sampled:**	09/18/15
Matrix:	SO - Soil	**Date Received:**	09/19/15
		Percent Solids:	65.7
Project:	Burrows Island, WA		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Phosphate, Ortho	3.4	1.5	mg/kg	1	09/22/15 19:20	FN	EPA 365.3 M
Solids, Percent	65.7		%	1	09/22/15 13:40	JL	SM19 2540G

RL = Reporting Limit

Report of Analysis

Client Sample ID:	TSP-1 WEEK 4		
Lab Sample ID:	FA27723-3	**Date Sampled:**	09/18/15
Matrix:	SO - Soil	**Date Received:**	09/19/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

Metals Analysis, SPLP Leachate SW846 1312

Analyte	Result	MCL	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	0.20		0.0050	mg/l	1	09/22/15	09/22/15	LM	SW846 6010C [1]	SW846 3010A [2]

(1) Instrument QC Batch: MA12668
(2) Prep QC Batch: MP29420

RL = Reporting Limit
MCL = Maximum Contamination Level (not available)

Report of Analysis

Client Sample ID: TSP-1 WEEK 4
Lab Sample ID: FA27723-3
Matrix: SO - Soil
Project: Burrows Island, WA

Date Sampled: 09/18/15
Date Received: 09/19/15
Percent Solids: n/a

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
pH, SPLP Leachate [a]	7.52		su	1	09/21/15	CP	SW846 1312

(a) Sample pH was 5.92 prior to leaching.

RL = Reporting Limit

Report of Analysis

Client Sample ID:	TSP-1 WEEK 4		
Lab Sample ID:	FA27723-3A	**Date Sampled:**	09/18/15
Matrix:	SO - Soil	**Date Received:**	09/19/15
		Percent Solids:	65.2
Project:	Burrows Island, WA		

Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	2180	6.4	mg/kg	5	09/22/15	09/23/15	LM	SW846 6010C [1]	SW846 3050B [2]

(1) Instrument QC Batch: MA12669
(2) Prep QC Batch: MP29418

RL = Reporting Limit

Report of Analysis

Client Sample ID:	TSP-1 WEEK 4		
Lab Sample ID:	FA27723-3A	**Date Sampled:**	09/18/15
Matrix:	SO - Soil	**Date Received:**	09/19/15
		Percent Solids:	65.2
Project:	Burrows Island, WA		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Phosphate, Ortho	162	77	mg/kg	50	09/22/15 19:20	FN	EPA 365.3 M
Solids, Percent	65.2		%	1	09/22/15 13:40	JL	SM19 2540G

RL = Reporting Limit

Report of Analysis

Client Sample ID:	TSP-2 WEEK 4		
Lab Sample ID:	FA27723-4	**Date Sampled:**	09/18/15
Matrix:	SO - Soil	**Date Received:**	09/19/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

Metals Analysis, SPLP Leachate SW846 1312

Analyte	Result	MCL	RL	Units	DF	Prep	Analyzed By		Method	Prep Method
Lead	0.17		0.0050	mg/l	1	09/22/15	09/22/15	LM	SW846 6010C [1]	SW846 3010A [2]

(1) Instrument QC Batch: MA12668
(2) Prep QC Batch: MP29420

RL = Reporting Limit
MCL = Maximum Contamination Level (not available)

Report of Analysis

Client Sample ID:	TSP-2 WEEK 4		
Lab Sample ID:	FA27723-4	**Date Sampled:**	09/18/15
Matrix:	SO - Soil	**Date Received:**	09/19/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
pH, SPLP Leachate [a]	6.56		su	1	09/21/15	CP	SW846 1312

(a) Sample pH was 5.89 prior to leaching.

RL = Reporting Limit

Report of Analysis

Client Sample ID:	TSP-2 WEEK 4		
Lab Sample ID:	FA27723-4A	**Date Sampled:**	09/18/15
Matrix:	SO - Soil	**Date Received:**	09/19/15
		Percent Solids:	62.7
Project:	Burrows Island, WA		

Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	3360	14	mg/kg	10	09/22/15	09/23/15	LM	SW846 6010C [1]	SW846 3050B [2]

(1) Instrument QC Batch: MA12669
(2) Prep QC Batch: MP29418

RL = Reporting Limit

Report of Analysis

Client Sample ID:	TSP-2 WEEK 4			
Lab Sample ID:	FA27723-4A		**Date Sampled:**	09/18/15
Matrix:	SO - Soil		**Date Received:**	09/19/15
			Percent Solids:	62.7
Project:	Burrows Island, WA			

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Phosphate, Ortho	476	160	mg/kg	100	09/22/15 19:20	FN	EPA 365.3 M
Solids, Percent	62.7		%	1	09/22/15 13:40	JL	SM19 2540G

RL = Reporting Limit

Report of Analysis

Client Sample ID:	TSP-3 WEEK 4		
Lab Sample ID:	FA27723-5	**Date Sampled:**	09/18/15
Matrix:	SO - Soil	**Date Received:**	09/19/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

Metals Analysis, SPLP Leachate SW846 1312

Analyte	Result	MCL	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	0.16		0.0050	mg/l	1	09/22/15	09/22/15	LM	SW846 6010C [1]	SW846 3010A [2]

(1) Instrument QC Batch: MA12668
(2) Prep QC Batch: MP29420

RL = Reporting Limit
MCL = Maximum Contamination Level (not available)

Report of Analysis

Client Sample ID:	TSP-3 WEEK 4		
Lab Sample ID:	FA27723-5	**Date Sampled:**	09/18/15
Matrix:	SO - Soil	**Date Received:**	09/19/15
		Percent Solids:	n/a
Project:	Burrows Island, WA		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
pH, SPLP Leachate [a]	6.22		su	1	09/21/15	CP	SW846 1312

(a) Sample pH was 5.79 prior to leaching.

RL = Reporting Limit

Report of Analysis

Client Sample ID:	TSP-3 WEEK 4		
Lab Sample ID:	FA27723-5A	**Date Sampled:**	09/18/15
Matrix:	SO - Soil	**Date Received:**	09/19/15
		Percent Solids:	61.8
Project:	Burrows Island, WA		

Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Lead	2080	7.4	mg/kg	5	09/22/15	09/23/15	LM	SW846 6010C [1]	SW846 3050B [2]

(1) Instrument QC Batch: MA12669
(2) Prep QC Batch: MP29418

RL = Reporting Limit

Report of Analysis

Client Sample ID:	TSP-3 WEEK 4		
Lab Sample ID:	FA27723-5A	**Date Sampled:**	09/18/15
Matrix:	SO - Soil	**Date Received:**	09/19/15
		Percent Solids:	61.8
Project:	Burrows Island, WA		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Phosphate, Ortho	854	400	mg/kg	250	09/22/15 19:20	FN	EPA 365.3 M
Solids, Percent	61.8		%	1	09/22/15 13:40	JL	SM19 2540G

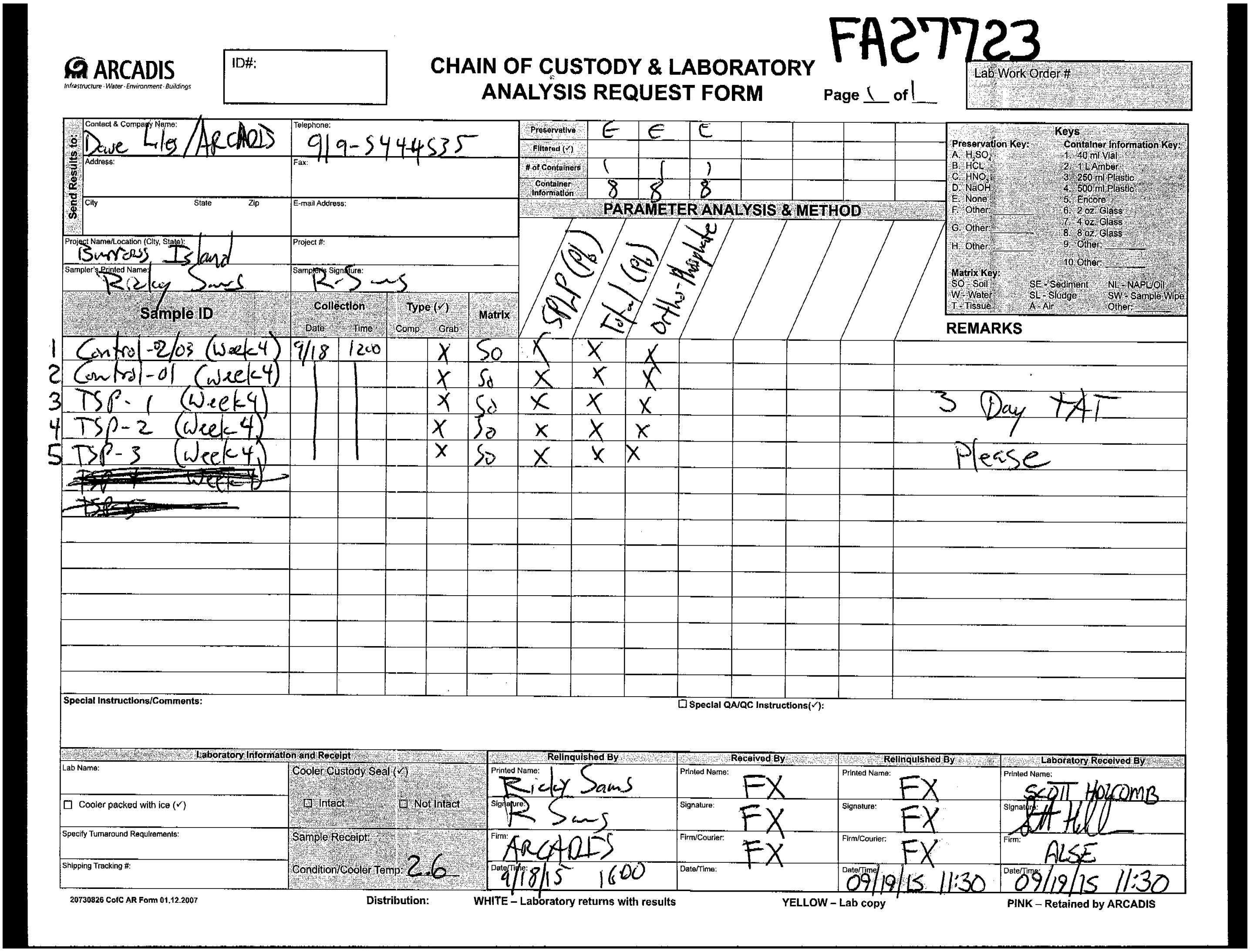
RL = Reporting Limit

Misc. Forms

Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody



FA27723

ARCADIS
Infrastructure · Water · Environment · Buildings

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page 1 of 1

Lab Work Order #

Send Results to: Contact & Company Name: Dave Liles/ARCADIS	Telephone: 919-5444535
Address:	Fax:
City State Zip	E-mail Address:
Project Name/Location (City, State): Burrows Island	Project #:
Sampler's Printed Name: Ricky Sams	Sampler's Signature: R Sams

Preservative	E	E	E	
Filtered (✓)				
# of Containers	1	1	1	
Container Information	8	8	8	

PARAMETER ANALYSIS & METHOD

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: ______
G. Other: ______
H. Other: ______

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: ______
10. Other: ______

Matrix Key:
SO - Soil
W - Water
T - Tissue
SE - Sediment
SL - Sludge
A - Air
NL - NAPL/Oil
SW - Sample Wipe
Other: ______

	Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix	SPLP (Pb)	Total (Pb)	Ortho-Phosphate	REMARKS
1	Control-2/03 (Week4)	9/18	1200		X	So	X	X	X	
2	Control-01 (Week4)	|	|		X	So	X	X	X	
3	TSP-1 (Week4)	|	|		X	So	X	X	X	3 Day TAT
4	TSP-2 (Week4)	|	|		X	So	X	X	X	
5	TSP-3 (Week4)	|	|		X	So	X	X	X	Please
	~~TSP-[illegible] (Week4)~~									
	~~TSP-[illegible]~~									

Special Instructions/Comments:

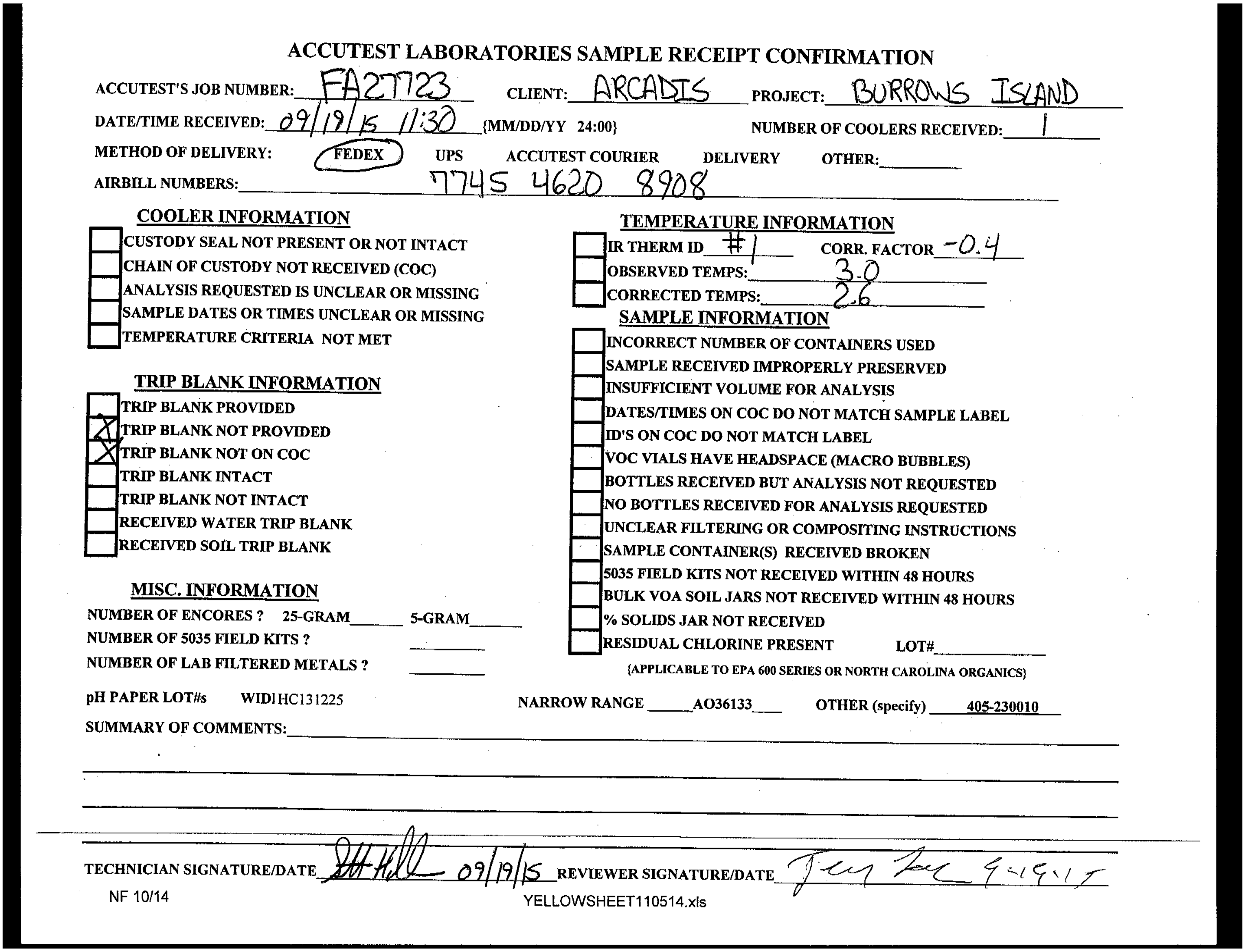
☐ **Special QA/QC Instructions(✓):**

Laboratory Information and Receipt		**Relinquished By**	**Received By**	**Relinquished By**	**Laboratory Received By**
Lab Name:	Cooler Custody Seal (✓)	Printed Name: Ricky Sams	Printed Name: FX	Printed Name: FX	Printed Name: SCOTT HOLCOMB
☐ Cooler packed with ice (✓)	☐ Intact ☐ Not Intact	Signature: R Sams	Signature: FX	Signature: FX	Signature:
Specify Turnaround Requirements:	Sample Receipt:	Firm: ARCADIS	Firm/Courier: FX	Firm/Courier: FX	Firm: ALSE
Shipping Tracking #:	Condition/Cooler Temp: 2.6	Date/Time: 9/18/15 1600	Date/Time:	Date/Time: 09/19/15 11:30	Date/Time: 09/19/15 11:30

20730826 CofC AR Form 01.12.2007

Distribution: WHITE – Laboratory returns with results YELLOW – Lab copy PINK – Retained by ARCADIS

FA27723: Chain of Custody
Page 1 of 3



ACCUTEST LABORATORIES SAMPLE RECEIPT CONFIRMATION

ACCUTEST'S JOB NUMBER: FA27723 CLIENT: ARCADIS PROJECT: BURROWS ISLAND

DATE/TIME RECEIVED: 09/19/15 11:30 {MM/DD/YY 24:00} NUMBER OF COOLERS RECEIVED: 1

METHOD OF DELIVERY: [✓ FEDEX] UPS ACCUTEST COURIER DELIVERY OTHER:

AIRBILL NUMBERS: 7745 4620 8908

COOLER INFORMATION

- ☐ CUSTODY SEAL NOT PRESENT OR NOT INTACT
- ☐ CHAIN OF CUSTODY NOT RECEIVED (COC)
- ☐ ANALYSIS REQUESTED IS UNCLEAR OR MISSING
- ☐ SAMPLE DATES OR TIMES UNCLEAR OR MISSING
- ☐ TEMPERATURE CRITERIA NOT MET

TRIP BLANK INFORMATION

- ☐ TRIP BLANK PROVIDED
- ☒ TRIP BLANK NOT PROVIDED
- ☒ TRIP BLANK NOT ON COC
- ☐ TRIP BLANK INTACT
- ☐ TRIP BLANK NOT INTACT
- ☐ RECEIVED WATER TRIP BLANK
- ☐ RECEIVED SOIL TRIP BLANK

MISC. INFORMATION

NUMBER OF ENCORES ? 25-GRAM______ 5-GRAM______

NUMBER OF 5035 FIELD KITS ? ______

NUMBER OF LAB FILTERED METALS ? ______

TEMPERATURE INFORMATION

- ☐ IR THERM ID #1 CORR. FACTOR -0.4
- ☐ OBSERVED TEMPS: 3.0
- ☐ CORRECTED TEMPS: 2.6

SAMPLE INFORMATION

- ☐ INCORRECT NUMBER OF CONTAINERS USED
- ☐ SAMPLE RECEIVED IMPROPERLY PRESERVED
- ☐ INSUFFICIENT VOLUME FOR ANALYSIS
- ☐ DATES/TIMES ON COC DO NOT MATCH SAMPLE LABEL
- ☐ ID'S ON COC DO NOT MATCH LABEL
- ☐ VOC VIALS HAVE HEADSPACE (MACRO BUBBLES)
- ☐ BOTTLES RECEIVED BUT ANALYSIS NOT REQUESTED
- ☐ NO BOTTLES RECEIVED FOR ANALYSIS REQUESTED
- ☐ UNCLEAR FILTERING OR COMPOSITING INSTRUCTIONS
- ☐ SAMPLE CONTAINER(S) RECEIVED BROKEN
- ☐ 5035 FIELD KITS NOT RECEIVED WITHIN 48 HOURS
- ☐ BULK VOA SOIL JARS NOT RECEIVED WITHIN 48 HOURS
- ☐ % SOLIDS JAR NOT RECEIVED
- ☐ RESIDUAL CHLORINE PRESENT LOT#______

{APPLICABLE TO EPA 600 SERIES OR NORTH CAROLINA ORGANICS}

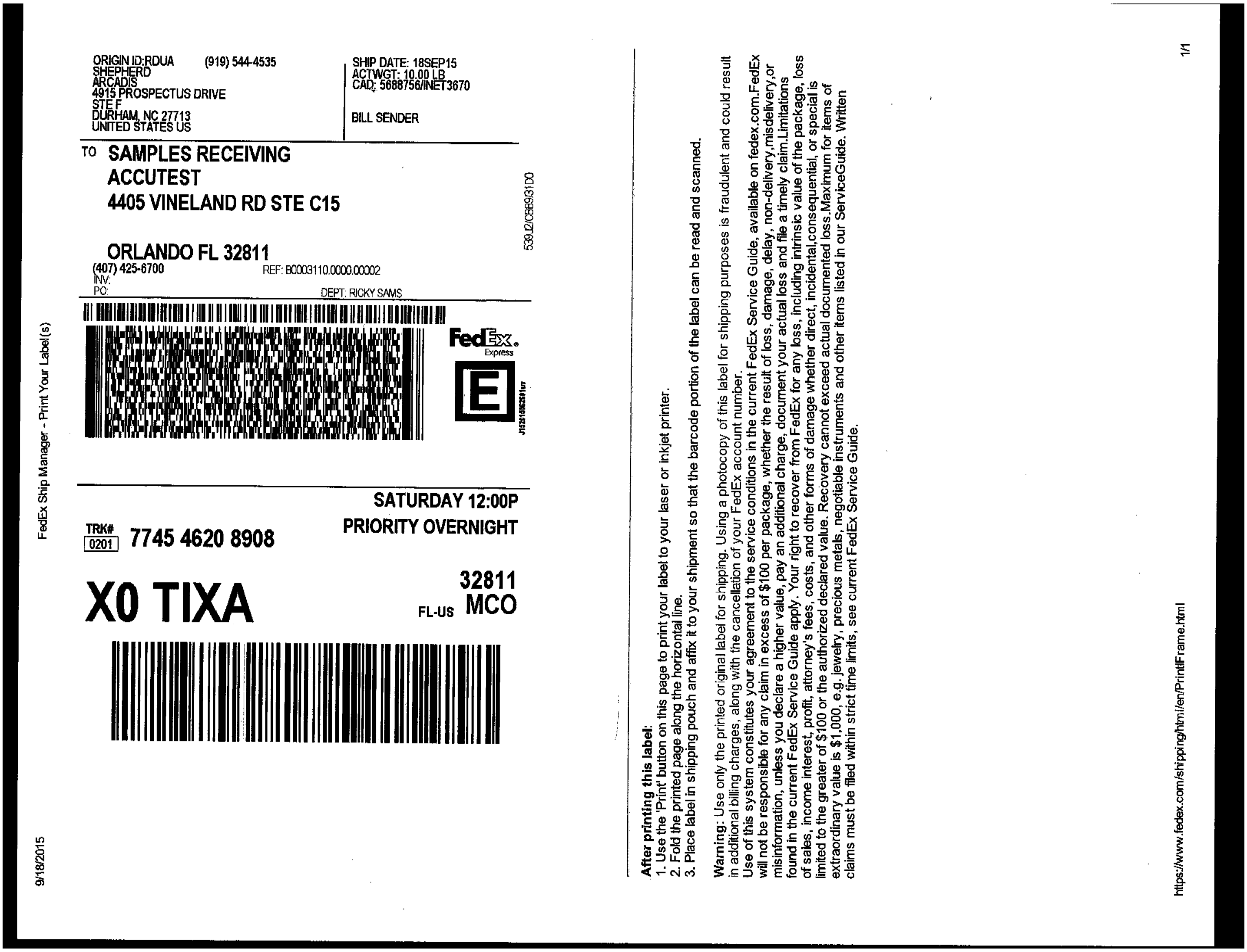
pH PAPER LOT#s WIDE HC131225 NARROW RANGE A036133 OTHER (specify) 405-230010

SUMMARY OF COMMENTS:

TECHNICIAN SIGNATURE/DATE 09/19/15 REVIEWER SIGNATURE/DATE 9-19-15

NF 10/14

YELLOWSHEET110514.xls



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ORIGIN ID:RDUA (919) 544-4535
SHEPHERD
ARCADIS
4915 PROSPECTUS DRIVE
STE F
DURHAM, NC 27713
UNITED STATES US

SHIP DATE: 18SEP15
ACTWGT: 10.00 LB
CAD: 5688756/INET3670

BILL SENDER

TO SAMPLES RECEIVING
ACCUTEST
4405 VINELAND RD STE C15

ORLANDO FL 32811
(407) 425-6700 REF: B0003110.0000.00002
INV:
PO: DEPT: RICKY SAMS

539J2/CBB9/31D0

FedEx Express

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9/18/2015

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1/1

Southeast ACCUTEST LABORATORIES

Metals Analysis

QC Data Summaries

Includes the following where applicable:

- Method Blank Summaries
- Matrix Spike and Duplicate Summaries
- Blank Spike and Lab Control Sample Summaries
- Serial Dilution Summaries

BLANK RESULTS SUMMARY
Part 2 - Method Blanks

Login Number: FA27723
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29418
Matrix Type: SOLID

Methods: SW846 6010C
Units: mg/kg

Prep Date: 09/22/15

Metal	RL	IDL	MDL	MB raw	final
Aluminum	10	.7	1.8		
Antimony	1.0	.05	.065		
Arsenic	0.50	.065	.1		
Barium	10	.05	.05		
Beryllium	0.25	.01	.025		
Cadmium	0.20	.01	.025		
Calcium	250	2.5	2.5		
Chromium	0.50	.05	.05		
Cobalt	2.5	.01	.025		
Copper	1.3	.05	.05		
Iron	15	.85	.85		
Lead	1.0	.05	.05	0.025	<1.0
Magnesium	250	1.8	1.8		
Manganese	0.75	.025	.025		
Molybdenum	2.5	.015	.025		
Nickel	2.0	.02	.025		
Potassium	500	10	10		
Selenium	1.0	.12	.12		
Silver	0.50	.035	.041		
Sodium	500	25	25		
Strontium	0.50	.025	.025		
Thallium	0.50	.055	.055		
Tin	2.5	.045	.045		
Titanium	0.50	.025	.025		
Vanadium	2.5	.025	.025		
Zinc	1.0	.15	.15		

Associated samples MP29418: FA27723-1A, FA27723-2A, FA27723-3A, FA27723-4A, FA27723-5A

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(anr) Analyte not requested

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: FA27723
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29418
Matrix Type: SOLID

Methods: SW846 6010C
Units: mg/kg

			Prep Date: 09/22/15					Prep Date: 09/22/15	
	FA27751-1			QC	FA27751-1		Spikelot		QC
Metal	Original	DUP	RPD	Limits	Original	MS	MPFLICP2	% Rec	Limits
Aluminum									
Antimony									
Arsenic	anr								
Barium	anr								
Beryllium									
Cadmium	anr								
Calcium									
Chromium									
Cobalt									
Copper									
Iron	anr								
Lead	85.7	80.2 (a)	11.1	0-20	85.7	152 (a)	23.8	262.6N(b	80-120
Magnesium									
Manganese									
Molybdenum									
Nickel									
Potassium									
Selenium									
Silver									
Sodium									
Strontium									
Thallium									
Tin									
Titanium									
Vanadium									
Zinc									

Associated samples MP29418: FA27723-1A, FA27723-2A, FA27723-3A, FA27723-4A, FA27723-5A

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(N) Matrix Spike Rec. outside of QC limits
(anr) Analyte not requested
(a) Elevated reporting limit(s) due to matrix interference.
(b) Spike recovery indicates possible matrix interference and/or sample non-homogeneity.

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: FA27723
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29418
Matrix Type: SOLID

Methods: SW846 6010C
Units: mg/kg

Prep Date: 09/22/15

Metal	FA27751-1 Original	MSD	Spikelot MPFLICP2	% Rec	MSD RPD	QC Limit
Aluminum						
Antimony						
Arsenic	anr					
Barium	anr					
Beryllium						
Cadmium	anr					
Calcium						
Chromium						
Cobalt						
Copper						
Iron	anr					
Lead	85.7	105 (a)	20.4	75.5 (b)	36.6 (c)	20
Magnesium						
Manganese						
Molybdenum						
Nickel						
Potassium						
Selenium						
Silver						
Sodium						
Strontium						
Thallium						
Tin						
Titanium						
Vanadium						
Zinc						

Associated samples MP29418: FA27723-1A, FA27723-2A, FA27723-3A, FA27723-4A, FA27723-5A

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(N) Matrix Spike Rec. outside of QC limits
(anr) Analyte not requested
(a) Elevated reporting limit(s) due to matrix interference.
(b) Spike amount low relative to the sample amount. Refer to lab control or spike blank for recovery information.
(c) High RPD due to possible sample non-homogeneity.

SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: FA27723
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29418
Matrix Type: SOLID

Methods: SW846 6010C
Units: mg/kg

Prep Date: 09/22/15

Metal	BSP Result	Spikelot MPFLICP2	% Rec	QC Limits
Aluminum				
Antimony				
Arsenic	anr			
Barium	anr			
Beryllium				
Cadmium	anr			
Calcium				
Chromium				
Cobalt				
Copper				
Iron	anr			
Lead	23.6	25	94.4	80-120
Magnesium				
Manganese				
Molybdenum				
Nickel				
Potassium				
Selenium				
Silver				
Sodium				
Strontium				
Thallium				
Tin				
Titanium				
Vanadium				
Zinc				

Associated samples MP29418: FA27723-1A, FA27723-2A, FA27723-3A, FA27723-4A, FA27723-5A

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(anr) Analyte not requested

SERIAL DILUTION RESULTS SUMMARY

Login Number: FA27723
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29418
Matrix Type: SOLID

Methods: SW846 6010C
Units: ug/l

Prep Date: 09/22/15

Metal	FA27751-1 Original	SDL 1:5	%DIF	QC Limits
Aluminum	anr			
Antimony	anr			
Arsenic	anr			
Barium	anr			
Beryllium	anr			
Cadmium	anr			
Calcium	anr			
Chromium	anr			
Cobalt	anr			
Copper	anr			
Iron	anr			
Lead	1740	1740	0.3	0-10
Magnesium				
Manganese	anr			
Molybdenum	anr			
Nickel	anr			
Potassium	anr			
Selenium	anr			
Silver	anr			
Sodium	anr			
Strontium	anr			
Thallium	anr			
Tin	anr			
Titanium				
Vanadium	anr			
Zinc	anr			

Associated samples MP29418: FA27723-1A, FA27723-2A, FA27723-3A, FA27723-4A, FA27723-5A

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(anr) Analyte not requested

POST DIGESTATE SPIKE SUMMARY

Login Number: FA27723
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29418
Matrix Type: SOLID

Methods: SW846 6010C
Units: ug/l

Prep Date: 09/22/15

Metal	Sample ml	Final ml	FA27751-1 Raw	Corr.**	PS ug/l	Spike ml	Spike ug/ml	Spike ug/l	% Rec	QC Limits
Aluminum										
Antimony										
Arsenic										
Barium										
Beryllium										
Cadmium										
Calcium										
Chromium										
Cobalt										
Copper										
Iron										
Lead	9.8	10	1663	1703.24	1817	0.2	2.5	50	227.5*(a	80-120
Magnesium										
Manganese										
Molybdenum										
Nickel										
Potassium										
Selenium										
Silver										
Sodium										
Strontium										
Thallium										
Tin										
Titanium										
Vanadium										
Zinc										

Associated samples MP29418: FA27723-1A, FA27723-2A, FA27723-3A, FA27723-4A, FA27723-5A

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(**) Corr. sample result = Raw * (sample volume / final volume)
(anr) Analyte not requested
(a) Spike recovery indicates matrix interference and/or outside control limits due to high level in sample relative to spike amount.

BLANK RESULTS SUMMARY
Part 2 - Method Blanks

Login Number: FA27723
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29420
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

					Prep Date: 09/22/15		Prep Date: 09/22/15
Metal	RL	IDL	MDL	MB raw	final	MB raw	final
Aluminum	0.20	.014	.014				
Antimony	0.0060	.001	.001				
Arsenic	0.010	.0013	.0013				
Barium	0.20	.001	.005				
Beryllium	0.0040	.0002	.0002				
Cadmium	0.0050	.0002	.0002				
Calcium	1.0	.05	.05				
Chromium	0.010	.001	.001				
Cobalt	0.050	.0002	.0002				
Copper	0.025	.001	.001				
Iron	0.30	.017	.017				
Lead	0.0050	.001	.0011	-0.00010	<0.0050	0.0	<0.0050
Magnesium	5.0	.035	.035				
Manganese	0.015	.0005	.001				
Molybdenum	0.050	.0003	.0003				
Nickel	0.040	.0004	.0004				
Potassium	10	.2	.2				
Selenium	0.010	.0024	.0029				
Silver	0.010	.0007	.0007				
Sodium	10	.5	.5				
Strontium	0.010	.0005	.0005				
Thallium	0.010	.0011	.0014				
Tin	0.050	.0009	.001				
Titanium	0.010	.0005	.001				
Vanadium	0.050	.0005	.0006				
Zinc	0.020	.003	.01				

Associated samples MP29420: FA27723-1, FA27723-2, FA27723-3, FA27723-4, FA27723-5

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(anr) Analyte not requested

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: FA27723
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29420
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

	FA27723-5			QC	FA27723-5		Spikelot		QC
Metal	Original	DUP	RPD	Limits	Original	MS	MPFLICP2	% Rec	Limits
Prep Date:			09/22/15					09/22/15	
Aluminum									
Antimony									
Arsenic									
Barium									
Beryllium									
Cadmium									
Calcium									
Chromium									
Cobalt									
Copper									
Iron									
Lead	0.16	0.16	0.0	0-20	0.16	0.67	0.50	102.0	80-120
Magnesium									
Manganese									
Molybdenum									
Nickel									
Potassium									
Selenium									
Silver									
Sodium									
Strontium									
Thallium									
Tin									
Titanium									
Vanadium									
Zinc									

Associated samples MP29420: FA27723-1, FA27723-2, FA27723-3, FA27723-4, FA27723-5

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(N) Matrix Spike Rec. outside of QC limits
(anr) Analyte not requested

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: FA27723
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29420
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

	FA27723-5		Spikelot		MSD	QC	FA27723-1			QC
Prep Date:					09/22/15				09/22/15	
Metal	Original	MSD	MPFLICP2	% Rec	RPD	Limit	Original	DUP	RPD	Limits
Aluminum										
Antimony										
Arsenic										
Barium										
Beryllium										
Cadmium										
Calcium										
Chromium										
Cobalt										
Copper										
Iron										
Lead	0.16	0.66	0.50	100.0	1.5	20	0.14	0.097	36.3*(a)	0-20
Magnesium										
Manganese										
Molybdenum										
Nickel										
Potassium										
Selenium										
Silver										
Sodium										
Strontium										
Thallium										
Tin										
Titanium										
Vanadium										
Zinc										

Associated samples MP29420: FA27723-1, FA27723-2, FA27723-3, FA27723-4, FA27723-5

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(N) Matrix Spike Rec. outside of QC limits
(anr) Analyte not requested
(a) High RPD due to possible sample non-homogeneity.

SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: FA27723
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29420
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: mg/l

Prep Date:		09/22/15				09/22/15		
Metal	BSP Result	Spikelot MPFLICP2	% Rec	QC Limits	BSP Result	Spikelot MPFLICP2 % Rec		QC Limits
Aluminum								
Antimony								
Arsenic								
Barium								
Beryllium								
Cadmium								
Calcium								
Chromium								
Cobalt								
Copper								
Iron								
Lead	0.50	0.50	100.0	80-120	0.50	0.50	100.0	80-120
Magnesium								
Manganese								
Molybdenum								
Nickel								
Potassium								
Selenium								
Silver								
Sodium								
Strontium								
Thallium								
Tin								
Titanium								
Vanadium								
Zinc								

Associated samples MP29420: FA27723-1, FA27723-2, FA27723-3, FA27723-4, FA27723-5

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(anr) Analyte not requested

SERIAL DILUTION RESULTS SUMMARY

Login Number: FA27723
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

QC Batch ID: MP29420
Matrix Type: LEACHATE

Methods: SW846 6010C
Units: ug/l

Prep Date: 09/22/15

Metal	FA27723-5 Original	SDL 1:5	%DIF	QC Limits
Aluminum				
Antimony				
Arsenic				
Barium				
Beryllium				
Cadmium				
Calcium				
Chromium				
Cobalt				
Copper				
Iron				
Lead	157	134	14.5*(a)	0-10
Magnesium				
Manganese				
Molybdenum				
Nickel				
Potassium				
Selenium				
Silver				
Sodium				
Strontium				
Thallium				
Tin				
Titanium				
Vanadium				
Zinc				

Associated samples MP29420: FA27723-1, FA27723-2, FA27723-3, FA27723-4, FA27723-5

Results < IDL are shown as zero for calculation purposes
(*) Outside of QC limits
(anr) Analyte not requested
(a) Serial dilution indicates possible matrix interference.

Southeast

ACCUTEST

LABORATORIES

General Chemistry

QC Data Summaries

Includes the following where applicable:

- Method Blank and Blank Spike Summaries
- Duplicate Summaries
- Matrix Spike Summaries

METHOD BLANK AND SPIKE RESULTS SUMMARY
GENERAL CHEMISTRY

Login Number: FA27723
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

Analyte	Batch ID	RL	MB Result	Units	Spike Amount	BSP Result	BSP %Recov	QC Limits
Phosphate, Ortho	GP26675/GN67932	1.0	0.0	mg/kg	3.0	3.3	109.2	78-121%

Associated Samples:
Batch GP26675: FA27723-1A, FA27723-2A, FA27723-3A, FA27723-4A, FA27723-5A
(*) Outside of QC limits

DUPLICATE RESULTS SUMMARY
GENERAL CHEMISTRY

Login Number: FA27723
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

Analyte	Batch ID	QC Sample	Units	Original Result	DUP Result	RPD	QC Limits
Solids, Percent	GN67918	FA27723-2A	%	65.7	66.8	1.7	0-5%

Associated Samples:
Batch GN67918: FA27723-1A, FA27723-2A, FA27723-3A, FA27723-4A, FA27723-5A
(*) Outside of QC limits

MATRIX SPIKE RESULTS SUMMARY
GENERAL CHEMISTRY

Login Number: FA27723
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

Analyte	Batch ID	QC Sample	Units	Original Result	Spike Amount	MS Result	%Rec	QC Limits
Phosphate, Ortho	GP26675/GN67932	FA27723-5A	mg/kg	854	4.9	1960	91.3	78-121%

Associated Samples:
Batch GP26675: FA27723-1A, FA27723-2A, FA27723-3A, FA27723-4A, FA27723-5A
(*) Outside of QC limits
(N) Matrix Spike Rec. outside of QC limits

MATRIX SPIKE DUPLICATE RESULTS SUMMARY
GENERAL CHEMISTRY

Login Number: FA27723
Account: ARCNCR - ARCADIS
Project: Burrows Island, WA

Analyte	Batch ID	QC Sample	Units	Original Result	Spike Amount	MSD Result	RPD	QC Limit
Phosphate, Ortho	GP26675/GN67932	FA27723-5A	mg/kg	854	4.9	2010	2.4	31%

Associated Samples:
Batch GP26675: FA27723-1A, FA27723-2A, FA27723-3A, FA27723-4A, FA27723-5A
(*) Outside of QC limits
(N) Matrix Spike Rec. outside of QC limits

Table [3a]. Potential Federal and State Chemical-Specific Applicable or Relevant and Appropriate Requirements and To Be Considered Guidance [United States Coast Guard SITE, CITY, Michigan]

[THIS TABLE IS TABLE 3a AS INCLUDED IN THE ENGINEERING EVALUATION/COST ANALYSIS AND TABLE 1a IN THE REMOVAL ACTION WORK PLAN AND REMOVAL ACTION COMPLETION REPORT. IF TABLES ARE ADDED OR REMOVED TO THE REPORTS, CHANGE THE TABLE NUMBER ACCORDINGLY.]

Constituent of Concern and Media [ADD OR REMOVE COC AND MEDIA AS APPRORIATE]	**Authority**	**Act**	**Statute, Regulation, Administrative Code, or Guidance Document**	**Status** [REMOVE "POTENTIALLY" OR REPLACE "POTENTIALLY" WITH "NOT" AS APPROPRIATE]	**Synopsis of Requirement, Criteria, or Guidance** [IF STATUTE, REGULATION, CODE, OR GUIDANCE REGULATION IS NOT SELECTED AS AN ARAR OR TBC, PROVIDE BRIEF EXPLAINATION FOR WHY IT WAS NOT SELECTED]	**Consideration/Comments** [REMOVE THIS COLUMN AFTER SELECTING SITE-SPECIFIC ARARs and TBCs]
Lead in Soil	Federal Regulatory Requirement and/or Criteria.	Toxic Substances Control Act (TSCA) (Sections 401 through 403)	15 United States Code (USC) 2681 through 2683 15 USC 2681-2683 40 Code of Federal Regulations (CFR) Part 745 Subpart D Lead-Based Paint Hazards Sections 745.61, 745.63, 745.65 40 CFR 745	[Potentially] Relevant and Appropriate.	The regulation sets a hazard standard of 400 milligrams per kilogram (mg/kg) by weight in play areas, based on play area bare soil samples and an average of 1,200 mg/kg in bare soil samples collected in the remainder of a residential yard (assumes vegetated soil cover in an area other than the child's play area as the exposure scenario). Cleanup level for lead in soils at hazardous waste sites and levels greater than these could be consistent with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) requirements, depending on site-specific factors.	REMOVE IF FUTURE LAND USE IS NOT ANTICIPATED TO BE RESIDENTIAL OR IF RESIDENTIAL LAND USE IS NOT SELECTED AS THE DEFAULT CONSERVATIVE SCENARIO IN THE DEVELOPMENT OF THE REMOVAL ACTION OBJECTIVES (RAO).
	Federal Advisories, Guidance, and Training Material.	NA	Revised Interim Soil Lead Guidance for CERCLA Sites and Resource Conservation and Recovery Act (RCRA) Corrective Action Facilities, Office of Solid Waste and Emergency Response (OSWER) Directive #9355.4-12 (United States Environmental Protection Agency 1994) OSWER Directive 9355.4-12 Clarification to the 1994 Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, OSWER Directive 9200.4-27P(United States Environmental Protection Agency 1998) Clarification Memo	[Potentially] To Be Considered.	These documents are non-promulgated guidance to be used as guidelines for evaluating site investigation data. Describes how to develop site-specific Preliminary Remediation Goals (PRGs) at CERCLA Sites and Media Clean-up Standards (MCSs) at RCRA Corrective Action facilities for residential land use. They describe a plan for soil lead cleanup at CERCLA sites and RCRA Corrective Action facilities that have multiple sources of lead. The recommended Screening Levels for Lead in Soil is 400 mg/kg for generic residential land use (assumes bare soil in child's play area as the exposure scenario).	REMOVE IF FUTURE LAND USE IS NOT ANTICIPATED TO BE RESIDENTIAL OR IF RESIDENTIAL LAND USE IS NOT SELECTED AS THE DEFAULT CONSERVATIVE SCENARIO IN THE DEVELOPMENT OF THE REMOVAL ACTION OBJECTIVES.
		NA	Recommendations of the Technical Review Workgroup (TRW) for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil. Technical Review Workgroup for Lead (TRW), Washington, D.C. (United States Environmental Protection Agency 1996.) USEPA Technical Working Group for Lead 1996	[Potentially] To Be Considered.	This is non-promulgated guidance that describes a methodology for assessing risks associated with non-residential adult exposures to lead in soil.	REMOVE IF RESIDENTIAL LAND USE AND/OR GENERIC CRITERIA ARE SELECTED IN THE DEVELOPMENT OF THE REMOVAL ACTION OBJECTIVES.
		NA	United States Environmental Protection Agency (USEPA) Integrated Exposure Uptake Biokinetic (IEUBK) Model for lead. And Adult Lead Models (ALM). IEUBK and ALM Models	[Potentially] To Be Considered.	These values are non-promulgated models used to assess risks associated with lead.	REMOVE IF RESIDENTIAL LAND USE AND/OR GENERIC CRITERIA ARE SELECTED IN THE DEVELOPMENT OF THE REMOVAL ACTION OBJECTIVES.
		NA	Ecological Soil Screening Levels for Lead Interim Final OSWER Directive 9285.7-70. ECO SSLs for Lead	[Potentially] To Be Considered.	These values are non-promulgated guidance for evaluating potential risk to terrestrial ecological receptors. These screening levels should be used to identify the contaminants of potential concern (COPCs) that require further evaluation in the site-specific baseline ecological risk assessment. However, the Eco-Soil Screening Levels (SSLs) are not designed to be used as cleanup levels and the USEPA emphasizes that it would be inappropriate to adopt or modify the intended use of these Eco-SSLs as national cleanup standards. Lead Eco –SSLs include 120 mg/kg (Plants), 1,700 mg/kg (Soil Invertebrates), 11 mg/kg (Avian), 56 mg/kg (Mammalian).	CONSIDER USING IF THREATENED AND ENDANGERED SPECIES ARE PRESENT AT THE SITE AND ARE CONSIDERED RECEPTORS. REMOVE IF POTENTIAL ECOLOGICAL RECEPTORS ARE NOT BEING EVALUATED.
	State Requirements and/or Criteria.	Natural Resources Environmental Protection Act of 1994, Public Act 451 as amended (NREPA)	Michigan Compiled Law 324, Part 201, Michigan Administrative Code (MAC) Rules 299.5706, 299.5707, 299.5718 through 299.5726, 299.5732, 299.5746, 299.5748, 299.5750, and 299.5752. MAC Rules for Part 201	[Potentially] Relevant and Appropriate.	These are promulgated statues and rules associated with cleanup criteria. See Tables 2 and 3 in the MAC Rules for Generic Criteria and Screening Levels for each land use category. Generic Criteria for Lead in soil are: • Residential and Commercial I, Commercial III, and Commercial IV = 400 mg/kg • Recreational = NA (use Rule 299.5732 for site-specific criterion calculation) • Commercial II = 900 mg/kg • Drinking Water Protection = 700 mg/kg • Groundwater/Surface-Water Interface Protection = Varies depending on pH and hardness of receiving water (see footnote G in R299.5750) Alternatively, development of a site-specific limited criterion for lead is allowed by Rule 299.5732 and is calculated based on site-specific exposure pathway evaluation, exposure controls measures, and land-use considerations.	IT IS ANTICPITED THAT THE STATE OF MICHIGAN WILL LIST NREPA PART 201 AS AN ARAR FOR ALL LEAD IN SOIL REMOVAL ACTIONS.
	State Advisories, Guidance, and Training Material.	NA	Michigan Department of Environmental Quality (MDEQ) Remediation and Redevelopment Divisions (RRD) Operational Memorandum Number 1 (Part 201 Cleanup Criteria). MDEQ RRD Op Memo 1	[Potentially] To Be Considered.	This document is a non-promulgated memorandum prepared by the MDEQ to provide guidance on satisfying the cleanup criteria requirements under NREPA Part 201; it defines land-use categories and provides updated and interim cleanup criteria and screening levels. The attachments to the operational memorandum provide technical support documentation for the chemical physical data and algorithms used to calculate the criteria.	OPERATIONAL MEMORANDUM NUMBER 1 IS A COMPANION DOCUMENT TO THE PART 201 RULES. REMOVE AS TBC, IF THE PART 201 RULES ARE NOT SELECTED AS ARARs.
		NA	MDEQ RRD Operational Memorandum Number 2 (Part 201Sampling and Analysis Guidance). MDEQ RRD Op Memo 2	[Potentially] To Be Considered.	This document is a non-promulgated memorandum prepared by the MDEQ to provide guidance on target detection limits and designated analytical methods; soil leaching methods; sample preservation; sampling, handling, and holding times; and the collection of samples for comparison to generic Criteria	OPERATIONAL MEMORANDUM NO. 2 IS A COMPANION DOCUMENT TO THE PART 201 RULES. REMOVE AS TBC IF THE PART 201 RULES ARE NOT SELECTED AS ARARs.

Table [3a]. Potential Federal and State Chemical-Specific Applicable or Relevant and Appropriate Requirements and To Be Considered Guidance [United States Coast Guard SITE, CITY, Michigan]

[THIS TABLE IS TABLE 3a AS INCLUDED IN THE ENGINEERING EVALUATION/COST ANALYSIS AND TABLE 1a IN THE REMOVAL ACTION WORK PLAN AND REMOVAL ACTION COMPLETION REPORT. IF TABLES ARE ADDED OR REMOVED TO THE REPORTS, CHANGE THE TABLE NUMBER ACCORDINGLY.]

Constituent of Concern and Media [ADD OR REMOVE COC AND MEDIA AS APPRORIATE]	**Authority**	**Act**	**Statute, Regulation, Administrative Code, or Guidance Document**	**Status** [REMOVE "POTENTIALLY" OR REPLACE "POTENTIALLY" WITH "NOT" AS APPROPRIATE]	**Synopsis of Requirement, Criteria, or Guidance** [IF STATUTE, REGULATION, CODE, OR GUIDANCE REGULATION IS NOT SELECTED AS AN ARAR OR TBC, PROVIDE BRIEF EXPLAINATION FOR WHY IT WAS NOT SELECTED]	**Consideration/Comments** [REMOVE THIS COLUMN AFTER SELECTING SITE-SPECIFIC ARARs and TBCs]
Lead in Air	Federal Regulatory Requirement and/or Criteria.	Clean Air Act (CAA)	42 USC 7409 42 USC 7409 40 CFR 50.12 and Appendix G to Part 50. 40 CFR 50.12 Appendix G to Part 50	[Potentially] Applicable.	These rules establish emissions limits for lead and describe test methods and procedures to determine emissions. The national primary and secondary ambient air quality standards for lead and its compounds, measured as elemental lead by a reference method based on Appendix G to 40 CFR 50, or by an equivalent method, are 1.5 micrograms per cubic meter (μg/m^3), maximum arithmetic mean averaged over a calendar quarter.	REMOVE IF SOIL EXCAVATION OR OTHER TECHNOLOGIES THAT MAY GENERATE DUST CONTAINING LEAD ARE NOT SELECTED.
	Federal Advisories, Guidance, and Training Material.	NA	None.	None.	None.	ADD REFERENCE TO ADDITIONAL ARARs IF NECESSARY IF COCs OTHER THAN LEAD IMPACTS ARE COMINGLED WITH THE LEAD IN SOIL IMPACTS AT THE SITE.
	State Regulatory Requirement and/or Criteria.	NA	Michigan Air Pollution Control Rules Part 2. Air Use Approval Exemptions R336.1290. Part 2 Air Use Approval Exemptions	[Potentially] Applicable.	Establishes exemption from permit to install for emission units with limited emissions. Establishes thresholds and limits by pollutant type and recordkeeping requirements.	REMOVE IF SOIL EXCAVATION OR OTHER TECHNOLOGIES THAT MAY GENERATE DUST CONTAINING LEAD ARE NOT SELECTED.
	State Advisories and Guidance.	NA	None.	None.	None.	ADD REFERENCE TO ADDITIONAL ARARs IF NECESSARY IF COCs OTHER THAN LEAD IMPACTS ARE COMINGLED WITH THE LEAD IN SOIL IMPACTS AT THE SITE
Lead in Water (Groundwater and Surface Water)	Federal Regulatory Requirement and/or Criteria.	Safe Drinking Water Act (SDWA) Act 399 of 1976 (SDWA)	42 USC Chapter 6A Public Health Section 300g. 42 USC 300g National Primary Drinking Water Standards-Maximum Contaminant Levels (MCLs) (40 CFR 141). 40 CFR 141	[Potentially] Relevant and Appropriate.	MCLs have been promulgated for a number of common organic and inorganic contaminants. These levels regulate the concentration of contaminants in public drinking water supplies based on health effects and technical capabilities. MCLs may also be considered relevant and appropriate for groundwater aquifers potentially used for drinking water sources. The MCL for lead in drinking water is 0.015 milligrams per liter (mg/L).	REMOVE IF GROUNDWATER AND WASTEWATER SOURCES ARE NOT IMPACTED WITH LEAD ASSOCIATED WITH THE LEAD-BASED PAINT AT THE SITE AND/OR IF THE SITE GROUNDWATER BELOW THE SITE IS NOT USED AS A DRINKING WATER SOURCE DUE TO A USE RESTRICTION OR AN ORDINANCE.
		SDWA	42 USC Chapter 6A Public Health Section 300g. 42 USC 300g Maximum Contaminant Level Goals (MCLGs) (40 CFR 141). 40 CFR 141	[Potentially] To be Considered.	These rules establish Health Based Drinking Water Quality goals at the levels of anticipated adverse health effects, with an adequate margin of safety. The MCLG for lead is 0.00 mg/L.	REMOVE IF GROUNDWATER AND WASTEWATER SOURCES ARE NOT IMPACTED WITH LEAD ASSOCIATED WITH THE LEAD-BASED PAINT AT THE SITE
		Clean Water Act (CWA)	Effluent Limitations 33 USC 1311. 33 USC 1311 General pretreatment regulations for existing and new sources of pollution (40 CFR 403). 40 CFR 403	[Potentially] Applicable.	These rules establish a list of toxic pollutants and promulgate pretreatment standards for discharges into publicly owned treatment works (POTWs).	REMOVE IF GROUNDWATER AND SURFACE WATER ARE NOT IMPACTED WITH LEAD ASSOCIATED WITH THE LEAD-BASED PAINT AT THE SITE, AND THERE WILL NOT BE DISCHARGE TO A POTW
		CWA	Water Pollution Prevention and Control, Standards and Enforcement, 33 USC 1313 through 1314. USC 33 General Provisions (40 CFR Parts 401). 40 CFR 401	[Potentially] Relevant and Appropriate.	Ambient water quality criteria are developed for the protection of freshwater and marine aquatic life and for the protection of human health from the ingestion of water and/or organisms.	REMOVE IF GROUNDWATER AND SURFACE WATER ARE NOT IMPACTED WITH LEAD ASSOCIATED WITH THE LEAD-BASED PAINT AT THE SITE
	Federal Advisories, Guidance, and Training Material.	NA	USEPA Region 9 Human Health PRGs for Tap Water USEPA Region 9 PRGs	[Potentially] To be Considered.	These values are non-promulgated guidance to be used as guidelines for evaluating site investigation data. PRGs are based on potential adult worker exposure to water contaminants through incidental ingestion, inhalation, and dermal absorption. PRGs correspond to a lifetime cancer risk of 1.0 x 10^{-6} for carcinogens (i.e., one person in one million), or a hazard quotient of 1 for noncarcinogens. The Region 9 PRG for lead in tap water is 3.6E-03 micrograms per liter (μg/L).	REMOVE IF GROUNDWATER AND WASTEWATER SOURCES ARE NOT IMPACTED WITH LEAD ASSOCIATED WITH THE LEAD-BASED PAINT AT THE SITE AND/OR IF THE SITE GROUNDWATER BELOW THE SITE IS NOT USED AS A DRINKING WATER SOURCE DUE TO A USE RESTRICTION OR AN ORDINANCE.
		NA	USEPA IEUBK Model for and ALM IEUBK and ALM Models	[Potentially] To be Considered.	These values are non-promulgated models used to assess risks associated with lead.	
	State Regulatory Requirement.	NREPA, Act 451 of 1994	Michigan Compiled Laws Chapter 324, Part 201. MAC Rules, Groundwater Clean-up Criteria. R299.5706, R299.5708, R299.5709, R299.5710. R299.5712, R299.5716, R299.5730, R299.5732, and R299.5744. MAC Part 201 Rules	[Potentially] Relevant and Appropriate.	See Table1 in the MAC Part 201 Rules for Generic Criteria and Screening Levels. Generic Criteria for Lead in groundwater are • Residential and all Commercial Land-Use Drinking Water Protection = 0.004 mg/L • Groundwater/Surface-Water Interface = Varies depending on pH and hardness of receiving water (see footnote G and X in R299.5744) • Groundwater Contact = Not Calculated due to Insufficient Data Alternatively, the development of a site-specific limited criterion for lead is allowed by Rule 299.5732 and is calculated based on a site-specific exposure pathway evaluation, exposure controls measures, and land-use considerations.	REMOVE IF GROUNDWATER AND WASTEWATER SOURCES ARE NOT IMPACTED WITH LEAD ASSOCIATED WITH THE LEAD-BASED THE SITE IS NOT USED AS A DRINKING WATER SOURCE DUE TO A USE RESTRICTION OR AN ORDINANCE.

Table [3a]. Potential Federal and State Chemical-Specific Applicable or Relevant and Appropriate Requirements and To Be Considered Guidance [United States Coast Guard SITE, CITY, Michigan]

[THIS TABLE IS TABLE 3a AS INCLUDED IN THE ENGINEERING EVALUATION/COST ANALYSIS AND TABLE 1a IN THE REMOVAL ACTION WORK PLAN AND REMOVAL ACTION COMPLETION REPORT. IF TABLES ARE ADDED OR REMOVED TO THE REPORTS, CHANGE THE TABLE NUMBER ACCORDINGLY.]

Constituent of Concern and Media [ADD OR REMOVE COC AND MEDIA AS APPRORIATE]	**Authority**	**Act**	**Statute, Regulation, Administrative Code, or Guidance Document**	**Status** [REMOVE "POTENTIALLY" OR REPLACE "POTENTIALLY" WITH "NOT" AS APPROPRIATE]	**Synopsis of Requirement, Criteria, or Guidance** [IF STATUTE, REGULATION, CODE, OR GUIDANCE REGULATION IS NOT SELECTED AS AN ARAR OR TBC, PROVIDE BRIEF EXPLAINATION FOR WHY IT WAS NOT SELECTED]	**Consideration/Comments** [REMOVE THIS COLUMN AFTER SELECTING SITE-SPECIFIC ARARs and TBCs]
Lead in Water (Groundwater and Surface Water) Continued					These rules define effluent guidelines based on actual water quality, receiving stream properties, and appropriate water-quality criteria and specify remedial obligations. These rules may be relevant and appropriate for groundwater and wastewater discharges to surface water.	
		NREPA, Act 451 of 1994	Michigan Compiled Laws Chapter 324. MAC Rules Water Resources Protection (Part 31, Section 324.3109). MAC Part 31 Rules	[Potentially] Relevant and Appropriate.	These are promulgated statutes and rules associated with the discharge of pollutants to surface waters of the state.	REMOVE IF GROUNDWATER AND SURFACE WATER ARE NOT IMPACTED WITH LEAD ASSOCIATED WITH THE LEAD-BASED PAINT AT THE SITE
	State Advisories, Guidance, and Training Material.	NA	RRD Operational Memorandum Number 1 (Part 201 Cleanup Criteria). MDEQ RRD Op Memo 1	[Potentially] To be Considered.	This document is a non-promulgated memorandum prepared by the MDEQ to provide guidance on satisfying the cleanup criteria requirements under NREPA Part 201; it defines land-use categories and provides updated and interim cleanup criteria and screening levels. The attachments to the operational memorandum provide technical support documentation for the chemical/physical data and algorithms used to calculate the criteria.	OPERATIONAL MEMORANDUM NO. 1 IS A COMPANION DOCUMENT TO THE PART 201 RULES. REMOVE AS TBC, IF THE PART 201 RULES ARE NOT SELECTED AS ARARs.
		NA	MDEQ RRD Operational Memorandum Number 2 (Part 201 Sampling and Analysis Guidance). MDEQ RRD Op Memo 2	[Potentially] To be Considered.	This document is a non-promulgated memorandum prepared by the MDEQ to provide guidance on target detection limits and designated analytical methods; soil leaching methods; sample preservation; sampling, and handling and holding times; and the collection of samples for comparison to generic criteria.	OPERATIONAL MEMORANDUM NO. 2 IS A COMPANION DOCUMENT TO THE PART 201 RULES. REMOVE AS TBC IF THE PART 201 RULES ARE NOT SELECTED AS ARARs.
		NA	MDEQ RRD Operational Memorandum Number 5 (Part 201 Groundwater/Surface-Water Pathway Criteria). MDEQ RRD Op Memo 5	[Potentially] To be Considered.	This document is a non-promulgated memorandum prepared by the MDEQ to provide guidance on groundwater/surface-water interface criteria.	OPERATIONAL MEMORANDUM NO. 5 IS A COMPANION DOCUMENT TO THE PART 201 RULES. REMOVE AS TBC IF THE PART 201 RULES ARE NOT SELECTED AS ARARs.

Notes:

NA Not Applicable.

Table [3b]. Potential Location-Specific Applicable or Relevant and Appropriate Requirements and To Be Considered Requirements [United States Coast Guard Site, City, Michigan]

[THIS TABLE IS TABLE 3b AS INCLUDED IN THE ENGINEERING EVALUATION/COST ANALYSIS AND TABLE 1b IN THE REMOVAL ACTION WORK PLAN AND REMOVAL ACTION COMPLETION REPORT. IF TABLES ARE ADDED OR REMOVED TO THE REPORTS, CHANGE THE TABLE NUMBER ACCORDINGLY.]

Location [INCLUDE BRIEF DESCRIPTION OF THE SITE AND THE SPECIFIC AREA BEING INVESTIGATED OR ADDRESSED IN THE REMOVAL ACTION]	**Authority**	**Act**	**Statute, Regulation, Administrative Code, or Guidance Document**	**Status**	**Synopsis of Requirement, Criteria, or Guidance** [IF STATUTE, REGULATION, CODE, OR GUIDANCE REGULATION IS NOT SELECTED AS AN ARAR OR TBC, PROVIDE BRIEF EXPLAINATION FOR WHY IT WAS NOT SELECTED]	**Consideration/Comments** [REMOVE THIS COLUMN AFTER SELECTING ARARs and TBCs]
• Within or directly adjacent to a protected coastal area or wetland • Federally owned property • Registered National Historic Site • Within or directly adjacent to a wildlife refuge • Within or directly adjacent to Habitat for Endangered or • Within or directly adjacent to stop-over for migratory birds	Federal Regulatory Requirement.	National Historic Preservation Act of 1966.	National Historic Preservation 16 USC 470. USC 16 Section 470 Protection of Historic Properties (36 CFR 800). 36 CFR 800	[Potentially] Applicable.	These rules require the identification and preservation of historic and archaeological sites. The act created the National Register of Historic Places, the list of National Historic Landmarks, and the State Historic Preservation Offices. Among other things, the act requires federal agencies to evaluate the impact of all federally funded or permitted projects through a process known as a Section 106 Review.	MODIFY THE CITATION TO THE REQUIREMENTS TO NARROW THE ARAR TO SPECIFIC SECTIONS OF THE REGULATION IF HISTORICAL OR CULTURAL RESOURCES ARE DETERMINED TO NOT BE PRESENT.
		Fish and Wildlife Control Act.	National Wildlife Refuge System 16 USC 668dd (c). USC 16 Section 668dd Wildlife and Fisheries, Prohibited Acts 50 (CFR) 27. 50 CFR 27	[Potentially] Relevant and Appropriate.	These rules restrict activities within a national wildlife refuge.	REMOVE IF THE SITE OR ADJACENT PROPERTIES ARE NOT WITHIN A NATIONAL WILDLIFE REFUGE (E.G., NATIONAL FOREST).
		Migratory Bird Treaty Act.	Taking, killing, or possessing migratory birds is unlawful (16 USC 703). USC 16 Section 703 Importation, Exportation, and Transportation of Wildlife (50 CFR Part 14). 50 CFR 14	[Potentially] Relevant and Appropriate.	Actions taken or funded that result in the killing, hunting, taking, or capturing or any migratory birds, part, nest, or egg are unlawful.	REMOVE IF MIGRATORY BIRDS ARE NOT FOUND TO NEST OR INHABIT THE SITE BASED ON THE CONSULTATION WITH THE MICHIGAN DEPARTMENT OF NATURAL RESOURCES (MDNR).
		Endangered Species Act of 1973.	Endangered Species 16 USC 1531-1544. 16 USC Chapter 35 Endangered and Threatened Wildlife and Plants (50 CFR Part 17) 50 CFR 17 Cooperation of Endangered and Threatened Species of Fish, Wildlife, and plants – Cooperation with the States (50 CFR Part 81) 50 CFR 81 Threatened Maine and Anadromous Species (50 CFR Part 223) 50 CFR 223 Endangered Maine and Anadromous Species (50 CFR Part 224) 50 CFR 224 Designated Critical Habitat (50 CFR 226) 50 CFR 226 Interagency Cooperation Endangered Species Act of 1973 (50 CFR 402) 50 CFR 402	[Potentially] Relevant and Appropriate.	These rules require federal agencies to ensure that their actions do not jeopardize the continued existence of any threatened or endangered species or adversely modify the habitat of such species. The rules provide criteria for determining threatened and endangered species and require that federal agencies confer with the Fish and Wildlife Service and state agencies. For non-major construction, a request for determination of whether any listed species or habitat are in the project area is required, and based on that determination, a biological assessment may be also required.	MODIFY THE CITATION TO THE REQUIREMENTS TO NARROW THE ARAR TO SPECIFIC SECTIONS OF THE REGULATION IF THREATENED AND ENDANGERED SPECIES ARE DETERMINED TO NOT BE PRESENT.
	Federal Advisories, Guidance, and Training Material.	None.	None.	None.	None.	None.
	State Regulatory Requirement and/or Criteria.	Natural Resources Environmental and Protection Act of 1994, Public Act 451 as amended (NREPA).	Michigan Compiled Law 324 Part 365 Endangered Species Protection - Investigations; determinations; rule; review (Section 324.36503). Part 365 Section 324.36503 Michigan Department of Natural Resources (MDNR) Michigan Administrative Code (MAC) R299.1021 through R299.1028 R299.1021 through R299.1028 R299.1021 - 299.1028	[Potentially] Relevant and Appropriate.	These rules include species of mollusks, insects, fishes, amphibians, reptiles, birds, mammals, and plants on the States Endangered Species List.	REMOVE IF THREATENED AND ENDANGERED SPECIES ARE DETERMINED TO NOT BE PRESENT.

Table [3b]. Potential Location-Specific Applicable or Relevant and Appropriate Requirements and To Be Considered Requirements [United States Coast Guard Site, City, Michigan]

[THIS TABLE IS TABLE 3b AS INCLUDED IN THE ENGINEERING EVALUATION/COST ANALYSIS AND TABLE 1b IN THE REMOVAL ACTION WORK PLAN AND REMOVAL ACTION COMPLETION REPORT. IF TABLES ARE ADDED OR REMOVED TO THE REPORTS, CHANGE THE TABLE NUMBER ACCORDINGLY.]

Location [INCLUDE BRIEF DESCRIPTION OF THE SITE AND THE SPECIFIC AREA BEING INVESTIGATED OR ADDRESSED IN THE REMOVAL ACTION]	**Authority**	**Act**	**Statute, Regulation, Administrative Code, or Guidance Document**	**Status**	**Synopsis of Requirement, Criteria, or Guidance** [IF STATUTE, REGULATION, CODE, OR GUIDANCE REGULATION IS NOT SELECTED AS AN ARAR OR TBC, PROVIDE BRIEF EXPLAINATION FOR WHY IT WAS NOT SELECTED]	**Consideration/Comments** [REMOVE THIS COLUMN AFTER SELECTING ARARs and TBCs]
		NREPA.	Michigan Compiled Law 324 Part 365 Endangered Species Protection - Programs; cooperative agreements (Section 324.36504). Part 365 Section 324.36504 MAC R322.2.1 through 322.73.1 R322.2.1 - 322.73.1	[Potentially] Relevant and Appropriate.	The department may establish programs, including acquisition of land or aquatic habitat, as is considered necessary for the management of endangered or threatened species. The rules list the specific land and aquatic habit.	REMOVE IF THREATENED AND ENDANGERED SPECIES ARE DETERMINED TO NOT BE PRESENT.
		NREPA.	Michigan Compiled Law 324 Part 365 Endangered Species Protection – Prohibitions; exceptions (Section 324.36505). Part 365 Section 324.36505	[Potentially] Relevant and Appropriate.	Actions taken or funded involving the transport and possession of endangered or threatened species are unlawful.	REMOVE IF THREATENED AND ENDANGERED SPECIES ARE DETERMINED TO NOT BE PRESENT.
	State Advisories, Guidance, and Training Material.	None.	None.	None.	None.	None.

Table 3c. Potential Action-Specific Applicable or Relevant and Appropriate Requirements and To Be Considered Requirements [United States Coast Guard Site, City, Michigan]

[THIS TABLE IS TABLE 3c AS INCLUDED IN THE ENGINEERING EVALUATION/COST ANALYSIS AND TABLE 1c IN THE REMOVAL ACTION WORK PLAN AND REMOVAL ACTION COMPLETION REPORT. IF TABLES ARE ADDED OR REMOVED TO THE REPORTS, CHANGE THE TABLE NUMBER ACCORDINGLY.]

Action Include brief description of the action being conducted; for example, one or more of the following:	**Authority**	**Act or Statute**	**Regulation, Administrative Code, or Guidance Document**	**Status**	**Synopsis** [IF STATUTE, REGULATION, CODE, OR GUIDANCE REGULATION IS NOT SELECTED AS AN ARAR OR TBC, PROVIDE BRIEF EXPLAINATION FOR WHY IT WAS NOT SELECTED]	**Consideration/Comments** [REMOVE THIS COLUMN AFTER SELECTING ARARs and TBCs]
Excavation of lead-impacted soil and monitoring or remediation related to lead impacts to groundwater.	Federal Regulatory Requirement.	Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the 1986 Superfund Amendments and Reauthorization Act (SARA).	Federal Facilities 42 United States Code (USC) 9620 42 USC 9620 Reporting Hazardous Substance Activity When Selling or Transferring Federal Real Property (Title 40 Code of Federal Regulations [CFR] 373) 40 CFR 373	[Potentially] Applicable.	These rules require notifications related to hazardous substances prior to the sale or transfer of real property owned by the federal government. This is applicable if a property with residual contamination is transferred.	REMOVE IF REMOVAL ACTION SUCCESSFULLY ELIMINATES THE REPORTING REQUIREMENT.
		CERCLA as amended by the 1986 SARA.	National Contingency Plan (42 USC 9605). 42 USC 9605 National Contingency Plan (40 CFR Section 300.400 through 300.415). 40 CFR 300	[Potentially] Applicable.	These promulgated rules require performing a Removal Site Evaluation and a Removal Action including preparing certain documents (a Quality Assurance Project Plan [QAPP], a field sampling plan [FSP], and an engineering evaluation and cost assessment [EE/CA]), considering federal and state ARARs, soliciting community involvement, and providing notifications prior to the removal action.	REMOVE IF THE U.S. COAST GUARD DOES NOT TAKE THE LEAD AGENCY ROLE.
		Executive Order 12580 of January 23, 1987, Superfund Implementation.	Executive Order 12580- Superfund Implementation Executive Order 12580	[Potentially] Applicable.	The Executive Order provides federal agencies, including the United States Coast Guard, the authority to carry out their CERLCA responsibilities under the National Contingency Plan as a lead agency.	REMOVE IF THE U.S. COAST GUARD DOES NOT TAKE THE LEAD AGENCY ROLE.
		Resource Conservation and Recovery Act of 1976 (RCRA).	Identification and Listing of Hazardous Waste 42 USC 6921. 42 USC 6921 Identification and Listing of Hazardous Waste (40 CFR 261). 40 CFR 261 Land Disposal Restrictions 40 Part 268. 40 CFR 268	[Potentially] Applicable.	These regulations establish requirements for identifying any hazardous wastes that may be generated in the course of the removal action.	REMOVE IF SOIL IS NOT CHARACTERIZED AS HAZARDOUS WASTE.
		RCRA.	Standards Applicable to Generators of Hazardous Waste 42 USC 6922. 42 USC 6922 Standards Applicable to Generators of Hazardous Waste (40 CFR 262). 40 CFR 262 Standards Applicable to Transporters of Hazardous Waste (40 CFR 263). 40 CFR 263	[Potentially] Applicable.	These regulations establish requirements for the on-site management of any hazardous wastes that may be generated in the course of the remedial action.	REMOVE IF SOIL IS NOT CHARACTERIZED AS HAZARDOUS WASTE.
		RCRA.	Standards Applicable to Generators of Hazardous Waste. (42 USC 6923). 42 USC 6921 Standards Applicable to Transporters of Hazardous Waste (40 CFR 263). 40 CFR 263 Standards for Universal Waste Management (40 CFR 273). 40 CFR 273	[Potentially] Applicable.	These regulations establish requirements for the off-site transportation of any hazardous wastes that may be generated in the course of the remedial action.	REMOVE IF SOIL IS NOT CHARACTERIZED AS HAZARDOUS WASTE.

Table 3c. Potential Action-Specific Applicable or Relevant and Appropriate Requirements and To Be Considered Requirements [United States Coast Guard Site, City, Michigan]

[THIS TABLE IS TABLE 3c AS INCLUDED IN THE ENGINEERING EVALUATION/COST ANALYSIS AND TABLE 1c IN THE REMOVAL ACTION WORK PLAN AND REMOVAL ACTION COMPLETION REPORT. IF TABLES ARE ADDED OR REMOVED TO THE REPORTS, CHANGE THE TABLE NUMBER ACCORDINGLY.]

Action Include brief description of the action being conducted; for example, one or more of the following:	**Authority**	**Act or Statute**	**Regulation, Administrative Code, or Guidance Document**	**Status**	**Synopsis** [IF STATUTE, REGULATION, CODE, OR GUIDANCE REGULATION IS NOT SELECTED AS AN ARAR OR TBC, PROVIDE BRIEF EXPLAINATION FOR WHY IT WAS NOT SELECTED]	**Consideration/Comments** [REMOVE THIS COLUMN AFTER SELECTING ARARs and TBCs]
		Hazardous Materials Transport Act (HMTA) as Amended by the Hazardous Materials Transport Uniform Safety Act of 1990.	Transportation of Hazardous Materials (49 USC 5101-5127). 49 USC Chapter 51 Hazardous Materials Regulations - General Information, Regulations and Definitions (49 CFR 171). 49 CFR 171 Hazardous Materials Regulations - Hazardous materials table, special provisions, hazardous materials communications, emergency response information, and training requirements (49 CFR 172). 49 CFR 172 Hazardous Materials Regulations Shippers – General Requirements for Shipments and Packages (49 CFR 173) 49 CFR 173	[Potentially] Applicable.	These regulations establish requirements for the off-site transportation of any hazardous wastes that may be generated in the course of the remedial action.	REMOVE IF SOIL IS NOT CHARACTERIZED AS HAZARDOUS WASTE.
		Clean Air Act of 1970.	National primary and secondary ambient air quality standards 42 USC 7409. 42 USC 7409 National Primary and Secondary Ambient Air Quality Standards (40 CFR 50) 40 CFR 50	[Potentially] Applicable.	Engineering controls are required to reduce emissions associated with excavation and transportation, as needed, to maintain ambient air quality standards.	REMOVE IF SOIL EXCAVATION OR OTHER TECHNOLOGIES THAT MAY GENERATE DUST CONTAINING LEAD ARE NOT SELECTED.
		Clean Water Act (CWA).	Water Pollution Prevention and Control, Standards and Enforcement, 33 USC 1313 through 1314. USC 33 National Pollution Discharge Elimination System (NPDES) (40 CFR 122 – 125). 40 CFR Parts 122-125	[Potentially] Applicable.	This regulation establishes requirements for storm-water discharges associated with industrial activity, including waste disposal areas. Soil remediation may require consideration of storm-water regulations.	REMOVE IF GROUNDWATER AND SURFACE WATER ARE NOT IMPACTED WITH LEAD ASSOCIATED WITH THE LEAD-BASED PAINT AT THE SITE.
		Occupational Safety & Health Administration Act (OSHA) of 1970.	Occupational Safety & Health Administration Act (Public Law 91-596 84 STAT. 1590). PL 91-596 OSHA Occupational Safety & Health Administration (29 CFR 1910). 29 CFR 1910	[Potentially] Applicable.	These regulations specify requirements for health and safety protection for workers potentially exposed to contaminants during hazardous waste site remediation.	REMOVE IF SOIL REMOVAL OR OTHER ACTIVE REMEDIES ARE NOT IMPLEMENTED.
		OSHA.	Occupational Safety & Health Administration Act (Public Law 91-596 84 STAT. 1590). PL 91-596 OSHA ACT Occupational Safety & Health Administration (29 CFR 1926). 29 CFR 1926	[Potentially] Applicable.	These regulations specify requirements for health and safety protection for workers at construction sites.	REMOVE IF SOIL REMOVAL OR OTHER ACTIVE REMEDIES THAT REQUIRE HEAVY EQUIPMENT ARE NOT IMPLEMENTED.
	State Regulatory Requirement.	Natural Resources Environmental Protection Act of 1994, Public Act 451 as amended (NREPA).	Soil Conservation, Erosion, and Sedimentation Control Part 91 Michigan Administrative Code (MAC) R323.1702(1), R323.1709 (2), R323.1709 (3), R323.1709 (4), R323.1709 (5). Part 91	[Potentially] Relevant and Appropriate.	These regulations specify requirements for earth change actions including erosion and sedimentation control measures that will effectively reduce accelerated soil erosion and resulting sedimentation. These regulations require the construction of temporary or permanent control measures to remove sediment from run-off water before it leaves the site.	REMOVE IF SOIL REMOVAL OR OTHER ACTIVE REMEIDES ARE NOT IMPLEMENTED.
		NREPA.	Michigan Compiled Law 324, Part 55 Section 324.5524 Air Pollution Control. MCL 324 Part 55 MAC Air Pollution Control Rules 336.1370 through 336.1374. Michigan Air Pollution Control Rules	[Potentially] Relevant and Appropriate.	These promulgated statues and rules are associated with fugitive dust emissions.	REMOVE IF SOIL REMOVAL OR OTHER TECHNOLOGIES THAT MAY GENERATE DUST CONTAINING LEAD ARE NOT SELECTED.
		NREPA.	Michigan Compiled Law 324, Part 55 Section 336.1290 Michigan Air Pollution Control Rules Part 2. Air Use Approval Exemptions. R336.1290 - Rule 290	[Potentially] Applicable.	Potential emissions are required to be calculated for pollutant prior to initiation of project to show that potential project emissions will not exceed established thresholds and that project is exempt from the requirements to obtain a permit to install.	REMOVE IF SOIL EXCAVATION OR OTHER TECHNOLOGIES THAT MAY GENERATE DUST CONTAINING LEAD ARE NOT SELECTED.
		NREPA.	Michigan Compiled Law 324, Part 111 Hazardous Waste Management Sections 324.11138 and 324.11132a. Section 324.11138 Section 324.11132a MAC R299.9208, R299.9209, R299.9212, R299.9216, R299.9217, R299.9301- 9308, R299.9311, R299.9401-9413. Part 111 Rules	[Potentially] Relevant and Appropriate.	These are promulgated statues and rules associated with hazardous waste management for Generators and transports of hazardous waste.	REMOVE IF SOIL REMOVAL OR OTHER ACTIVE REMEDIES ARE NOT IMPLEMENTED.
		NREPA.	Michigan Compiled Law 324, Part 121 Sections 324.12103, 324.12109. Part 121 Section 324.12103 Part 121 Section 324.12109	[Potentially] Relevant and Appropriate.	These are promulgated statues and rules associated with liquid industrial waste management.	REMOVE IF LIQUID WASTES ARE NOT GENERATED.

Table 3c. Potential Action-Specific Applicable or Relevant and Appropriate Requirements and To Be Considered Requirements [United States Coast Guard Site, City, Michigan]

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Action Include brief description of the action being conducted; for example, one or more of the following:	**Authority**	**Act or Statute**	**Regulation, Administrative Code, or Guidance Document**	**Status**	**Synopsis** [IF STATUTE, REGULATION, CODE, OR GUIDANCE REGULATION IS NOT SELECTED AS AN ARAR OR TBC, PROVIDE BRIEF EXPLAINATION FOR WHY IT WAS NOT SELECTED]	**Consideration/Comments** [REMOVE THIS COLUMN AFTER SELECTING ARARs and TBCs]
	Federal Advisories and Guidance.	None.	None.	NA.	NA.	NA.
	State Advisories and Guidance.	NA.	Michigan Department of Environmental Quality (MDEQ) Sampling Strategies and Statistical Training Materials for Part 201 Clean up Criteria (S3TM) S3TM Guidance	[Potentially] To Be Considered.	This document includes non-promulgated training materials prepared by the MDEQ to provide recommendations on sampling of environmental media for various sampling objectives under NREPA Part 201, determine when it is appropriate to use statistics, and identify which statistical methods to use for comparing data to Part 201 cleanup criteria.	S3TM GUIDANCE IS A COMPANION DOCUMENT TO THE PART 201 RULES. REMOVE AS TBC IF THE PART 201 RULES ARE NOT SELECTED AS ARARs.
		NA.	MDEQ Water Bureau Soil Erosion and Sedimentation (SES) Control Program, Soil Erosion and Sedimentation Training Manual SES Training Manual	[Potentially] To Be Considered.	This document includes non-promulgated guidance material prepared to assist in the design and construction of erosion and sedimentation control measures.	THE SES MANUAL IS A COMPANION DOCUMENT TO THE PART 91 RULES. REMOVE AS TBC IF THE PART 201 RULES ARE NOT SELECTED AS ARARs.
		NA.	MDEQ Remediation and Redevelopment Division (RRD) Operational Memorandum Number 2 (Part 201 Sampling and Analysis Guidance) MDEQ RRD Op Memo 2	[Potentially] To Be Considered.	This document is a non-promulgated memorandum prepared by the MDEQ to provide guidance on target detection limits and designated analytical methods; soil leaching methods; sample preservation, sampling, and handling and holding times; and the collection of samples for comparison to generic criteria.	OPERATIONAL MEMORANDUM NO. 2 IS A COMPANION DOCUMENT TO THE PART 201 RULES. REMOVE AS TBC, IF THE PART 201 RULES ARE NOT SELECTED AS ARARs.
			MDEQ RRD Operational Memorandum Number 4 (Site Characterization and Remediation Verification) MDEQ RRD Op Memo 4	[Potentially] To Be Considered.	This document is a non-promulgated memorandum prepared by the MDEQ to provide direction for generating data for facility characterization (nature, extent, and impact of a release or threat of a release) and monitoring to support remedial decisions and assessing exposure pathways for compliance with cleanup criteria. The sampling strategies identified in this document represent acceptable approaches and ranges of appropriate assumptions that are intended to support consistent exercise of professional judgment in a manner that produces satisfactory outcomes. Alternative approaches may be used if the person proposing the alternative demonstrates that the approach meets all requirements of the statute and rules.	OPERATIONAL MEMORANDUM NO. 4 IS A COMPANION DOCUMENT TO THE PART 201 RULES. REMOVE AS TBC, IF THE PART 201 RULES ARE NOT SELECTED AS ARARs.
	Local Regulatory Requirement.	Local Publicly Owned Treatment Works (POTW) Authority Regulations.	Effluent Guidelines and Pretreatment Standards for a Particular POTW Authority.	[Potentially] Applicable.	Defines pretreatment standards and requirements for discharge to a specific POTW.	REMOVE IF GROUNDWATER AND SURFACE WATER ARE NOT IMPACTED WITH LEAD ASSOCIATED WITH THE LEAD-BASED PAINT AT THE SITE OR IF GROUNDWATER TREATMENT TECHNOLOGY DOES NOT INVOLVE DISCHARGE TO A POTW.

Notes:

NA	Not Applicable.

APPENDIX C

Field Sampling Memorandum for Mobilization 1

MEMO

To:

James Hall, USCG

Copies:

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Suite 800
Concord
California 94520
Tel 925 274 1100
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From:

Arcadis

Date:

November 26, 2018

Arcadis Project No.:

B0003010.0006

Subject:

Mobilization 1 Summary Memorandum
USCG Burrows Island Light Station
Burrows Island, Skagit County, Washington

Arcadis U.S., Inc. (Arcadis) has prepared this memorandum on behalf of the United States Coast Guard (USCG) to summarize Mobilization 1 field activities that were conducted at the Burrows Island Light Station, located in Skagit County, Washington (the site) and to identify key site conditions. The activities described in this memorandum were conducted as part of the Remedial Investigation, Focused Feasibility Study, and Remedial Design for the Burrows Island Light Station under task order number 70Z088-18-F-PXA01700. Field activities were completed between November 13th and 16th, 2018 in accordance with the Field Sampling Memorandum for Mobilization 1 document dated November 11, 2018.

The Burrows Island Light Station (site) encompasses approximately 2 acres on the west side of Burrows Island, near Anacortes, Washington. The site is primarily open and grassy and is surrounded by wooded areas, which have overgrown some of the former structures. Access to the site is from a fixed concrete dock, located on the north side of the site. The area is on a bluff with steep, rocky slopes to the west and north extending down to the water. Many of the structures at the site have been removed or demolished, including:

- Officer in Charge Quarters and associated fuel oil tank(s)
- Water treatment system
- Generators
- 10,000-gallon above ground fuel oil tank

- Oil/Paint building
- Transformer and fuel storage tanks adjacent to light building
- Water tanks

Remaining infrastructure at the site includes the following:

- Light and fog signal building
- Boathouse
- Duplex
- Fixed dock and stairs
- Pumphouse and spring cistern
- Saltwater flushing pumphouse
- Helicopter landing pad

Additional remaining infrastructure includes various sidewalks, fencing, pipelines and other minor structures. At least some of the structures are known to have been painted with lead-based paint, which has deteriorated and spread to soil in the areas surrounding the buildings. In addition, petroleum products, including gasoline and fuel oil have been stored on site. In 1980, there was a documented spill of polychlorinated biphenyl (PCB) containing transformer oil located south of the light and fog signal building. The approximate locations of current and former structures are shown on **Figure 1.**

The objectives of Mobilization 1 were as follows:

- Identify locations of all existing and historic site features to the extent that these locations can be visually identified in the field.
- Photo document study area (existing and former infrastructure).
- Identify areas for visual evidence of contamination (e.g., stained soils, paint chips, impaired vegetation, etc.).
- Identify approximate depth to bedrock at each sampling area (e.g., select hand auger locations).
- Visually assess conditions of existing painted structures for evidence of deterioration of painted surfaces (chipping, flaking, etc.).
- Identify areas where soil sampling is not practicable or is unsafe due to steep slopes, dense vegetation (that cannot be readily cleared), bedrock outcroppings, or other adverse conditions. Determinations of unsafe or inaccessible areas will be made by the field team leader in consultation-with the field staff. Inaccessible areas will be documented in the field notes and photo documentation.
- Perform initial XRF screening of surficial soils (ground surface to 6 inches below ground surface [bgs]) at various locations within 40 feet of existing or historical painted structures to inform the final selection of decision units and future sampling locations for lead. Sample locations will be determined in the field with the goal of collecting one surface soil reading for every 100 to 150 square feet of accessible area within 40 linear feet of current and historical structures (see Attachment A). The

number of readings collected is approximate and will dependent on field conditions (weather, obstructions, etc.).

- Evaluate subsurface soils (> 6 inches bgs) using XRF in select areas where indications of elevated surface lead concentrations are observed. Approximately one-third of the soil screening locations will be evaluated further. These locations will be selected based on elevated screening results as determined in the field.
- Collect and analyze soil samples for lead using EPA Method 6010 at select locations that are co-located with XRF sample locations to establish correlation between analytical data and XRF data.

SITE RECONNISANCE

All the buildings identified as part of the investigation were accessed during the field event. The locations shown on Figure 1 were generally consistent with observations in the field, with exceptions noted below. The overall condition of each structure or former structure were assessed and clear visual markers of paint chips or other potentially contaminated materials were noted. In addition, obstructions or areas that could not be sampled were observed. A photo log is provided in **Attachment 1**. A summary of the observations for each structure is provided below:

Light and Fog Signal Building (101)

- Structure is intact and generally appears to be in good condition.
- Paint chipping was visible on some window sills and trim. Green trim paint was previously encapsulated based on historical documentation but is significantly weathered and the encapsulation is no longer viable. White paint generally appears to be intact.
- A brush pile and debris were observed south of the light and fog signal building in the general vicinity of the 1980 transformer oil release. Recent tree and vegetation removal was conducted in 2017 to make the signal light visible and extends south from building with materials stacked in various piles.
- A concrete pad and cistern identified south of the light and fog signal building. These appear to be consistent with historical drawings.
- Soil staining or dark coloration was apparent in the area near the former transformer. Three soil samples were collected in the area of discolored soil for PCB analysis (TP-1, TP-2, and TP-3).
- Bedrock outcroppings were visible on the west side of building towards the water.

Former Oil & Paint Storage Building (102)

- The only remaining part of the structure is a concrete footing, retaining wall and a concrete anchor. These areas could not be sampled due to the lack of surface soil and presence of obstructions.
- Shallow bedrock was present west of the former Oil and Paint Storage Building.
- The helicopter pad is adjacent to the concrete footing to the east.

Duplex (103)

- This structure is generally intact. There has been repair work completed on the roof (as evidenced by the pile of roofing material located southeast of the building) and porch.
- Visible paint chipping and sloughing was observed in areas on trim and from porches. Paint is also very weathered in drip lines and where it is exposed to water running off the roof. Paint chips are visible in grass and soil in some areas surrounding the building.
- Fencing around the east side of the building is in poor condition. Paint is very weathered and flaking.
- Two tanks on east side of building are in poor condition with rust and some paint flaking.
- Building materials that appear to be painted are present to the south of the building and on porches. The team was unable to ascertain if these materials are historical or more recent.
- Debris piles were observed southeast of the building, including roofing material and brush. Additional debris piles were located west of the building. These areas could not be accessed for sampling.
- Daylighted pipelines were present along the west and south sides of the building.

Former Officer In Charge Quarters (104)

- The foundation and other remnants of the former building are overgrown by trees and ivy. Limited soil or sampling was possible within the apparent building footprint. Concrete debris and voids were apparent within the former building footprint.
- The area to the west of the former building footprint is not accessible due to steep slope and the helicopter pad.

Boathouse (105)

- This structure is intact and appears to be in good condition. The dock, stairs, and deck on north side of building appear to be in good shape and have been replaced since original construction with metal and treated lumber.
- Apparent soil excavation and replacement of siding was observed along the east, south and west sides of the building.
- Some building materials with paint were encountered east of the building.
- The north side of the boathouse is inaccessible for sampling due to steep slope and rocks.

Pumphouse & Spring Cistern (106)

- This structure is intact and appears to be in good condition. The building is constructed of concrete with a concrete cistern. Paint cans were found inside the building and garden hoses were in the cistern and just outside the building.
- Access to this area is limited due to a steep slope to get down to the building. There is area surrounding the building that could be sampled.

Former Firehouse Pump Building (107)

- No structure is present, although the concrete pad remains. The area surrounding the pad is very overgrown with trees and brush. Sampling access is limited due to brush and trees.

Salt Water Flushing Pumphouse (108)

- The structure is intact and appears to be in poor condition with flaking and weathered paint. Stairs leading to the structure are exposed with no railing to protect from fall.
- Some woody debris and sediment were present within the structure, but it appears to be contained on the concrete footing. No soil present is present in the area surrounding the building. The concrete footing and foundation appear to have been poured directly onto bedrock.

Former Water Tanks (109, 110, 111)

- Five tank platforms were identified. These platforms were located generally east of the locations shown on historical drawings. The wooden platforms and remaining infrastructure were in poor condition. No tanks are currently present.
- Painted materials were visible. The piping that was observed appears to lead towards the Duplex, which is consistent with historical drawings.

Former Above Ground Fuel Oil Tank (112)

- The concrete saddle for the 10,000-gallon tank remains, but the tank is no longer present. The area is heavily overgrown with ivy and brush.
- Pipeline connections are visible at the former loading area east of the boathouse and adjacent to the former tank.

Other Structures and Obstructions

- The helicopter pad consists of interlocking metal plates and is located in the central portion of the site. The plates remain intact with some vegetation growing through the connections.
- A former helicopter landing area is located to the north of the current helicopter pad.

CURRENT SITE CONDITIONS

The site encompasses approximately 2 acres on the west side of Burrows Island, near Anacortes, Washington. The site is primarily open and grassy and is surrounded by wooded areas, which have overgrown some of the former structures. Access to the site is from a fixed concrete dock, located on the north side of the site. The area is on a bluff with steep, rocky slopes to the west and north extending down to the water. The soils at the site consist of a shallow sandy soil lens with no evidence of significant groundwater existing within the current site footprint, beyond potentially minor perched areas or saturated pore space during the wet season. The site generally slopes towards the bluff, with the northeastern portion of the site containing a steep heavily forested slope leading to a beach that is submerged at high tide. The beach consists primarily of cobbles based on visual inspections. Future Site use

The USCG plans to transfer the light station to the Northwest Schooner Society (NWSS) pursuant to the National Historic Lighthouse Preservation Act of 2000 (NHLPA) and CERCLA §120(h) once the site is cleaned up to a level that is protective of human health and environment. The NWSS intends to restore the site to reflect various periods of time, and to rehabilitate the duplex to a condition that would allow guests to stay on site for short periods of time. They envision having a rotating caretaker to remain on site for extended periods not to exceed 6 months.

SOIL SAMPLING AND XRF ANALYSIS

Soil samples were collected adjacent to former and current structures and screened using an XRF analyzer. Samples were collected within 40 feet of the limits or former boundaries of Buildings 101, 102, 103, 104 and 105 at a frequency of 1 sample per 100 to 150 square feet. Areas that were obstructed or unsafe to access were not sampled. Initial samples were collected from approximately 0 to 0.5 feet using hand tools and placed in plastic bags for on-site XRF analysis. Analytical samples were collected from select locations representing the range of lead concentrations measured using the XRF analyzer and sent to Onsite Environmental Inc. located in Redmond, Washington (Onsite) for analysis of lead by United States Environmental Protection Agency (USEPA) Method 6010. Samples from locations deeper than 6 inches were collected in select locations where concentrations measured using the XRF analyzer exceeded 250 parts per million (ppm). A summary of sampling results is provided in **Table 1.** A summary of the XRF sampling data is provided in **Table 2**. Field documentation is provided in **Attachment 2**.

Lead concentrations measured with the XRF analyzers ranged from non-detect to approximately 9,000 ppm. The highest lead concentrations observed during the sampling event were generally in the vicinity of the Light and Fog Signal Building (101) and the Former Oil & Paint Storage Building (102). Lead concentrations above 1,000 ppm were observed in the soil surrounding the Duplex (103), Former Officer In Charge Quarters (104), Former Water Tanks (109, 110, 111), and the Former Above Ground Fuel Tank (112). Lead concentrations in soil generally decreased further from the structures, but there were areas of spatial variability that could be associated with historical infrastructure or debris that has been relocated. Minimal concentrations of lead were observed in samples from the Pumphouse & Spring Cistern (106) and the Former Firehouse Pump Building (107). Additional observations made during soil sampling are summarized below:

- The 0 to 0.5-foot sample from location WT-2-2 adjacent on the water tanks contained elevated lead (>2,000 ppm). Additional samples were collected from the 0.5 to 1.0 foot and 1.0 to 1.5-foot interval to provide further vertical delineation at this location. Soil samples were collected from the apparent outlet of the tank and were in the vicinity of a visible pipeline going west towards the Duplex.

- Soil sampling location 104-27 on the northeast side of the former officer in charge quarters building contained charcoal and other woody debris with elevated XRF readings (>1,000 ppm) from surface to 2 feet bgs.

- Soil sampling locations within 10 feet of the Duplex structure were spatial varied and included samples from the areas that were previously excavated as well as samples outside of the sidewalk surrounding the building. The locations collected within the sidewalk surrounding the structure are noted on Table 1.

INVESTIGATION DERIVED WASTE

Soil generated from sampling activities was collected and composited in closed-top 5-gallon containers and stored onsite in the basement of the duplex building. Additional general waste (i.e. PPE, plastic bags, and other materials that contacted soil) were collected and sealed in a plastic garbage bag and stored onsite with soil waste. Waste characterization samples were collected from the composited soil and the general waste and were submitted to Onsite for analysis of lead by USEPA Method 1311.

SUMMARY

Structures associated with the Light Station were located and visually assessed to determine the condition of the materials and observe if signs of paint or other potentially contaminated materials are present in the surrounding areas. All locations were identified and documented. Soil samples were collected for XRF analysis to evaluate the presence of lead in soils surrounding current and former structures. Based on preliminary XRF results, lead appears to be present at levels greater than 500 ppm in areas surrounding 7 of the structures. Generally it appears that the concentrations of lead decrease as the distance from the buildings increase. Step out samples collected by ERRG in 2009 demonstrated an average of a 66% reduction in concentration after a 5-foot step out. XRF results from the Mobilization 1 were generally consistent with high concentrations observed close to buildings or former structures and decreasing concentrations moving away from the structures. There does not appear to be evidence of surface water distributing lead along concentrated flow paths, primarily due to the lack of source material near any visible surface channels. In general, sheet flow does not appear be a significant transport mechanism for lead at this site based on the preliminary data.

ATTACHMENTS

Table 1 – XRF Sample Log

Table 2 – XRF Results Summary

Table 3 – Initial Mobilization Summary Table

Figure 1 – Site Location Map

Figure 2 – Decision Unit Boundaries with XRF Sample Results November 2018 Sampling Event

Attachment 1 – Photo Log

Attachment 2 – Field Forms

TABLES

Table 1
XRF Sample Log
USCG Burrows Island Light Station
Burrows Island, Washington

Sample ID	Date	Time	Building/Structure	Sample Interval	Approximate Offset from Building (feet)	XRF Lead Concetration (ppm)[1]
101-01-0.5	11/14/2018	1537	Light and Fog Signal	0 - 0.5	0 - 10	986 ± 18
101-02-0.5	11/14/2018	1541	Light and Fog Signal	0 - 0.5	0 - 10	1920 ± 29
101-02-1.0	11/15/2018	1206	Light and Fog Signal	0.5 - 1.0	0 - 10	50 ± 4
101-03-0.5	11/14/2018	1544	Light and Fog Signal	0 - 0.5	0 - 10	1515 ± 25
101-04-0.5	11/14/2018	1546	Light and Fog Signal	0 - 0.5	0 - 10	591 ± 14
101-05-0.5	11/14/2018	1547	Light and Fog Signal	0 - 0.5	0 - 10	3592 ± 48
101-06-0.5	11/14/2018	1549	Light and Fog Signal	0 - 0.5	0 - 10	1455 ± 24
101-07-0.5	11/14/2018	1548	Light and Fog Signal	0 - 0.5	0 - 10	931 ± 13
101-08-0.5	11/15/2018	1549	Light and Fog Signal	0 - 0.5	0 - 10	8975 ± 67
101-08-1.0	11/15/2018	1208	Light and Fog Signal	0.5 - 1.0	0 - 10	404 ± 9
101-09-0.5	11/15/2018	1551	Light and Fog Signal	0 - 0.5	0 - 10	2529 ± 28
101-10-0.5	11/15/2018	1553	Light and Fog Signal	0 - 0.5	0 - 10	2367 ± 27
101-11-0.5	11/15/2018	1555	Light and Fog Signal	0 - 0.5	0 - 10	838 ± 15
101-12-0.5	11/15/2018	1556	Light and Fog Signal	0 - 0.5	0 - 10	5885 ± 51
101-12-1.0	11/15/2018	1210	Light and Fog Signal	0.5 - 1.0	0 - 10	1206 ± 17
101-12-1.5	11/15/2018	1540	Light and Fog Signal	1.0 - 1.5	0 - 10	279 ± 10
101-13-0.5	11/14/2018	1555	Light and Fog Signal	0 - 0.5	10 - 20	404 ± 11
101-14-0.5	11/14/2018	1557	Light and Fog Signal	0 - 0.5	10 - 20	761 ± 15
101-15-0.5	11/14/2018	1559	Light and Fog Signal	0 - 0.5	10 - 20	921 ± 15
101-15-1.0	11/15/2018	1224	Light and Fog Signal	0.5 - 1.0	10 - 20	45 ± 5
101-16-0.5	11/14/2018	1601	Light and Fog Signal	0 - 0.5	10 - 20	775 ± 14
101-17-0.5	11/14/2018	1602	Light and Fog Signal	0 - 0.5	10 - 20	1126 ± 19
101-17-1.0	11/15/2018	1212	Light and Fog Signal	0.5 - 1.0	10 - 20	208 ± 7
101-18-0.5	11/15/2018	1602	Light and Fog Signal	0 - 0.5	10 - 20	510 ± 10
101-19-0.5	11/15/2018	1558	Light and Fog Signal	0 - 0.5	10 - 20	388 ± 8
101-20-0.5	11/15/2018	1600	Light and Fog Signal	0 - 0.5	10 - 20	366 ± 9
101-21-0.5	11/15/2018	1559	Light and Fog Signal	0 - 0.5	10 - 20	271 ± 7

Table 1
XRF Sample Log
USCG Burrows Island Light Station
Burrows Island, Washington

PRELIMINARY DRAFT

Sample ID	Date	Time	Building/Structure	Sample Interval	Approximate Offset from Building (feet)	XRF Lead Concetration (ppm)[1]
101-22-0.5	11/15/2018	937	Light and Fog Signal	0 - 0.5	10 - 20	276 ± 7
101-23-0.5	11/15/2018	941	Light and Fog Signal	0 - 0.5	10 - 20	446 ± 9
101-23-1.0	11/15/2018	1215	Light and Fog Signal	0.5 - 1.0	10 - 20	161 ± 6
101-24-0.5	11/15/2018	948	Light and Fog Signal	0 - 0.5	10 - 20	90 ± 4
101-25-0.5	11/15/2018	951	Light and Fog Signal	0 - 0.5	10 - 20	148 ± 5
101-26-0.5	11/15/2018	952	Light and Fog Signal	0 - 0.5	10 - 20	824 ± 12
101-27-0.5	11/15/2018	953	Light and Fog Signal	0 - 0.5	10 - 20	702 ± 12
101-27-1.0	11/15/2018	1318	Light and Fog Signal	0.5 - 1.0	10 - 20	808 ± 15
101-28-0.5	11/15/2018	955	Light and Fog Signal	0 - 0.5	10 - 20	219 ± 7
101-29-0.5	11/15/2018	957	Light and Fog Signal	0 - 0.5	10 - 20	62 ± 4
101-30-0.5	11/15/2018	938	Light and Fog Signal	0 - 0.5	10 - 20	307 ± 9
101-31-0.5	11/15/2018	940	Light and Fog Signal	0 - 0.5	10 - 20	884 ± 15
101-32-0.5	11/15/2018	948	Light and Fog Signal	0 - 0.5	20 - 30	78 ± 5
101-33-0.5	11/15/2018	950	Light and Fog Signal	0 - 0.5	20 - 30	360 ± 10
101-34-0.5	11/15/2018	952	Light and Fog Signal	0 - 0.5	20 - 30	386 ± 10
101-35-0.5	11/15/2018	954	Light and Fog Signal	0 - 0.5	20 - 30	388 ± 10
101-36-0.5	11/15/2018	956	Light and Fog Signal	0 - 0.5	20 - 30	509 ± 12
101-37-0.5	11/15/2018	958	Light and Fog Signal	0 - 0.5	20 - 30	1367 ± 19
101-38-0.5	11/15/2018	1000	Light and Fog Signal	0 - 0.5	20 - 30	678 ± 13
101-39-0.5	11/15/2018	1000	Light and Fog Signal	0 - 0.5	20 - 30	397 ± 9
101-40-0.5	11/15/2018	958	Light and Fog Signal	0 - 0.5	20 - 30	160 ± 6
101-41-0.5	11/15/2018	1029	Light and Fog Signal	0 - 0.5	20 - 30	147 ± 5
101-42-0.5	11/15/2018	1031	Light and Fog Signal	0 - 0.5	20 - 30	273 ± 6
101-43-0.5	11/15/2018	1033	Light and Fog Signal	0 - 0.5	20 - 30	313 ± 8
101-44-0.5	11/15/2018	1035	Light and Fog Signal	0 - 0.5	20 - 30	237 ± 6
101-45-0.5	11/15/2018	1036	Light and Fog Signal	0 - 0.5	20 - 30	78 ± 4
101-46-0.5	11/15/2018	1039	Light and Fog Signal	0 - 0.5	20 - 30	44 ± 3

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XRF Sample Log
USCG Burrows Island Light Station
Burrows Island, Washington

Sample ID	Date	Time	Building/Structure	Sample Interval	Approximate Offset from Building (feet)	XRF Lead Concetration (ppm)[1]
101-47-0.5	11/15/2018	1040	Light and Fog Signal	0 - 0.5	30 - 40	19 ± 3
101-48-0.5	11/15/2018	1042	Light and Fog Signal	0 - 0.5	30 - 40	103 ± 5
101-49-0.5	11/15/2018	1028	Light and Fog Signal	0 - 0.5	30 - 40	62 ± 5
101-50-0.5	11/15/2018	1033	Light and Fog Signal	0 - 0.5	20 - 30	328 ± 9
101-51-0.5	11/15/2018	1035	Light and Fog Signal	0 - 0.5	20 - 30	3239 ± 44
101-52-0.5	11/15/2018	1037	Light and Fog Signal	0 - 0.5	30 - 40	60 ± 5
101-53-0.5	11/15/2018	1039	Light and Fog Signal	0 - 0.5	30 - 40	38 ± 4
101-54-0.5	11/15/2018	1042	Light and Fog Signal	0 - 0.5	30 - 40	61 ± 4
101-55-0.5	11/15/2018	1043	Light and Fog Signal	0 - 0.5	30 - 40	86 ± 6
101-56-0.5	11/15/2018	1045	Light and Fog Signal	0 - 0.5	30 - 40	132 ± 6
101-57-0.5	11/15/2018	1047	Light and Fog Signal	0 - 0.5	30 - 40	99 ± 5
101-58-0.5	11/15/2018	1048	Light and Fog Signal	0 - 0.5	30 - 40	104 ± 5
101-59-0.5	11/15/2018	1043	Light and Fog Signal	0 - 0.5	30 - 40	45 ± 4
101-60-0.5	11/15/2018	1046	Light and Fog Signal	0 - 0.5	30 - 40	34 ± 3
102-01-0.5	11/14/2018	1221	Oil & Paint Storage	0 - 0.5	30 - 40	133 ± 5
102-02-0.5	11/14/2018	1224	Oil & Paint Storage	0 - 0.5	30 - 40	82 ± 4
102-03-0.5	11/14/2018	1226	Oil & Paint Storage	0 - 0.5	30 - 40	120 ± 5
102-04-0.5	11/14/2018	1228	Oil & Paint Storage	0 - 0.5	20 - 30	420 ± 9
102-04-1.0	11/14/2018	1354	Oil & Paint Storage	0.5 - 1.0	20 - 30	123 ± 5
102-05-0.5	11/14/2018	1230	Oil & Paint Storage	0 - 0.5	20 - 30	91 ± 4
102-06-0.5	11/14/2018	1223	Oil & Paint Storage	0 - 0.5	20 - 30	52 ± 5
102-07-0.5	11/14/2018	1232	Oil & Paint Storage	0 - 0.5	20 - 30	67 ± 4
102-08-0.5	11/14/2018	1233	Oil & Paint Storage	0 - 0.5	20 - 30	82 ± 4
102-09-0.5	11/14/2018	1235	Oil & Paint Storage	0 - 0.5	10 - 20	88 ± 5
102-10-0.5	11/14/2018	1236	Oil & Paint Storage	0 - 0.5	10 - 20	248 ± 7
102-11-0.5	11/14/2018	1240	Oil & Paint Storage	0 - 0.5	10 - 20	334 ± 9
102-12-0.5	11/14/2018	1242	Oil & Paint Storage	0 - 0.5	10 - 20	1006 ± 18

Table 1
XRF Sample Log
USCG Burrows Island Light Station
Burrows Island, Washington

PRELIMINARY DRAFT

Sample ID	Date	Time	Building/Structure	Sample Interval	Approximate Offset from Building (feet)	XRF Lead Concetration (ppm)[1]
102-12-1.0	11/14/2018	1356	Oil & Paint Storage	0.5 - 1.0	10 - 20	51 ± 4
102-13-0.5	11/14/2018	1244	Oil & Paint Storage	0 - 0.5	20 - 30	1119 ± 18
102-13-1.0	11/14/2018	1358	Oil & Paint Storage	0.5 - 1.0	20 - 30	421 ± 10
102-14-0.5	11/14/2018	1247	Oil & Paint Storage	0 - 0.5	20 - 30	91 ± 5
102-15-0.5	11/14/2018	1250	Oil & Paint Storage	0 - 0.5	10 - 20	879 ± 16
102-15-1.5	11/14/2018	1457	Oil & Paint Storage	1.0 - 1.5	10 - 20	572 ± 10
102-15-1.0	11/14/2018	1415	Oil & Paint Storage	0.5 - 1.0	10 - 20	627 ± 13
102-16-0.5	11/14/2018	1253	Oil & Paint Storage	0 - 0.5	0 - 10	918 ± 17
102-16-1.0	11/14/2018	1420	Oil & Paint Storage	0.5 - 1.0	0 - 10	252 ± 9
102-17-0.5	11/14/2018	1240	Oil & Paint Storage	0 - 0.5	0 - 10	233 ± 6
102-18-0.5	11/14/2018	1242	Oil & Paint Storage	0 - 0.5	10 - 20	278 ± 7
102-19-0.5	11/14/2018	1244	Oil & Paint Storage	0 - 0.5	20 - 30	157 ± 6
102-20-0.5	11/14/2018	1245	Oil & Paint Storage	0 - 0.5	20 - 30	131 ± 5
102-21-0.5	11/14/2018	1249	Oil & Paint Storage	0 - 0.5	10 - 20	48 ± 4
102-22-0.5	11/14/2018	1333	Oil & Paint Storage	0 - 0.5	0 - 10	245 ± 6
102-23-0.5	11/14/2018	1335	Oil & Paint Storage	0 - 0.5	0 - 10	1001 ± 14
102-24-0.5	11/14/2018	1337	Oil & Paint Storage	0 - 0.5	10 - 20	4720 ± 42
102-24-1.0	11/14/2018	1422	Oil & Paint Storage	0.5 - 1.0	10 - 20	3718 ± 44
102-25-0.5	11/14/2018	1300	Oil & Paint Storage	0 - 0.5	20 - 30	4073 ± 40
102-25-1.0	11/14/2018	1425	Oil & Paint Storage	0.5 - 1.0	20 - 30	1191 ± 20
102-26-0.5	11/14/2018	1340	Oil & Paint Storage	0 - 0.5	20 - 30	1299 ± 17
102-26-1.0	11/14/2018	1427	Oil & Paint Storage	0.5 - 1.0	20 - 30	302 ± 9
102-27-0.5	11/14/2018	1333	Oil & Paint Storage	0 - 0.5	10 - 20	367 ± 10
102-28-0.5	11/14/2018	1339	Oil & Paint Storage	0 - 0.5	10 - 20	198 ± 7
102-29-0.5	11/14/2018	1342	Oil & Paint Storage	0 - 0.5	10 - 20	15 ± 4
102-30-0.5	11/14/2018	1345	Oil & Paint Storage	0 - 0.5	10 - 20	100 ± 6
102-31-0.5	11/14/2018	1400	Oil & Paint Storage	0 - 0.5	20 - 30	407 ± 9

Table 1
XRF Sample Log
USCG Burrows Island Light Station
Burrows Island, Washington

Sample ID	Date	Time	Building/Structure	Sample Interval	Approximate Offset from Building (feet)	XRF Lead Concetration (ppm)[1]
102-31-1.0	11/14/2018	1452	Oil & Paint Storage	0.5 - 1.0	20 - 30	217 ± 6
102-32-0.5	11/14/2018	1402	Oil & Paint Storage	0 - 0.5	20 - 30	252 ± 7
102-33-0.5	11/14/2018	1403	Oil & Paint Storage	0 - 0.5	20 - 30	5643 ± 48
102-33-1.0	11/14/2018	1450	Oil & Paint Storage	0.5 - 1.0	20 - 30	588 ± 11
102-34.0.5	11/14/2018	1410	Oil & Paint Storage	0 - 0.5	20 - 30	97 ± 4
102-35-0.5	11/14/2018	1415	Oil & Paint Storage	0 - 0.5	20 - 30	203 ± 7
102-36-0.5	11/14/2018	1417	Oil & Paint Storage	0 - 0.5	30 - 40	130 ± 6
102-37-0.5	11/14/2018	1418	Oil & Paint Storage	0 - 0.5	30 - 40	128 ± 5
102-38-0.5	11/14/2018	1422	Oil & Paint Storage	0 - 0.5	30 - 40	167 ± 6
102-39-0.5	11/14/2018	1424	Oil & Paint Storage	0 - 0.5	30 - 40	143 ± 6
102-40-0.5	11/14/2018	1425	Oil & Paint Storage	0 - 0.5	30 - 40	362 ± 8
102-41-0.5	11/14/2018	1427	Oil & Paint Storage	0 - 0.5	30 - 40	215 ± 6
102-42-0.5	11/14/2018	1428	Oil & Paint Storage	0 - 0.5	30 - 40	42 ± 4
103-001-0.5	11/15/2018	1343	Duplex	0 - 0.5	0 - 10	419 ± 11
103-002-0.5	11/15/2018	1345	Duplex	0 - 0.5	0 - 10	317 ± 9
103-003-0.5	11/15/2018	1346	Duplex	0 - 0.5	0 - 10	546 ± 13
103-004-0.5	11/15/2018	1347	Duplex	0 - 0.5	0 - 10	17 ± 4
103-005-0.5	11/15/2018	1349	Duplex	0 - 0.5	0 - 10	321 ± 9
103-006-0.5	11/15/2018	1351	Duplex	0 - 0.5	0 - 10	433 ± 11
103-007-0.5	11/15/2018	1352	Duplex	0 - 0.5	0 - 10	378 ± 40
103-008-0.5	11/15/2018	1353	Duplex	0 - 0.5	0 - 10	43 ± 5
103-009-0.5	11/15/2018	1356	Duplex	0 - 0.5	0 - 10	149 ± 7
103-010-0.5	11/15/2018	1357	Duplex	0 - 0.5	0 - 10	135 ± 7
103-011-0.5	11/15/2018	1358	Duplex	0 - 0.5	0 - 10	1352 ± 23
103-011-1.0	11/16/2018	1017	Duplex	0.5 - 1.0	0 - 10	130 ± 7
103-012-0.5	11/15/2018	1339	Duplex	0 - 0.5	0 - 10	1057 ± 19
103-012-1.0	11/16/2018	1018	Duplex	0.5 - 1.0	0 - 10	< 11

Table 1
XRF Sample Log
USCG Burrows Island Light Station
Burrows Island, Washington

PRELIMINARY DRAFT

Sample ID	Date	Time	Building/Structure	Sample Interval	Approximate Offset from Building (feet)	XRF Lead Concetration (ppm)[1]
103-013-0.5	11/15/2018	1340	Duplex	0 - 0.5	0 - 10	13 ± 4
103-014-0.5	11/15/2018	1340	Duplex	0 - 0.5	0 - 10	212 ± 8
103-015-0.5	11/15/2018	1326	Duplex	0 - 0.5	0 - 10	56 ± 6
103-016-0.5	11/15/2018	1327	Duplex	0 - 0.5	0 - 10	653 ± 14
103-017-0.5	11/15/2018	1329	Duplex	0 - 0.5	0 - 10	25 ± 5
103-018-0.5	11/15/2018	1331	Duplex	0 - 0.5	0 - 10	183 ± 8
103-019-0.5	11/15/2018	1333	Duplex	0 - 0.5	0 - 10	917 ± 17
103-019-1.0	11/16/2018	1016	Duplex	0.5 - 1.0	0 - 10	17 ± 4
103-020-0.5	11/15/2018	1334	Duplex	0 - 0.5	0 - 10	367 ± 10
103-021-0.5	11/15/2018	1310	Duplex	0 - 0.5	0 - 10	504 ± 10
103-022-0.5	11/15/2018	1336	Duplex	0 - 0.5	0 - 10	90 ± 5
103-023-0.5	11/15/2018	1337	Duplex	0 - 0.5	0 - 10	16 ± 4
103-024-0.5	11/15/2018	1416	Duplex	0 - 0.5	10 - 20	98 ± 6
103-025-0.5	11/15/2018	1420	Duplex	0 - 0.5	10 - 20	256 ± 8
103-026-0.5	11/15/2018	1421	Duplex	0 - 0.5	10 - 20	110 ± 6
103-027-0.5	11/15/2018	1423	Duplex	0 - 0.5	10 - 20	131 ± 6
103-028-0.5	11/15/2018	1424	Duplex	0 - 0.5	10 - 20	194 ± 7
103-029-0.5	11/15/2018	1426	Duplex	0 - 0.5	10 - 20	112 ± 6
103-030-0.5	11/15/2018	1427	Duplex	0 - 0.5	10 - 20	430 ± 11
103-031-0.5	11/15/2018	1428	Duplex	0 - 0.5	10 - 20	60 ± 4
103-032-0.5	11/15/2018	1430	Duplex	0 - 0.5	10 - 20	133 ± 6
103-033-0.5	11/15/2018	1431	Duplex	0 - 0.5	10 - 20	154 ± 6
103-034-0.5	11/15/2018	1417	Duplex	0 - 0.5	10 - 20	806 ± 15
103-035-0.5	11/15/2018	1419	Duplex	0 - 0.5	10 - 20	368 ± 9
103-036-0.5	11/15/2018	1421	Duplex	0 - 0.5	10 - 20	55 ± 5
103-037-0.5	11/15/2018	1423	Duplex	0 - 0.5	10 - 20	155 ± 7
103-038-0.5	11/15/2018	1425	Duplex	0 - 0.5	10 - 20	80 ± 6

Table 1
XRF Sample Log
USCG Burrows Island Light Station
Burrows Island, Washington

PRELIMINARY DRAFT

Sample ID	Date	Time	Building/Structure	Sample Interval	Approximate Offset from Building (feet)	XRF Lead Concetration (ppm)[1]
103-039-0.5	11/15/2018	1426	Duplex	0 - 0.5	10 - 20	699 ± 15
103-039-1.0	11/16/2018	1014	Duplex	0.5 - 1.0	10 - 20	< 11
103-040-0.5	11/15/2018	1428	Duplex	0 - 0.5	10 - 20	844 ± 16
103-041-0.5	11/15/2018	1430	Duplex	0 - 0.5	10 - 20	259 ± 8
103-042-0.5	11/15/2018	1431	Duplex	0 - 0.5	10 - 20	199 ± 7
103-043-0.5	11/15/2018	1433	Duplex	0 - 0.5	10 - 20	279 ± 8
103-044-0.5	11/15/2018	1434	Duplex	0 - 0.5	10 - 20	180 ± 7
103-045-0.5	11/15/2018	1436	Duplex	0 - 0.5	10 - 20	119 ± 6
103-046-0.5	11/15/2018	1437	Duplex	0 - 0.5	10 - 20	157 ± 6
103-047-0.5	11/15/2018	1439	Duplex	0 - 0.5	10 - 20	104 ± 6
103-048-0.5	11/15/2018	1440	Duplex	0 - 0.5	10 - 20	145 ± 6
103-049-0.5	11/15/2018	1441	Duplex	0 - 0.5	10 - 20	278 ± 8
103-050-0.5	11/15/2018	1443	Duplex	0 - 0.5	10 - 20	254 ± 8
103-051-0.5	11/15/2018	1435	Duplex	0 - 0.5	10 - 20	237 ± 8
103-052-0.5	11/15/2018	1503	Duplex	0 - 0.5	20 - 30	< 14
103-053-0.5	11/15/2018	1505	Duplex	0 - 0.5	20 - 30	37 ± 5
103-054-0.5	11/15/2018	1506	Duplex	0 - 0.5	20 - 30	124 ± 6
103-055-0.5	11/15/2018	1508	Duplex	0 - 0.5	20 - 30	88 ± 6
103-056-0.5	11/15/2018	1510	Duplex	0 - 0.5	20 - 30	65 ± 5
103-057-0.5	11/15/2018	1512	Duplex	0 - 0.5	20 - 30	57 ± 5
103-058-0.5	11/15/2018	1514	Duplex	0 - 0.5	20 - 30	52 ± 5
103-059-0.5	11/15/2018	1515	Duplex	0 - 0.5	20 - 30	12 ± 3
103-060-0.5	11/15/2018	1517	Duplex	0 - 0.5	20 - 30	92 ± 5
103-061-0.5	11/15/2018	1518	Duplex	0 - 0.5	20 - 30	231 ± 8
103-062-0.5	11/15/2018	1507	Duplex	0 - 0.5	20 - 30	29 ± 4
103-063-0.5	11/15/2018	1510	Duplex	0 - 0.5	20 - 30	39 ± 4
103-064-0.5	11/15/2018	1512	Duplex	0 - 0.5	20 - 30	55 ± 5

Table 1
XRF Sample Log
USCG Burrows Island Light Station
Burrows Island, Washington

Sample ID	Date	Time	Building/Structure	Sample Interval	Approximate Offset from Building (feet)	XRF Lead Concetration (ppm)[1]
103-065-0.5	11/15/2018	1514	Duplex	0 - 0.5	20 - 30	35 ± 4
103-066-0.5	11/15/2018	1517	Duplex	0 - 0.5	20 - 30	43 ± 4
103-067-0.5	11/15/2018	1520	Duplex	0 - 0.5	20 - 30	32 ± 4
103-068-0.5	11/15/2018	1520	Duplex	0 - 0.5	20 - 30	94 ± 6
103-069-0.5	11/15/2018	1521	Duplex	0 - 0.5	20 - 30	31 ± 4
103-070-0.5	11/15/2018	1522	Duplex	0 - 0.5	20 - 30	73 ± 5
103-071-0.5	11/15/2018	1524	Duplex	0 - 0.5	20 - 30	143 ± 6
103-072-0.5	11/15/2018	1526	Duplex	0 - 0.5	20 - 30	367 ± 10
103-073-0.5	11/15/2018	1526	Duplex	0 - 0.5	20 - 30	164 ± 6
103-074-0.5	11/15/2018	1523	Duplex	0 - 0.5	20 - 30	83 ± 6
103-075-0.5	11/15/2018	1525	Duplex	0 - 0.5	20 - 30	134 ± 6
103-076-0.5	11/15/2018	1529	Duplex	0 - 0.5	20 - 30	116 ± 5
103-077-0.5	11/15/2018	1532	Duplex	0 - 0.5	20 - 30	68 ± 5
103-078-0.5	11/15/2018	1533	Duplex	0 - 0.5	20 - 30	308 ± 9
103-079-0.5	11/15/2018	1535	Duplex	0 - 0.5	20 - 30	31 ± 4
103-080-0.5	11/15/2018	1536	Duplex	0 - 0.5	20 - 30	109 ± 5
103-081-0.5	11/15/2018	1530	Duplex	0 - 0.5	20 - 30	186 ± 7
103-082-0.5	11/15/2018	1531	Duplex	0 - 0.5	20 - 30	78 ± 5
103-083-0.5	11/15/2018	1533	Duplex	0 - 0.5	20 - 30	147 ± 7
103-084-0.5	11/15/2018	1534	Duplex	0 - 0.5	20 - 30	54 ± 5
103-085-0.5	11/15/2018	1536	Duplex	0 - 0.5	20 - 30	128 ± 6
103-086-0.5	11/15/2018	1547	Duplex	0 - 0.5	30 - 40	32 ± 4
103-087-0.5	11/15/2018	1548	Duplex	0 - 0.5	30 - 40	75 ± 5
103-088-0.5	11/15/2018	1550	Duplex	0 - 0.5	30 - 40	58 ± 5
103-089-0.5	11/15/2018	1552	Duplex	0 - 0.5	30 - 40	60 ± 5
103-090-0.5	11/15/2018	1553	Duplex	0 - 0.5	30 - 40	62 ± 5
103-091-0.5	11/15/2018	1555	Duplex	0 - 0.5	30 - 40	32 ± 4

Table 1
XRF Sample Log
USCG Burrows Island Light Station
Burrows Island, Washington

PRELIMINARY DRAFT

Sample ID	Date	Time	Building/Structure	Sample Interval	Approximate Offset from Building (feet)	XRF Lead Concetration (ppm)[1]
103-092-0.5	11/15/2018	1557	Duplex	0 - 0.5	30 - 40	32 ± 4
103-093-0.5	11/15/2018	1558	Duplex	0 - 0.5	30 - 40	19 ± 4
103-094-0.5	11/15/2018	1603	Duplex	0 - 0.5	30 - 40	< 11
103-095-0.5	11/15/2018	1604	Duplex	0 - 0.5	30 - 40	203 ± 6
103-096-0.5	11/15/2018	1606	Duplex	0 - 0.5	30 - 40	98 ± 5
103-097-0.5	11/15/2018	1613	Duplex	0 - 0.5	30 - 40	70 ± 6
103-098-0.5	11/15/2018	1615	Duplex	0 - 0.5	30 - 40	133 ± 6
103-099-0.5	11/15/2018	1616	Duplex	0 - 0.5	30 - 40	94 ± 6
103-100-0.5	11/15/2018	1618	Duplex	0 - 0.5	30 - 40	43 ± 5
103-101-0.5	11/15/2018	1619	Duplex	0 - 0.5	30 - 40	44 ± 5
103-102-0.5	11/15/2018	1620	Duplex	0 - 0.5	30 - 40	33 ± 4
103-103-0.5	11/15/2018	1622	Duplex	0 - 0.5	30 - 40	33 ± 4
103-104-0.5	11/15/2018	1623	Duplex	0 - 0.5	30 - 40	32 ± 4
103-105-0.5	11/16/2018	902	Duplex	0 - 0.5	30 - 40	47 ± 5
103-106-0.5	11/16/2018	904	Duplex	0 - 0.5	30 - 40	382 ± 10
103-107-0.5	11/16/2018	906	Duplex	0 - 0.5	30 - 40	115 ± 6
103-108-0.5	11/16/2018	907	Duplex	0 - 0.5	30 - 40	284 ± 8
103-109-0.5	11/16/2018	910	Duplex	0 - 0.5	30 - 40	326 ± 10
103-110-0.5	11/16/2018	611	Duplex	0 - 0.5	30 - 40	177 ± 7
103-111-0.5	11/16/2018	908	Duplex	0 - 0.5	30 - 40	34 ± 4
103-112-0.5	11/16/2018	910	Duplex	0 - 0.5	30 - 40	35 ± 4
103-113-0.5	11/16/2018	911	Duplex	0 - 0.5	30 - 40	147 ± 4
103-114-0.5	11/16/2018	913	Duplex	0 - 0.5	30 - 40	89 ± 5
103-115-0.5	11/16/2018	613	Duplex	0 - 0.5	30 - 40	87 ± 5
103-116-0.5	11/16/2018	615	Duplex	0 - 0.5	30 - 40	87 ± 5
103-117-0.5	11/16/2018	617	Duplex	0 - 0.5	30 - 40	118 ± 6
103-118-0.5	11/16/2018	915	Duplex	0 - 0.5	30 - 40	152 ± 6

Table 1
XRF Sample Log
USCG Burrows Island Light Station
Burrows Island, Washington

Sample ID	Date	Time	Building/Structure	Sample Interval	Approximate Offset from Building (feet)	XRF Lead Concetration (ppm)[1]
103-119-0.5	11/16/2018	917	Duplex	0 - 0.5	30 - 40	189 ± 6
103-120-0.5	11/16/2018	919	Duplex	0 - 0.5	30 - 40	159 ± 7
103-121-0.5	11/16/2018	919	Duplex	0 - 0.5	30 - 40	157 ± 6
104-01-0.5	11/16/2018	1035	OIC Quarters	0 - 0.5	10 - 20	182 ± 7
104-02-0.5	11/16/2018	1038	OIC Quarters	0 - 0.5	10 - 20	148 ± 7
104-03-0.5	11/16/2018	1039	OIC Quarters	0 - 0.5	10 - 20	134 ± 6
104-04-0.5	11/16/2018	1041	OIC Quarters	0 - 0.5	10 - 20	196 ± 7
104-05-0.5	11/16/2018	1041	OIC Quarters	0 - 0.5	10 - 20	193 ± 7
104-06-0.5	11/16/2018	1047	OIC Quarters	0 - 0.5	10 - 20	87 ± 5
104-07-0.5	11/16/2018	1048	OIC Quarters	0 - 0.5	20 - 30	72 ± 5
104-08-0.5	11/16/2018	1050	OIC Quarters	0 - 0.5	20 - 30	38 ± 5
104-09-0.5	11/16/2018	1051	OIC Quarters	0 - 0.5	10 - 20	88 ± 5
104-10-0.5	11/16/2018	1053	OIC Quarters	0 - 0.5	0 - 10	48 ± 5
104-11-0.5	11/16/2018	1107	OIC Quarters	0 - 0.5	0 - 10	146 ± 7
104-12-0.5	11/16/2018	1118	OIC Quarters	0 - 0.5	0 - 10	16 ± 3
104-13-0.5	11/16/2018	1119	OIC Quarters	0 - 0.5	0 - 10	75 ± 5
104-14-0.5	11/16/2018	1120	OIC Quarters	0 - 0.5	0 - 10	68 ± 5
104-15-0.5	11/16/2018	1044	OIC Quarters	0 - 0.5	0 - 10	590 ± 13
104-15-1.0	11/16/2018	1256	OIC Quarters	0.5 - 1.0	0 - 10	162 ± 7
104-16-0.5	11/16/2018	1045	OIC Quarters	0 - 0.5	10 - 20	197 ± 7
104-17-0.5	11/16/2018	1047	OIC Quarters	0 - 0.5	20 - 30	78 ± 5
104-18-0.5	11/16/2018	1049	OIC Quarters	0 - 0.5	0 - 10	289 ± 9
104-19-0.5	11/16/2018	1052	OIC Quarters	0 - 0.5	10 - 20	287 ± 9
104-20-0.5	11/16/2018	1053	OIC Quarters	0 - 0.5	20 - 30	73 ± 5
104-21-0.5	11/16/2018	1108	OIC Quarters	0 - 0.5	20 - 30	150 ± 6
104-22-0.5	11/16/2018	1109	OIC Quarters	0 - 0.5	10 - 20	427 ± 10
104-22-1.0	11/16/2018	1254	OIC Quarters	0.5 - 1.0	10 - 20	130 ± 5

Table 1
XRF Sample Log
USCG Burrows Island Light Station
Burrows Island, Washington

PRELIMINARY DRAFT

Sample ID	Date	Time	Building/Structure	Sample Interval	Approximate Offset from Building (feet)	XRF Lead Concetration (ppm)[1]
104-23-0.5	11/16/2018	1110	OIC Quarters	0 - 0.5	0 - 10	75 ± 5
104-24-0.5	11/16/2018	1111	OIC Quarters	0 - 0.5	30 - 40	196 ± 8
104-25-0.5	11/16/2018	1115	OIC Quarters	0 - 0.5	20 - 30	110 ± 7
104-26-0.5	11/16/2018	1116	OIC Quarters	0 - 0.5	10 - 20	148 ± 6
104-27-0.5	11/16/2018	1117	OIC Quarters	0 - 0.5	0 - 10	1241 ± 22
104-27-1.0	11/16/2018	1253	OIC Quarters	0.5 - 1.0	0 - 10	1890 ± 30
104-27-1.5	11/16/2018	1304	OIC Quarters	1.0 - 1.5	0 - 10	2095 ± 32
104-27-2.0	11/16/2018	1312	OIC Quarters	1.5 - 2.0	0 - 10	3345 ± 47
104-28-0.5	11/16/2018	1113	OIC Quarters	0 - 0.5	30 - 40	23 ± 4
104-29-0.5	11/16/2018	1112	OIC Quarters	0 - 0.5	20 - 30	98 ± 5
104-30-0.5	11/16/2018	1116	OIC Quarters	0 - 0.5	10 - 20	74 ± 5
104-31-0.5	11/16/2018	1135	OIC Quarters	0 - 0.5	20 - 30	15 ± 3
104-32-0.5	11/16/2018	1214	OIC Quarters	0 - 0.5	10 - 20	44 ± 5
104-33-0.5	11/16/2018	1212	OIC Quarters	0 - 0.5	20 - 30	< 12
104-34-0.5	11/16/2018	1208	OIC Quarters	0 - 0.5	30 - 40	22 ± 4
104-35-0.5	11/16/2018	1207	OIC Quarters	0 - 0.5	30 - 40	42 ± 5
104-36-0.5	11/16/2018	1214	OIC Quarters	0 - 0.5	20 - 30	80 ± 5
104-37-0.5	11/16/2018	1213	OIC Quarters	0 - 0.5	10 - 20	118 ± 5
104-38-0.5	11/16/2018	1150	OIC Quarters	0 - 0.5	0 - 10	444 ± 10
104-38-1.0	11/16/2018	1258	OIC Quarters	0.5 - 1.0	0 - 10	11 ± 3
104-39-0.5	11/16/2018	1152	OIC Quarters	0 - 0.5	0 - 10	307 ± 9
104-40-0.5	11/16/2018	1210	OIC Quarters	0 - 0.5	10 - 20	3447 ± 45
104-40-1.0	11/16/2018	1259	OIC Quarters	0.5 - 1.0	10 - 20	197 ± 8
104-41-0.5	11/16/2018	1209	OIC Quarters	0 - 0.5	20 - 30	86 ± 5
104-42-0.5	11/16/2018	1208	OIC Quarters	0 - 0.5	30 - 40	< 10
104-43-0.5	11/16/2018	1206	OIC Quarters	0 - 0.5	30 - 40	31 ± 3
104-44-0.5	11/16/2018	1205	OIC Quarters	0 - 0.5	20 - 30	52 ± 4

Table 1
XRF Sample Log
USCG Burrows Island Light Station
Burrows Island, Washington

PRELIMINARY DRAFT

Sample ID	Date	Time	Building/Structure	Sample Interval	Approximate Offset from Building (feet)	XRF Lead Concetration (ppm)[1]
104-45-0.5	11/16/2018	1154	OIC Quarters	0 - 0.5	10 - 20	84 ± 5
104-46-0.5	11/16/2018	1155	OIC Quarters	0 - 0.5	0 - 10	200 ± 7
104-47-0.5	11/16/2018	1139	OIC Quarters	0 - 0.5	0 - 10	90 ± 5
104-48-0.5	11/16/2018	1157	OIC Quarters	0 - 0.5	10 - 20	45 ± 4
104-49-0.5	11/16/2018	1158	OIC Quarters	0 - 0.5	20 - 30	43 ± 4
104-50-0.5	11/16/2018	1200	OIC Quarters	0 - 0.5	30 - 40	12 ± 4
104-51-0.5	11/16/2018	1202	OIC Quarters	0 - 0.5	30 - 40	17 ± 3
104-52-0.5	11/16/2018	1152	OIC Quarters	0 - 0.5	20 - 30	14 ± 4
104-53-0.5	11/16/2018	1154	OIC Quarters	0 - 0.5	10 - 20	29 ± 4
104-54-0.5	11/16/2018	1141	OIC Quarters	0 - 0.5	10 - 20	37 ± 4
104-55-0.5	11/16/2018	1155	OIC Quarters	0 - 0.5	20 - 30	35 ± 4
104-56-0.5	11/16/2018	1157	OIC Quarters	0 - 0.5	20 - 30	42 ± 4
104-57-0.5	11/16/2018	1159	OIC Quarters	0 - 0.5	20 - 30	55 ± 4
104-58-0.5	11/16/2018	1201	OIC Quarters	0 - 0.5	30 - 40	49 ± 5
104-59-0.5	11/16/2018	1202	OIC Quarters	0 - 0.5	30 - 40	58 ± 5
104-60-0.5	11/16/2018	1203	OIC Quarters	0 - 0.5	30 - 40	30 ± 4
104-61-0.5	11/16/2018	1204	OIC Quarters	0 - 0.5	30 - 40	34 ± 4
104-62-0.5	11/16/2018	1144	OIC Quarters	0 - 0.5	30 - 40	32 ± 4
104-63-0.5	11/16/2018	1146	OIC Quarters	0 - 0.5	0 - 10	160 ± 7
104-64-0.5	11/16/2018	1148	OIC Quarters	0 - 0.5	10 - 20	34 ± 3
104-65-0.5	11/16/2018	1134	OIC Quarters	0 - 0.5	20 - 30	1011 ± 18
104-65-1.0	11/16/2018	1309	OIC Quarters	0.5 - 1.0	20 - 30	1823 ± 38
104-65-1.5	11/16/2018	1318	OIC Quarters	1.0 - 1.5	20 - 30	165 ± 7
104-66-0.5	11/16/2018	1139	OIC Quarters	0 - 0.5	30 - 40	31 ± 4
104-67-0.5	11/16/2018	1140	OIC Quarters	0 - 0.5	30 - 40	16 ± 4
104-68-0.5	11/16/2018	1143	OIC Quarters	0 - 0.5	20 - 30	101 ± 6
104-69-0.5	11/16/2018	1145	OIC Quarters	0 - 0.5	10 - 20	39 ± 4

Table 1
XRF Sample Log
USCG Burrows Island Light Station
Burrows Island, Washington

Sample ID	Date	Time	Building/Structure	Sample Interval	Approximate Offset from Building (feet)	XRF Lead Concetration (ppm)[1]
104-70-0.5	11/16/2018	1147	OIC Quarters	0 - 0.5	0 - 10	87 ± 6
105-01-0.5	11/14/2018	956	Boathouse	0 - 0.5	0 - 10	448 ± 9
105-01-1.0	11/14/2018	1150	Boathouse	0.5 - 1.0	0 - 10	55 ± 5
105-02-0.5	11/14/2018	1002	Boathouse	0 - 0.5	0 - 10	126 ± 5
105-03-0.5	11/14/2018	1005	Boathouse	0 - 0.5	0 - 10	143 ± 5
105-04-0.5	11/14/2018	1007	Boathouse	0 - 0.5	0 - 10	130 ± 5
105-05-0.5'	11/14/2018	1009	Boathouse	0 - 0.5	0 - 10	79 ± 4
105-06-0.5'	11/14/2018	1012	Boathouse	0 - 0.5	0 - 10	67 ± 4
105-07-0.5	11/14/2018	956	Boathouse	0 - 0.5	0 - 10	81 ± 5
105-08-0.5	11/14/2018	959	Boathouse	0 - 0.5	0 - 10	44 ± 4
105-09-0.5	11/14/2018	1001	Boathouse	0 - 0.5	0 - 10	< 12
105-10-0.5	11/14/2018	1004	Boathouse	0 - 0.5	0 - 10	198 ± 7
105-11-0.5	11/14/2018	1007	Boathouse	0 - 0.5	0 - 10	412 ± 10
105-11-1.0	11/14/2018	1153	Boathouse	0.5 - 1.0	0 - 10	21 ± 4
105-12-0.5	11/14/2018	1015	Boathouse	0 - 0.5	0 - 10	52 ± 5
105-13-0.5	11/14/2018	1018	Boathouse	0 - 0.5	10 - 20	283 ± 8
105-13-1.0	11/14/2018	1152	Boathouse	0.5 - 1.0	10 - 20	10 ± 3
105-14-0.5	11/14/2018	1020	Boathouse	0 - 0.5	10 - 20	60 ± 4
105-15-0.5	11/14/2018	1022	Boathouse	0 - 0.5	10 - 20	35 ± 4
105-16-0.5	11/14/2018	1024	Boathouse	0 - 0.5	10 - 20	57 ± 3
105-17-0.5	11/14/2018	1020	Boathouse	0 - 0.5	10 - 20	31 ± 4
105-18-0.5	11/14/2018	1022	Boathouse	0 - 0.5	10 - 20	32 ± 4
105-19-0.5	11/14/2018	1024	Boathouse	0 - 0.5	10 - 20	24 ± 4
105-20-0.5	11/14/2018	1026	Boathouse	0 - 0.5	10 - 20	30 ± 4
105-21-0.5	11/14/2018	1043	Boathouse	0 - 0.5	10 - 20	36 ± 3
105-22-0.5	11/14/2018	1045	Boathouse	0 - 0.5	10 - 20	45 ± 3
105-23-0.5	11/14/2018	1047	Boathouse	0 - 0.5	10 - 20	223 ± 7

Table 1
XRF Sample Log
USCG Burrows Island Light Station
Burrows Island, Washington

Sample ID	Date	Time	Building/Structure	Sample Interval	Approximate Offset from Building (feet)	XRF Lead Concetration (ppm)[1]
105-24-0.5	11/14/2018	1050	Boathouse	0 - 0.5	10 - 20	134 ± 6
105-25-0.5	11/14/2018	1052	Boathouse	0 - 0.5	10 - 20	197 ± 6
105-26-0.5	11/14/2018	1041	Boathouse	0 - 0.5	10 - 20	207 ± 8
105-27-0.5	11/14/2018	1047	Boathouse	0 - 0.5	20 - 30	89 ± 5
105-28-0.5	11/14/2018	1049	Boathouse	0 - 0.5	20 - 30	31 ± 4
105-29-0.5	11/14/2018	1051	Boathouse	0 - 0.5	20 - 30	34 ± 4
105-30-0.5	11/14/2018	1053	Boathouse	0 - 0.5	20 - 30	48 ± 5
105-31-0.5	11/14/2018	1100	Boathouse	0 - 0.5	20 - 30	44 ± 3
105-32-0.5	11/14/2018	1102	Boathouse	0 - 0.5	20 - 30	44 ± 3
105-33-0.5	11/14/2018	1103	Boathouse	0 - 0.5	20 - 30	50 ± 3
105-34-0.5	11/14/2018	1105	Boathouse	0 - 0.5	20 - 30	32 ± 3
105-35-0.5	11/14/2018	1106	Boathouse	0 - 0.5	20 - 30	32 ± 4
105-36-0.5	11/14/2018	1107	Boathouse	0 - 0.5	20 - 30	26 ± 3
105-37-0.5	11/14/2018	1104	Boathouse	0 - 0.5	20 - 30	14 ± 4
105-38-0.5	11/14/2018	1105	Boathouse	0 - 0.5	20 - 30	22 ± 4
105-39-0.5	11/14/2018	1108	Boathouse	0 - 0.5	20 - 30	23 ± 4
105-40-0.5	11/14/2018	1109	Boathouse	0 - 0.5	20 - 30	57 ± 5
105-41-0.5	11/14/2018	1110	Boathouse	0 - 0.5	20 - 30	42 ± 5
105-42-0.5	11/14/2018	1111	Boathouse	0 - 0.5	30 - 40	30 ± 4
105-43-0.5	11/14/2018	1117	Boathouse	0 - 0.5	30 - 40	54 ± 4
105-44-0.5	11/14/2018	1120	Boathouse	0 - 0.5	30 - 40	22 ± 4
105-45-0.5	11/14/2018	1123	Boathouse	0 - 0.5	30 - 40	31 ± 4
105-46-0.5	11/14/2018	1125	Boathouse	0 - 0.5	30 - 40	26 ± 4
105-47-0.5	11/14/2018	1121	Boathouse	0 - 0.5	30 - 40	27 ± 3
105-48-0.5	11/14/2018	1123	Boathouse	0 - 0.5	30 - 40	21 ± 3
105-49-0.5	11/14/2018	1125	Boathouse	0 - 0.5	30 - 40	32 ± 3
105-50-0.5	11/14/2018	1127	Boathouse	0 - 0.5	30 - 40	66 ± 4

Table 1
XRF Sample Log
USCG Burrows Island Light Station
Burrows Island, Washington

Sample ID	Date	Time	Building/Structure	Sample Interval	Approximate Offset from Building (feet)	XRF Lead Concetration (ppm)[1]
105-51-0.5	11/14/2018	1129	Boathouse	0 - 0.5	30 - 40	25 ± 3
105-52-0.5	11/14/2018	1200	Boathouse	0 - 0.5	30 - 40	27 ± 3
105-53-0.5	11/14/2018	1202	Boathouse	0 - 0.5	30 - 40	18 ± 3
105-54-0.5	11/14/2018	1204	Boathouse	0 - 0.5	30 - 40	33 ± 3
105-55-0.5	11/14/2018	1206	Boathouse	0 - 0.5	30 - 40	55 ± 4
105-56-0.5	11/14/2018	1207	Boathouse	0 - 0.5	30 - 40	37 ± 4
105-57-0.5	11/14/2018	1208	Boathouse	0 - 0.5	30 - 40	35 ± 4
105-58-0.5	11/14/2018	1210	Boathouse	0 - 0.5	30 - 40	51 ± 5
105-59-0.5	11/14/2018	1212	Boathouse	0 - 0.5	30 - 40	51 ± 5
106-1-0.5	11/14/2018	1435	Pumphouse	0 - 0.5	0 - 10	111 ± 5
106-2-0.5	11/14/2018	1438	Pumphouse	0 - 0.5	0 - 10	61 ± 6
106-3-0.5	11/14/2018	1439	Pumphouse	0 - 0.5	0 - 10	9 ± 3
107-1-0.5	11/16/2018	1225	Firehouse Pump	0 - 0.5	0 - 10	51 ± 4
107-2-0.5	11/16/2018	1228	Firehouse Pump	0 - 0.5	0 - 10	65 ± 4
107-3-0.5	11/16/2018	1229	Firehouse Pump	0 - 0.5	0 - 10	42 ± 4
107-4-0.5	11/16/2018	1221	Firehouse Pump	0 - 0.5	0 - 10	281 ± 9
112-1-0.5	11/13/2018	1604	Above Ground Fuel Tank	0 - 0.5	0 - 10	557 ± 16
112-1-1.0	11/14/2018	1348	Above Ground Fuel Tank	0.5 - 1.0	0 - 10	64 ± 4
112-2-0.5	11/13/2018	1606	Above Ground Fuel Tank	0 - 0.5	0 - 10	1086 ± 18
112-2-1.0	11/14/2018	1344	Above Ground Fuel Tank	0.5 - 1.0	0 - 10	194 ± 6
112-3-0.5	11/13/2018	1607	Above Ground Fuel Tank	0 - 0.5	0 - 10	312 ± 9
112-4-0.5	11/13/2018	1610	Above Ground Fuel Tank	0 - 0.5	0 - 10	99 ± 2
112-5-0.5	11/13/2018	1612	Above Ground Fuel Tank	0 - 0.5	0 - 10	158 ± 7
112-6-0.5	11/13/2018	1614	Above Ground Fuel Tank	0 - 0.5	0 - 10	178 ± 7
112-7-0.5	11/13/2018	1615	Above Ground Fuel Tank	0 - 0.5	0 - 10	318 ± 9
112-8-0.5	11/13/2018	1617	Above Ground Fuel Tank	0 - 0.5	0 - 10	125 ± 6
WT-1-1-0.5	11/13/2018	1514	Water Tanks	0 - 0.5	0 - 10	127 ± 6

Table 1
XRF Sample Log
USCG Burrows Island Light Station
Burrows Island, Washington

Sample ID	Date	Time	Building/Structure	Sample Interval	Approximate Offset from Building (feet)	XRF Lead Concetration (ppm)[1]
WT-1-2-0.5	11/13/2018	1552	Water Tanks	0 - 0.5	0 - 10	63 ± 6
WT-1-3-0.5	11/13/2018	1554	Water Tanks	0 - 0.5	0 - 10	79 ± 6
WT-2-1-0.5	11/13/2018	1520	Water Tanks	0 - 0.5	0 - 10	97 ± 6
WT-2-2-0.5	11/13/2018	1522	Water Tanks	0 - 0.5	0 - 10	2222 ± 31
WT-2-2-1.0	11/13/2018	1620	Water Tanks	0.5 - 1.0	0 - 10	692 ± 14
WT-2-2-1.5	11/14/2018	1346	Water Tanks	1.0 - 1.5	0 - 10	159 ± 6
WT-2-3-0.5	11/13/2018	1527	Water Tanks	0 - 0.5	0 - 10	259 ± 9
WT-2-4-0.5	11/13/2018	1527	Water Tanks	0 - 0.5	0 - 10	142 ± 7
WT-3-1-0.5	11/13/2018	1531	Water Tanks	0 - 0.5	0 - 10	218 ± 9
WT-3-2-0.5	11/13/2018	1535	Water Tanks	0 - 0.5	0 - 10	< 10
WT-3-3-0.5	11/13/2018	1543	Water Tanks	0 - 0.5	0 - 10	108 ± 6
WT-4-1-0.5	11/13/2018	1546	Water Tanks	0 - 0.5	0 - 10	< 11
WT-4-2-0.5	11/13/2018	1549	Water Tanks	0 - 0.5	0 - 10	15 ± 4
WT-4-3-0.5	11/13/2018	1550	Water Tanks	0 - 0.5	0 - 10	< 11

Notes:

1. Concentrations that were not detected by the XRF analyzer are indicated by a "<" symbol with the detection level shown. The standard deviation provided by the XRF analyzer is indicated after the recorded value.

bgs = below ground surface
OIC = Officer In Charge
ppm = parts per million
XRF = x-ray fluorescence

Table 2
XRF Results Summary
USCG Burrows Island Light Station
Burrows Island, Washington

Sampling Area	Number of XRF Soil Samples	XRF Detected Lead Concentration Range (ppm)			Number of Samples Greater Than 300 ppm
		Low	High	Average[1]	
Light and Fog Signal Building (101)	68	19	8,975	795	38
Former Oil & Paint Storage Building (102)	53	15	5,643	650	21
Duplex (103)	125	12	1,352	184	21
Former Officer In Charge Quarters (104)	79	11	3,447	291	11
Boathouse (105)	62	10	448	74	2
Pumphouse & Spring Cistern (106)	3	9	111	60	0
Former Firehouse Pump Building (107)	4	42	281	110	0
Salt Water Flushing Pumphouse (108)	--[2]	--	--	--	--
Former Water Tanks (109, 110, 111)	15	15	2,222	348	2
Former Above Ground Fuel Oil Tank (112)	10	64	1,086	309	4

Notes:

1. Average concentration is presented for reference only. The result shown is not normalized to area and does not account for areas that could not be readily accessed for sampling. Concentrations may be skewed in areas where spatial distribution was not consistent around the entire structure.

2. No samples were collected from the area surrounding the Salt Water Flushing Pumphouse as there was not significant soil that could be readily collected.

ppm = parts per million

Concentration Range (ppm)	Number of XRF Soil Samples	Percent of Total
<175	267	64%
175-250	35	8%
250-500	56	13%
500-1000	29	7%
>1000	32	8%

Table 3
Mobilization 1 Summary Table
USCG Burrows Island Light Station
Burrows Island, Washington

Location ID	Location Name	Picture	XRF Samples	High (ppm)	Low (ppm)	Number of samples >300 ppm	Number of Analytical Samples	Comments
101	Light and Fog Signal Station		**68 total** 60, 0.0-0.5 feet 7, 0.5-1.0 feet 1, 1.0-1.5 feet	8,975 ± 67	19 ± 3	38	5	- Paint chipping visible on some window sills and trim. - Additional samples collected for PCB analysis from south of the building - Bedrock outcroppings visible on west side of building towards the water
102	Oil and Paint Storage Building		**53 total** 42, 0.0-0.5 feet 11, 0.5-1.0 feet	5,643 ± 48	15 ± 4	21	6	- Sloped area present west of the concrete pad with large aggregate, possibly a retaining wall or other structure - Shallow bedrock present west of former building
103	Duplex		**125 total** 121, 0.0-0.5 feet 4, 0.5-1.0 feet	1,352 ± 23	ND, <11	21	5	- Visible paint chipping and sloughing in areas on trim and from porches. Also very weathered in drip lines. - Removal area within parts of the sidewalks adjacent to building. - Fence around the east side of building is chipping and in poor condition.

Table 3
Mobilization 1 Summary Table
USCG Burrows Island Light Station
Burrows Island, Washington

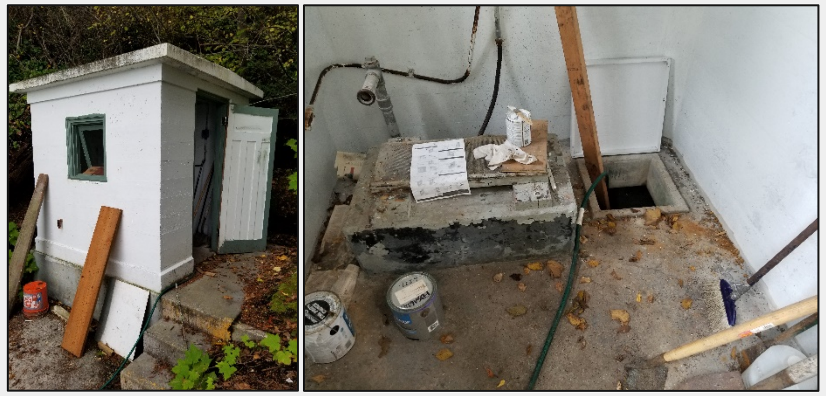
Location ID	Location Name	Picture	XRF Samples	High (ppm)	Low (ppm)	Number of samples >300 ppm	Number of Analytical Samples	Comments
104	OIC Quarters		**79 total** 70, 0.0-0.5 feet 6, 0.5-1.0 feet 2, 1.0-1.5 feet 1, 1.5-2.0 feet	3,447 ± 45	ND, <10	11	7	• Foundation and other remnants of building present and overgrown by trees and ivy. Limited soil or sampling was possible within the apparent building footprint. • Location on NE side of former building encountered charcoal and other woody debris with elevated XRF readings (>1,000 ppm) from surface to 2 feet bgs. • West of footprint not accessible due to steep slope and helicopter pad.
105	Boathouse		**62 total** 59, 0.0-0.5 feet 3, 0.5-1.0 feet	448 ± 9	ND, <12	2	6	• Apparent excavation and replacement of siding along east, south and west sides. • North side inaccessible for sampling due to slope and rocks. • Some building materials with paint encountered east of the building
106	Pumphouse and Spring Cistern		**3 total** 3, 0.0-0.5 feet	111 ± 5	9 ± 3	0	0	• Access limited, steep slope to get down to the building. • Samples collected in sand/soil adjacent to buildings. • Limited area that could be sampled.

Table 3
Mobilization 1 Summary Table
USCG Burrows Island Light Station
Burrows Island, Washington

Location ID	Location Name	Picture	XRF Samples	High (ppm)	Low (ppm)	Number of samples >300 ppm	Number of Analytical Samples	Comments
107	Firehouse Pump Building	 	**4 total** 4, 0.0-0.5 feet	281 ± 9	31 ± 4	0	0	• Former pad very overgrown, sampling access is limited due to brush and trees.
108	Salt Water Flushing Pumphouse	 	None	--	--	--	--	• No XRF samples collected due to lack of soil in vicinity of the structure. • Some woody debris and sediment present within the structure, but appears to be contained on the concrete footing. • Concrete appears to have been poured directly onto bedrock/
109, 110, 111	Water Tanks	 	**15 total** 13, 0.0-0.5 feet 1, 0.5-1.0 feet 1, 1.0-1.5 feet	2,222 ± 31	ND, <11	2	2	• 4 tank stands identified and located, orientation different from that shown on historical drawings. • Tanks are collapsed, pad structures remain. Painted material visible as well as some piping. • Once location had elevated readings, with samples collected from two additional depths.

Table 3
Mobilization 1 Summary Table
USCG Burrows Island Light Station
Burrows Island, Washington

Location ID	Location Name	Picture	XRF Samples	High (ppm)	Low (ppm)	Number of samples >300 ppm	Number of Analytical Samples	Comments
112	10,000-Gallon Fuel AST	 11/13/2018 13:56 11/13/2018 13:57	**9 total** 7, 0.0-0.5 2, 0.5-1.0	1,086 ± 18	64 ± 4	4	1	• Concrete stands for tank and pipeline components remaining, tank is no longer present. • Area overgrown with ivy and brush. • Pipeline visible at connection to former loading area east of the boathouse.

FIGURES

Note:
1. Site features based on U.S. Coast Guard historical drawing Fire Protection, Water & Sewer Systems, Burrows Island Light Station, Dwg No. 60.5804, December 1960.

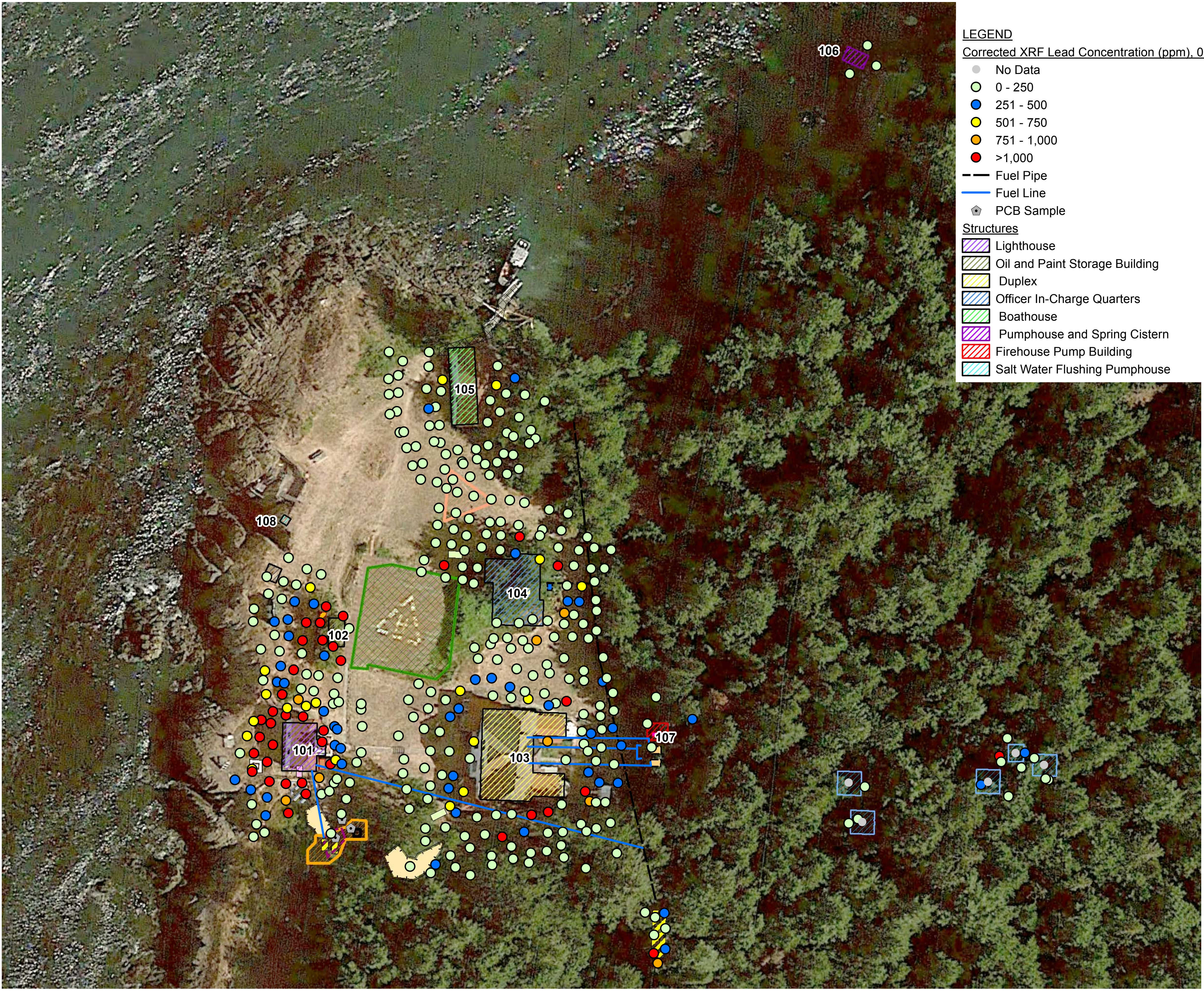
BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

Site Plan with Current and Historical Features

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1

CITY: SAN FRANCISCO DIV/GROUP: ENV/IM DB: kgpeters LD: PIC: PM: TM:
PROJECT: PATH: Z:\GISProjects_ENV\Burrows_Island_Lighthouse_2018\MXD\Fig2_Site Plan with Current and Historical Features.mxd DATE: 1/25/2019 5:21:34 PM



LEGEND

Corrected XRF Lead Concentration (ppm), 0 to 6 inches bgs

●	No Data
●	0 - 250
●	251 - 500
●	501 - 750
●	751 - 1,000
●	>1,000
— —	Fuel Pipe
—	Fuel Line
⬟	PCB Sample

Structures

▨	Lighthouse
▨	Oil and Paint Storage Building
▨	Duplex
▨	Officer In-Charge Quarters
▨	Boathouse
▨	Pumphouse and Spring Cistern
▨	Firehouse Pump Building
▨	Salt Water Flushing Pumphouse
■	675-Gallon Fuel Oil Tank
▨	540-Gallon Fuel Tank
▨	Excavated Tank Area
■	Fuel Oil Tank
■	F.O. Tank
▨	690-Gallon Fuel Tank
▨	Old Cistern
▨	Transformer Pad
■	Fire Pump
☐	Dark Staining
▨	Old Helicopter Pad
▨	Helicopter Pad
■	Debris Pile
▨	Elevated 10,000-Gallon Fuel Oil Tank
■	Septic Tank
■	675-Gallon Fuel Oil Tank
■	Fuel Oil Tank
▨	Gasoline Storage Tank
▨	Landing/Dock

Notes:
bgs - below ground surface
GPS - global positioning system
ppm - parts per million
> - Greater than
XRF - X-ray fluorescence
PCB - polychlorinated biphenyls

1. Sampling locations were recorded in the field using GPS with an approximate horizontal accuracy of 3 feet.
2. XRF lead concentrations are adjusted based on the correlation between laboratory analytical and XRF field screening results. Results were corrected using the following formula: Y = 1.136X - 0.02354 Where,
   Y = Log of the corrected XRF concentration
   X = Log of the XRF field measurement concentration
   Logarithms in the equation are in base 10.
3. Site features based on U.S. Coast Guard historical drawing Fire Protection, Water & Sewer Systems, Burrows Island Light Station, Dwg No. 60.5804, December 1960.

0 60 120

SCALE IN FEET

BURROWS ISLAND LIGHT STATION
SKAGIT COUNTY, WASHINGTON

XRF SAMPLING RESULTS
NOVEMBER 2018 SAMPLING EVENT

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2

CITY: SAN FRANCISCO DIV/GROUP: ENV/IM DB: jchen LD: PIC: PM: TM:
PROJECT: PATH: Z:\GISProjects_ENV\Burrows_Island_Lighthouse_2018\MXD\Memo_XRF SampleLocationsNovember_2018.mxd DATE: 2/18/2019 11:15:58 AM

ATTACHMENT 1

Photo Log

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 1

Date:
11/13/2018

Description:
East side of light station

Location:
Light and Fog Signal Building (101)

Photo: 2

Date:
11/13/2018

Description:
Peeling paint at light station

Location:
Light and Fog Signal Building (101)

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 3

Date:
11/13/2018

Description:
West side of light station

Location:
Light and Fog Signal Building (101)

Photo: 4

Date:
11/13/2018

Description:
North side of light station

Location:
Light and Fog Signal Building (101)

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 5

Date:
11/13/2018

Description:
Pipe visible on southwest side of Light and Fog Signal Building

Location:
Light and Fog Signal Building (101)

Photo: 6

Date:
11/13/2018

Description:
North side of Duplex

Location:
Duplex (103)

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 7

Date:
11/13/2018

Description:
West side of Duplex

Location:
Duplex (103)

Photo: 8

Date:
11/13/2018

Description:
Debris piles southwest of the Duplex

Location:
Duplex (103)

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 9

Date:

11/13/2018

Description:

Area of previous soil removal on south side of Duplex

Location:

Duplex (103)

Photo: 10

Date:

11/15/2018

Description:

Peeling paint visible on east side of Duplex

Location:

Duplex (103)

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 11

Date:

11/15/2018

Description:

Paint deterioration visible on drip lines and trim on north side of Duplex

Location:

Duplex (103)

Photo: 12

Date:

11/15/2018

Description:

Chipped paint in soil on west side of Duplex

Location:

Duplex (103)

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 13

Date:
11/15/2018

Description:
Peeling paint on trim on north side of Duplex

Location:
Duplex (103)

Photo: 14

Date:
11/13/2018

Description:
Fence on east side of Duplex

Location:
Duplex (103)

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 15

Date:

11/13/2018

Description:

East side of Duplex with water tanks

Location:

Duplex (103)

Photo: 16

Date:

11/13/2018

Description:

Fence and water tanks at southeast corner of Duplex

Location:

Duplex (103)

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 17

Date:

11/13/2018

Description:

Remaining concrete support structure for tank

Location:

Former Above Ground Fuel Oil Tank (112)

Photo: 18

Date:

11/13/2018

Description:

Pipeline leading north from former tank

Location:

Former Above Ground Fuel Oil Tank (112)

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 19

Date:
11/13/2018

Description:
West side of Boathouse

Location:
Boathouse (105)

Photo: 20

Date:
11/13/2018

Description:
Excavated area at southwest side of Boathouse

Location:
Boathouse (DU-105)

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 21

Date:

11/13/2018

Description:

East side of Boathouse with excavated area

Location:

Boathouse (105)

Photo: 22

Date:

11/13/2018

Description:

North side of boathouse at entrance to dock

Location:

Boathouse (105)

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 23

Date:

11/15/2018

Description:

Cistern identified south of the Light and Fog Signal Building

Location:

Light and Fog Signal Building (101)

Photo: 24

Date:

11/15/2018

Description:

Cistern identified south of the Light and Fog Signal Building

Location:

Light and Fog Signal Building (101)

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 25

Date:

11/13/2018

Description:

Helicopter pad with Boathouse in distance and OIC Quarters uphill.

Location:

Helicopter pad

Photo: 26

Date:

11/13/2018

Description:

Concrete foundation from Former Oil & Paint Storage Building west of helicopter pad

Location:

Former Oil & Paint Storage Building (102)

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 27

Date:

11/15/2018

Description:

Concrete foundation from Former Oil & Paint Storage Building west of helicopter pad

Location:

Former Oil & Paint Storage Building (102)

Photo: 28

Date:

11/15/2018

Description:

Obstruction west of Former Oil & Paint Storage Building

Location:

Former Oil & Paint Storage Building (102)

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 29

Date:
11/13/2018

Description:
Location of former PCB oil spill

Location:
Light and Fog Signal Building (101)

Photo: 30

Date:
11/16/2018

Description:
Location of former PCB oil spill

Location:
Light and Fog Signal Building (101)

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 31

Date:

11/16/2018

Description:

Location of former PCB oil spill

Location:

Light and Fog Signal Building (101)

Photo: 32

Date:

11/13/2018

Description:

Pipe in the back of the pumphouse building

Location:

Pumphouse and Spring Cistern (106)

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 33

Date:

11/13/2018

Description:

Pumphouse

Location:

Pumphouse and Spring Cistern (106)

Photo: 34

Date:

11/13/2018

Description:

West-facing view of salt water flushing pumphouse

Location:

Salt Water Flushing Pumphouse (108)

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 35

Date:
11/16/2018

Description:
Salt water pumphouse on concrete foundation

Location:
Salt Water Flushing Pumphouse (108)

Photo: 36

Date:
11/13/2018

Description:
Platform for water tank in the forest

Location:
Former Water Tanks (109, 110, 111)

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 37

Date:
11/13/2018

Description:
Platform for water tank in the forest

Location:
Former Water Tanks (109, 110, 111)

Photo: 38

Date:
11/16/2018

Description:
Concrete foundation of Former Firehouse Pump Building

Location:
Former Firehouse Pump Building (107)

Project Photographs

Burrows Island Light Station
Burrows Island, Anacortes, WA

Photo: 39

Date:

11/13/2018

Description:

Vegetated area covering the former OIC Quarters

Location:

Former OIC Quarters (104)

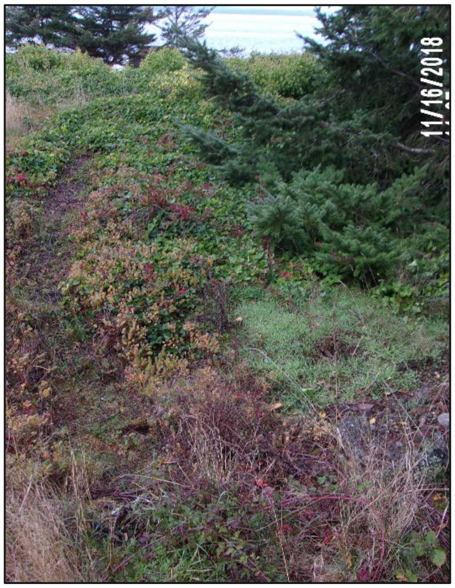


Photo: 40

Date:

11/16/2018

Description:

Foundation and building debris from the OIC Quarters

Location:

Former OIC Quarters (104)

ATTACHMENT 2

Field Forms

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006 Page______ of _______

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Julia Vidonish XRF Unit 5635

Sample Type: XRF Date: 11/14/18

Sampling Equipment: Probe / Trowel Other____________________

Shot #	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes	Sample
72	102-25-0.5	11/14/18	1300	med. brown, well-graded, sandy silt	4073±40	☑	100-0594	
76	102-22-0.5	11/14/18	1333	SAA	245± 6	☑	100-0595	
77	102-23-0.5	11/14/18	1335	SAA	1001±14	☑	100-0596	
78	102-24-0.5	11/14/18	1337	med brown, well-graded, sandy silt, high organics	4720±42	☑	100-0597	
79	102-26-0.5	11/14/18	1340	med. brown, well-graded, silty-sand	1299±17	☑	100-0598	
80	~~109~~ N112-2-1.0 ~~102-2-1'~~	11/14/18	1344	med. brown, well-graded, sandy soil	194±6	☑	100-0599	
81	WT-2-2-1.5'	11/14/18	1346	med. brown, well-graded, sandy soil	159± 6	☑	100-0600	
82	~~109~~ 112-1-1'	11/14/18	1348	med brown, well graded, sandy plus gravel	64±4	☑	100-0602	
83	102-4-1	11/14/18	1354	med. brown, well graded, sandy silt	123±5	☑	100-0603	
84	102-12-1	11/14/18	1356	SAA	51± 4	☑	100-0604	
85	102-13-1	11/14/18	1358	SAA	421±10	☑	100-0605	X
86	102-31-0.5	11/14/18	1400	dark brown, well-graded, sandy silt	407±9	☑	100-0606	
87	102-32-0.5	11/14/18	1402	SAA	252±7	☑	100-0607	X
88	102-33-0.5	11/14/18	1403	SAA	5643±48	☑	100-0608	X
89	102-34-0.5	11/14/18	1410	SAA	97± 4	☑	100-0609	

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006 Page____ of ____

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Julia Vidonish XRF Unit 5635

Sample Type: XRF Date: 11/14/18

Sampling Equipment: Probe / Trowel Other__________

Shot	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes
53	105-55-0.5	11/14/18	1206	dark brown, well-graded + sand	55 ± 4	☑	100-0577
57	102-1-0.5	11/14/18	1221	dark brown, well-graded sandy silt	133 ± 5	☑	100-0578
58	102-2-0.5	11/14/18	1224	SAA	82 ± 4	☑	100-0579
59	102-3-0.5	11/14/18	1226	SAA	120 ± 5	☑	100-0580
60	102-4-0.5	11/14/18	1228	SAA	420 ± 9	☑	100-0581
61	102-5-0.5	11/14/18	1230	SAA	91 ± 4	☑	100-0582
62	102-7-0.5	11/14/18	1232	SAA	67 ± 4	☑	100-0583
63	102-8-0.5	11/14/18	1233	SAA	82 ± 4	☑	100-0585
64	102-9-0.5	11/14/18	1235	SAA	88 ± 5	☑	100-0586
65	102-10-0.5	11/14/18	1236	SAA	248 ± 7	☑	100-0587
66	102-17-0.5	11/14/18	1240	dark brown, well-graded sandy silt	233 ± 6	☑	100-0588
67	102-18-0.5	11/14/18	1242	medium brown, well-graded, sandy silt	278 ± 7	☑	100-0593
68	102-19-0.5	11/14/18	1244	SAA	157 ± 6	☑	100-0589
69	102-20-0.5	11/14/18	1245	SAA	131 ± 5	☑	100-0590
70	102-21-0.5	11/14/18	1249	SAA	48 ± 4	☑	100-0591

Sample

TJV

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006 Page____of____

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Julia Vidonish XRF Unit 5635

Sample Type: XRF Date: ~~11/18/1~~ 11/14/18

Sampling Equipment: Probe / Trowel Other________

	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes	Sample
90	102-35-0.5	11/14/18	1415	dark brown, well-graded, sandy silt	203 ± 7	☑	100-0611	
91	102-36-0.5	11/14/18	1417	SAA	130 ± 6	☑	100-0612	
92	102-37-0.5	11/14/18	1418	SAA	128 ± 5	☑	100-0613	
93	102-38-0.5	11/14/18	1422	SAA	167 ± 6	☑	100-0614	
94	102-39-0.5	11/14/18	1424	SAA	143 ± 6	☑	100-0615	
95	102-40-0.5	11/14/18	1425	SAA	362 ± 8	☑	100-0616	
96	102-41-0.5	11/14/18	1427	SAA	215 ± 6	☑	100-0617	
97	102-42-0.5	11/14/18	1428	SAA	42 ± 4	☑	100-0618	
98	106-1-0.5	11/14/18	1435	med. brown, well-graded, sandy silt	111 ± 5	☑	100-0619	
99	106-2-0.5	11/14/18	1438	med. brown, well-graded, sandy silt w/ organics	61 ± 6	☑	101-0319	
100	106-3-0.5	11/14/18	1439	grey-brown sand, well graded	9 ± 3	☑	100-0620	
104	102-33-1' (refusal at 9")	11/14/18	1450	dark brown, well-graded, sandy silt	588 ± 11	☑	100-0621	
105	102-31-1'	11/14/18	1452	SAA	217 ± 6	☑	100-0622	
106	102-15-1'	11/14/18	1457	SAA	572 ± 10	☑	100-0623	
112	101-7-0.5	11/14/18	1548	dark brown, well-graded, sandy silt	931 ± 13	☑	100-0625	

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006

Page_____ of _____

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Mark Ullery

XRF Unit: 10102

Sample Type: XRF

Date: 11/14/18

Sampling Equipment: Probe / Trowel

Other_____

Shot #	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes	
57	105-59-0.5	11/14/18	1212	Well graded sand, no fines, black/grey	51±5	☒	101-285	
61	102-6-0.5	11/14/18	1223	Sandy silt, some organics, dk brown	52±5	☒	101-284	X
62	102-11-0.5	11/14/18	1240	Silty sand, some organics, black/dk brown	334±9	☒	101-296	
63	102-12-0.5	11/14/18	1242	SAA	1006±18	☒	101-294	
64	102-13-0.5	11/14/18	1244	SAA	1119±18	☒	101-297	
65	102-14-0.5	11/14/18	1247	SAA	91±5	☒	101-298	
66	102-15-0.5	11/14/18	1250	Silty sand, poorly graded, dk brown	879±16	☒	101-300	
67	102-16-0.5	11/14/18	1253	SAA	918±17	☒	101-301	X
72	102-27-0.5	11/14/18	1333	Silty sand, poorly graded, dk brown	367±10	☒	101-303	
73	102-28-0.5	11/14/18	1339	SAA	198±7	☒	101-305	
74	102-29-0.5	11/14/18	1342	Silt with some sand, organics, dk brown	15±4	☒	101-306	
75	102-30-0.5	11/14/18	1345	SAA	100±6	☒	101-308	
76	102-15-1.0	11/14/18	1415	Sandy silt, poorly graded, dk brown	627±13	☒	101-310	X
77	102-16-1.0	11/14/18	1420	SAA	252±9	☒	101-312	
78	102-24-1.0	11/14/18	1422	~~Sand~~ Silty sand, some organics, black	3718±44	☒	101-313	

Burrows Island XRF Sample Log

Project No.: B0003010.0006 **Page** 1 **of** 4

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Julia Vidonish & Kelsey Fray XRF unit #8580

Sample Type: XRF **Date:** 11/16/18

Sampling Equipment: Probe / Trowel Other

Shot #	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes
18	103-111-0.5	11/16/18	0908	Silty sand w/ gravel + trace organics	34 ± 4	☑	100-0689
19	103-112-0.5	│	0910	S.A.A	35 ± 4	☑	100-0690
20	103-113-0.5	│	0911	S.A.A.	147 ± 4	☑	100-0691
21	103-114-0.5	│	0913	S.A.A	89 ± 5	☑	100-0692
22	103-118-0.5	│	0915	Silty sand w/ organics + gravel	152 ± 6	☑	100-0696
23	103-119-0.5	│	0917	S.A.A	189 ± 6	☑	100-0697
24	103-120-0.5	│	0919	S.A.A.	157 ± 6	☑	100-0699
25	104-3-0.5	│	1039	dark brown, well-graded, sandy silt	134 ± 6	☑	100-0700
26	104-5-0.5	│	1041	SAA	193 ± 7	☑	100-0701
27	104-15-0.5	│	1044	SAA	590 ± 13	☑	100-0702
28	104-16-0.5	│	1045	SAA JV	[illegible]	197 ± 7 ☑	100-0703
29	104-17-0.5	│	1047	SAA	78 ± 5	☑	100-0704
30	104-18-0.5	│	1049	SAA	289 ± 9	☑	100-0705
31	104-19-0.5	│	1052	SAA	287 ± 9	☑	100-0706
32	104-20-0.5	↓	1053	SAA	73 ± 5	☑	100-0707

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006 Page ____ of ____

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Mark Ullery XRF unit 10102

Sample Type: XRF Date: 11/13/18

Sampling Equipment: Probe / Trowel Other________

Shot #	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes	Sample
39	~~109~~ 112-3-0.5	11/13/18	1607	SW with organics, dk brown	312 ± 9	☒	Julia's Phone	
40	~~109~~ 112-4-0.5	11/13/18	1610	SW, dk brown	99 ± 2	☒	Julia's Phone	
41	~~109~~ 112-5-0.5	11/13/18	1612	SW, dk brown	158 ± 7	☒	Julia's Phone	
42	~~109~~ 112-6-0.5	11/13/18	1614	SW, dk brown	178 ± 7	☒	Julia's Phone	
43	~~109~~ 112-7-0.5	11/13/18	1615	SW w/ gravel, dk brown	318 ± 9	☒	Julia's Phone	
44	~~109~~ 112-8-0.5	11/13/18	1617	SW, dk brown	125 ± 6	☒	Julia's Phone	
45	WT-2-2-1.0	11/13/18	1620	SW, dk brown	692 ± 14	☒	Julia's Phone	X
						☐		
						☐		
						☐		
						☐		
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ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006 **Page**____ **of**____

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Mark Ullery XRF Unit 10102

Sample Type: XRF **Date:** 11/13/18

Sampling Equipment: Probe / Trowel **Other**________

Shot #	Sample ID	Date	Time	General Soil Description	ppm Lead	Photo Taken?	Notes	Sample
18	WT-1-1-0.5	11/13/18	1514	SW, dk brown w/ org	127 ± 6	☒	100-529	
19	WT-2-1-0.5	11/13/18	1520	SW, dk brown w/ org	97 ± 6	☒	100-531	
20	WT-2-2-0.5	11/13/18	1522	SW, dk brown w/ wood	2,222 ± 31	☒	100-533	X
22	WT-2-3-0.5	11/13/18	1527	SW, dk brown w/ org	259 ± 9	☒	100-534	
23	WT-2-4-0.5	11/13/18	1529	SW, dk brown.	142 ± 7	☒	100-535	
24	WT-3-1-0.5	11/13/18	1531	SW, dk brown w/ org	218 ± 9	☒	100-537	
25	WT-3-2-0.5	11/13/18	1535	SW, dk brown/grey	<10	☒	100-538	
28	WT-3-3-0.5	11/13/18	1543	Organic, black/brown	108 ± 6	☒	100-539	
29	WT-4-1-0.5	11/13/18	1546	SW, dk brown	<11	☒	100-540	
30	WT-4-2-0.5	11/13/18	1549	SW/dk brown, w/ org	15 ± 4	☒	100-542	
31	WT-4-3-0.5	11/13/18	1550	SW, dk brw w/org	<11	☒	100-543	
32	WT-1-2-0.5	11/13/18	1552	SW, dk brown w/org	63 ± 6	☒	~~100-544~~ Julia's phone	
33	WT-1-3-0.5	11/13/18	1554	SW, dk brown w/org	79 ± 6	☒	Julia's Phone	
37	~~WT-109~~ ~~104~~ 112-1-0.5	11/13/18	1604	SW/w/gravel, dk brown	557 ± 16	☒	" "	
38	~~104~~ 112-2-0.5	11/13/18	1606	SW, dk brown w/ org	1086 ± 18 [illegible]	☒	Julia's phone	X

Burrows Island XRF Sample Log

Project No.: B0003010.0006 **Page** ____ **of** ____

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Mark Ullery XRF Unit 10102

Sample Type: XRF **Date:** 11/14/18

Sampling Equipment: Probe / Trowel **Other** ________

Shot #	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes
39	105-37-0.5	11/14/18	1104	Well graded sand w/ fines and trace gravel, black/brown	14±4	☒	101-264
40	105-38-0.5	11/14/18	1105	SAA	22±4	☒	101-266
41	105-39-0.5	11/14/18	1108	Well graded sand, dk brown/black	23±4	☒	101-267
42	105-40-0.5	11/14/18	1109	Well graded sand, trace woody debris, black/dk brown	57±5	☒	101-268
43	105-41-0.5	11/14/18	1110	Well graded sand, dk brown / black	42±5	☒	101-269
44	105-42-0.5	11/14/18	1111	Well graded sand, trace woody debris, light/dk brown	30±4	☒	101-270
48	105-43-0.5	11/14/18	1117	well graded sand, black/dk brown	54±4	☒	101-272
49	105-44-0.5	11/14/18	1120	SAA	22±4	☒	101-273
50	105-45-0.5	11/14/18	1123	well graded sand, black/dk brown	31±4	☒	101-274
51	105-46-0.5	11/14/18	1125	well graded, trace woody debris, black/dk brown	26±4	☒	101-275
52	105-1-1.0	11/14/18	1150	Well graded sand, ~~light~~ brown	55±5	☒	101-276
53	105-11-1.0	11/14/18	1153	well graded sand, dk brown/black	21±4	☒	101-278
54	105-56-0.5	11/14/18	1207	well graded sand, with fines, black/dk brown	37±4	☒	101-279
55	105-57-0.5	11/14/18	1208	SAA	35±4	☒	101-281
56	105-58-0.5	11/14/18	1210	SAA	51±5	☒	101-282

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006 **Page** _____ **of** _____

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Mark Ullery XRF Unit 10102

Sample Type: XRF **Date:** 11/14/18

Sampling Equipment: Probe / Trowel Other__________

Shot #	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes	
21	105-7-0.5	11/14/18	0956	Well graded Sand, black	81±5	☒	101-247	
22	105-8-0.5	11/14/18	0959	SAA	44±4	☒	101-248	
23	105-9-0.5	11/14/18	1001	SAA	<12	☒	101-249	
~~23~~ 24	105-10-0.5	11/14/18	1004	SAA	198±7	☒	101-250	
25	105-11-0.5	11/14/18	1007	Well graded sand, some organics/wood, black	412±10	☒	101-251	X
26	105-12-0.5	11/14/18	1015	Well graded sand, black	52±5	☒	101-252	
27	105-17-0.5	11/14/18	1020	Sand with some fines, black	31±4	☒	101-253	
28	105-18-0.5	11/14/18	1022	SAA	32±4	☒	101-254	
29	105-19-0.5	11/14/18	1024	SAA	24±4	☒	101-255	
30	105-20-0.5	11/14/18	1026	SAA	30±4	☒	101-256	
34	105-~~28~~ 26-0.5	11/14/18	1041	Well graded sand w/ some organics, black/dk brown	207±8	☒	101-258	
~~32~~ 35	105-27-0.5	11/14/18	1047	Well graded sand, dk brown/black	nm ~~28~~ 89±5	☒	101-~~2~~259	X
~~33~~ 36	105-28-0.5	11/14/18	1049	SAA	31±4	☒	101-260	
~~34~~ 37	105-29-0.5	11/14/18	1051	Well graded Sand, dk brown/black w/ trace organics	34±4	☒	101-261	
38	105-30-0.5	11/14/18	1053	SAA	48±5	☒	101-262	

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006 **Page** ____ **of** ____

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Mark Ullery XRF Unit 10102

Sample Type: XRF **Date:** 11/14/18

Sampling Equipment: Probe / Trowel Other________

Shot #	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes
79	102-25-1.0	11/14/18	1425	Silty sand, poorly graded, fine, dk brown	1191±20	☒	101-314
80	102-26-1.0	11/14/18	1427	Silty sand, ~~some~~ trace gravel, some org, dk brown	302±9	☒	101-315
87	101-1-0.5	11/14/18	1537	Sandy silt with some organics, brown	986±18	☒	101-318
88	101-2-0.5	11/14/18	1541	Silty sand, some organics Brown	1920±29	☒	101-320
89	101-3-0.5	11/14/18	1544	Silty sand with some gravel and organics, brown	1515±25	☒	101-321
90	101-4-0.5	11/14/18	1546	Silty sand, trace gravel, dk brown	591±14	☒	101-322
91	101-5-0.5	11/14/18	1547	Silty sand, trace wood, brown	3592±48	☒	101-323
92	101-6-0.5	11/14/18	1549	Silty sand with organics dk brown	1455±24	☒	101-324
93	101-13-0.5	11/14/18	1555	~~Silt~~ Silt with organics, trace sand, dk brown	404±11	☒	101-328
94	101-14-0.5	11/14/18	1557	SAA	761±15	☒	101-329
95	~~[illegible]~~ 101-15-0.5	11/14/18	1559	Sandy silt, dk brown	927±15	☒	101-330
96	101-16-0.5	11/14/18	1601	Silt, trace sand, dk brown	775±14	☒	101-331
97	101-17-0.5	11/14/18	1602	Silt, trace cobbles and sand, brown	1126±19	☒	101-332
						☐	
						☐	

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006 **Page**____ **of** ____

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Julia Vidonish XRF Unit 5635

Sample Type: XRF **Date:** 11/14/18

Sampling Equipment: Probe / Trowel Other__________

	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes	Sample
35	105-31-0.5	11/14/18	1100	brown, sand, well-graded	44±3	☑	100-0562	
36	105-32-0.5	11/14/18	1102	SAA	44±3	☑	100-0563	
37	105-33-0.5	11/14/18	1103	SAA	50±3	☑	100-0564	X
38	105-34-0.5	11/14/18	1105	SAA	32±3	☑	100-0565	
39	105-35-0.5	11/14/18	1106	SAA	32±4	☑	100-0566	
40	105-36-0.5	11/14/18	1107	SAA	26±3	☑	100-0567	
44	105-47-0.5	11/14/18	1121	SAA	27±3	☑	100-0568	
45	105-48-0.5	11/14/18	1123	SAA	21±3	☑	100-0569	
46	105-49-0.5	11/14/18	1125	brown, sand, well-graded, high organics	32±3	☑	100-0570	
47	105-50-0.5	11/14/18	1127	SAA	66±4	☑	100-0571	
48	105-51-0.5	11/14/18	1129	SAA	25±3	☑	100-0572	
49	105-13-1	11/14/18	1152	light brown, well-graded sand	10±3	☑	100-0573	
50	105-52-0.5	11/14/18	1200	dark brown, well-graded, sand	27±3	☑	100-0574	
51	105-53-0.5	11/14/18	1202	SAA	18±3	☑	100-0575	
52	105-54-0.5	11/14/18	1204	SAA	33±3	☑	100-0576	

Burrows Island XRF Sample Log

Project No.: B0003010.0006 **Page**_____ **of** _____

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Julia Vidonish XRF Unit #5635

Sample Type: XRF **Date:** 11/14/2018

Sampling Equipment: Probe / Trowel **Other**__________

Shot #	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes	Sample
17	105-1-0.5'	11/14/18	0956	Well graded, Sandy, Some gravel Dark brown, high organics	448 ± 9	☑	100-0545 ~~100-0543~~	X
18	105-2-0.5'	11/14/18	1002	Well graded, brown, sand, some gravel	126 ± 5	☑	100-0546	
19	105-3-0.5'	11/14/18	1005	well graded sand, brown	143 ± 5	☑	100-0547	
20	105-4-0.5'	11/14/18	1007	well graded sand, brown	130 ± 5	☑	100-0548	
21	105-5-0.5'	11/14/18	1009	well graded, brown, sand, organics	79 ± 4	☑	100-0549	
22	105-6-0.5'	11/14/18	1012	well graded, sand, brown	67 ± 4	☑	100-0551	
23	105-13-0.5'	11/14/18	1018	well graded sand with large organic fraction + wood	283 ± 8	☑	100-0553	X
24	105-14-0.5'	11/14/18	1020	well graded, sandy, brown	60 ± 4	☑	100-0554	
25	105-15-0.5'	11/14/18	1022	well graded, sandy, brown	35 ± 4	☑	100-0555	
26	105-16-0.5'	11/14/18	1024	dark brown, well-graded, sandy	57 ± 3	☑	100-0556	
30	105-21-0.5	11/14/18	1043	dark brown, well-graded, sand	36 ± 3	☑	100-0557	
31	105-22-0.5	11/14/18	1045	dark brown, well-graded sand	45 ± 3	☑	100-0558	
32	105-23-0.5	11/14/18	1047	dark brown, well-graded sand	223 ± 7	☑	100-0559	
33	105-24-0.5	11/14/18	1050	dark brown, well-graded, sand	134 ± 6	☑	100-0560	
34	105-25-0.5	11/14/18	1052	SAA	197 ± 6	☑	100-0561	X

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006 Page 3 of 7

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Kelsey Franz XRF-10102

Sample Type: XRF Date:

Sampling Equipment: Probe / Trowel Other

Shot #	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes	
57	103-14-0.5	11/15/18	1340	Sandy Silt w/ gravel + trace org.	212±8	☑	101-0380	
58	103-1-0.5	11/15/18	1343	Silty sand w/ trace organics	414±11	☑	101-0381	
59	103-2-0.5	11/15/18	1345	silty sand w/ trace gravel + organics	317±9	☑	101-0382	
60	103-3-0.5	11/15/18	1346	sandy Silt w/ gravel + trace org.	546±13	☑	101-0383	X
61	103-4-0.5	11/15/18	1347	s.a.a.	17±4	☑	101-0384	
62	103-5-0.5	11/15/18	1349	silty Sand w/ gravel + trace organics	321±9	☑	101-0385	
63	103-6-0.5	11/15/18	1351	s.a.a.	433±11	☑	101-0386	
64	103-7-0.5	11/15/18	1352	Sandy Silt w/ gravel + trace org.	378±10	☑	101-0387	
65	103-8-0.5	11/15/18	1353	s.a.a.	43±5	☑	101-0388	
66	103-9-0.5	11/15/18	1356	s.a.a.	149±7	☑	101-0389	
67	103-10-0.5	11/15/18	1357	silty Sand w/ gravel + trace org.	135±7	☑	101-0390	
68	103-11-0.5	11/15/18	1358	s.a.a.	1352±23	☑	101-0391	
72	103-34-0.5	11/15/18	1417	s.a.a.	866±15	☑	101-0392	
73	103-35-0.5	11/15/18	1419	s.a.a.	368±9	☑	101-0393	
74	103-36-0.5	11/15/18	1421	sandy silt w/ gravel + trace org.	55±5	☑	101-0394	

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006 Page 1 of

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: K. Haslam XRF Ser. No 8580

Sample Type: XRF Date: 11-15-2018

Sampling Equipment: Probe / Trowel Other

Shot #	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes
17	103-24-0.5	11/15/18	14:16	Silty Sand w/ organics	98±6	☒	100-0657
18	103-25-0.5	11/15/18	14:20	SAA	256±8	☒	100-0658
19	103-26-0.5		14:21	SAA	110±6	☒	100-0659
20	103-27-0.5		14:23	Silty Sand, black	131±6	☒	100-0660
21	103-28-0.5		14:24	Silty Sand w/ some gravel	194±7	☒	100-0661
22	103-29-0.5		14:26	SAA	112±6	☒	100-0662
23	103-30-0.5		14:27	SAA	430±11	☒	100-0663
24	103-31-0.5		14:28	SAA	60±4	☒	100-0664
25	103-32-0.5		14:30	SAA	133±6	☒	100-0665
26	103-33-0.5		14:31	SAA; lots of organics	154±6	☒	100-0666
28	103-51-0.5		14:35	Silty Sand w/ organics	237±8	☒	100-0667
33	103-62-0.5		15:07	Silty Sand w/ some gravel	29±4	☒	100-669
34	103-63-0.5		15:08	SAA	39±4	☒	100-670
35	103-64-0.5		15:12	SAA	55±5	☒	100-671
36	103-65-0.5		15:14	SAA	35±4	☒	100-672

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006

Page 5 of 7

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Kelsey Franz

XRF unit 10102

Sample Type: XRF

Date: 11/15/18

Sampling Equipment: Probe / Trowel Other

Shot#	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes
93	103-53-0.5	11/15/18	1505	Silty Sand w/ gravel + trace organics	37±5	☑	101-0410
94	103-54-0.5	11/15/18	1506	S.A.A	124±6	☑	101-0411
96	103-56-0.5	11/15/18	1510	S.A.A	65±5	☑	101-0413
97	103-57-0.5	11/15/18	1512	S.A.A.	57±5	☑	101-0414
95	103-55-0.5	11/15/18	1508	S.A.A.	88±6	☑	101-0412
98	103-58-0.5	11/15/18	1514	S.A.A	52±5	☑	101-0415
99	103-59-0.5	11/15/18	1515	S.A.A	12±3	☑	101-0416
100	103-60-0.5	11/15/18	1517	S.A.A	92±5	☑	101-0417
101	103-61-0.5	11/15/18	1518	S.A.A	231±8	☑	101-0418
102	103-68-0.5	11/15/18	1520	S.A.A.	94±6	☑	101-0420
103	103-69-0.5	11/15/18	1521	Sandy Silt w/ gravel + trace organics	31±4	☑	101-0421
104	103-74-0.5	11/15/18	1523	Silty Sand w/ gravel + trace organics	83±6	☑	101-0422
105	103-75-0.5	11/15/18	1525	S.A.A	134±6	☑	101-0423
106	103-72-0.5	11/15/18	1526	S.A.A.	367±10	☑	101-0424
107	103-81-0.5	11/15/18	1530	S.A.A.	186±7	☑	101-0425

X

Burrows Island XRF Sample Log

Project No.: B0003010.0006 Page 6 of 7

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Kelsey Franz XRF Unit 10102

Sample Type: XRF Date: 11/15/18

Sampling Equipment: Probe / Trowel Other________

Shot#	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes	
108	103-82-0.5	11/15/18	1531	Silty Sand w/ gravel + trace organics	78±5	☑	101-0426	
109	103-83-0.5	11/15/18	1533	S.A.A.	147±7	☑	101-0427	
110	103-84-0.5	11/15/18	1534	S.A.A.	54±5	☑	101-0428	
111	103-85-0.5	11/15/18	1536	S.A.A	128±6	☑	101-0429	
115	103-86-0.5	11/15/18	1547	S.A.A	32±4	☑	101-0430	X
116	103-87-0.5	11/15/18	1548	S.A.A	75±5	☑	101-0431	
117	103-88-0.5	11/15/18	1550	S.A.A	58±5	☑	101-0433	
118	103-89-0.5	11/15/18	1552	S.A.A	60±5	☑	101-0434	
119	103-90-0.5	11/15/18	1553	Silty sand + gravel w/ trace org.	62±5	☑	101-0435	
120	103-91-0.5	11/15/18	1555	S.A.A	32±4	☑	101-0436	
121	103-92-0.5	11/15/18	1557	Silty sand w/ gravel + trace organics	32±4	☑	101-0437	
122	103-93-0.5	11/15/18	1558	S.A.A	19±4	☑	101-0438	
123	103-94-0.5	11/15/18	1603	S.A.A	<11	☑	101-0439	
124	103-95-0.5	11/15/18	1604	S.A.A	203±6	☑	101-0440	
125	103-96-0.5	11/15/18	1606	S.A.A	98±5	☑	101-0441	

Burrows Island XRF Sample Log

Project No.:	B0003010.0006	Page 4 of 7	
Site Location:	Burrows Island Light Station, Anacortes, WA		
Personnel:	Kelsey Franz	XRF unit 10102	
Sample Type:	XRF	Date:	11/15/18

Sampling Equipment: Probe / Trowel Other________

Shot #	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes	
75	103-37-0.5	11/15/18	1423	silty sand w/ gravel + trace organics	155+7	☑	101-0395	
76	103-38-0.5	11/15/18	1425	S.a.a.	80±6	☑	101-0396	
77	103-39-0.5	11/15/18	1426	S.a.a.	699±15	☑	101-0397	
78	103-40-0.5	11/15/18	1428	S.a.a.	849±16	☑	101-0398	
79	103-41-0.5	11/15/18	1430	S.a.a	259±8	☑	101-0399	
80	103-42-0.5	11/15/18	1431	S.a.a.	199±7	☑	101-0400	
81	103-43-0.5	11/15/18	1433	S.a.a.	279±8	☑	101-0401	
82	103-44-0.5	11/15/18	1434	S.a.a.	180±7	☑	101-0402	
83	103-45-0.5	11/15/18	1436	S.a.a.	119±6	☑	101-0403	
84	103-46-0.5	11/15/18	1437	S.a.a.	157±6	☑	101-0404	
85	103-47-0.5	11/15/18	1439	S.a.a.	104±6	☑	101-0405	
86	103-48-0.5	11/15/18	1440	S.a.a.	145±6	☑	101-0406	
87	103-49-0.5	11/15/18	1441	S.a.a.	278±8	☑	101-0407	
88	103-50-0.5	11/15/18	1443	S.a.a.	254±8	☑	101-0408	X
92	103-52-0.5	11/15/18	1503	S.a.a.	<14	☑	101-0409	

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006

Page 2 of 7

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Mark Ullery

XRF Unit 10102

Sample Type: XRF

Date: 11/15/18

Sampling Equipment: Probe / Trowel Other

Shot #	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes	
35	101-55-0.5	11/15/18	1043	Silty sand, some organics, dk brown	86±6	☒	101-354	
36	101-56-0.5	11/15/18	1045	Silty sand, dk brown	132±6	☒	101-355	
37	101-57-0.5	11/15/18	1047	Silty sand, trace organics, dk brown	94±5	☒	101-356	
41	101-15-1	11/15/18	1224	Silty sand w/ gravel and organics	45±5	☑	101-0368	
46	101-27-1'	11/15/18	1318	S.a.a.	808±15	☑	101-0367	[illegible]
47	103-15-0.5	11/15/18	1326	silty sand with gravel	56±6	☑	101-0370	
48	103-16-0.5	11/15/18	1327	S.a.a.	653±14	☑	101-0371	
49	103-17-0.5	11/15/18	1329	S.a.a	25±5	☑	101-0372	
50	103-18-0.5	11/15/18	1331	S.a.a.	183±8	☑	101-0373	
51	103-19-0.5	11/15/18	1333	Silty sand w/gravel and trace organics	917±17	☑	101-0374	X
52	103-20-0.5	11/15/18	1334	S.a.a.	367±10	☑	101-0375	
53	103-22-0.5	11/15/18	1336	sandy silt, w/gravel + organics	90±5	☑	101-0376	
54	103-23-0.5	11/15/18	1337	S.a.a.	16± 4	☑	101-0377	
55	103-12-0.5	11/15/18	1339	silty sand w/ gravel + trace organics	1057±19	☑	101-0378	X
56	103-13-0.5	11/15/18	1340	S.a.a.	13± 4	☐	101-0379	

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006 Page 2 of

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Kelsey Franz & Kyle Haslam XRF Unit = 5635

Sample Type: XRF Date: 11/15/18

Sampling Equipment: Probe / Trowel Other

Shot #	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes
35	101-46-0.5	11/15/18	1039	Silty Sand w/ organics	44±3	☑	100-0642
36	101-47-0.5	11/15/18	1040	S.a.a.	19±3	☑	100-0643
37	101-48-0.5	11/15/18	1042	Silty Sand w/ gravel and organics	103±5	☑	100-0644
38	101-59-0.5	11/15/18	1043	Silty Sand w/ organics	45±4	☑	100-0645
39	101-60-0.5	11/15/18	1046	Silty sand w/ organics and some gravel	34±3	☑	100-0646
40	101-58-0.5	11/15/18	1048	Silty Sand w/ organics	104±5	☑	100-0647
51	103-21-0.5	11/15/18	13:10	Silty Sand w/ some gravel	504± 10	☒	100-0654
52	~~103-23-0.5~~	~~11/15/18~~		~~Silty Sand w/ gravel; barn~~		☒	~~100-0656~~
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Burrows Island XRF Sample Log

Project No.: B0003010.0006 **Page** 1 **of** 4

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Kelsey Franz XRF Unit # 10102

Sample Type: XRF **Date:** 11/16/18

Sampling Equipment: Probe / Trowel **Other**__________

Shot #	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes
18	103-105-0.5	11/16/18	0902	Silty Soil w/ gravel + trace organics	47±5	☑	100-0683
19	103-106-0.5		0904	S.A.A.	382±10	☑	100-0684
20	103-107-0.5		0906	S.A.A	115±6	☑	100-0685
21	103-108-0.5		0907	S.A.A	284±8	☑	100-0686
22	103-109-0.5		0910	S.A.A	326±10	☑	100-0687
23	103-110-0.5		0911	S.A.A	177±7	☑	100-0688
24	103-115-0.5		0913	S.A.A	87±5	☑	100-0693
25	103-116-0.5		0915	S.A.A	87±5	☑	100-0694
26	103-117-0.5		0917	S.A.A	118±6	☑	100-0695
27	103-120-0.5		0919	Silty Sand w/ organics	159±7	☑	100-0698
31	103-39-1		1014	clay and silt w/ trace organics	<11	☑	101-0470
32	103-19-1		1016	silty Sand w/ trace organics + gravel	17±4	☑	101-0471
33	103-11-1		1017	silty sand w/ some clay and trace organics	130±7	☑	101-0472
34	103-12-1		1018	silty Sand w/ trace organics + gravel	<11	☑	101-0473
						☐	

Burrows Island XRF Sample Log

Project No.: B0003010.0006 Page 2 of

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: K. Haslam XRF Ser. No. 8580

Sample Type: XRF Date: 11-15-2018

Sampling Equipment: Probe / Trowel Other

Shot #	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes
37	103-66-0.5	11/15/18	15:17	Silty Sand w/ gravel & organics	43±4	☒	100-673
38	103-67-0.5		15:20	SAA	32±4	☒	100-674
39	103-70-0.5		15:22	SAA	73±5	☒	100-675
40	103-71-0.5		15:24	SAA	143±6	☒	100-676
41	103-73-0.5		15:26	Silty Sand, black, organics	164±6	☒	100-677
42	103-76-0.5		15:29	SAA	116±5	☒	100-678
43	103-77-0.5		15:32	SAA	68±5	☒	100-679
44	103-78-0.5		15:33	SAA	308±9	☒	100-680
45	103-79-0.5		15:35	SAA	31±4	☒	100-681
46	103-80-0.5		15:36	SAA	109±5	☒	100-682
47						☐	
						☐	
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						☐	
						☐	

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006 Page 7 of 7

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Kelsey Franz XRF unit 10102

Sample Type: XRF Date: 11/15/18

Sampling Equipment: Probe / Trowel Other

	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes
126	103-97-0.5	11/15/18	1613	silty sand w/gravel + trace organics	70 ± 6	☑	101-0442
127	103-98-0.5	11/15/18	1615	S.A.A.	133±6	☑	101-0444
128	103-99-0.5	11/15/18	1616	S.A.A.	94±6	☑	101-0445
129	103-100-0.5	11/15/18	1618	S.A.A	43±5	☑	101-0446
130	103-101-0.5	11/15/18	1619	S.A.A	44±5	☑	101-0447
131	103-102-0.5	11/15/18	1620	S.A.A	33± 4	☑	101-0449
132	103-103-0.5	11/15/18	1622	S.A.A	33±4	☑	101-0450
133	103-104-0.5	11/15/18	1623	S.A.A	32±4	☑	101-0451
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Burrows Island XRF Sample Log

Project No.: B0003010.0006 Page 1 of ____

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Julia Vidonish / Kelsey Franz XRF Unit = 5635

Sample Type: XRF Date: 11/15/18

Sampling Equipment: Probe / Trowel Other____

Shot #	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes	
17	101-22-0.5	11/15/18	0937	Sandy, Silt w/ organics	276±7	☑	100-0626	
18	101-23-0.5	11/15/18	0941	Saa	446±9	☑	100-0627	
19	101-24-0.5	11/15/18	0948	S.a.a	90±4	☑	100-0628	
20	101-25-0.5	11/15/18	0951	S.a.a.	148±5	☑	100-0629	
21	101-26-0.5	11/15/18	0952	S.a.a.	824±12	☑	100-0630	X
22	101-27-0.5	11/15/18	0953	S.a.a	702±12	☑	100-0631	
23	100-28-0.5	11/15/18	0955	Sandy, silt w/ organics and some gravel	219±7	☑	100-0632	
24	100+29-0.5	11/15/18	0957	Silty sand w/ organics	62±4	☑	100-0633	X
25	100-40-0.5	11/15/18	0958	Sandy silt w/ gravel and organics	160±6	☑	100-0634	
26	101-39-0.5	11/15/18	1000	S.a.a.	397±9	☑	100-0635	
30	101-41-0.5	11/15/18	1029	Silty sand w/ organics	147±5	☑	100-0637	
31	101-42-0.5	11/15/18	1031	Silty sand w/ organics and some gravel	273±6	☑	100-0638	
32	101-43-0.5	11/15/18	1033	Silty sand w/ organics	313±8	☑	100-0639	X
33	101-44-0.5	11/15/18	1035	S.a.a.	237±6	☑	100-0640	
34	101-45-0.5	11/15/18	1036	S.a.a.	78±4	☑	100-0641	

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006

Page_____ of _____

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Julia Vidonish

XRF Unit 5635

Sample Type: XRF

Date: 11/14/18

Sampling Equipment: Probe / Trowel Other________

Shot	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes	Sample
113	101-8-0.5	11/14/18	1549	dark brown, well-graded, sandy silt	8975 ± 67	☑	101-0325	X
114	101-9-0.5	11/14/18	1551	SAA	2539 ± 28	☑	101-0326	
115	101-10-0.5	11/14/18	1553	med brown, poorly-graded silt, minor sand	2367 ± 27	☑	Julia's phone	
116	101-11-0.5	11/14/18	1555	dark brown, well-graded, sandy silt	838 ± 15	☑	Julia's phone	X
117	101-12-0.5	11/14/18	1556	SAA	5885 ± 51	☑	Julia's phone	
118	101-19-0.5	11/14/18	1558	SAA	388 ± 8	☑	Julia's phone	
119	101-21-0.5	11/14/18	1559	SAA	271 ± 7	☑	Julia's phone	
120	101-20-0.5	11/14/18	1600	SAA	366 ± 9	☑	Julia's phone	
121	101-18-0.5	11/14/18	1602	SAA	510 ± 10	☑	Julia's phone	
44	101-2-1.0	11/15/18	12:06	light brown, silty sand w/ subrounded gravel	50 ± 4	☑	100-0648	
45	101-6-1.0	11/15/18	12:08	dark brown silty sand	404 ± 9	☑	100-0649	
46	101-12-1.0	11/15/18	12:10	SAA; organic matter	1,206 ± 17	☑	100-0650	
48	101-17-1.0	11/15/18	12:12	dark brown silty sand	208 ± 7	☑	100-0651	
49	101-23-1.0	11/15/18	12:15	SAA w/ some gravel	161 ± 6	☑	100-0652	
50	101-12-1.5	11/15/18	12:40	Silt w/ some gravel; dark brown	279 ± 10	☑	100-0653	

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006 Page 1 of 1

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Mark Ulley XRF 10102

Sample Type: XRF Date:

Sampling Equipment: Probe / Trowel Other

Shot #	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes
~~16~~ 17	101-30-0.5	11/15/18	938	Silty sand with some gravel with some organics, dk brown	307 ± 19	☒	101-333
~~17~~ 18	101-31-0.5	11/15/18	940	silty sand with some organics, dk brown	884 ± 15	☒	101-334
19	101-32-0.5	11/15/18	948	Silty sand, dk brown	78 ± 5	☒	~~101-340~~ 101-335
20	101-33-0.5	11/15/18	950	Silty sand with organics, dk brown	360 ± 10	☒	101-340
21	101-34-0.5	11/15/18	952	SAA	386 ± 10	☒	101-341
22	101-35-0.5	11/15/18	954	Silt, trace sand, dk brown	388 ± 10	☒	101-342
23	101-36-0.5	11/15/18	956	~~SAA~~ Silt, dk brown	509 ± 12	☒	101-343
24	101-37-0.5	11/15/18	958	Silt, with organics, dk brown	1367 ± 19	☒	101-344
25	101-38-0.5	11/15/18	1000	SAA	678 ± 13	☒	101-345
29	101-49-0.5	11/15/18	1028	~~Silty sand,~~ Silt, some organics, dk brown	62 ± 5	☒	101-348
30	101-50-0.5	11/15/18	1033	Silty sand, dk brown	328 ± 9	☒	101-~~350~~ 349
31	101-51-0.5	11/15/18	1035	Silty sand with gravel, dk brown	3239 ± 44	☒	101-350
32	101-52-0.5	11/15/18	1037	SAA	100 ± 5	☒	101-351
33	101-53-0.5	11/15/18	1039	SAA	38 ± 4	☒	101-352
34	101-54-0.5	11/15/18	1042	Sand with organics, dk brown/black	61 ± 4	☒	101-353

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006 Page 3 of 4

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Kelsey Frantz XRF unit # 8580

Sample Type: XRF Date: 11/16/18

Sampling Equipment: Probe / Trowel Other________

Shot #	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes
51	104-45-0.5	11/16/18	1154	Silty sand w/ gravel + trace organics	84±5	☑	100-0723
52	104-46-0.5		1155	SAA	200±7	☑	100-0724
53	104-48-0.5		1157	SAA	45±4	☑	100-0725
54	104-49-0.5		~~1200~~ 1158	SAA	43±4	☑	100-0726
55	104-50-0.5		1200	SAA	12±4	☑	100-0727
56	104-51-0.5		1202	SAA	17±3	☑	100-0728
57	104-44-0.5		1205	SAA	52±4	☑	100-0729
58	104-43-0.5		1206	Silty clay w/ sand gravel + trace organics	31±3	☑	100-0730
59	104-42-0.5		1208	SAA	<10	☑	100-0731
60	104-41-0.5		1209	Silty sand w/ gravel + trace organics	86±5	☑	100-0732
61	104-40-0.5		1210	SAA	3447±45	☑	100-0733
62	104-37-0.5		1213	SAA	118±5	☑	100-0734
63	104-36-0.5		1214	SAA	80±5	☑	100-0735
64	107-1-0.5		1225	Silty sand w/ gravel + trace organics	51±4	☑	100-0736
65	107-2-0.5	↓	1228	SAA	65±4	☑	100-0737

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006

Page 4 of 4

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Julia Vidonish

XRF Unit # 10102

Sample Type: XRF

Date: 11/16/18

Sampling Equipment: Probe / Trowel Other

	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes
68	104-35-0.5	11/16/18	1207	med. brown, well-graded, sandy silt	42 ± 5	☑	101-0506
69	104-34-0.5		1208	SAA	22 ± 4	☑	101-0507
70	104-33-0.5		1212	SAA	<12	☑	101-0508
71	104-32-0.5		1214	SAA	44 ± 5	☑	101-0509
	~~104-22-1'~~					☐	
						☐	
						☐	
						☐	
						☐	
						☐	
						☐	
						☐	
						☐	
						☐	
						☐	

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006

Page 4 of 4

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Kelsey Franz

XRF unit # 8580

Sample Type: XRF

Date: 11/16/18

Sampling Equipment: Probe / Trowel Other

Shot#	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes
66	107-3-0.5	11/16/18	1229	Silty sand w/ gravel + organics	42±4	☑	100-0738
67	107-4-0.5	↓	1221	SAA	281±9	☑	100-0739
73	104-27-1		1253	silty sand w/ gravel + trace organics	1890±30	☑	101-0513
74	104-22-1		1254	SAA	130±5	☑	101-0511
75	104-15-1		1256	SAA	162±7	☑	101-0512
76	104-38-1		1258	silty sand w/ clay, gravel + trace organics	11±3	☑	100-0754
77	104-40-1		1259	silty sand w/ gravel + trace organics	197±8	☑	100-0755
78	104-27-1.5		1304	SAA + charcoal	2095±32	☑	100-0756
79	104-65-1.0		1309	S.A.A	1823±38	☑	100-0757
80	104-27-2.0		1312	Silty sand w/ gravel and charcoal, BLACK	3345±47	☑	100-0758
81	104-65-1.5'		1318	Silty sand w/ gravel + trace organics	165±7	☑	100-0759
						☐	
						☐	
						☐	
						☐	

Burrows Island XRF Sample Log

Project No.: B0003010.0006 Page 2 of 4

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Julia Vidonish / Kelsey Franz XRF Unit # 10102

Sample Type: XRF Date: 11/16/18

Sampling Equipment: Probe / Trowel Other

	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes
35	104-1-0.5	11/16/18	1035	dark brown, well graded, sandy silt	182±7	☑	101-0474
36	104-2-0.5	11/16/18	1038	SAA	148±7	☑	101-0475
37	104-4-0.5	11/16/18	1041	SAA	196±7	☑	101-0476
38	104-6-0.5	11/16/18	1047	SAA	87±5	☑	101-0477
39	104-7-0.5	11/16/18	1048	SAA	72±5	☑	101-0478
40	104-8-0.5	11/16/18	1050	SAA	38±5	☑	101-0479
41	104-9-0.5	11/16/18	1051	SAA	88±5	☑	101-0480
42	104-10-0.5	11/16/18	1053	SAA	48±5	☑	101-0481
43	104-11-0.5	11/16/18	1107	SAA	146±7	☑	101-0482
44	104-22-0.5	↓	1109	SAA	427±10	☑	101-0483
45	104-24-0.5		1111	SAA	196±8	☑	101-0484
46	104-25-0.5		1115	SAA	110±7	☑	101-0485
47	104-26-0.5		1116	SAA	148±6	☑	101-0486
48	104-27-0.5		1117	SAA	1241±22	☑	101-0489
49	104-13-0.5		1119	SAA	75±5	☑	101-04 97

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006 Page 3 of 4

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Julia Vidonish XRF Unit 10102

Sample Type: XRF Date: 11/16/18

Sampling Equipment: Probe / Trowel Other

	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes
53	104-65-0.5	11/16/18	1134	dark brown, well-graded, sandy silt	1011 ± 18	☑	101-0496
54	104-66-0.5		1139	SAA	31 ± 4	☑	101-0490
55	104-67-0.5		1140	SAA	16 ± 4	☑	101-0491
56	104-68-0.5		1143	med. brown, well-graded sandy silt + organics	101 ± 6	☑	101-0492
57	104-69-0.5		1145	SAA	39 ± 4	☑	101-0493
58	104-70-0.5		1147	SAA	87 ± 6	☑	101-0494
59	104-52-0.5		1152	SAA	14 ± 4	☑	101-0495
60	104-53-0.5		1154	SAA	29 ± 4	☑	101-0498
61	104-55-0.5		1155	SAA	35 ± 4	☑	101-0499
62	104-56-0.5		1157	SAA	42 ± 4	☑	101-0500
63	104-57-0.5		1159	SAA	55 ± 4	☑	101-0501
64	104-58-0.5		1201	SAA	49 ± 5	☑	101-0502
65	104-59-0.5		1202	SAA	58 ± 5	☑	101-0503
66	104-60-0.5		1203	SAA	30 ± 4	☑	101-0504
67	104-61-0.5		1204	SAA	34 ± 4	☑	101-0505

ARCADIS Design & Consultancy for natural and built assets

Burrows Island XRF Sample Log

Project No.: B0003010.0006 Page 2 of 4

Site Location: Burrows Island Light Station, Anacortes, WA

Personnel: Julia Vidonish / Kelsey Frant XRF unit # 8580

Sample Type: XRF Date: 11/16/18

Sampling Equipment: Probe / Trowel Other

	Sample ID	Date	Time	General Soil Description	Lead	Photo Taken?	Notes
33	104-21-0.5	11/16/18	1108	dark brown, well-graded, sandy silt	150±6	☑	100-0708
34	104-23-0.5	↓	1110	SAA	75±5	☑	100-0709
35	104-29-0.5		1112	SAA	98±5	☑	100-0710
36	104-28-0.5		1113	SAA	23±4	☑	100-0711
37	104-30-0.5		1116	SAA	74±5	☑	100-0712
38	104-12-0.5		1118	SAA	16±3	☑	100-0713
39	104-14-0.5		1120	SAA	68±5	☑	100-0714
43	104-31-0.5		1135	SAA	15±3	☑	100-0715
44	104-47-0.5		1139	SAA	90±5	☑	100-0716
45	104-54-0.5		1141	med. brown, well-graded, sandy silt T. organics	37±4	☑	100-0717
46	104-62-0.5		1144	SAA	32±4	☑	100-0718
47	104-63-0.5		1146	SAA	160±7	☑	100-0719
48	104-64-0.5		1148	SAA	34±3	☑	100-0720
49	104-38-0.5		1150	silty sand w/ gravel & trace organics	444±10	☑	100-0721
50	104-39-0.5		1152	SAA	307±9	☑	100-0722

Standards

SiO_2 Blank

Shot #	time	Pb
8	0850	<10
9	0851	<10
10	0853	<10
11	0855	<10
12	0856	<11
~~42~~	1127	<10
	~~[illegible]~~	~~<11~~
70	1248	<10

2781

Shot #	time	Pb
3	~~[illegible]~~ 0844	197 ± 7
4	0845	189 ± 7
5	0846	201 ± 7
6	0847	181 ± 7
7	0849	197 ± 7
40	1124	195 ± 7
~~[illegible]~~	~~[illegible]~~	~~132 ± 8~~
72	1252	194 ± 7

2702

Shot #	time	Pb
13	0857	132 ± 7
14	0858	115 ± 7
15	0900	121 ± 7
16	0902	122 ± 7
17	0904	129 ± 7
41	1125	121 ± 7
~~72~~	1257	
71	1249	138 ± 8

Calibration: NIST 2702 11/13/18 XRF unit 10102

Shot #		Pb (mg/kg)
3		122 ± 8 mg/kg
4		114 ± 8
5		114 ± 8
6		116 ± 8
7		114 ± 8
35	1359	109 ± 7

NIST 2781

Shot #		Pb (mg/kg)
8		187 ± 7
9		178 ± 7
10		186 ± 7
11		183 ± 7
12		180 ± 7
36	1400	171 ± 7

SiO_2 Blank

Shot #		Pb (mg/kg)
13		< 13
14		< 13
15		< 14
16		< 14
17		< 14
34	1358	< 14

Calibration Log: XRF Unit 10102 11/14/18

Change battery at 1530

NIST 2702

Shot #	Time	Pb (ppm)
6	0920	106 ± 8
7	0927	119 ± 8
8	0928	121 ± 8
9	0929	106 ± 8
10	0930	118 ± 8

SiO2

Shot #	Time	Pb (ppm)
31	1028	< 14
45	1114	< 15
58	1216	<15
68	1326	<16
81	1444	< 11
84	1531	< 13

SiO2 Blank

Shot #	Time	Pb (ppm)
11	0938	< 14
12	0935	< 15
13	0937	< 15
14	0939	<16
15	0941	< 14

NIST 2781

Shot #	Time	Pb (ppm)
32	1030	173 ± 7
47	1117	190 ± 7
59	1218	187 ± 7
70	1330	181 ± 7
83	1448	184 ± 7
85	1533	172 ± 7

NIST 2781

Shot #	Time	Pb (ppm)
16	0943	187 ± 7
17	0945	182 ± 7
18	0947	187 ± 7
19	0948	181 ± 7
20	0949	181 ± 7

NIST 2702

Shot #	Time	Pb (ppm)
33	1032	121 ± 8
46	1116	111 ± 8
~~58~~ 60	~~1218~~ 1220	106 ± 7
71	1333	115 ± 8
82	1446	115 ± 8
86	1535	115 ± 8

Calibration : XRF Unit 5635 11/14/18

SiO_2 Blank

Shot #	Time	Pb (ppm)
2	0905	<7
3	0907	<7
4	0910	<7
5	0912	<7
6	0924	<6

Shot #	Time	Pb (ppm)
27	1027	<10
42	1116	<9
54	1213	<9
74	1327	<9
101	1441	<8
109	1543	11 ± 3

2781 Blank

Shot #	Time	Pb (ppm)
7	0927	167 ± 6
8	0929	159 ± 5
9	0932	160 ± 6
10	0933	173 ± 6
11	0935	163 ± 6

Shot #	Time	Pb (ppm)
28	1028	166 ± 6
41	1114	167 ± 6
55	1215	165 ± 6
73	1326	178 ± 6
103	1445	161 ± 6
110	1545	161 ± 6

2702

Shot #	Time	Pb (ppm)
12	0937	117 ± 7
13	0939	126 ± 7
14	0940	121 ± 6
15	0941	128 ± 7
16	0943	122 ± 7

Shot #	Time	Pb (ppm)
29	1030	119 ± 6
43	1118	110 ± 6
56	1216	123 ± 7
75	1330	132 ± 7
102	1444	130 ± 7
111	1546	132 ± 7

11/15/2018 Serial No 8580

~~Shot #~~

SiO_2

Shot	Time	Lead
2	13:37	<12
3	13:39	<12
4	13:41	<12
5	13:42	<10
6	13:43	<11
29	14:37	<10

2781

Shot	Time	Lead
7	13:45	195 ± 7
8	13:46	188 ± 7
9	13:48	185 ± 7
10	13:49	188 ± 7
11	13:50	192 ± 7
30	14:39	188 ± 7

2702

Shot	Time	Lead
12	13:52	127 ± 7
13	13:53	120 ± 7
14	13:54	124 ± 7
15	13:56	124 ± 7
16	13:57	116 ± 7
31	14:41	125 ± 7

SiO2 Blank

Shot #	time	reading (Pb)
2	0832	<16
3	0835	<16
4	0837	<14
5	0839	<15
7	0843	<15
28	1609	<14
51	1125	<14
~~77~~		~~<15~~

2702

Shot #	time	Pb
6	0841	121±8
8	0844	111 ± 8
9	0846	107±8
10	0847	118±8
11	0849	103±8
12	0850	123±8
30	1012	111 ± 8
50	1124	120 ± 8

2781

Shot #	time	Pb
13	0852	187 ± 7
14	0854	186 ± 7
15	0855	169 ± 7
16	0856	181 ± 7
17	0858	175 ± 7
29	1016	183 ± 7
52	1126	179 ± 7

11/15/18

SiO$_2$

Shot #	Time	Lead
2	0857	< 9
13	0915	< 7
14	0916	< 7
15	0917	< 7
16	0918	< 7
28	1010	< 9
42	1055	< 9

2781

Shot #	Time	Lead
3	0859	175 ± 6
4	0900	167 ± 6
5	0902	165 ± 8
6	0903	165 ± 6
7	0904	158 ± 5
29	1012	165 ± 6
41	1054	166 ± 6

2702

Shot #	Time	Lead
8	0906	122 ± 6
9	0908	122 ± 7
10	0910	119 ± 6
11	0912	125 ± 7
12	0914	119 ± 6
27	1007	123 ± 7
42	1057	126 ± 7

Calibration log: XRF Unit 10102 11/15/18

SiO_2 Blank

Shot #	Time	Pb (ppm)
2	900	<15
3	903	<14
4	905	<14
5	907	<15
6	909	<14
26	1005	<14
38	1050	<14

Shot #	time	Pb (ppm)
43	1310	<14
69	1400	<15
89	1444	<15
112	1538	<16

NIST 2781

Shot #	Time	Pb (ppm)
7	911	195 ± 8
8	912	181 ± 7
9	914	184 ± 7
10	916	185 ± 7
11	917	177 ± 7
27	1008	168 ± 7

Shot #	Time	Pb (ppm)
39	1052	179 ± 7
44	1313	177 ± 7
70	1403	190 ± 7
90	1445	181 ± 7
113	1539	183 ± 7

NIST 2702

Shot #	Time	Pb (ppm)
12	920	115 ± 8
13	923	110 ± 8
14	924	108 ± 8
15	925	113 ± 8
16	926	102 ± 7
28	1010	106 ± 8

Shot #	Time	Pb (ppm)
40	1054	115 ± 8
45	1317	112 ± 8
71	1404	116 ± 8
91	1407	108 ± 8
114	1540	109 ± 8

APPENDIX D

Technical Guidance Documents and Standard Operating Procedures

SOP - SAMPLE CHAIN OF CUSTODY

Rev: #1

Rev Date: May 23, 2017

VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	April 19, 2017	All	Re-write to COC only	Richard Murphy
1	May 23, 2017	4 9 7	Add: Guidance on use of previous version of SOP. Add: Info on COCs for multiple shipping containers Modify: Move letter i. to letter m. and change to "when appropriate"	Peter Frederick

APPROVAL SIGNATURES

Prepared by:	Peter C. Frederick	Date: 05/23/2017
Technical Expert Reviewed by:	Richard J. Murphy	Date: 05/23/2017

1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) describes the general Chain of Custody (COC) procedures and guidance instructions for samples collected from project sites that are relinquished from Arcadis' possession.

COC is defined as the maintenance of an unbroken record of possession of an item from the time of its collection through some analytical or testing procedure. COC is typically documented by a written record of the collection, possession, and handling of samples collected from a project location. Each sample will be tracked by a documented record that efficiently documents the individuals who were responsible for the sample during each successive transfer of that sample to various recipients beyond Arcadis' possession. This information can be used to legally establish the integrity of the samples and therefore the analytical results derived from the samples. This information can be used in addition to other records and documentation regarding the samples, such as field forms, field logs, and photographs.

A sample is considered under custody if:

- It is in your possession; or
- It is in your view, after being in your possession; or
- It was in your possession and then you then locked it up to prevent tampering; or
- It is in a designated secure area.

Continued use of previous version of SOP:

Although not recommended, Arcadis program-, project-, and client-teams may be able to use the previous version of this SOP provided that it meets all of the quality expectations of Arcadis and client, and meets applicable regulatory requirements. It is up to the program, project, and/or client-team leader to determine whether it is appropriate to adopt the current SOP or to continue using the previous version.

However, all new work not associated with the previous version of this SOP must be performed with the current version of the SOP.

When adopting this new SOP, users of the previous versions must be aware that specific handling, packing, and shipping procedures and guidance has been removed and that those should be addressed within program or project plans (e.g. QAPPs, Work Plans, SAPs, etc.) or in a more detailed SOP or TGI specific to that sampling activity, whether related to media, constituent/analyte, client, state, etc.

In addition, adopting this new SOP will require users to refer to the Arcadis DOT Safety Program for procedures and guidance on the determination and handling, packing, and shipping of samples that are or may be considered hazardous materials.

3 PERSONNEL QUALIFICATIONS

Arcadis personnel performing work under the purview of this SOP will have received appropriate training and have field experience regarding the collection of samples from project locations. Arcadis personnel will have all other applicable and appropriate training relevant to the sampling work and project site.

4 EQUIPMENT LIST

The following list provides materials that may be required for each COC. Project reporting and documentation requirements must be reviewed with the CPM prior to execution of work. Additional materials, tools, equipment, etc. may be required, and project staff are required to verify with the CPM and/or Technical Expert what specific equipment is required to complete the COC.

- Indelible ink pen (preferably either black or blue ink);
- COC form https://thesourceus.arcadissource.com/TKI/Documents/COC%20Form.pdf (**Appendix A**) from either Arcadis, laboratory receiving and analyzing the samples, or other applicable and appropriate entity for the work performed;
- When appropriate, such as for litigation or expert testimony work, custody seals or tape.

5 CAUTIONS

One way in which the law tries to ensure the integrity of evidence is by requiring proof of the chain of custody by the party who is seeking to introduce a particular piece of evidence.

A proper chain of custody requires three types of affirmations: (1) affirmation that a sample is what it purports to be (for example, soil collected from a specified location and depth); (2) affirmation of continuous possession by each individual who has had possession of the sample from the time it is collected until the time it is analyzed or held by a laboratory; and (3) affirmation by each person who has had possession that sample remained in substantially the same condition and not contaminated or affected by outside influences from the moment one person took possession until the moment that person released the evidence into the custody of another (for example, affirmation that the sample was stored in a secure location where no one but the person in custody had access to it).

Proving chain of custody is necessary to "lay a foundation" for the samples in question, by showing the absence of alteration, substitution, or change of condition.

Ensure that appropriate sample containers with applicable preservatives, coolers, and packing material are planned for and provided at the site at the time of sample collection.

Understand the offsite transfer requirements of the samples for the facility at which samples are collected.

If overnight courier service is required schedule pick-up or know where the drop-off service center is located and the hours of operation.

An Arcadis employee appropriately trained at the correct level of internal hazardous materials/DOT (Department of Transportation) shipping must complete an Arcadis shipping determination to address applicable DOT and IATA (International Air Transport Association) shipping requirements. Review the applicable Arcadis procedures and guidance instructions for sample packaging, and labeling. Prior to using air transportation, confirm air shipment is acceptable under DOT and IATA regulations.

The person relinquishing possession of the samples or other member of the project team should contact the final recipient of the samples to confirm receipt and review any special provisions on the COC or questions that they may have.

6 HEALTH AND SAFETY CONSIDERATIONS

Follow the health and safety procedures outlined in the project/site Health and Safety Plan (HASP) as well as other applicable H&S requirements, such as:

- Arcadis Hazardous Material/DOT handling, packaging, and shipping training
- Project site-specific H&S training
- Client-specific H&S training
- Constituent-specific H&S training
- Media-specific H&S training

7 PROCEDURE

Collected samples must be uniquely identified, and properly documented, containerized, labeled with unique identifier, possessed in a secure manner during remainder of sampling event, packaged, and shipped to recipient laboratory.

Sample Identification

The method of sample identification depends on the type of measurement or analyses performed. In some cases, in-situ measurements of existing conditions and/or sample location must be made during sample collection. These data will be recorded directly on field forms, logbooks, or other project record data sheets used to permanently retain this information for the project file. Examples of location identification information includes: latitude/longitudinal measurements, compass directions, well number, building number, floor number, room name, or proximity to a site feature unique to the site. Examples of in-situ measurements are pH, temperature, conductivity, flow measurement, or physical condition of the media being sampled. Physical samples collected are identified by a unique identifying number or code on a sample tag or label. These physical samples are removed from the sample location and transported to a laboratory for analyses.

In some cases, before samples are placed into individual containers and labeled as individual samples, samples may be separated into portions depending upon the analytical methods and required duplicate or triplicate analyses to be performed.

When completing a COC for samples, personnel must complete the following:

1. Written COCs must be completed with indelible ink (preferably either black or blue colored ink).
2. Written COCs must be completed using legible printed writing, and not cursive writing.
3. All entry fields on the COC form must be completed. If information is not applicable for a specific entry field, personnel will either put “N/A” or use a strike-out line or dash like “-----------“ to indicate no applicable information is needed for that field.
4. Use of quotation marks or lines/down arrows to represent repetitive/duplicative text in similar fields.
5. Regardless of the type or specific COC form, the following pertinent information must be provided on the COC form:
    a. Arcadis project number
    b. Arcadis project name
    c. Project location, including street address, city, state, building number, providing as much detail as appropriate
    d. Recipient laboratory contact and sample receiving shipping location information
    e. Entities’/persons’ contact information for who will be receiving analytical results
    f. Name of sampler, i.e. person collecting sample and relinquishing possession of samples to the next entity in the chain of custody
    g. Date of sample collection

   h. If appropriate for the sample media, contaminant/constituent of concern, or analytical method, document time of sample collection using standard military time
   i. Sample analytical method(s)
   j. Turnaround time required for analyses and/or reporting
   k. Instructions to laboratory regarding handling, timing, analyses, etc. as applicable and appropriate
   l. Printed name and signature of the individual person who collected the samples and relinquishing possession of the samples
   m. If appropriate or when documentation of the specific sample collection method will influence how the laboratory handles, prepares, or analyzes the samples, document the sample collection methodology used for collecting the samples (e.g. ASTM D5755)

6. The following additional specific information will be entered on the COC form, regardless of what type of COC is being used:
   a. <u>Unique Sample Identifier</u> – The sample identifier (ID) must be unique to the individual sample it is applied to. The information in which the sample ID conveys is determined by the CPM, Technical Expert, and/or other project team members in advance of sample collection so that sample identification is consistently applied for the project. The sample nomenclature may be dictated by a specific client, program, or project database and require unique identification for each sample collected for the project. Consult with the CPM and/or Technical Expert for additional information regarding sample identification.

      The sample ID could convey specific information regarding the sample to aid personnel in recognizing what the sample represents, or they may be arbitrary so as to facilitate the anonymity of the sample location, media, constituent of concern, project site, etc.

      Examples of unique identifiers include:
      1. Well locations, grid points, or soil boring identification numbers (e.g., MW-3, X-20, SB-30). When the depth interval is included, the complete sample ID would be “SB-30 (0.5-1.0) where the depth interval is in feet. Please note it is very important that the use of hyphens in sample names and depth units (i.e., feet or inches) remain consistent for all samples entered on the chain of custody form. DO NOT use the apostrophe or quotes in the sample ID.
      2. Sample names may also use the abbreviations “FB,” “TB,” and “DUP” as prefixes or suffixes to indicate that the sample is a field blank, trip blank, or field duplicate, respectively.
   b. List the date of sample collection. All indicated dates must be formatted using either mm/dd/yy (e.g., 03/07/09) or mm/dd/yyyy (e.g. 03/07/2009).
   c. When appropriate for the analytical procedure used, list the local time that the sample was collected. The time value should be presented using military format. For example, 3:15 P.M. should be entered as 15:15.

d. Samples should be indicated to be either “Grab” or “Composite”. Grab samples are collected from only one unique location at one specific point in time.

e. Composite samples are a group of individual samples that are combined for analysis in their totality. Composite samples need to be documented if they are either collected from a number of different locations over a broader area to be representative of the entire area being sampled, or if they are representative of a single location over an extended period of time.

f. If used, preservatives for the individual sample will be noted.

g. The requested analytical method(s) that the samples are being analyzed for must be indicated. As much detail, as necessary, should be presented to allow the analytical laboratory to properly analyze the samples. For example, polychlorinated biphenyl (PCB) analyses may be represented by entering “EPA Method 8082 – PCBs” or “EPA PLM 600-R93-116.” In cases where multiple analytical methods and/or analytical parameters are required for an individual sample, each method should be indicated for the sample (e.g., EPA 8082/8260/8270 or EPA PLM/400-point count).

h. If there are project-specific sample analytes to be reported, they should be specifically listed for each individual sample (e.g., 40 CFR 264 Appendix IX).

i. The total number of containers for each analytical method requested should be documented. This information may be included under the parameter or as a total for the sample.

j. When necessary, note which samples should be used for site specific matrix spikes.

k. Indicate special project-specific requirements pertinent to the handling, shipping, or analyses. These requirements may be on a per sample basis such as “extract and hold sample until notified,” or may be used to inform the laboratory of special reporting requirements for the entire sample delivery group (SDG).

l. Indicate turnaround time (TAT) required for samples on COC. If individual samples have differing TATs, the different TATs for each sample or groups of samples must be clearly indicated.

m. Provide contact name and phone number in the event that problems are encountered when samples are received at the laboratory. The person relinquishing possession of the samples or other member of the project team should contact the final recipient of the samples to confirm receipt and review any special provisions on the COC or questions that they may have.

n. If available, attach the Laboratory Task Order or Work Authorization forms.

o. The “Relinquished By” field must contain the signature of the Arcadis person who relinquished custody of the samples to the next entity in the chain of custody, which may be another person, the shipping courier, or the analytical laboratory.

p. Dates and times must be indicated using the following format:

    1) Date: either mm/dd/yy e.g., 01/01/17 <u>OR</u> mm/dd/yyyy e.g., 01/01/2017

    2) Time: use military format, e.g. 9:30 a.m. is 0930 and 9:30 p.m. is 2130

   q. The "Received By" section is signed by sample courier or laboratory representative who received the samples from the sampler or it is signed upon laboratory receipt from the overnight courier service.

4. When more than one page of the COC form is required to complete the total number of samples, use as many sheets as necessary to accurately and clearly document the samples and information. Some COCs may have a standard first page/cover page, and subsequent pages may not contain all the detailed fields as the first page/cover page. Ensure that any subsequent pages convey all of the necessary and pertinent information for each individual sample as required in this procedure document.
5. Pages of the COC must retain a page count of the total number of pages; e.g., Page 1 of 3, Page 2 of 3, Page 3 of 3.
6. Upon completing the COC forms, forward the original signed COC with the sample package. Ensure that the original COC form is secured with the sample package so that it remains with the physical samples for the duration of transport and handling to its final destination and ensure that the COC form will not be become damaged or rendered unreadable due to sample breakage/leakage if stored inside the sample shipping container or outside influences if COC is stored in an outside plastic pouch to the container.
7. If you've collected enough samples that would require more than one container to ship them all to the same laboratory or location, then each separate/individual container that contains any number of samples must have a separate COC representing only those samples contained within that specific container. For example, if you have 3 total shipping containers for all of your samples, you must have a total of 3 separate, individual COCs for each of the 3 containers representing only those samples in their representative container. Thus, every container holding samples must have its own, individual COC.
8. If electronic chain of custody (eCOC) forms are utilized, ensure that the requirements of this procedure and guidance instructions are followed to the extent possible. Verify that proper signature and COC procedures are maintained with the CPM and/or Technical Expert when using eCOC.

8 WASTE MANAGEMENT

Not Applicable.

9 DATA RECORDING AND MANAGEMENT

The original signed COC shall be submitted with the samples. Copies of COC records will be transmitted to the CPM or designee at the end of each day unless otherwise directed by the CPM. The sampling team leader retains copies of the chain of custody forms for filing in the project file. Record retention shall be in accordance with client- and project-specific requirements and Arcadis policies, the most stringent will apply.

10 QUALITY ASSURANCE

COC forms will be legibly completed in accordance with this procedure and guidance instruction document, as well as other applicable and appropriate project documents such as Sampling and Analysis Plan (SAP), Quality Assurance Project Plan (QAPP), Work Plan, or other project guidance documents.

COC records will be reviewed by the CPM or their appropriate designee for completeness and accuracy to the applicable requirements. Non-conformances will be noted and corrected in a timely manner on the copies retained by Arcadis as well as contacting the ultimate receiving entity for correction to the originally signed COC in their possession.

11 REFERENCES

Arcadis Client Document Retention Guide

Arcadis Transportation Safety Program requirements, procedures, and guidance instructions

EPA Samplers' Guide – Contract Laboratory Program Guidance for Field Samplers, EPA document EPA-540-R014-013 October 2014

EPA Region III – *Sample Submission Procedures for the Office of Analytical Services and Quality Assurance (OASQA) Laboratory Branch* revision 13.0 January 29, 2014

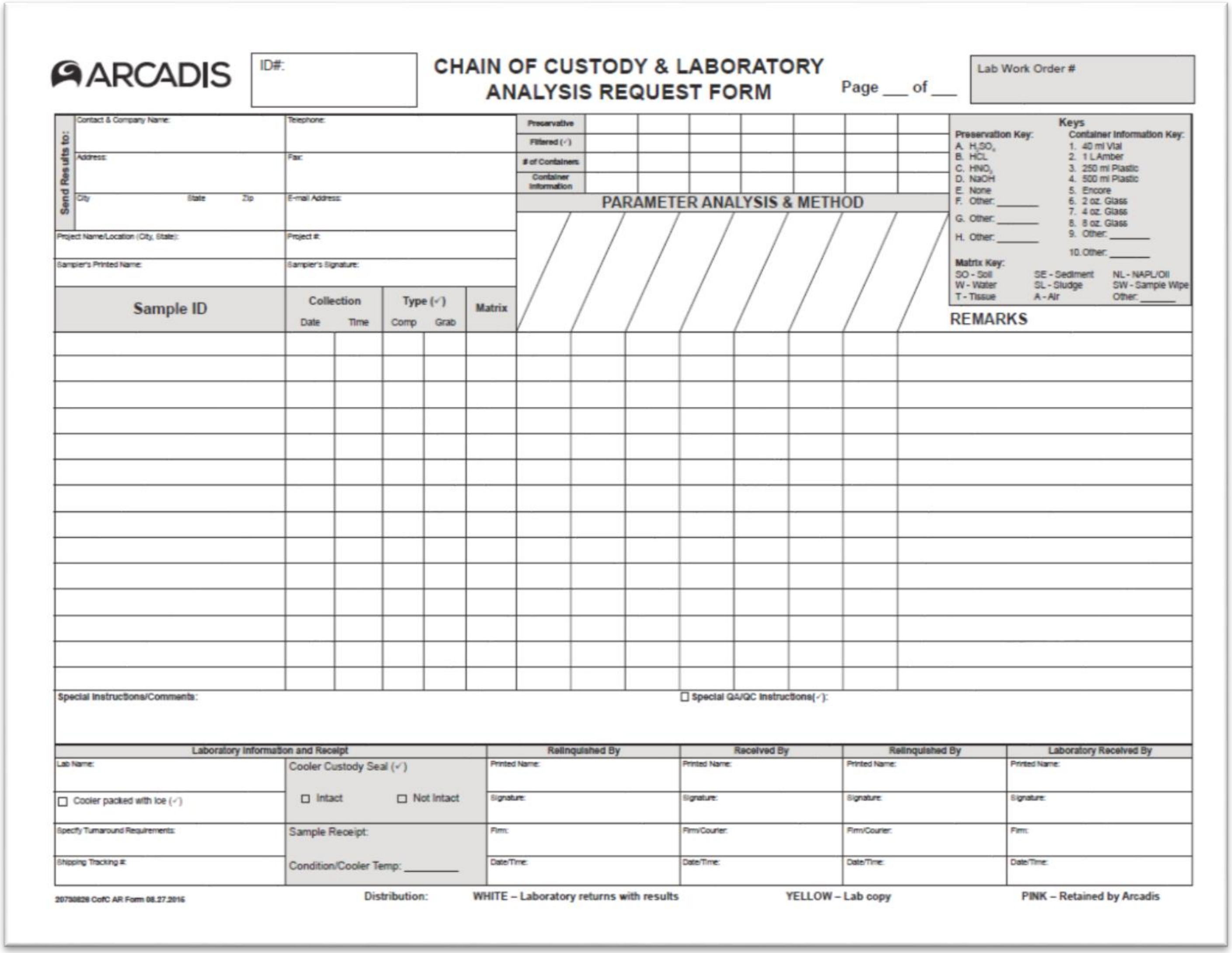
EPA Region I Office Environmental Measurement and Evaluation – *Standard Operating Procedures for Chain of Custody of Samples* revision 1 March 25, 2002

EPA Region IV Science and Ecosystem Support Division *Operating Procedure for Sample and Evidence Management* January 29, 2013

APPENDIX A

Chain of Custody Form

[click image below to access form]



ARCADIS

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page ___ of ___

Lab Work Order #

Send Results to:

Contact & Company Name:	Telephone:
Address:	Fax:
City State Zip	E-mail Address:
Project Name/Location (City, State):	Project #:
Sampler's Printed Name:	Sampler's Signature:

Preservative							
Filtered (✓)							
# of Containers							
Container Information							

PARAMETER ANALYSIS & METHOD

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: ______
G. Other: ______
H. Other: ______

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: ______
10. Other: ______

Matrix Key:

SO - Soil	SE - Sediment	NL - NAPL/Oil
W - Water	SL - Sludge	SW - Sample Wipe
T - Tissue	A - Air	Other: ______

Sample ID	Collection		Type (✓)		Matrix								REMARKS
	Date	Time	Comp	Grab									

Special Instructions/Comments:

☐ **Special QA/QC Instructions(✓):**

Laboratory Information and Receipt		Relinquished By	Received By	Relinquished By	Laboratory Received By
Lab Name:	Cooler Custody Seal (✓)	Printed Name:	Printed Name:	Printed Name:	Printed Name:
☐ Cooler packed with ice (✓)	☐ Intact ☐ Not Intact	Signature:	Signature:	Signature:	Signature:
Specify Turnaround Requirements:	Sample Receipt:	Firm:	Firm/Courier:	Firm/Courier:	Firm:
Shipping Tracking #:	Condition/Cooler Temp: ______	Date/Time:	Date/Time:	Date/Time:	Date/Time:

20730826 CofC AR Form 08.27.2016

Distribution: **WHITE – Laboratory returns with results** **YELLOW – Lab copy** **PINK – Retained by Arcadis**

APPENDIX A

Chain of Custody Form

[click image below to access form]

TGI – GROUNDWATER AND SOIL SAMPLING EQUIPMENT DECONTAMINATION

Rev: 0

Rev Date: February 23, 2017

VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	February 23, 2017	ALL	Conversion from SOP to TGI	Cassandra McCloud / Pete Frederick

APPROVAL SIGNATURES

Prepared by: Derrick Maurer Date: 02/23/2017

Derrick Maurer

Technical Expert Reviewed by: Date: 02/23/2017

Cassandra McCloud (Technical Expert)

1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

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In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, state-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

Decontamination is performed on sampling equipment prior to sample collection to ensure that the sampling equipment that contacts a sample, or monitoring equipment that is brought into contact with environmental media to be sampled, is free from analytes of interest and/or constituents that could interfere with laboratory analysis for analytes of interest. Sampling equipment must be appropriately cleaned prior to use for sampling or coming into contact with environmental media to be sampled, and following completion of the sampling event prior to shipment or storage. The effectiveness of the decontamination procedure should be verified by collecting and analyzing equipment blank samples.

The sampling equipment cleaning procedures described herein includes pre-field, in the field, and post-field cleaning of sampling equipment which may be conducted at an established equipment decontamination area (EDA) on site, as appropriate and necessary. Sampling equipment that may require decontamination at a given site includes: soil sampling tools; groundwater, sediment, and surface-water sampling devices; water testing instruments; down-hole instruments; and other activity-specific sampling equipment. Non-disposable equipment will be cleaned before collecting each sample, between each sample collected, and prior to placing sampling equipment in protective cases, or containers for transport. Cleaning procedures for sampling equipment should be monitored by collecting equipment blank samples as required in project work plans, field sampling plans, quality assurance project plans (QAPP), or other pertinent project documents. Dedicated and/or single-use (i.e., not to be re-used) sampling equipment will not require decontamination.

3 PERSONNEL QUALIFICATIONS

Arcadis field sampling personnel will have completed or are in the process of completing site-specific training as well as having current health and safety training as required by Arcadis, client, or regulations, such as 40-hour HAZWOPER training and/or OSHA HAZWOPER site supervisor training. Arcadis personnel will also have current training as specified in the Health and Safety Plan (HASP) which may include first aid, cardiopulmonary resuscitation (CPR), Blood Borne Pathogens (BBP) as needed. In addition, Arcadis field sampling personnel will be knowledgeable in the relevant processes, procedures, and Technical Guidance Instructions (TGIs) and possess the demonstrated required skills and experience necessary to successfully complete the desired field work. The project health and safety plan (HASP) and other documents will identify other training requirements or access control requirements.

4 EQUIPMENT LIST

The equipment required for equipment decontamination is presented below:

- Health and safety equipment, including appropriate PPE, as required in the site Health and Safety Plan (HASP)
- Deionized water that meets that analytical criteria for deionized water with no detectable constituents above the reporting limits for the methods to be used and analytes being analyzed for. Deionized water is used for inorganics, and organic-free water for VOCs, SVOCs, pesticides, etc.
- Non-phosphate detergent such as Alconox or, if sampling for phosphorus or phosphorus-containing compounds, Liquinox (or equivalent).
- Tap water
- Rinsate collection plastic containers
- DOT-approved waste shipping container(s), as specified in the work plan, field sampling plan, or regulatory requirements if decontamination waste is to be shipped for disposal
- Brushes
- Large heavy-duty garbage bags
- Spray bottles
- (Optional) – Isopropyl alcohol (free of ketones) or methanol. These can be wipes or diluted with water (usually 1part isopropyl/methanol to 10 parts water) if a spray is needed.
- Airtight, sealable plastic baggies, such as Ziploc-type
- Plastic sheeting

5 CAUTIONS

Rinse equipment thoroughly and allow the equipment to dry before re-use or storage to prevent introducing solvent into sample medium. If manual drying of equipment is required, use clean lint-free material to wipe the equipment dry. Ensure all rinsate materials do not adversely affect sample collection efficiency or analytical results.

Store decontaminated equipment in a clean, dry environment. Do not store near combustion engine exhausts. Properly containerize equipment to ensure cross-contamination doesn't happen from other uncontaminated surfaces or equipment.

If equipment is damaged to the extent that decontamination is uncertain due to cracks, gouges, crevices, or dents, the equipment should not be used and should be discarded or submitted for repair prior to use for sample collection.

A proper shipping determination regarding hazardous materials will be performed by a DOT-trained individual for cleaning materials shipped by Arcadis.

Caution should be exercised to avoid contact with the pump casing and water in the container while the pump is running (do not use metal drums or garbage cans) to avoid electric shock.

6 HEALTH AND SAFETY CONSIDERATIONS

Review the safety data sheets (SDS) for the cleaning agents and materials used in decontamination. If solvent is used during decontamination, use appropriate PPE and work in a well-ventilated area and stand upwind while applying solvent to equipment. Apply solvent in a manner that minimizes potential for exposure to workers and bystanders. Follow health and safety procedures outlined in the HASP.

7 PROCEDURE

A designated area will be established to clean sampling equipment in the field prior to and following sample collection. Equipment cleaning areas will be set up within or adjacent to the specific work area, but not at a location that expose equipment to contamination (i.e. exposed to combustion engine exhaust). Detergent solutions will be prepared in clean containers for use in equipment decontamination. Decontaminated equipment should be handled by workers wearing clean gloves, properly changed to prevent cross-contamination.

Cleaning Sampling Equipment

1. Wash the equipment/pump with potable water.
2. Wash with detergent solution (Alconox, Liquinox or equivalent) to remove all visible particulate matter and any residual oils or grease.
3. If equipment is very dirty, precleaning gross debris with a brush and tap water may be necessary.
4. If non-aqueous phase liquids are present, the use of isopropyl alcohol (free of ketones) or methanol is recommended. Cloth wipes or diluted solution can be used to remove the non-aqueous phase liquids that are hard to remove with detergent solution in step 2. Consult with project manager if

non-aqueous phase liquids are present onsite and design an appropriate decontamination procedure that includes step 4.

5. Rinse with deionized water.

Decontaminating Submersible Pumps

Submersible pumps may be used during well development, groundwater sampling, or other investigative activities. The pumps must be cleaned and flushed before and between uses. This cleaning process will consist of an external detergent solution wash and tap water rinse, a flush of detergent solution through the pump, followed by a flush of potable water through the pump. Flushing will be accomplished by using an appropriate container filled with detergent solution and another container filled with potable water. The pump should be flushed with deionized water as the last step prior to use. The pump will run long enough to effectively flush the pump housing and hose (unless new, disposable hose is used). Disconnect the pump from the power source before handling. The pump and hose should be placed on or in clean polyethylene sheeting to avoid contact with the ground surface.

8 WASTE MANAGEMENT

Equipment decontamination rinsate will be managed in conjunction with all other waste produced during the field sampling effort. Waste management procedures are outlined in the work plan or Waste Management Plan (WMP).

9 DATA RECORDING AND MANAGEMENT

Equipment cleaning and decontamination will be noted in the field notebook for project documentation. Information will include the type of equipment cleaned, the decontamination location, specific procedures utilized, solvents and/or cleaning agents used, source of water, and deviations or omissions from this TGI.

Unusual field conditions should be noted if there is potential to impact the efficacy of the decontamination or subsequent sample collection.

An inventory of the solvents brought on site and used and removed from the site will be maintained in the project documentation. Records will be maintained for solvents used in decontamination, including lot number and expiration date.

Containers with decontamination fluids will be labeled.

10 QUALITY ASSURANCE

Equipment blanks should be collected to verify that the decontamination procedures are effective in minimizing potential for cross contamination. The equipment blank is prepared by pouring deionized water (or organic-free water, for organic analyses) over the clean and dry tools and collecting the water into appropriate sample containers. Equipment blanks should be analyzed for the same set of parameters that are performed on the field samples collected with the equipment that was cleaned as specified in the sampling and analysis plan. Equipment blanks are collected per equipment set, which represents all of the tools needed to collect a specific sample.

11 REFERENCES

USEPA Region 9 - Field Sampling Guidance #1230, Sampling Equipment Decontamination.

USEPA Region 1 - Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells.

ARCADIS Design & Consultancy for natural and built assets

TGI - INVESTIGATION-DERIVED WASTE HANDLING AND STORAGE

Rev #: 0

Rev Date: February 23, 2017

VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	February 23, 2017	ALL	Conversion from SOP to TGI	Ryan Mattson / Peter Frederick

APPROVAL SIGNATURES

Prepared by: Derrick Maurer 02/23/2017

Derrick Maurer Date:

Technical Expert Reviewed by: 02/23/2017

Ryan Mattson (Technical Expert) Date:

1 INTRODUCTION

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2 SCOPE AND APPLICATION

The objective of this Technical Guidance Instruction (TGI) is to describe the procedures to manage investigation-derived wastes (IDW), both hazardous and nonhazardous, generated during site activities, which may include, but are not limited to: drilling, trenching/excavation, construction, demolition, monitoring well sampling, soil sampling, decontamination and remediation. For the purposes of this TGI, IDW is considered to be discarded materials which are defined as solid waste by United States Environmental Protection Agency (EPA) standard 40 CFR § 261.2 (which may include liquids, solids, or sludges). IDW may include soil, groundwater, drilling fluids, decontamination liquids, as well as contaminated personal protective equipment (PPE), sorbent materials, construction and demolition debris, and disposable sampling materials. Hazardous or uncharacterized IDW will be collected and staged at the point of generation. Quantities small enough to be containerized in 55-gallon drums will be taken to a designated temporary onsite storage area (discussed in further detail under Drum Storage) pending characterization and disposal. IDW materials will be characterized using process knowledge and appropriate laboratory analyses to determine the waste classification and evaluate proper safe handling and disposal methods.

This TGI describes the necessary equipment, field procedures, materials, regulatory references, and documentation procedures necessary for proper handling and storage of IDW up to the time it is properly transported from the project site and disposed. The procedures included in this TGI for handling and temporary storage of IDW are based on the EPA's guidance document *Guide to Management of Investigation Derived Wastes* (USEPA, 1992). IDW is assumed to be contaminated with the site constituents of concern (COCs) until analytical evidence indicates otherwise. IDW will be managed to ensure the protection of human health and the environment and will comply with all applicable or relevant and appropriate requirements (ARAR). Although not comprehensive, the following laws and regulations on Hazardous Waste Management should be considered as potential ARAR. It is the Arcadis Certified Project Manager (CPM) and/or designated Technical Expert to determine which laws and regulations, at all levels of government, are applicable to each project site and activity falling under this TGI.

Federal Laws and Regulations

- Resource Conservation and Recovery Act (RCRA) 42 USC § 6901-6987.
- Federal Hazardous Waste Regulations 40 CFR § 260-265

Department of Transportation (DOT) Hazardous Materials Transportation 49 CFR

Occupational Safety and Health Administration (OSHA) Regulations 29 CFR

State Laws and Regulations

- To be determined based on location of site and location of treatment, storage, and/or disposal facility (TSDF) to be utilized.

Regional, County, Municipal, and Local Regulations

- To be determined based on location of site and location of treatment, storage, and/or disposal facility (TSDF) to be utilized.

Initial Storage

Pending characterization, IDW will be temporarily stored appropriately within each area of contamination (AOC). Under RCRA, "storage" is defined as the "holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of, or stored elsewhere" (40 CFR § 260.10). The onsite waste staging area will be in a secure and controlled area. Uncharacterized wastes are considered potentially hazardous wastes and must be stored in DOT approved packaging. Liquid wastes must be stored in DOT approved closed head drums or other approved containers (e.g., portable tank containers) that are compatible with the type of material stored therein. Solid materials must be stored in DOT approved open head drums where practicable. Larger quantities of solid IDW can be containerized in bulk containers (such as in a roll-off box). Soil from large excavation projects may be managed in stockpiles with within the AOC and does not need to be containerized until exiting the AOC.

Characterization

Waste characterization can either be based on generator knowledge, such as using historical process knowledge and safety data sheets (SDS), or can be based upon characterization sampling analytical results. IDW typically is not characterized using SDS as it is a mixture of aged chemicals and environmental media. Historical process knowledge should be used to determine if the IDW is a listed hazardous waste (40 CFR § 261.31-33). If the IDW is not a listed hazardous waste, waste characterization can be completed by laboratory analysis of representative samples of the IDW. The laboratory used for waste characterization analysis must have the appropriate state and federal accreditations and may be required to be pre-approved by the Client. IDW will be classified as RCRA hazardous or non-regulated under RCRA based on the waste characterization determination.

If IDW is characterized as RCRA hazardous waste, RCRA and DOT requirements must be followed for packaging, labeling, transporting, storing, and record keeping as described in 40 CFR § 262 and 49 CFR § 171-178. Waste material classified as RCRA nonhazardous may be handled and disposed of as nonhazardous waste in accordance with applicable federal, state, and local regulations.

Storage Time Limitations

Containerized hazardous wastes can be temporarily stored for a maximum of 90 calendar days from the accumulation start date for a large quantity generator or a maximum of 180 calendar days from the accumulation start date for a small quantity generator. Wastes classified as nonhazardous may be handled and disposed of as nonhazardous waste and are not subject to storage time limitations.

This is TGI may be modified by the CPM and/or Technical Expert for a specific project or client program, as required, dependent upon client requirements, site conditions, equipment limitations, or limitations imposed by the procedure. The resulting procedure employed to execute the work will be documented in the project work plans or reports. If changes to the sampling procedures are required due to unanticipated field conditions, the changes will be discussed with the CPM and/or Technical Expert as soon as practicable, and if approved to be performed, be documented.

3 PERSONNEL QUALIFICATIONS

Arcadis field sampling personnel will have current regulatory- and Arcadis-required health and safety training including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and cardiopulmonary resuscitation (CPR), as needed. Personnel handling and packaging hazardous waste and performing hazardous waste characterizations must have RCRA hazardous waste management training per 40 CFR § 264.16.

Although not common practice, in certain situations Arcadis personnel may sign waste profiles and/or waste manifests on a case by case basis for clients, provided the appropriate agreement is in place between Arcadis and the client documenting that Arcadis is not the generator, but is acting as an authorized representative of the generator. Arcadis personnel who sign waste profiles and/or waste manifests will have both current RCRA hazardous waste management training per 40 CFR § 264.16 and current DOT hazardous materials transportation training per 49 CFR § 172.704. Arcadis field personnel will also comply with client-specific training. In addition, Arcadis field sampling personnel will be knowledgeable in the relevant processes, procedures, and Technical Guidance Instructions (TGIs) and possess the demonstrated required skills and experience necessary to successfully complete the desired field work. The project health and safety plan (HASP) and other documents will identify other training requirements or access control requirements.

4 EQUIPMENT LIST

The Following Materials, as required, will be available for IDW handling and Storage:

- Appropriate personal protective equipment as specified in the Site Health and Safety Plan (HASP)
- DOT approved containers
- Hammer
- Leather gloves
- Drum dolly
- Appropriate drum labels (outdoor waterproof self-adhesive)
- Portable tank container
- Appropriate labeling, packing, chain-of-custody forms, and shipping materials as determined by the CPM and/or Technical Expert.
- Indelible ink and/or permanent marking pens
- Plastic sheeting
- Appropriate sample containers, labels, and forms
- Stainless-steel bucket auger
- Stainless steel spatula or knife
- Stainless steel hand spade
- Stainless steel scoop
- Digital camera
- Field logbook

5 CAUTIONS

Filled drums can be very heavy, become unbalanced, or spill its contents. Therefore, use appropriate moving techniques and equipment for safe handling. Similar media (e.g. soils with other soils; or liquids with other liquids) will be stored in the same drums to aid in sample analysis and disposal. Drum lids must be secured to prevent rainwater from entering the drums and leakage during movement. Drums containing solid material may not contain any free liquids. Waste containers stored for extended periods of time may be subject to deterioration. Drum Over Packs may be used as secondary containment. All drums must be visually inspected for condition to ensure that they are in good condition without visible evidence of rusting, holes, breakage, etc., to prevent potential leakage and facilitate subsequent disposal. All drum lids must be verified as having a properly functioning secured lid prior to use.

6 HEALTH AND SAFETY CONSIDERATIONS

As determined by the site's known and suspected hazards, appropriate PPE must be worn by all field personnel within the designated work area. Exposure air monitoring may be required during certain field activities as required in the Site Health and Safety Plan. If soil excavation in areas with potentially hazardous contaminants is possible, contingency plans will be developed to address the potential for encountering gross contamination or non-aqueous phase liquids. All excavation activities shall be in compliance with OSHA standard 29 CFR 1926.651 Excavations, and any other applicable regulations.

Arcadis field personnel and subcontractors will be trained in and perform their work in compliance with all applicable federal, state, and local health and safety regulations as well as Arcadis' HASP and applicable Client health and safety requirements.

7 PROCEDURE

Specific waste temporary storage and handling procedures to be used are dependent upon the type of generated waste, including type of media (e.g. soils or free liquids) and constituents of concern. For this reason, IDW can be stored in a secure location onsite in separate 55-gallon storage drums, where solids can be stockpiled onsite (if nonhazardous) and purge water may be stored in portable tank containers. Waste materials such as broken sample bottles or equipment containers and wrappings will be stored in 55-gallon drums unless they were not in contact with sample media.

Management of IDW

Minimization of IDW should be considered by the project team during all phases of the project. Site managers may want to consider techniques such as replacing solvent based cleaners with aqueous-based cleaners for decontamination of equipment, reuse of equipment (where it can be properly decontaminated), limitation of traffic between exclusion and support zones, and drilling methods and sampling techniques that minimize the generation of waste. Alternative drilling and subsurface sampling methods may include the use of small diameter boreholes, as well as borehole testing methods such as a core penetrometer or direct push technique instead of coring.

Drum Storage

Drums containing hazardous waste will be stored in accordance with the requirements of 40 CFR 265 Subpart I (for containers) and 265 Subpart DD (for containment buildings). All 55-gallon drums will be stored at a secure, centralized onsite location that is readily accessible for vehicular pick-up. Drums confirmed as, or assumed to contain hazardous waste will be stored over an impervious surface provided with secondary spill containment. The storage location will, for drums containing liquid, have a containment system that can contain at least the larger of 10% of the aggregate volume of staged materials or 100% of the volume of the largest container. Drums will be closed during storage and be in good condition in accordance with the Guide to Management of Investigation-Derived Wastes (USEPA, 1992).

Hazardous Waste Determination

Waste material must be characterized to determine if it meets any of the federal definitions of hazardous waste as required by 40 CFR § 262.11. If the waste does not meet any of the federal definitions, it must then be established if any state-specific or local-specific hazardous waste criteria exist/apply.

Generator Status

Once hazardous waste determination has been made, the generator status will be determined. Large quantity generators (LQG) are generators who generate more than 1,000 kilograms of hazardous waste in a calendar month. Small quantity generators (SQG) of hazardous waste are generators who generate greater than 100 kilograms but less than 1,000 kilograms of hazardous waste in a calendar month. Conditionally exempt small quantity generators (CESQG) are generators who generate less than 100 kilograms of hazardous waste per month. Please note that a generator status may change from month to month and that a notice of this change is usually required by the generator's state agency.

Accumulation Time for Hazardous Waste

A LQG may accumulate hazardous waste on site for 90 calendar days or less without a permit and without having interim status, provided that such accumulation is in compliance with requirements in 40 CFR § 262.34. A SQG may accumulate hazardous waste on site for 180 calendar days or less without a permit or without having interim status, subject to the requirements of 40 CFR § 262.34(d). CESQG requirements are found in 40 CFR § 261.5. NOTE: The CESQG and SQG provisions of 40 CFR § 261.5, 262.20(e), 262.42(b) and 262.44 may not be recognized by some states (e.g., California and Rhode Island). State-specific and local-specific regulations must be reviewed and understood prior to the generation of hazardous waste.

Satellite Accumulation of Hazardous Waste Satellite accumulation (SAA) will mean the accumulation of as much as fifty-five (55) gallons of hazardous waste, or the accumulation of as much as one quart of acutely hazardous waste, in containers at or near any point of generation where the waste initially accumulates, which is under the control of the operator of the process generating the waste, without a permit or interim status and without complying with the requirements of 40 CFR § 262.34(a) and without any storage time limit, provided that the generator complies with 40 CFR § 262.34(c)(1)(i).

Once more than 55 gallons of hazardous waste accumulates in SAA, the generator has three days to move this waste into storage.

Storage recommendations for hazardous waste include:

- Ignitable Hazardous wastes must be >50 feet from the property line per 40 CFR § 265.176 (LQG generators only).
- Hazardous waste must be stored on a concrete slab (asphalt is acceptable if there are no free liquids in the waste) per 40 CFR § 265.176.
- Drainage must be directed away from the accumulation area.
- Area must be properly vented.
- Area must be secure.

Drum/Container Labeling

Drums will be labeled on both the side and lid of the drum using a permanent marking pen. Old drum labels must be removed to the extent possible, descriptions crossed out should any information remain, and new labels affixed on top of the old labels. Other containers used to store various types of waste (e.g., polyethylene tanks, roll-off boxes, end-dump trailers, etc.) will be labeled with an appropriate "Waste Container" or "Testing in Progress" label pending characterization. Drums and containers will be labeled as follows:

- Appropriate waste characterization label (Pending Analysis, Hazardous, or Nonhazardous)
- Waste generator's name (e.g., client name)
- Project Name
- Name and telephone number of Arcadis project manager

- Composition of contents (e.g., used oil, acetone 40%, toluene 60%)
- Media (e.g., solid, liquid)
- Accumulation start date
- Drum number of total drums as reconciled with the Drum Inventory maintained in the field log book.

IDW containers will remain closed except when adding or removing waste. Immediately upon beginning to place waste into the drum/container, a “Waste Container” or “Pending Analysis” label will be filled out to include the information specified above, and affixed to the container. Once the contents of the container are identified as either non-hazardous or hazardous, the following additional labels will be applied.

- Containers with waste determined to be non-hazardous will be labeled with a green and white "Nonhazardous Waste" label over the "Waste Container" label.
- Containers with waste determined to be hazardous will be stored in an onsite storage area and will be labeled with the "Hazardous Waste" label and affixed over the "Waste Container" label.

The ACCUMULATION DATE for the hazardous waste is the date the waste is first placed in the container and is the same date as the date on the "Waste Container" label. DOT hazardous class labels must be applied to all hazardous waste containers for shipment offsite to an approved disposal or recycling facility. In addition, a DOT proper shipping name will be included on the hazardous waste label. The transporter should be equipped with the appropriate DOT placards. However, placarding or offering placards to the initial transporter is the responsibility of the generator per 40 CFR § 262.33.

Inspections and Documentation

All IDW will be documented as generated on a Drum Inventory Log maintained in the field log book. The Drum Inventory will record the generation date, type, quantity, matrix and origin (e.g., Boring-1, Test Pit 3, etc.) of materials in every drum, as well as a unique identification number for each drum. The drum inventory will be used during drum pickup to assist with labeling of drums. The drum storage area and any other areas of temporarily staged waste, such as soil/debris piles, will be inspected weekly. The weekly inspections will be recorded in the field notebook or on a Weekly Inspection Log. Digital photographs will be taken upon the initial generation and drumming/staging of waste, and final labeling after characterization to document compliance with labeling and storage protocols, and condition of the container. Evidence of damage, tampering or other discrepancy should be documented photographically.

Emergency Response and Notifications

Specific procedures for responding to site emergencies will be detailed in the HASP. If the generator is designated as a LQG, a Contingency Plan will need to be prepared to include emergency response and notification procedures per 40 CFR § 265 Subpart D. In the event of a fire, explosion, or other release which could threaten human health outside of the site or when Client or ARCADIS has knowledge of a spill that has reached surface water, Client or ARCADIS must immediately notify the National Response Center (800-424-8802) in accordance with 40 CFR § 262.34. Other notifications to state and/or other local regulatory agencies may also be necessary.

Drilling Soil Cuttings and Muds

Soil cuttings are solid to semi-solid soils generated during trenching activities, subsurface soil sampling, or installation of monitoring wells. Depending on the drilling method, drilling fluids known as "muds" may be used to remove soil cuttings. Drilling fluids flushed from the borehole must be directed into a settling section of a mud pit. This allows reuse of the decanted fluids after removal of the settled sediments. Soil cuttings will be labeled and stored in 55-gallon drums with bolt-sealed lids.

Excavated Solids

Excavated solids may include, but are not limited to: soil, fill, and construction and demolition debris. Prior to permitted treatment or offsite disposal, potentially hazardous excavated solids may be temporarily stockpiled onsite as long as the stockpile remains in the same AOC from where it was excavated. Potentially hazardous excavated solids removed from the AOC must be immediately containerized in labeled drums or closable top roll-offs lined with 9-mil polyvinyl chloride (PVC) sheeting and are subject to LQG storage time limits. Nonhazardous excavated solids can be stockpiled either inside or outside of the AOC, do not have to be containerized and are not subject to hazardous waste regulations. Potentially hazardous excavated solids must not be mixed with nonhazardous excavated solids. All classes of excavated solid stockpiles should be maintained in a secure area onsite. At a minimum, the floor of the stockpile area will be covered with a 20-mil high density polyethylene liner that is supported by a foundation or at least a 60-mil high density polyethylene liner that is not supported by a foundation. The excavated material will not contain free liquids. The owner/operator will provide controls for windblown dispersion, run-on control, and precipitation runoff. The run-on control system will prevent flow onto the active portion of the pile during peak discharge from at least a 25-year storm and the run-off management system will collect and control at least the water volume resulting from a 24-hour, 25-year storm (USEPA, 1992). Additionally, the stockpile area will be inspected on a weekly basis and after storm events. Individual states may require that the stockpile be inspected/certified by a licensed professional engineer. Stockpiled material will be covered with a 6-mil polyvinyl chloride (PVC) liner or sprayed dust control product. The stockpile cover will be secured in place with appropriate material (concrete blocks, weights, etc.) to prevent the movement of the cover.

Decontamination Solutions

Decontamination solutions are generated during the decontamination of personal protective equipment and sampling equipment. Decontamination solutions may range from detergents, organic solvents and acids used to decontaminate small field sampling equipment to steam cleaning rinsate used to wash heavy field equipment. These solutions are to be labeled and stored in closed head drums compatible with the decontamination solution. Decontamination procedures, including personnel and field sampling equipment, must comply with applicable Arcadis procedural documents.

Disposable Equipment

Disposable equipment includes personal protective equipment (e.g., tyvek coveralls, gloves, booties and APR cartridges) and disposable sampling equipment such as trowels or disposable bailers. If the media sampled exhibits hazardous characteristics per results of waste characterization sampling, contaminated disposable equipment will also be disposed of as a hazardous waste. If compatible with the original IDW waste stream (i.e., the IDW is a solid and the disposal equipment is a solid), the disposable equipment can be combined with the IDW. If these materials are not compatible (i.e., the IDW is a liquid and the disposal equipment is a solid), the disposable equipment will be stored onsite in separate labeled 55-gallon drums. Uncontaminated or decontaminated disposable equipment can be considered nonhazardous waste.

Purge Water

Purge water includes groundwater generated during well development, groundwater sampling, or aquifer testing. The volume of groundwater generated will dictate the appropriate storage procedure. Monitoring well development and groundwater sampling may generate three well volumes of groundwater or more. This volume will be stored in labeled 55-gallon drums. Aquifer tests may generate significantly greater volumes of groundwater depending on the well yield and the duration of the test. Therefore, large-volume portable polyethylene tanks will be considered for temporary storage pending groundwater-waste characterization.

Purged Water Storage Tank Decontamination and Removal

The following procedures will be used for inspection, cleaning, and offsite removal of storage tanks used for temporary storage of purge water. These procedures are intended to be used for rented portable tanks such as Baker Tanks or Rain for Rent containers. Storage tanks will be made of inert plastic materials. The major steps for preparing a rented tank for return to a vendor include characterizing the purge water, disposing of the purge water, decontaminating the tank, final tank inspection, and mobilization. Decontamination and inspection procedures are described in further detail below.

- Tank Cleaning: Most vendors require that tanks be free of any visible sediment and water before returning, a professional cleaning service may be required. Each specific vendor should be consulted concerning specific requirements for returning tanks.
- Tank Inspection: After emptying the tank, purged water storage tanks should be inspected for debris, chemical staining, and physical damage. The vendors require that tanks be returned in the original condition (i.e., free of sediment, staining and no physical damage).

8 WASTE MANAGEMENT

Soil/Solids Characterization

Waste characterization will be conducted in accordance with waste hauler, waste handling facility, and local/state/federal requirements. In general, RCRA hazardous wastes are those solid wastes determined by a Toxicity Characteristic Leaching Procedure (TCLP) test or to contain levels of certain toxic metals, pesticides, or other organic chemicals above specific applicable regulatory agency thresholds. If the one or more of 40 toxic compounds listed in Table I of 40 CFR § 261.24 are detected in the sample at levels above the maximum unregulated concentrations, the waste must be characterized as a toxic hazardous waste. Wastes can also be considered “listed” hazardous waste depending on site-specific processes.

Composite soil samples will be collected at a frequency of one sample per 10 cubic yard basis for stockpiled soil or one per 55-gallon drum for containerized. A four-point composite sample will be collected per 10 cubic yards of stockpiled material and for each drum. Sample and composite frequencies may be adjusted in accordance with the waste handling facility’s requirements. Waste characterization samples may be analyzed for the TCLP volatile organic compounds (VOCs), TCLP semi-volatile organic compounds (SVOCs), TCLP RCRA metals, and polychlorinated biphenyls (PCBs), as well as reactivity and flammability (flashpoint). Additional samples may be collected and analyzed by the laboratory on a contingency basis. Site-specific constituents of concern including pesticides may require additional sampling. Please note that state- or local-specific regulations may require a different or additional sampling approaches.

Wastewater Characterization

Waste characterization will be conducted in accordance with the requirements of the waste hauler, waste handling facility, and local/state/federal governments. In general, purge water should be analyzed by methods appropriate for the known contaminants, if any, that have been historically detected in the monitoring wells. Samples will be collected and analyzed in accordance with the requirements of the waste disposal facility. Wastewater characterization samples may be analyzed for TCLP volatile organic compounds (VOCs), TCLP semi-volatile organic compounds (SVOCs), TCLP RCRA metals, and polychlorinated biphenyls, as well as corrosivity (pH), reactivity and flammability (flashpoint). Additional samples may be collected and analyzed by the laboratory on a contingency basis. Site-specific constituents of concern including pesticides may require additional sampling. Please note that state- and/or local-specific regulations may require different or additional sampling approaches.

Sample Handling and Shipping

All samples will be appropriately labeled, packed, and shipped, and the chain-of-custody will be filled out in accordance with current Arcadis sample chain of custody, handling, packing, and shipping procedures and guidance instructions.

It should be noted that additional training is required for packaging and shipping of hazardous and/or dangerous materials. Please refer to the current Arcadis training requirements related to handling and shipping of samples, shipping determinations, and hazardous materials.

Preparing Waste Shipment Documentation (Hazardous and Nonhazardous)

Waste profiles will be prepared by the Arcadis CPM and forwarded, along with laboratory analytical data to the Client for approval/signature. The Client will then return the profile to Arcadis who will then forward to the waste removal contractor for preparation of a manifest. The manifest will be reviewed by Arcadis prior to forwarding to the Client for approval. Upon approval of the manifest, the Client will return the original signed manifest directly to the waste contractor or to the Arcadis CPM for forwarding to the waste contractor. Arcadis personnel may sign waste profiles and/or waste manifests on a case by case basis for clients, provided the appropriate agreement is in place between Arcadis and the client documenting that Arcadis is not the generator, but is acting as an authorized representative of the generator.

Final drum labeling and pickup will be supervised by an Arcadis representative who is trained and experienced with applicable waste labeling procedures. The Arcadis representative will have a copy of the drum inventory maintained in the field book and will reconcile the drum inventory with the profile numbers on the labels and on the manifest. Different profile numbers will be generated for different matrices or materials in the drums. For example, the profile number for drill cuttings will be different than the profile number for purge water. When there are multiple profiles it is critical that the proper label, with the profile number appropriate to a specific material be affixed to the proper drums. A copy of the Arcadis drum inventory will be provided to the waste transporter during drum pickup and to the facility receiving the waste.

9 DATA RECORDING AND MANAGEMENT

Waste characterization sample handling, packing, and shipping procedures will be documented in accordance with relevant Arcadis procedures and guidance instructions as well as applicable client and/or project requirements, such as a Quality Assurance Project Plan or Sampling and Analysis Plan. Copies of the chain-of-custody forms will be maintained in the project file. Arcadis should photograph or maintain a copy of any hazardous waste manifest signed on behalf of Client in the corresponding office DOT record file.

10 QUALITY ASSURANCE

The CPM or APM will review all field documentation once per week for errors or omissions as compared to applicable project requirements including but not limited to: the proposal/scope of work, QAPP, SAP, HASP, etc. Deficiencies will be noted, tracked, and resolved. Upon correction, they will be noted for project documentation.

11 REFERENCES

United States Environmental Protection Agency (USEPA). 1992. Guide to Management of Investigation-Derived Wastes. Office of Remedial and Emergency Response. Hazardous Site Control Division. January 1992.

ARCADIS
Design & Consultancy
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TGI - SOIL DESCRIPTION

Rev: #2

Rev Date: February 16, 2018

VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	May 20, 2008	17	Original SOP	Joe Quinnan Joel Hunt
1	September 2016	15	Updated to TGI	Nick Welty Patrick Curry
2	February 16, 2018	15	Updated descriptions, attachments and references in text	Nick Welty Patrick Curry

APPROVAL SIGNATURES

Prepared by:

June 30, 2017

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Date:

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June 30, 2017

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Date:

1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

This Arcadis Technical Guidance Instruction (TGI) describes proper soil description procedures. This TGI should be followed for unconsolidated material unless there is an established client-required specific procedure or regulatory-required specific procedure. In cases where there is a required specific procedure, it should be followed and should be referenced and/or provided as an appendix to reports that include soil classifications and/or boring logs. When following a required non-Arcadis procedure, additional information required by this TGI should be included in field notes with client approval.

This TGI has been developed to emphasize field observation and documentation of details required to:

- make hydrostratigraphic interpretations guided by depositional environment/geologic settings;
- provide information needed to understand the distribution of constituents of concern; properly design wells, piezometers, and/or additional field investigations; and develop appropriate remedial strategies.

This TGI incorporates elements from various standard systems such as ASTM D2488-06, Unified Soil Classification System, Burmister and Wentworth. However, none of these standard systems focus specifically on contaminant hydrogeology and remedial design. Therefore, although each of these systems contain valuable guidance and information related to correct descriptions, strict application of these systems can omit information critical to our clients and the projects that we perform.

This TGI does not address details of health and safety; drilling method selection; boring log preparation; sample collection; or laboratory analysis. Refer to other Arcadis procedure, guidance, and instructional documents, the project work plans including the quality assurance project plan, sampling plan, and health and safety plan (HASP), as appropriate.

3 PERSONNEL QUALIFICATIONS

Soil descriptions should only be performed by Arcadis personnel or authorized sub-contractors with a degree in geology or a geology-related discipline. Field personnel will complete training on the Arcadis soil description TGI in the office and/or in the field under the guidance of an experienced field geologist with at least 2 years of prior experience applying the Arcadis soil description method.

4 EQUIPMENT LIST

The following equipment should be taken to the field to facilitate soil descriptions:

- field book, field forms or PDA to record soil descriptions;
- field book for supplemental notes;
- this TGI for Soil Descriptions and any project-specific procedure, guidance, and/or instructional documents (if required);
- field card showing Wentworth scale;
- Munsell® soil color chart;
- tape measure divided into tenths of a foot;
- stainless steel knife or spatula;
- hand lens;
- water squirt bottle;
- jar with lid;
- personal protective equipment (PPE), as required by the HASP; and
- digital camera

5 CAUTIONS

Drilling and drilling-related hazards including subsurface utilities are discussed in other procedure documents and site-specific HASPs and are not discussed herein.

Soil samples may contain hazardous substances that can result in exposure to persons describing soils. Routes for exposure may include dermal contact, inhalation and ingestion. Refer to the project specific HASP for guidance in these situations.

6 HEALTH AND SAFETY CONSIDERATIONS

Field activities associated with soil sampling and description will be performed in accordance with a site-specific HASP, a copy of which will be present on site during such activities. Know what hazardous substances may be present in the soil and understand their hazards. Always avoid the temptation to touch soils with bare hands, detect odors by placing soils close to your nose, or tasting soils.

7 PROCEDURE

1. Select the appropriate sampling method to obtain representative samples in accordance with the selected sub-surface exploration method, e.g. split-spoon or Shelby sample for hollow-stem drilling, acetate sleeves for direct push, bagged core for sonic drilling, etc.
2. Proceed with field activities in required sequence. Although completion of soil descriptions is often not the first activity after opening sampler, identification of stratigraphic changes is often necessary to select appropriate intervals for field screening and/or selection of laboratory samples.
3. Set up boring log field sheet.
    - Drillers in both the US and Canada generally work in feet due to equipment specifications. Use the Arcadis standard boring log form (**Attachment A**).
    - The preferred boring log includes a graphic log of the principal soil component to support quick visual evaluation of grain size. The purpose of the graphic log is to quickly assess relative soil permeability. Note, for poorly sorted soils (e.g. glacial till), the principal component may not correlate to permeability of the sample. In this case, the geologist should use best judgement to graph overall soil type consistent with relative soil permeability. For example, for a dense sand/silt/clay till, the graphic log would reflect the silt/clay, rather than sand.
    - Record depths along the left-hand side at a standard scale to aid in the use of this tool. See an example completed boring log (**Attachment B**).
4. Examine each soil core (this is different than examining each sample selected for laboratory analysis), and record the following for each stratum:
    - depth interval;
    - principal component with descriptors, as appropriate;
    - amount and identification of minor component(s) with descriptors as appropriate;
    - moisture;
    - consistency/density;
    - color; and
    - additional description or comments (recorded as notes).
5. At the end of the boring, record the amount of drilling fluid used (if applicable) and the total depth logged.

The above is described more fully below.

DEPTH

To measure and record the depth below ground surface (bgs) of top and bottom of each stratum, the following information should be recorded.

1. Measured depth to the top and bottom of sampled interval. Use starting depth of sample based upon measured tool length information and the length of sample interval.
2. Length of sample recovered, not including slough (material that has fallen into hole from previous interval), expressed as fraction with length of recovered sample as numerator over length of sampled interval as denominator (e.g. 14/24 for 14 inches recovered from 24-inch sampling interval that had 2 inches of slough discarded).
3. Thickness of each stratum measured sequentially from the top of recovery to the bottom of recovery.
4. Any observations of sample condition or drilling activity that would help identify whether there was loss from the top of the sampling interval, loss from the bottom of the sampling interval, or compression of the sampling interval. Examples: 14/24, gravel in nose of spoon; or 10/18 bottom 6 inches of spoon empty.

DETERMINATION OF COMPONENTS

Obtain a representative sample of soil from a single stratum. If multiple strata are present in a single sample interval, each stratum should be described separately. More specifically, if the sample is from a 2-foot long split-spoon where strata of coarse sand, fine sand and clay are present, then the resultant description should be of the three individual strata unless a combined description can clearly describe the interbedded nature of the three strata. Example: Fine Sand with interbedded lenses of Silt and Clay, ranging between 1 and 3 inches thick.

Identify principal component and express volume estimates for minor components on logs using the following standard modifiers.

Modifier	Percent of Total Sample (by volume)
and	36 - 50
some	21 - 35
little	10 - 20
trace	<10

Determination of components is based on using the Udden-Wentworth particle size classification (see below) and measurement of the average grain size diameter. Each size grade or class differs from the next larger grade or class by a constant ratio of ½. Due to visual limitations, the finer classifications of Wentworth’s scale cannot be distinguished in the field and the subgroups are not included. Visual determinations in the field should be made carefully by comparing the sample to the Soil Description Field Guide (**Attachment C**) that shows Udden-Wentworth scale or by measuring with a ruler. Use of field sieves is encouraged to assist in estimating percentage of coarse grain sizes. Settling test or wash method (Appendix X4 of ASTM D2488) is encouraged for determining presence and estimating percentage of clay and silt. Note that “gravel” is not an Udden-Wentworth size class.

Udden-Wenworth Scale **Modified Arcadis, 2008**			
Size Class	Millimeters	Inches	Standard Sieve #
Boulder	256 – 4096	10.08+	
Large cobble	128 - 256	5.04 -10.08	
Small cobble	64 - 128	2.52 – 5.04	
Very large pebble	32 – 64	0.16 - 2.52	
Large pebble	16 – 32	0.63 – 1.26	
Medium pebble	8 – 16	0.31 – 0.63	
Small pebble	4 – 8	0.16 – 0.31	No. 5 +
Granule	2 – 4	0.08 – 0.16	No.5 – No.10
Very coarse sand	1 -2	0.04 – 0.08	No.10 – No.18
Coarse sand	½ - 1	0.02 – 0.04	No.18 - No.35
Medium sand	¼ - ½	0.01 – 0.02	No.35 - No.60
Fine sand	1/8 -¼	0.005 – 0.1	No.60 - No.120
Very fine sand	1/16 – 1/8	0.002 – 0.005	No. 120 – No. 230
Silt (subgroups not included)	1/256 – 1/16	0.0002 – 0.002	Not applicable (analyze by pipette or hydrometer)
Clay (subgroups not included	1/2048 – 1/256	.00002 – 0.0002	

Identify components as follows. Remove particles greater than very large pebbles (64-mm diameter) from the soil sample. Record the volume estimate of the greater than very large pebbles. Examine the sample fraction of very large pebbles and smaller particles and estimate the volume percentage of the pebbles, granules, sand, silt and clay. Use the jar method, visual method, and/or wash method (Appendix X4 of ASTM D2488) to estimate the volume percentages of each category.

Determination of actual dry weight of each Udden-Wentworth fraction requires laboratory grain-size analysis using sieve sizes corresponding to Udden-Wentworth fractions and is highly recommended to determine grain-size distributions for each hydrostratigraphic unit.

Lab or field sieve analysis is advisable to characterize the variability and facies trends within each hydrostratigraphic unit. Field sieve-analysis can be performed on selected samples to estimate dry weight fraction of each category using ASTM D2488 Standard Practice for Classification of Soils for Engineering Purposes as guidance, but replace required sieve sizes with the following Udden-Wentworth set: U.S. Standard sieve mesh sizes 6; 12; 20; 40; 70; 140; and 270 to retain pebbles; granules; very coarse sand; coarse sand; medium sand; fine sand; and very fine sand, respectively.

PRINCIPAL COMPONENT

The principal component is the size fraction or range of size fractions containing the majority of the volume. Examples: the principal component in a sample that contained 55% pebbles would be “Pebbles”; or the principal component in a sample that was 20% fine sand, 30% medium sand and 25% coarse sand would be “Sand, fine to coarse” or for a sample that was 40% silt and 45% clay the principal component would be “Clay and Silt”. Shade the boxes on the graphic log (**Attachment A**) up to and including the box with the principal component. The purpose of the graphical log is to provide a relative estimate of permeability. As noted above, for poorly sorted soils such as glacial till, the principal component may not correlate to permeability of the sample. In this case, the geologist should use best judgement to graph overall soil type consistent with relative soil permeability.

Include appropriate descriptors with the principal component. These descriptors vary for different particle sizes as follows.

Angularity – Describe the angularity for very coarse sand and larger particles in accordance with the table below (ASTM D-2488-06). Figures showing examples of angularity are available in ASTM D-2488-06 and the Arcadis Soil Description Field Guide.

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Sub-angular	Particles are similar to angular description but have rounded edges.
Sub-rounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

Plasticity – Describe the plasticity for silt and clay based on observations made during the following test method (ASTM D-2488-06).

- As in the dilatancy test below, select enough material to mold into a ball about ½ inch (12 mm) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.
- Shape the test specimen into an elongated pat and roll by hand on a smooth surface or between the palms into a thread about 1/8 inch (3 mm) in diameter. If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation. Fold the sample threads and reroll repeatedly until the thread crumbles at a diameter of about 1/8 inch. The thread will crumble when the soil is near the plastic limit.

Description	Criteria
Non-plastic	A 1/8-inch (3 mm) thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

Dilatancy – Describe the dilatancy for silt and silt-sand mixtures using the following field test method (ASTM D-2488-06).

- From the specimen select enough material to mold into a ball about ½ inch (12 mm) in diameter. Mold the material adding water if necessary, until it has a soft, but not sticky, consistency.
- Smooth the ball in the palm of one hand with a small spatula.
- Shake horizontally, striking the side of the hand vigorously with the other hand several times.
- Note the reaction of water appearing on the surface of the soil.
- Squeeze the sample by closing the hand or pinching the soil between the fingers, and not the reaction as none, slow, or rapid in accordance with the table below. The reaction is the speed with which water appears while shaking and disappears while squeezing.

Description	Criteria
None	No visible change in the specimen.
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

Note that silt and silt-sand mixtures will be non-plastic and display dilatancy. Clay mixtures will have some degree of plasticity but do not typically react to dilatancy testing. Therefore, the tests outlined above can be used to differentiate between silt dominated and clay dominated soils.

MINOR COMPONENT(S)

The minor component(s) are the size fraction(s) containing less than 50% volume. Example: the identified components are estimated to be 60% medium sand to granules, 25% silt and clay; 15 % pebbles – there are two identified minor components: silt and clay; and pebbles.

Include a standard modifier to indicate percentage of minor components (see Table on Page 6) and the same descriptors that would be used for a principal component. Plasticity should be provided as a descriptor for clay and clay mixtures. Dilatancy should be provided for silt and silt mixtures. Angularity should be provided as a descriptor for pebbles and coarse sand. For the example above, the minor constituents with modifiers could be: some silt and clay, low plasticity; little medium to large pebbles, sub-round.

SORTING

Sorting is the opposite of grading, which is a commonly used term in the USCS or ASTM methods to describe the uniformity of the particle size distribution in a sample. Well-sorted samples are poorly graded and poorly sorted samples are well graded. Arcadis prefers the use of sorting for particle size distributions and grading to describe particle size distribution trends in the vertical profile of a sample or hydrostratigraphic unit because of the relationship between sorting and the energy of the depositional process. For soils with sand-sized or larger particles, sorting should be determined as follows:

Well sorted – the range of particle sizes is limited (e.g. the sample is comprised of predominantly one or two grain sizes).

Poorly sorted – a wide range of particle sizes are present.

You can also use sieve analysis to estimate sorting from a sedimentological perspective; sorting is the statistical equivalent of standard deviation. Smaller standard deviations correspond to higher degree of sorting (see Remediation Hydraulics, 2008).

MOISTURE

Moisture content should be described for every sample since increases or decreases in water content is critical information. Moisture should be described in accordance with the table below (percentages should not be used unless determined in the laboratory).

Description	Criteria
Dry	Absence of moisture, dry to touch, dusty.
Moist	Damp but no visible water.
Wet (Saturated)	Visible free water, soil is usually below the water table.

CONSISTENCY or DENSITY

This can be determined by standard penetration test (SPT) blow counts (ASTM D-1586) or field tests in accordance with the tables below. When drilling with hollow-stem augers and split-spoon sampling, the SPT blow counts and N-value is used to estimate density. The N-value is the blows per foot for the 6” to 18” interval. Example: for 24-inch spoon, recorded blows per 6-inch interval are: 4/6/9/22. Since the second interval is 6” to12”, the third interval is 12” to 18”, the N value is 6+9, or 15. Fifty blow counts for less than 6 inches is considered refusal. In recent years, more common drilling methods include rotary-sonic or direct push. When blow counts are not available, density is determined using a thumb test. Note however, the thumb test only applies to fine-grained soils.

Fine-grained soil – Consistency

Description	Criteria
Very soft	N-value < 2 or easily penetrated several inches by thumb.
Soft	N-value 2-4 or easily penetrated one inch by thumb.
Medium stiff	N-value 9-15 or indented about ¼ inch by thumb with great effort.
Very stiff	N-value 16-30 or readily indented by thumb nail.
Hard	N-value > than 30 or indented by thumbnail with difficulty

Coarse-grained soil – Density

Description	Criteria
Very loose	N-value 1- 4
Loose	N-value 5-10
Medium dense	N-value 11-30
Dense	N-value 31- 50
Very dense	N-value >50

COLOR

Color should be described using simple basic terminology and modifiers based on the Munsell system. Munsell alpha-numeric codes are required for all samples. If the sample contains layers or patches of varying colors this should be noted and all representative colors should be described. The colors should be described for moist samples. If the sample is dry it should be wetted prior to comparing the sample to the Munsell chart.

ADDITIONAL COMMENTS (NOTES)

Additional comments should be made where observed and should be presented as notes with reference to a specific depth interval(s) to which they apply. Some of the significant information that may be observed includes the following.

- Odor - You should not make an effort to smell samples by placing near your nose since this can result in unnecessary exposure to hazardous materials. However, odors should be noted if they are detected during the normal sampling procedures. Odors should be based upon descriptors such as those used in NIOSH “Pocket Guide to Chemical Hazards”, e.g. “pungent” or “sweet” and should not indicate specific chemicals such as “phenol-like” odor or “BTEX” odor.
- Structure
- Bedding planes (laminated, banded, geologic contacts).
- Presence of roots, root holes, organic material, man-made materials, minerals, etc.
- Mineralogy
- Cementation
- NAPL presence/characteristics, including sheen (based on client-specific guidance).
- Reaction with HCl - typically only used for special soil conditions, such as caliche environments.
- Origin, if known (Lacustrine; Fill; etc.).

EXAMPLE DESCRIPTIONS

51.4 to 54.0’ CLAY, some silt, medium to high plasticity; trace small to large pebbles, sub-round to sub-angular up to 2” diameter; moist, stiff, dark grayish brown (10 YR 4/2) NOTE: Lacustrine; laminated 0.1 to 0.2” thick, laminations brownish yellow (10 YR 4/3).

32.5 to 38.0’ SAND, medium to very coarse, sub-round to sub-angular; little granule and pebble, trace silt; poorly sorted, wet, grayish brown (10 YR 5/2).

Unlike the first example where a density of cohesive soils could be estimated, this rotary-sonic sand and pebble sample was disturbed during drilling (due to vibrations in a loose sand and pebble matrix) so no density description could be provided. Neither sample had noticeable odor so odor comments were not included.

The standard generic description order is presented below.

- Depth
- Principal Components
    - Angularity for very coarse sand and larger particles
    - Plasticity for silt and clay
    - Dilatancy for silt and silt-sand mixtures
- Minor Components
- Sorting
- Moisture
- Consistency or Density
- Color
- Additional Comments

8 WASTE MANAGEMENT

Project-specific requirements should be identified and followed. The following procedures, or similar waste management procedures are generally required.

Water generated during cleaning procedures will be collected and contained onsite in appropriate containers for future analysis and appropriate disposal. PPE (such as gloves, disposable clothing, and other disposable equipment) resulting from personnel cleaning procedures and soil sampling/handling activities will be placed in plastic bags. These bags will be transferred into appropriately labeled 55-gallon drums or a covered roll-off box for appropriate disposal.

Soil materials will be placed in sealed 55-gallon steel drums or covered roll-off boxes and stored in a secured area. Once full, the material will be analyzed to determine the appropriate disposal method.

9 DATA RECORDING AND MANAGEMENT

Upon collection of soil samples, the soil sample should be logged on a standard boring log and/or in the field log book depending on Data Quality Objectives (DQOs) for the task/project. The preferred standard boring log is presented below and is included as **Attachment A**.

The general scheme for soil logging entries is presented above; however, depending on task/project DQOs, specific logging entries that are not applicable to task/project goals may be omitted at the project manager's discretion. In any case, use of a consistent logging procedure is required.

Completed logs and/or logbook will be maintained in the task/project field records file. Digital photographs of typical soil types observed at the site and any unusual features should be obtained whenever possible. All photographs should include a ruler or common object for scale. Photo location, depth and orientation must be recorded in the daily log or log book and a label showing this information in the photo is useful.

10 QUALITY ASSURANCE

Soil descriptions should be completed only by appropriately trained personnel. Descriptions should be reviewed by an experienced field geologist for content, format and consistency. Edited boring logs should be reviewed by the original author to assure that content has not changed.

11 REFERENCES

Arcadis Soil Description Field Guide, 2008.

Munsell® Color Chart – available from Forestry Suppliers, Inc.- Item 77341 "Munsell® Color Soil Color Charts.

Field Gauge Card that Shows Udden-Wentworth scale – available from Forestry Suppliers, Inc. – Item 77332 "Sand Grain Sizing Folder."

ASTM D-1586, Test Method for Penetration Test and Split-Barrel Sampling of Soils.

ASTM D-2488-00, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

United States Bureau of Reclamation. Engineering Geology Field Manual. United States Department of Interior, Bureau of Reclamation. http://www.usbr.gov/pmts/geology/fieldmap.htm.

Petrology of Sedimentary Rocks, Robert L. Folk, 1980, p. 1-48.

NIOSH Pocket Guide to Chemical Hazards.

Remediation Hydraulics, Fred C. Payne, Joseph A. Quinnan, and Scott T. Potter, 2008, p 59-63.

ATTACHMENT A

Arcadis Standard Soil Boring Log Form

ARCADIS Design & Consultancy for natural and built assets

SOIL BORING LOG

Boring/Well ______________ Project ______________________________ Page ___ of ___

Site Location ______________________________ Drilling Started ______________

Total Depth Drilled ________ Feet Hole Diameter ________ inches Drilling Completed ______________

Type of Sample or Coring Device ______________ Length and Diameter of Coring Device ______________ Sampling Interval ________ feet

Drilling Method ______________ Drilling Fluid Used ______________

Drilling Contractor ______________________________ Driller ______________

Prepared By ______________________________ Helper ______________

Core Recovery (feet)	PID Reading (ppm)	Sample Depth (ft bgs)	MUD		SAND					GRAVEL				**Udden-Wentworth Description:** principal components, (angularity, plasticity, dilatency); minor components, (angularity, plasticity, dilatency); sorting, moisture content, consistency/density, color, additional comments
			clay	silt	very fine	fine	medium	coarse	very coarse	granular	pebble	cobble	boulder	

ARCADIS Design & Consultancy for natural and built assets

SOIL BORING LOG (CONT'D)

Boring/Well ____________________ Prepared By ____________________ Page ____ of ____

Core Recovery (feet)	PID Reading (ppm)	Sample Depth (ft bgs)	MUD		SAND					GRAVEL				Udden-Wentworth Description: principal components, (angularity, plasticity, dilatency); minor components, (angularity, plasticity, dilatency); sorting, moisture content, consistency/density, color, addtl. Comments
			clay	silt	very fine	fine	medium	coarse	very coarse	granular	pebble	cobble	boulder	

ATTACHMENT B

Example of Completed Arcadis Soil Boring Log

ARCADIS Design & Consultancy for natural and built assets

SOIL BORING LOG

Boring/Well SB-01

Project Example

Page 1 of 1

Site Location Anytown, North America

Drilling Started 6/26/17

Total Depth Drilled 20 Feet

Hole Diameter 4.5 inches

Drilling Completed 6/26/17

Type of Sample or Coring Device Continuous

Length and Diameter of Coring Device 5', 2.25" macrocore

Sampling Interval 5 feet

Drilling Method Geoprobe

Drilling Fluid Used NA

Drilling Contractor Fibertec

Driller Ryan Brown

Prepared By A. DeGrandis

Helper Grant Berger

Core Recovery (feet)	PID Reading (ppm)	Sample Depth (ft bgs)	MUD		SAND					GRAVEL				Udden-Wentworth Description: principal components, (angularity, plasticity, dilatency); minor components, (angularity, plasticity, dilatency); sorting, moisture content, consistency/density, color, additional comments
			clay	silt	very fine	fine	medium	coarse	very coarse	granular	pebble	cobble	boulder	
	0.3	1	☒	☒	☒	☒	☒							(0.0-4.0) SAND, fine to medium, sub-rounded;
	0.1	2	☒	☒	☒	☒	☒							little granules to small pebbles, sub-rounded
60"	0.0	3	☒	☒	☒	☒	☒							to sub-angular; trace silt; poorly sorted, dry
(HA)	0.0	4	☒	☒	☒	☒	☒							to moist, dark grayish brown (10YR 4/2).
	1.4	5	☒	☒										NOTE: Ablation till.
	1.7	6	☒	☒										
	0.9	7	☒	☒										(4.0-10.0) SILT, non-plastic, rapid dilatancy;
52"	1.2	8	☒	☒										dry to moist, soft to medium stiff,
	0.6	9	☒	☒										gray (10YR 5/1).
	0.2	10	☒	☒										
	0.0	11	☒	☒	☒	☒								(10.0-15.5) SAND, fine, sub-rounded; trace
	0.0	12	☒	☒	☒	☒								silt; well sorted, moist to wet, pale
60"	0.1	13	☒	☒	☒	☒								brown (10YR 6/3).
	0.0	14	☒	☒	☒	☒								
	0.0	15	☒	☒	☒	☒								NOTE: Wet at 12.0'
	0.2	16	☒	☒	☒	☒								
	0.0	17	☒											(15.5-20.0) CLAY, high plasticity, no dilatancy;
58"	0.0	18	☒											little silt; moist, soft to medium stiff,
	0.0	19	☒											light gray (10YR 7/1) to dark gray (10YR 4/1).
	0.0	20	☒											NOTE: Lacustrine, minor 0.1-0.25" lamination.
														End of boring - 20.0'

ATTACHMENT C

Arcadis Soil Description Field Guide

ON THE ORIGINAL DRAWING.
USE TO VERIFY FIGURE
REPRODUCTION SCALE

SOIL DESCRIPTION FIELD GUIDE (JUNE 30, 2017; REV. 2.0)

ARCADIS
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FINE-GRAINED SOILS

Description	Criteria
	Descriptor - Plasticity
Nonplastic	A 1/8-inch (3mm) thread cannot be rolled at any moisture content.
Low	Thread can barely be rolled, and lump cannot be formed when drier than plastic limit.
Medium	Takes considerable time and rolling to reach plastic limit. Thread cannot be rolled after reaching plastic limit. Lump crumbles when drier than plastic limit.
High	Thread is easy to roll and quickly reaches plastic limit. Thread can be rerolled several times after reaching plastic limit. Lump can be formed without crumbling when drier than plastic limit.
	Descriptor - Dilatancy
No Dilatancy	No visible change when shaken or squeezed.
Slow	Water appears slowly on the surface of soil during shaking and does not disappear or disappears slowly when squeezed.
Rapid	Water appears quickly on surface of soil during shaking and disappears quickly when squeezed.
Minor Components with Descriptors	
	Moisture
Dry	Absence of moisture, dry to touch, dusty.
Moist	Damp but no visible water.
Wet	Visible free water; soil is usually below the water table. (Saturated)
	Consistency
Very soft	N-value < 2 or easily penetrated several inches by thumb.
Soft	N-value 2-4 or easily penetrated 1 inch by thumb.
Medium stiff	N-value 5-8 or indented about 1/2 inch by thumb with great effort.
Stiff	N-value 9-15 or indented about 1/4 inch by thumb with great effort.
Very stiff	N-value 16-30 or readily indented by thumb nail.
Hard	N-value > than 30 or indented by thumbnail with difficulty.
Color using Munsell	
Geologic Origin (if known)	
Other	

EXAMPLE OF SOIL DESCRIPTION AND PHOTO

10-15 feet CLAY, medium to high plasticity; trace silt; trace small to very large pebbles, subround to subangular up to 2" diameter; moist, stiff, dark grayish brown (10YR 4/2). NOTE: Lacustrine; laminated 0.1 to 0.2" thick, laminations brownish yellow (10YR 4/3).

DESCRIPTION ORDER

Depth Interval
Principal Components with Descriptors
Minor Components with Descriptors
Sorting
Field Moisture Condition
Density/Consistency
Color using Munsell
Geologic Origin (if known)
Other descriptions as NOTES:
- Odor
- Stratigraphy
- Structure
- Sphericity
- Cementation
- Reaction to acid

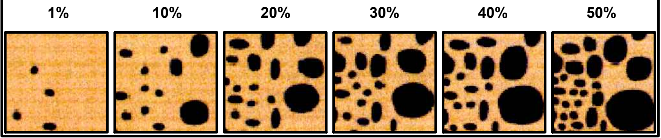
MINOR COMPONENTS % MODIFIERS

Modifier	Percent of Total Sample (by volume)
and	36 - 50
some	21 - 35
little	10 - 20
trace	<10

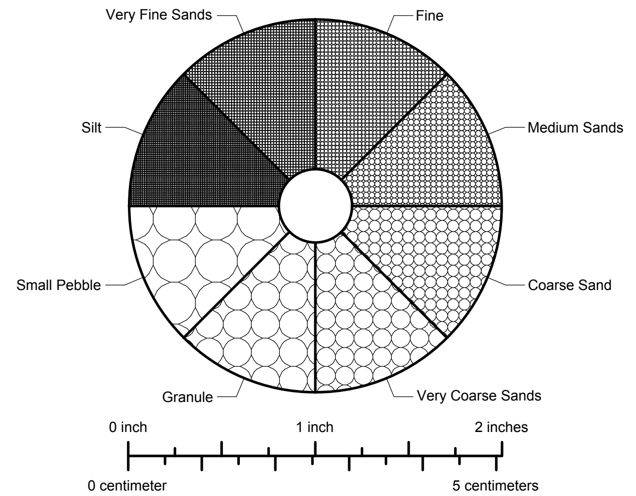
UDDEN-WENTWORTH SCALE

Fraction	Sieve Size	Grain Size	Approximate Scale
Boulder		256 - 4096 mm	Larger than volleyball
Large Cobble		128 - 256 mm	Softball to volleyball
Small Cobble		64 - 128 mm	Pool ball to softball
Very Large Pebble		32 - 64 mm	Pinball to pool ball
Large Pebble		16 - 32 mm	Dime size to pinball
Medium Pebble		8 - 16 mm	Pencil eraser to dime size
Small Pebble	No. 5+	4 - 8 mm	Pea size to pencil eraser
Granule	No. 10 - 5	2 - 4 mm	Rock salt to pea size
Very Coarse Sand	No. 18 - 10	1 - 2 mm	See field gauge card
Coarse Sand	No. 35 -18	0.5 - 1 mm	See field gauge card
Medium Sand	No. 60 - 35	0.25 - 0.5 mm	See field gauge card
Fine Sand	No. 120 - 60	0.125 - 0.25 mm	See field gauge card
Very Fine Sand	No. 230 - 120	0.0625 - 0.125 mm	See field gauge card
Silt and Clay. See SOP for description of fines	Not Applicable	<0.0625 mm	Analyze by pipette or hydrometer

PARTICLE PERCENT COMPOSITION ESTIMATION



GRAPH FOR DETERMINING SIZE OF PARTICLES



FOR COARSE-GRAINED SOILS

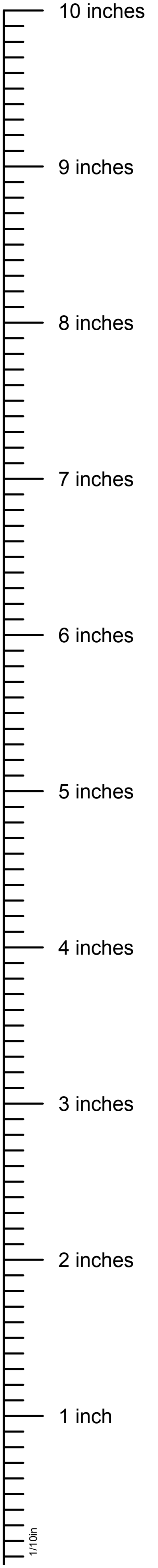
Description	Criteria
	Descriptor - Angularity
Angular	Particles have sharp edges and relatively planar sides withunpolished surfaces.
Subangular	Particles are similar to angular but have rounded edges.
Subround	Particles have nearly planar sides but have well-roundedcorners and edges.
Round	Particles have smoothly curved sides and no edges.
Minor Components with Descriptors	
	Sorting **Cu= d60/d10**
Well Sorted	Near uniform grain-size distribution Cu= 1 to 3.
Poorly Sorted	Wide range of grain size Cu= 4 to 6.
	Moisture
Dry	Absence of moisture, dry to touch, dusty.
Moist	Damp but no visible water.
Wet	Visible free water; soil is usually below the water table. (Saturated)
	Density
Very loose	N-value 1 - 4
Loose	N-value 5 - 10
Medium Dense	N-value 11 - 30
Dense	N-value 31 - 50
Very dense	N-value >50
Color using Munsell	
Geologic Origin (if known)	
Other	
	Cementation
Weak Cementation	Crumbles or breaks with handling or little finger pressure.
Moderate Cementation	Crumbles or breaks with considerable finger pressure.
Strong Cementation	Will not crumble with finger pressure.
	Reaction with Dilute HCl Solution (10%)
No Reaction	No visible reaction.
Weak Reaction	Some reaction, with bubbles forming slowly.
Strong Reaction	Violent reaction, with bubbles forming immediately.

EXAMPLE OF SOIL DESCRIPTION AND PHOTO

10 -15 feet SAND, medium to very coarse; little granules to medium pebbles, subround to subangular; trace silt; poorly sorted, wet, grayish brown (10YR5/2).

ON THE ORIGINAL DRAWING.
USE TO VERIFY FIGURE
REPRODUCTION SCALE

SOIL DESCRIPTION FIELD GUIDE (JUNE 30, 2017; REV. 2.0)



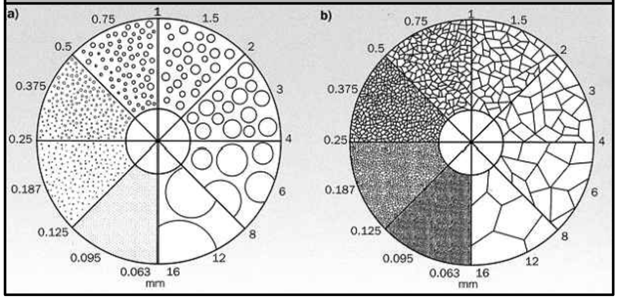
VARIATIONS IN SOIL STRATIGRAPHY

Term	Thickness of Configuration
Parting	0 - to 1/16-inch thickness.
Seam	1/16 - to 1/2-inch thickness.
Layer	1/2 - to 12-inch thickness.
Stratum	> 12-inch thickness.
Pocket	Small erratic deposit, usually less than 1 foot in size.
Varved Clay	Alternating seams or layers of sand, silt, and clay (laminated).
Occasional	≤ 1 foot thick.
Frequent	> 1 foot thick.

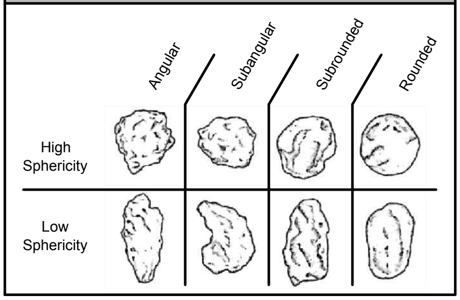
SOIL STRUCTURE DESCRIPTIONS

Term	Description
Homogeneous	Same color and appearance throughout.
Laminated	Alternating layers < 1/4 inch thick.
Stratified	Alternating layers ≥ 1/4 inch thick.
Lensed	Inclusions of small pockets of different materials, such as lenses of sand scattered through a mass of clay; note thickness.
Blocky	Cohesive soil can be broken down into small angular lumps, which resist further breakdown.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear to be polished or glossy, sometimes striated.

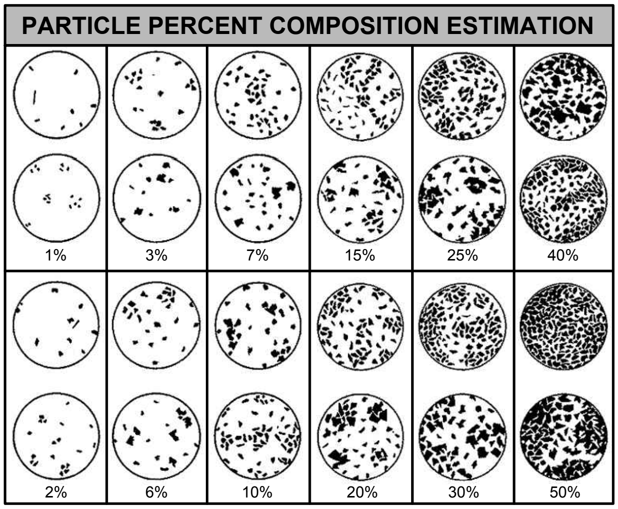
GRAPH FOR DETERMINING SIZE OF PARTICLES



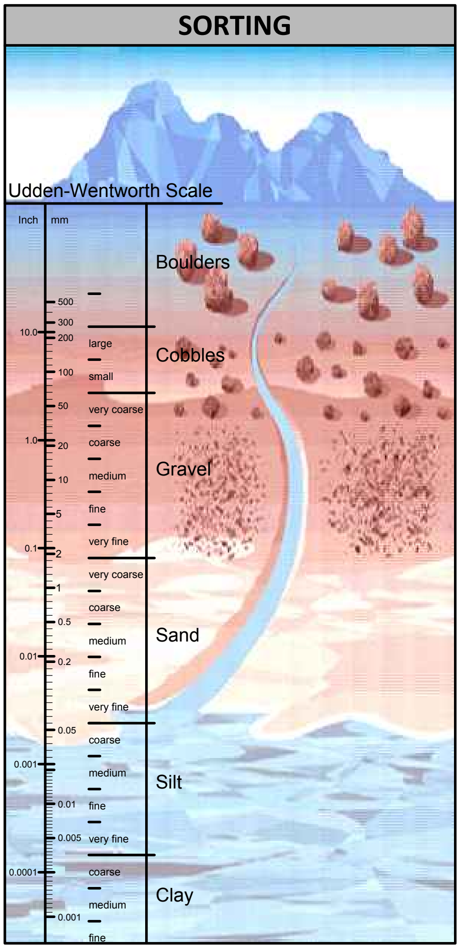
ANGULARITY CHART



PARTICLE PERCENT COMPOSITION ESTIMATION



SORTING



SETTLING TABLE (SILT/CLAY)

Diameter of Particle (mm)	<0.625	<0.031	<0.016	<0.008	<0.004	<0.002	<0.0005
Depth of Withdrawal (cm)	10	10	10	10	5	5	3
Time of Withdrawal	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec
Temperature (Celsius)							
20	00:00:29	00:01:55	00:07:40	00:30:40	00:61:19	04:05:00	37:21:00
21	00:00:28	00:01:52	00:07:29	00:29:58	00:59:50	04:00:00	
22	00:00:27	00:01:50	00:07:18	00:29:13	00:58:22	03:54:00	
23	00:00:27	00:01:47	00:07:08	00:28:34	00:57:05	03:48:00	
24	00:00:26	00:01:45	00:06:58	00:27:52	00:55:41	03:43:00	33:56:00
25	00:00:25	00:01:42	00:06:48	00:27:14	00:54:25	03:38:00	
26	00:00:25	00:01:40	00:06:39	00:26:38	00:53:12	03:33:00	
27	00:00:24	00:01:38	00:06:31	00:26:02	00:52:02	03:28:00	
28	00:00:24	00:01:35	00:06:22	00:25:28	00:50:52	03:24:00	31:00:00
29	00:00:23	00:01:33	00:06:13	00:24:53	00:49:42	03:10:00	
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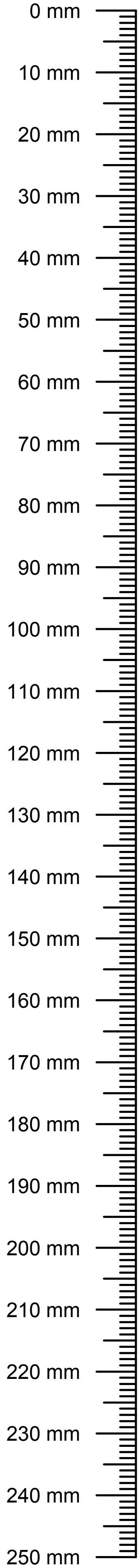

TGI – SOIL DRILLING AND SAMPLE COLLECTION

Rev #: 0

Rev Date: October 11, 2018

VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	October 11, 2018	All	Updated and re-written as a TGI	Marc Killingstad

APPROVAL SIGNATURES

Prepared by:		10/11/2018
	Christopher Keen	Date:
Technical Expert Reviewed by:		10/11/2018
	Marc Killingstad (Technical Expert)	Date:

1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to any and all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, state-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

This Technical Guidance Instruction (TGI) describes general drilling procedures and the methods to be used to field screen and collect soil samples for laboratory analysis in unconsolidated sediments. For soil description procedures, please refer to the *TGI - Soil Description*. For monitoring well installation in granular aquifers, please refer to the *TGI - Monitoring Well Installation*.

Overburden (unconsolidated sediments) drilling is commonly performed using the hollow-stem auger drilling method. Other drilling methods suitable for overburden drilling, which are sometimes necessary due to site-specific geologic conditions, include: drive-and-wash, spun casing, rotasonic, dual-rotary (Barber Rig), and fluid/mud rotary with core barrel or roller bit. Direct-push techniques (e.g., Geoprobe or cone penetrometer) and hand tools may also be used. Drilling within consolidated materials such as fractured bedrock is commonly performed using water-rotary (coring or tri-cone roller bit), air rotary or rotasonic methods. For guidance when drilling in consolidated materials (i.e., bedrock), please refer to the *TGI – Bedrock Core Collection and Description*.

The drilling method to be used at a given site will be selected based on site-specific consideration of anticipated drilling depths, site or regional geologic knowledge, types of sampling to be conducted, required sample quality and volume, and cost.

Field screening of soil samples is commonly performed using a photoionization detector (PID) and/or a flame ionization detector (FID). These instruments are used to measure relative concentrations of volatile organic compounds (VOCs) for the selection of samples for further laboratory or field analysis. Field screening for dense non-aqueous phase liquids (DNAPL) may be performed using hydrophobic dye (Oil Red O or Sudan IV), which is pertinent at chlorinated solvent sites.

Collection of soil samples for laboratory analysis may be performed using a variety of techniques including grab samples and composite or homogenized samples. Samples may require homogenization across a given depth interval, or several discrete grabs (usually five) may be combined into a composite sample. Samples for VOC analysis will not be homogenized or composited and are collected as discrete grab samples.

No oils or grease will be used on equipment introduced into the boring (e.g., drill rod, casing, or sampling tools).

3 PERSONNEL QUALIFICATIONS

Arcadis field personnel will have completed or are in the process of completing site-specific training as well as having current health and safety training as required by Arcadis, client, or state/federal regulations, such as 40-hour HAZWOPER training and/or OSHA HAZWOPER site supervisor training. Arcadis personnel will also have current training as identified in the site-specific Health and Safety Plan (HASP) which may include first aid, cardiopulmonary resuscitation (CPR), Blood Borne Pathogens (BBP) as needed. The HASP will also identify any access control requirements.

Prior to mobilizing to the field, Arcadis field personnel will review and be thoroughly familiar with relevant site-specific documents including but not limited to the task-specific work plan or field implementation plan (FIP), Quality Assurance Project Plan (QAPP), HASP, historical information, and other relevant site documents.

Arcadis field personnel will be knowledgeable in the relevant processes, procedures, and TGIs and possess the demonstrated required skills and experience necessary to successfully complete the desired field work. Personnel responsible for overseeing drilling operations will have at least 16 hours of prior training overseeing drilling activities with an experienced geologist, environmental scientist, or engineer with at least 2 years of prior experience.

Arcadis personnel directing, supervising, or leading soil sampling activities will have a minimum of 1 year of previous environmental soil sampling experience. Field employees with less than 6 months of experience will be accompanied by a supervisor (as described above) to ensure that proper sample collection techniques are employed.

Additionally, the Arcadis field team will review and be thoroughly familiar with documentation provided by equipment manufacturers and become familiar with the operation of (i.e., hands-on experience) all equipment that will be used in the field prior to mobilization.

4 EQUIPMENT LIST

The following materials will be available, as required, during soil boring drilling, field screening, and sampling activities:

- Site-specific HASP and health and safety documents identified in the HASP
- Field Implementation Plan (FIP)/work plan that includes site map with proposed boring locations, field sampling plan (with corresponding depths, sample analyses, sample volume required, and sample holding time), and previous boring logs (as available)
- Appropriate personal protective equipment (PPE), as specified in the HASP
- Traffic cones, delineators, and caution tape as appropriate for securing the work area as specified in the Traffic Safety Plan (TSP)
- Photoionization detector (PID), flame ionization detector (FID) or other air monitoring equipment, as needed, in accordance with the HASP
- Drilling equipment required by *ASTM D1586*, when performing split-spoon sampling
- Disposable plastic liners, when drilling with direct-push equipment
- Appropriate soil sampling equipment (e.g., stainless steel spatulas/spoons/bowls, knife)
- Stainless steel hand auger and stainless-steel spade if using manual methods
- Indelible ink pens
- Engineer’s ruler or survey rod
- Sealable plastic bags (e.g., Ziploc®)
- Air-tight sample containers and 8-oz. glass Mason jars or driller’s jars
- Aluminum foil
- Plastic sheeting (e.g., Weatherall Visqueen)
- Decontamination equipment (buckets, distilled or deionized water, cleansers appropriate for removing expected chemicals of concern, paper towels)
- Appropriate sample blanks (trip blank supplied by the laboratory), as specified in the FSP
- Soil sample containers and labels (supplied by the laboratory) appropriate for the analytical method(s) with preservative, as needed (parameter-specific)
- Appropriate transport containers (coolers) with ice and appropriate labeling, packing, and shipping materials;
- Appropriate soil boring log (**Attachment 1**)
- Chain-of-custody forms
- Field notebook.

- Digital camera (or smart phone with camera)
- Drums or other containers appropriate for soil and decontamination water, as specified by the site investigation-derived waste (IDW) management plan, and appropriate drum labels

5 CAUTIONS

Prior to beginning field work, underground utilities in the vicinity of the drilling areas will be delineated by the drilling contractor or an independent underground utility locator service. See appropriate guidance for proper utility clearance protocol. Work will be performed in accordance with the Arcadis *Utility Location and Clearance Health and Safety Standard* and the *Utilities and Structures Checklist* will be completed before beginning any intrusive work.

Prior to beginning field work, the project technical team will ensure that all field logistics (e.g., access issues, health and safety issues, communication network, schedules, etc.) and task objectives are clearly understood by all team members. An internal call with the project technical team to review the FIP/work plan scope and objectives is strongly recommended prior to mobilization to ensure that the field work will be effectively and efficiently executed.

Some regulatory agencies have specific requirements regarding borehole abandonment and grout mixtures. Determine whether the oversight agency has any such requirements prior to finalizing the drilling plan.

If DNAPL is known or expected to exist at the site, refer to the project specific documents (e.g., DNAPL Contingency Plan) for additional details regarding drilling to reduce the potential for inadvertent DNAPL remobilization.

Similarly, if light non-aqueous phase liquid (LNAPL) is known or expected to be present as “perched” layers above the water table, refer to the DNAPL Contingency Plan. Follow the general provisions and concepts in the DNAPL contingency plan during drilling above the water table at known or expected LNAPL sites.

Avoid using drilling fluids or materials that could impact groundwater or soil quality, or could be incompatible with the subsurface conditions.

Water used for drilling, decontamination of drilling/sampling equipment, or grouting boreholes upon completion will be of a quality acceptable for project objectives. Testing of water supply will be considered.

Specifications of materials used for backfilling the borehole will be obtained, reviewed and approved to meet project quality objectives. Bentonite is not recommended where DNAPL is likely to be present or in groundwater with high salinity. In these situations, neat cement grout is preferred.

Store and/or stage empty and full sample containers and coolers out of direct sunlight. Be careful not to over-tighten lids with Teflon® liners or septa. Over-tightening can impair the integrity of the seal and can cause the glass to shatter and create a risk for hand injuries.

NOTE: *Field logs and some forms are considered to be legal documents. All field logs and forms will therefore be filled out in indelible ink. Do not use permanent marker or felt-tipped pens for labels on* *sample container or sample coolers. Permanent markers could introduce volatile constituents into the samples.*

NOTE: *An Arcadis employee that is appropriately trained at the correct level of internal hazardous materials/DOT (Department of Transportation) shipping must complete an Arcadis shipping determination to address applicable DOT and IATA (International Air Transport Association) shipping requirements. Review the applicable Arcadis procedures and guidance instructions for sample packaging and labeling. Prior to using air transportation, confirm air shipment is acceptable under DOT and IATA regulations.*

6 HEALTH AND SAFETY CONSIDERATIONS

The HASP will be followed, as appropriate, to ensure the safety of field personnel.

Appropriate personal protective equipment (PPE) will be worn at all times in line with the task and the site-specific HASP.

Review all site-specific and procedural hazards as they are provided in the HASP, and review Job Safety Analysis (JSA) documents in the field each day prior to beginning work.

Working outside at sites with suspected contamination may expose field personnel to hazardous materials such as contaminated groundwater or non-aqueous phase liquid (NAPL) (e.g., oil). Other potential hazards include biological hazards (e.g., stinging insects, ticks in long grass/weeds, etc.), and potentially the use of sharp cutting tools (scissors, knife). Only use non-toxic peppermint oil spray for stinging insect nests. Review client-specific health and safety requirements, which may preclude the use of fixed/folding-blade knives and use appropriate hand protection.

If thunder or lighting is present, discontinue drilling and sampling until 30 minutes have passed after the last occurrence of thunder or lighting.

7 PROCEDURE

The procedures for drilling and the methods to be used to field screen and collect soil samples for laboratory analysis are presented below:

DRILLING PROCEDURES

Hollow-Stem Auger, Drive-and-Wash, Spun Casing, Fluid/Mud Rotary, Rotasonic, and Dual-Rotary Drilling Methods

1. Find/identify boring location, establish work zone, and set up sampling equipment decontamination area.
2. Advance boring to designated depth:
    a. Collect soil samples at appropriate interval as specified in the FIP/work plan (or equivalent)
    b. Collect, document, and store samples for laboratory analysis as specified in the FIP/work plan (or equivalent)

   c. Decontaminate equipment between samples in accordance with the FIP/work plan (or equivalent)
   d. A common sampling method that produces high-quality soil samples with relatively little soil disturbance is described in *ASTM D1586 – Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils* (ASTM D1586).
      i. Split-spoon samples are obtained during drilling using hollow-stem auger, drive-and-wash, spun casing, and fluid/mud rotary
   e. Rotasonic drilling produces soil cores that, for the most part, are relatively undisturbed, but note that when drilling in consolidated or finer-grained sediment the vibratory action during core barrel advancement may create secondary fractures or breaks
   f. Dual-rotary removes cuttings by compressed air or water/mud and allow only a general assessment of geology

3. Describe each soil sample as outlined in the appropriate project records (refer to the description procedures outlined in the *TGI - Soil Description*)
   a. Record descriptions on the soil boring log (**Attachment 1**) and/or field notebook.
   b. When possible photo document the samples (e.g., soil cores, split-spoons)
   c. During soil boring advancement, document all drilling events in field notebook, including blow counts (i.e., the number of blows from a soil sampling drive weight [140 pounds] required to drive the split-barrel sampler in 6-inch increments) and work stoppages
   d. Blow counts will not be available if rotasonic, dual-rotary, or direct-push methods are used; however, if standard penetration testing is required during rotasonic drilling, an automatic drop hammer may be used in conjunction with the method to switch from core barrel advancement to standard penetration testing
4. The drilling contractor will be responsible for obtaining accurate and representative samples, informing the supervising Arcadis geologist of changes in drilling pressure, and keeping a separate general log of soils encountered, including blow counts
   a. The term “samples” means soil materials from particular depth intervals, whether or not portions of these materials are submitted for laboratory analyses
   b. Records will also be kept of occurrences of premature refusal due to boulders or construction materials that may have been used as fill
   c. Where a boring cannot be advanced to the desired depth, the boring will be abandoned, and an additional boring will be advanced at an adjacent location to obtain the required sample
   d. Where it is desirable to avoid leaving vertical connections between depth intervals (e.g., if DNAPL or perched LNAPL are known or expected to exist at the site), the borehole will be sealed using cement and/or bentonite (see **Section 5** above)

- e. Multiple refusals may lead to a decision by the supervising geologist to abandon that sampling location

Direct-Push Method

The direct-push drilling method may also be used to complete soil borings. Examples of this technique include Geoprobe®, Diedrich Environmental Soil Probe (ESP) System, or AMS PowerProbe. Environmental probe systems typically use a hydraulically operated percussion hammer.

Depending on the equipment used, the hammer delivers 140- to 350-foot pounds of energy with each blow. The hammer provides the force needed to penetrate very stiff to medium dense soil formations. The hammer simultaneously advances an outer steel casing that contains a dual tube liner for sampling soil (dual tube sampling system).

The outside diameter (OD) of the outer casing ranges from 2.25 to 6 inches and the OD of the inner sampling tube diameter ranges from 1.4 to 4.5 inches. The outer casing isolates overlying soil and permits the unit to continue to probe at depth. The dual tube sampling system provides a borehole that may be tremie-grouted from the bottom up. Alternatively, a single rod system may be used that does not provide a cased boring and which does not allow for tremie-grouting from the bottom up.

The known or expected site conditions (e.g., presence of NAPL) will be evaluated when selecting the type of direct-push sampling system to be employed.

Direct-push drilling can generally achieve target depths 100 feet or less and the achievable depth is based on the site geology.

1. Find/identify boring location, establish work zone, and set up sampling equipment decontamination area
2. Advance soil boring to designated depth.
    - a. Collect soil samples at appropriate interval as specified in in the FIP/work plan (or equivalent)
    - b. Collect, document, and store samples for laboratory analysis as specified in in the FIP/work plan (or equivalent)
    - c. Decontaminate equipment between samples in accordance with in the FIP/work plan (or equivalent)
    - d. Samples will be collected using dedicated, disposable, plastic liners
3. Describe samples in accordance with the procedures outlined in **Step 3** under ***Hollow-Stem Auger, Drive-and-Wash, Spun Casing, Fluid/Mud Rotary, Rotasonic, and Dual-Rotary Drilling Methods*** above (refer to the description procedures outlined in the *TGI - Soil Description*)

Manual Methods

Manual methods may also be used to complete shallow soil borings. Examples of this technique include using a spade, spoon, scoop, hand auger, or slide hammer. Manual methods are typically used to collect surface soil samples (0 to 6 inches) or to complete soil borings/collect soil samples from a depth of 5 feet or less.

1. Find/identify boring location, establish work zone, and set up sampling equipment decontamination area
2. Clear the ground surface of brush, root mat, grass, leaves, or other debris
3. Use a spade, spoon, scoop, hand auger, or slide hammer to collect a sample of the required depth interval
4. Use an engineer's ruler or survey rod to verify that the sample is collected to the correct depth and record the top and bottom depths from the ground surface
5. To collect samples below the surface interval, remove the surface interval first; then collect the deeper interval
    a. To prevent the hole from collapsing, it may be necessary to remove a wider section from the surface or use cut polyvinyl chloride (PVC) pipe to maintain the opening
    b. Collect soil samples at appropriate interval as specified in the FIP/work plan (or equivalent)
    c. Collect, document, and store samples for laboratory analysis as specified in the FIP/work plan (or equivalent)
    d. Decontaminate equipment between samples in accordance with the FIP/work plan (or equivalent)
6. Describe samples in accordance with the procedures outlined in **Step 3** under ***Hollow-Stem Auger, Drive-and-Wash, Spun Casing, Fluid/Mud Rotary, Rotasonic, and Dual-Rotary Drilling Methods*** above (refer to the description procedures outlined in the *TGI - Soil Description*)

FIELD SCREENING PROCEDURES

PID and FID Screening

Soils are typically field screened with a PID or FID for a relative measure of the total VOCs at sites where VOCs are known or suspected to exist. The PID employs a UV lamp to measure VOCs and the ionization energy (IE) of the site constituents need to be considered when selecting the type of lamp (e.g., 10.6 eV, 11.7 eV) that will be used. In general, any compound with an IE lower than that of the lamp photons can be measured. The FID has a wide linear range and responds to almost all VOCs. Field screening is performed using one (or both) of the following two methods:

1. Upon opening the sampler, the soil is split open and the PID or FID probe is placed in the opening and covered with a gloved hand. Such readings will be obtained at several locations along the length of the sample.
2. A portion of the collected soil is placed in a jar, which is covered with aluminum foil, sealed, and allowed to warm to room temperature. After warming, the cover is removed, the foil is pierced with the PID or FID probe, and a reading is obtained.

Initial PID readings will be recorded on the soil boring log (**Attachment 1**) and/or in the field notebook. The soil sample will be separated from the slough material (if any) by using disposable gloves and a pre-cleaned stainless-steel spoon.

For the second method, a representative portion of the sample will be placed in a pre-cleaned air-tight 8-ounce container (as quickly as possible to avoid loss of VOCs), filling the container half full to allow for the accumulation of vapors above the soil. An aluminum foil seal will be placed between the glass and metal cap and the cap will be screwed on tightly. Unless the screening will be performed immediately after the sample is placed in the container, the sample containers will be stored in a cooler chilled to approximately 4ºC until screening can be performed.

The headspace of the 8-ounce container will be measured using a PID or FID as follows:

1. Samples will be taken to a warm work space and allowed to equilibrate to room temperature for at least one hour.
2. Prior to measuring the soil vapor headspace concentration, the 8-ounce container will be shaken.
3. The headspace of the sample will then be measured directly from the 8-ounce container by piercing the aluminum foil seal with the probe of the PID or FID and measuring the relative concentration of VOCs in the headspace of the soil sample. The initial (peak) reading must be recorded.

The PID or FID must be calibrated according to the manufacturer's specifications at a minimum frequency of once per day prior to collecting PID or FID readings. The PID will be calibrated to a benzene-related compound (isobutylene) while the FID will be calibrated to methane.

The time, date, and calibration procedure must be clearly documented in the field notebook and/or the calibration log book.

If at any time the PID or FID results appear erratic or inconsistent with field observations, then the instrument will be recalibrated.

If calibration is difficult to achieve, then the PID’s lamp will be checked for dirt or moisture and cleaned, or technical assistance will be required. Maintenance and calibration records will be kept as part of the field quality assurance program.

NAPL Screening

To screen for the potential presence of non-aqueous phase liquid (NAPL) in soil, drilling procedures must allow for high-quality porous media samples to be taken. Split-spoon samplers or direct-push samplers will be collected continuously ahead of the auger, drill casing/rods, or probe rods.

Upon opening each split-spoon sampler or direct-push plastic liner sleeve, the soil will immediately be evaluated for the presence of visible NAPL. If NAPL is immediately visible in the sample, its depth will be noted.

Additionally, the soil will be screened for the presence of organic vapors using a PID or FID. During screening, the soil will be split open using a clean spatula or knife and the PID or FID probe will be placed in the opening and covered with a gloved hand (**Method 1** above). Such readings will be obtained along the entire length of the sample. Alternatively, **Method 2** for PID/FID screening (outlined above) may also be performed. If the PID or FID examination reveals the presence of organic vapors above 100 parts per million (ppm), the sample will undergo further detailed evaluation for visible NAPL.

The assessment for NAPL will include the following tests/observations:

- Evaluation for Visible NAPL Sheen or Free-Phase NAPL in Soil Sampler
    - NAPL sheen will be a colorful iridescent appearance on the soil sample
    - NAPL may also appear as droplets or continuous accumulations of liquid with a color typically ranging from yellow to brown to black, depending on the type of NAPL
    - Creosote DNAPL (associated with wood-treating sites) and coal tar DNAPL (associated with manufactured gas plant [MGP] sites) are typically black and have a characteristic, pungent odor
    - Pure chlorinated solvents may be colorless in the absence of hydrophobic dye. Solvents mixed with oils may appear brown
    - Particular care will be taken to fully describe any sheens observed, staining, discoloration, droplets (blebs), or NAPL saturation
- Soil-Water Pan Test
    - A portion of the selected soil interval with the highest PID or FID reading above 100 ppm will be placed in a disposable polyethylene dish along with a small volume of potable or distilled water
    - The dish will be gently tilted back and forth to mix the soil and water, and the surface of the water will be viewed in natural light to observe the development of a sheen, if any
    - A small quantity of Oil Red O or Sudan IV hydrophobic dye powder will be added, and the soil and dye will be manually mixed for approximately 30 to 60 seconds and smeared in the dish to create a paste-like consistency
    - A positive test result will be indicated by a sheen on the surface of the water and/or a bright red color imparted to the soil following mixing with dye
- Soil-Water Shake Test
    - A small quantity of soil (up to 15 cc) will be placed in a clear, colorless, jar containing an equal volume of potable or distilled water (40-mL vials are well suited to this purpose, but not required)
    - After the soil settles into the water, the surface of the water will be evaluated for a visible sheen under natural light
    - The jar will be closed and gently shaken for approximately 10 to 20 seconds
    - Again, the surface of the water will be evaluated for a visible sheen or a temporary layer of foam
    - A small quantity (approximately 0.5 to 1 cc) of Oil Red O or Sudan IV powder will be placed in the jar
    - The sheen layer, if present, will be evaluated for a reaction to the dye (change to bright red color)
    - The jar will be closed and gently shaken for approximately 10 to 20 seconds
    - The contents in the closed jar will be examined under natural light for visible bright red dyed liquid inside the jar

- A positive test result will be indicated by the presence of a visible sheen or foam on the surface of water, a reaction between the dye and the sheen layer upon first addition of the dye powder, a bright red coating on the inside of the vial (particularly above the water line), or red-dyed droplets within the soil

NOTE: *If NAPL is obviously present upon opening the soil sampler or evaluating the soil sample within the split-spoon sampler or direct-push liner sleeve, it is not necessary to perform a soil-water pan test or soil-water shake test. In addition, it is not necessary to perform both a soil-water pan test and a soil-water shake test; either test method is acceptable. The pan test may be preferred in some circumstances because the presence of a sheen may be easier to see on a wider surface.*

NOTE: *When using hydrophobic dye in the tests above, color will be assessed outdoors under natural light during the period between sunrise and sunset, regardless of the degree of cloud cover. The hydrophobic dye Safety Data Sheets (SDS) will be incorporated into the HASP and reviewed prior to use and the dyes will be carefully handled and disposed in accordance with regulations*.

SOIL SAMPLE COLLECTION FOR LABORATORY PROCEDURES

If not specifically identified in the FIP, soil samples will be selected for laboratory analysis based on:

1. Their position in relation to identified source areas
2. The visual presence of source residues (e.g., NAPL)
3. The relative levels of total VOCs based on field screening measurements
4. The judgment of the field coordinator

Samples designated for laboratory analysis will be placed in the appropriate containers.

Sample containers for VOC analysis will be filled first immediately following soil core retrieval to reduce loss of VOCs.

If samples will be collected for other analytical parameters, a sufficient amount of the remaining soil will then be homogenized as described below and sample containers will be filled for other parameters.

VOC samples will be collected as discrete samples using a small diameter core sampler (e.g., En Core® Sampler, Terra Core™ Sampler).

The En Core® Sampler is a disposable volumetric sampling device that collects, stores and delivers soil samples without in-field chemical preservation. The En Core® Sampler requires the use of a reusable T-handle.

The Terra Core™ Sampler is a one-time use transfer tool, designed to collect soil samples and transfer them to the appropriate containers for in-field chemical preservation (e.g., methanol).

The small diameter core sampler will be used according to the manufacturer's instructions (e.g., En Novative Technologies). Some regulatory agencies have specific requirements regarding VOC sample collection. Determine whether the oversight agency has specific requirements prior to commencing sampling and collect samples at appropriate interval as specified in the FIP/work plan (or equivalent). Samples may require homogenization across a given depth interval, or several discrete grabs (usually five) may be combined into a composite sample.

NOTE: *Samples for VOC analysis will NOT be homogenized or composited and will be collected as discrete samples as described above*.

The procedure for mixing samples is provided below.

1. Mix the materials in a stainless steel (or appropriate non-reactive material) bowl using a stainless-steel spoon (or disposable equivalents)
    a. When dealing with large sample quantities, use disposable plastic sheeting and a shovel or trowel
    b. NOTE: *When preparing samples for metals analyses, do not use disposable aluminum (or metal tools or trays other than stainless steel), as it may influence the analytical results*
2. Flatten the pile by pressing the top without further mixing
3. Divide the circular pile by into equal quarters by dividing out two diameters at right angles
4. Mix each quarter individually using appropriate non-reactive bowls, spoons and/or sheeting
5. Mix two quarters (as described above) to form halves, then mix the two halves to form a composite or homogenized sample
6. Place composite or homogenized sample into specified containers
7. Remaining material will be disposed of in accordance with project requirements and applicable regulations
8. Sample containers will be labeled with sample identification number, date, and time of collection and placed on ice in a cooler (target 4° Celsius)
9. Samples selected for laboratory analysis will be documented (chain-of-custody forms), handled, packed, and shipped in accordance with the procedures outlined in the FIP/work plan (or equivalent).

8 WASTE MANAGEMENT

Investigative-Derived Waste (IDW) generated during drilling activities, including soil and excess drilling fluids (if used), decontamination liquids, and disposable materials (plastic sheeting, PPE, etc.) will be stored on site in appropriately labeled containers (disposable materials will be contained separately) and disposed of properly. Containers must be labeled at the time of collection and will include date, location(s), site name, city, state, and description of matrix contained (e.g., soil, PPE). Waste will be managed in accordance with the *TGI – Investigation-Derived Waste Handling and Storage,* the procedures identified in the FIP or QAPP as well as state-, federal- or client-specific requirements. Be certain that waste containers are properly labeled and documented in the field log book.

9 DATA RECORDING AND MANAGEMENT

Management of the original documents from the field will be completed in accordance with the site-specific QAPP.

In general, drilling activities will be documented on appropriate field/log forms as well as in a proper field notebook. All field data will be recorded in indelible ink. Field forms, logs/notes (including daily field and calibration logs), digital records, and chain-of-custody records will be maintained by the field team lead.

Initial field logs and chain-of-custody records will be transmitted to the Arcadis Certified Project Manager (CPM) and Technical Lead at the end of each day unless otherwise directed by the CPM. The field team leader retains copies of the field documentation.

Additionally, all documents (and photographs) will be scanned and electronically filed in the appropriate project directory for easy access. Pertinent information will include personnel present on site, times of arrival and departure, significant weather conditions, timing of drilling activities, soil descriptions, soil boring information, and quantities of materials used.

In addition, the locations of soil borings will be documented photographically and in a site sketch. If appropriate, a measuring wheel or engineer’s tape will be used to determine approximate distances between important site features.

Records generated as a result of this TGI will be controlled and maintained in the project record files in accordance with project requirements.

10 QUALITY ASSURANCE

Quality assurance procedures shall be conducted in accordance with the Arcadis Quality Management System or the site-specific QAPP.

All drilling equipment and associated tools (including augers, drill rods, sampling equipment, wrenches, and any other equipment or tools) that may have come in contact with soil will be cleaned in accordance with the procedures outlined in the appropriate TGI.

Field-derived quality assurance blanks will be collected as specified in the FIP/work plan and/or site-specific QAPP, depending on the project quality objectives. Typically, field rinse blanks (equipment blanks) will be collected when non-dedicated equipment (e.g., split-spoon sampler, stainless steel spoon) is used during soil sampling. Field rinse blanks will be used to confirm that decontamination procedures are sufficient and samples are representative of site conditions. Trip blanks for VOCs, which aid in the detection of contaminants from other media, sources, or the container itself, will be kept with the coolers and the sample containers throughout the sampling activities and during transport to the laboratory.

Operate all monitoring instrumentation in accordance with manufacturer’s instructions and calibration procedures. Calibrate instruments at the beginning of each day and verify the calibration at the end of each day. Record all calibration activities in the field notebook.

11 REFERENCES

ASTM D1586 - *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils*. ASTM International. West Conshohocken, Pennsylvania.

12 ATTACHMENTS

Attachment 1. Soil Boring Log Form

ATTACHMENT 1

Soil Boring Log Form

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SOIL BORING LOG

Boring/Well ____________ Project ______________________________ Page ___ of ___

Site Location ______________________________ Drilling Started ____________

Total Depth Drilled ______ Feet Hole Diameter ______ inches Drilling Completed ____________

Type of Sample or Coring Device ________ Length and Diameter of Coring Device ________________ Sampling Interval ________ feet

Drilling Method ________ Drilling Fluid Used ____________

Drilling Contractor ______________________ Driller ____________

Prepared By ______________________ Helper ____________

Core Recovery (feet)	PID Reading (ppm)	Sample Depth (ft bgs)	MUD		SAND					GRAVEL				**Udden-Wentworth Description:** principal components, (angularity, plasticity, dilatency); minor components, (angularity, plasticity, dilatency); sorting, moisture content, consistency/density, color, additional comments
			clay	silt	very fine	fine	medium	coarse	very coarse	granular	pebble	cobble	boulder	

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SOIL BORING LOG (CONT'D)

Boring/Well ________________ Prepared By ________________ Page ____ of ____

Core Recovery (feet)	PID Reading (ppm)	Sample Depth (ft bgs)	MUD		SAND					GRAVEL				Udden-Wentworth Description: principal components, (angularity, plasticity, dilatency); minor components, (angularity, plasticity, dilatency); sorting, moisture content, consistency/density, color, addtl. Comments
			clay	silt	very fine	fine	medium	coarse	very coarse	granular	pebble	cobble	boulder	

OnSite Environmental Inc.
Redmond, Washington

Polychlorinated Biphenyls (PCBs) by GC-ECD
Method 8082A

Prepared by: ______________________ Date: ____________
Kathryn Speirs, Senior Chemist

Reviewed by: ______________________ Date: ____________
Karl Hornyik, Lab Manager

Approved by: ______________________ Date: ____________
Stacey Duran, QA/QC Officer

Revision History

Origination Date: **Unknown**

Revision 2.0 (12/13/00)

Electronic and paper copies of revision 4.02.01 cannot be found. SOP was revised to 4.02.02. These revisions predate SOP 1.00.02 and were not kept controlled as required by SOP 1.00.02. Revision 4.02.02 is currently promulgated by SOP 1.00.01.

Revision 3.0 (07/26/02)

SOP revised to new format. SOP officially revised using SOP 1.00.02 to revision 4.02.03.

Revision 4.0 (03/13/06)

Revised to replace the 50/50 methylene chloride/acetone references with methylene chloride only and added quality control sample preparation for wipe samples.

Revision 4.0 (06/07/06)

Revised 6890 instrument parameters. Changed the extraction procedure to add 50 µL of the water matrix spike solution to the spike blank and MS/MSD samples instead of 100 µL.

Revision 5.0 (11/21/13)

- Revised to include new Instrument Ulysses.
- Updated Equipment and Supplies and Appendix A.
- Updated Equipment and Supplies to reflect that all instruments now use Hydrogen for the carrier gas instead of Helium.
- Updated references.
- Removed the deionized water rinse and added a Methylene Chloride rinse in Section 11.2.
- Updated sections 11.3 and 11.4 to lower the level of hexane added during solvent exchange to 1 mL and the level you boil down to 0.5 mL.
- Updated sections 11.3.3 and 11.4.2 to include spike blank duplicate.
- Updated section 11.4.7 to include sodium sulfate added to the filter paper.
- Streamlined Procedures section by removing explicit details for specific apparatuses and referring to the SOP governing each specific apparatus.

Revision 6.0 (06/12/17)

- Updated to EPA Method 8000D.
- Added Lower Limit of Quantitation information.
- Removed “Aroclor 1232 does not have a stock standard but is combined with the surrogates TCMX and DCB in hexane to form the initial calibration standard” from Section 8.2.
- Updated Section 8.2.1.1 to include Aroclors 1262 and 1268 purchased as certified stocks.
- Updated section 10.1.4.1 to indicate the calibration correlation coefficient (r) is required to be greater than or equal to 0.995. As a result, r^2>=0.990.
- Revised Section 10.1.5 to include Aroclors 1262 and 1268 as single-point quantitation standards.
- Updated Section 10.3 to state the percent recovery for each analyte in the CCVs should not exceed ±20 percent.

Revision 7.0 (05/23/18)

- Updated Section 3.3 to include SBD.

- Updated Section 7.4 Apparatus – Extractions in Equipment and Supplies.
- Pared down “Reagents” section.
- Separated out ICAL and CCV information in Section 8.2.
- Updated Section 8.2.4 to include SB/SBD.
- Section 9.2 now includes SB/SBD information.
- Updated “Procedure” section to only reference the appropriate SOP for glassware prep and extraction procedures other than wipe extraction procedures.

Table of Contents

1.0 Scope and Application

1.1 The purpose of this method is to quantitatively determine concentrations of polychlorinated biphenyls (PCBs) as Aroclors in soil, water, oil and wipe matrices.

1.2 The reporting limit is 0.050 μg/L for waters, 0.050 mg/kg for soils, 1.0 mg/kg for oils, and 2.0 μg/100cm^2 for wipes.

2.0 Summary of Method

2.1 Water samples are extracted by measuring out 1000 mL and extracting it three times with methylene chloride using a separatory funnel.

2.2 Soil samples are extracted by measuring out 20g of sample into a beaker, drying the sample with sodium sulfate, and extracting it three times with methylene chloride using a sonicator.

2.3 Oil samples are extracted by measuring out 0.5g into a 10 mL volumetric flask and diluting to the mark with hexane.

2.4 Wipe samples are extracted by adding 40 mL of hexane to the sample container.

2.5 The water and soil extracts are concentrated and solvent exchanged into hexane. The extracts are analyzed and confirmed by dual-column capillary GC/ECD.

2.6 Extracts are cleaned using sulfuric acid. Cleanup techniques such as silica gel or mercury are also used if deemed necessary. The method blank must undergo the same cleanup procedures as the samples.

3.0 Definitions

3.1 Reagent Water – Water free of target analytes or interferences greater than the reporting limits for this SOP. Also referred to as deionized water.

3.2 Method Blank (MB) – A sample aliquot (usually reagent water or Ottowa sand) free from target analytes is treated exactly as a sample, including exposure to all glassware, equipment, solvents, and surrogates. The MB is used to determine if method analytes or other interferences are present in the laboratory environment, the solvents, or the equipment.

3.3 Spike Blank/Spike Blank Duplicate (SB/SBD) – Sample aliquots (usually reagent water or purified sand) free from target analytes to which known quantities of method analytes are added. The SB and SBD are treated exactly as a sample. The SB and SBD are used to determine whether the methodology is in control and to indicate the accuracy and precision associated with laboratory procedures. Also referred to as a Laboratory Control Sample (LCS).

3.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD) – Two aliquots of the same sample to which known quantities of the method analytes are added. The MS and MSD are treated exactly as a sample. The MS and MSD are used to determine whether the sample matrix contributes bias to the sample results and to indicate the precision associated with laboratory procedures.

3.5 %R: Percent Recovery

3.6 RPD: Relative Percent Difference

3.7 SOP: Standard Operating Procedure

3.8 GC: Gas Chromatograph

3.9 ECD: Electron Capture Detector

3.10 ICV: Initial Calibration Verification

3.11 CCV: Continuing Calibration Verification

3.12 MDL: Method Detection Limit

3.13 LLOQ: Lower Limit of Quantitation

3.14 DCB: Decachlorobiphenyl

3.15 TCMX: Tetrachloro-*m*-xylene

4.0 Sample Handling and Preservation

4.1 Water samples are collected in unpreserved, one liter amber containers.

4.2 Soil samples are collected in 4-ounce jars.

4.3 All samples should be shipped and stored at 4°C ± 2°C.

4.4 The holding time (from collection) for extraction for PCBs is 7 days for waters and 14 days for soils, oils and wipes. Holding time for analysis of the extract is 40 days.

5.0 Interferences

5.1 Interferences by phthalate esters can pose a major problem in PCB determinations with an electron capture detector (ECD). These compounds generally appear in the chromatogram as large late-eluting peaks. Flexible plastics contain varying amounts of phthalates. These phthalates are easily extracted or leached from such materials during laboratory operations. Avoid contact with any plastic materials. Samples can also be contaminated by phthalate esters from an inverted septum during handling of the loaded GC vials.

5.2 Samples may be cross-contaminated by using a dirty scoopula or by poor rinsing of the sonicator tip between samples. The latter can be avoided by rinsing the tip with methylene chloride between samples.

5.3 Highly contaminated samples can cause carryover contamination on the gas chromatograph. Running reagent blanks after samples suspected of being highly contaminated can prevent this carryover.

5.4 All glassware used for PCB analysis must be scrupulously cleaned prior to use. This includes soap and solvent washes.

6.0 Safety

6.1 All reagents and standards must be handled with extreme care due to their possible deleterious health effects. All applicable personal safety equipment must be used at all times when handling chemicals.

7.0 Equipment and Supplies

7.1 Apparatus – GC/ECD (Instrument Frank)

7.1.1 Hewlett Packard 6890+ Series Gas Chromatograph equipped with electronic pressure control (EPC)

7.1.2 Hewlett Packard Micro-Electron Capture Detectors (2) - Model G2397A

7.1.3 Capillary columns: The following capillary columns are joined to a “Y” splitter and then connected to the inlet by a 5-10 meter 0.32 mm id guard column:

7.1.3.1 Restek RTx-CLPesticides: 30 meter by 0.32 mm id by 0.50 μm film thickness

7.1.3.2 Restek RTx-CLPesticides II: 30 meter by 0.32 mm id by 0.25 μm film thickness

7.1.4 HP ChemStation for data acquisition and data processing

7.1.5 Carrier gas - Hydrogen

7.1.6 Make-up gas for ECD - 5% Methane/95% Argon

7.2 Apparatus – GC/ECD (Instrument George)

7.2.1 Hewlett Packard 5890 Series II Gas Chromatograph equipped with electronic pressure control (EPC)

7.2.2 Hewlett Packard Electron Capture Detectors (2) - Model G1223A

7.2.3 Capillary columns: The following capillary columns are joined to a “Y” splitter and then connected to the inlet by a 5 meter 0.32 mm id guard column:

7.2.3.1 Restek RTx-CLPesticides: 30 meter by 0.32 mm id by 0.50 µm film thickness

7.2.3.2 Restek RTx-CLPesticides II: 30 meter by 0.32 mm id by 0.25 µm film thickness

7.2.4 HP ChemStation for data acquisition and data processing

7.2.5 Carrier gas - Hydrogen

7.2.6 Make-up gas for ECD - 5% Methane/95% Argon

7.3 Apparatus – GC/ECD (Instrument Ulysses)

7.3.1 Hewlett Packard 7890A Gas Chromatograph equipped with electronic pressure control (EPC)

7.3.2 Hewlett Packard Micro-Electron Capture Detectors (2) - Model G2397A

7.3.3 Capillary columns: The following capillary columns are joined to a microfluidic splitter and then connected to the inlet by a 5 meter 0.32 mm id guard column:

7.3.3.1 Restek RTx-CLPesticides: 30 meter by 0.32 mm id by 0.50 µm film thickness

7.3.3.2 Restek RTx-CLPesticides II: 30 meter by 0.32 mm id by 0.25 µm film thickness

7.3.4 HP ChemStation for data acquisition and data processing

7.3.5 Carrier gas - Hydrogen

7.3.6 Make-up gas for ECD – Nitrogen

7.4 Apparatus – Extractions

7.4.1 Gauze pads

7.4.2 4-ounce jars with Teflon-lined lids

7.4.3 Solvent pump apparatus

7.4.4 Syringes - various sizes

7.4.5 Sonic bath

7.4.6 Vials - various sizes with Teflon-lined caps, amber and clear

8.0 Reagents and Standards

8.1 Reagents

8.1.1 *n*-Hexane, pesticide grade

8.1.2 Acetone, pesticide grade

8.2 Standards

8.2.1 Initial Calibration Standards (ICAL)

8.2.1.1 PCB Stock Standards: Aroclors 1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262, and 1268 are purchased as certified stocks.

8.2.1.1.1 Aroclors 1016 and 1260 are combined with the surrogates TCMX and DCB to form a single stock standard at a concentration of 25 ppm for 1016/1260 and 5 ppm for TCMX and DCB in hexane. The standards for the initial calibration curve shall be prepared from this stock standard.

8.2.1.1.2 Aroclors 1221, 1232, 1242, 1248, and 1254 are prepared separately. Aroclors 1221, 1232, 1242, 1248, and 1254 are combined individually with the surrogates TCMX and DCB to form stock standards at a concentration of 25 ppm for each Aroclor and 5 ppm for TCMX and DCB in hexane. These stock standards will provide pattern recognition and single-point quantitations.

8.2.2 Continuing Calibration Verification (CCV) Standard

8.2.2.1 The 1016/1260 stock standard listed in 8.2.1.1.1 is diluted to a concentration of 0.50 ppm for 1016/1260 and 0.10 ppm for TCMX and DCB.

8.2.3 Initial Calibration Verification (ICV) Stock Standard

8.2.3.1 ICV PCB Stock Standard: Aroclors 1016 and 1260 are purchased as certified stocks from a source other than the initial calibration. These standards are combined to form a single stock standard at a concentration of 25 ppm for 1016/1260 and 5 ppm for TCMX and DCB in hexane.

8.2.3.2 PCB ICV Standard: The 1016/1260 ICV Stock standard is diluted to a concentration of 0.50 ppm for 1016/1260 and 0.10 ppm for TCMX and DCB.

8.2.4 Surrogate

8.2.4.1 2,4,5,6-Tetrachloro-*m*-xylene (TCMX) and Decachlorobiphenyl (DCB) are purchased separately as certified stock standards.

8.2.4.2 PCB soil surrogate: TCMX and DCB at 20 ppm in acetone.

8.2.4.3 PCB water surrogate: TCMX and DCB at 2.0 ppm in acetone.

8.2.5 SB/SBD/MS/MSD Spiking Solution

8.2.5.1 PCB Matrix Spike solution is Aroclor 1260 purchased as a certified stock standard.

8.2.5.2 PCB Soil Spike: Aroclor 1260 at 100 ppm in acetone.

8.2.5.3 PCB Water Spike: Aroclor 1260 at 10 ppm in acetone.

8.2.6 Standard Handling

8.2.6.1 Purchased standards expire on the manufacturer’s date or one year from the date of opening, whichever comes first.

8.2.6.2 Stock standards prepared internally expire one year after preparation or on the manufacturer’s date, whichever comes first.

8.2.6.3 Working surrogate, spike, daily and initial calibration standards expire six months after preparation or on the manufacturer’s date, whichever comes first.

8.2.6.4 These expiration dates hold if no observed degradation of the solutions has taken place. All expired or degraded standards shall be properly disposed to avoid accidental use.

8.2.6.5 Stock and working standards should be kept at –20ºC or according to manufacturer’s recommendation when not in use.

9.0 Quality Control

9.1 Method Blank (MB)

9.1.1 Method blanks are prepared and analyzed for every extraction batch at a 5% frequency (one method blank per extraction batch of 20). The method blank must not contain any target analytes greater than the reporting limit.

9.1.2 Corrective action for contaminated method blanks:

9.1.2.1 If the method blank contains target analytes greater than the reporting limit, the method blank must be reanalyzed.

9.1.2.2 If the method blank is contaminated after reanalysis, corrective action must be taken to identify and eliminate the source of the problem. In this case, the samples may have to be re-extracted prior to reanalysis depending upon the source of the contamination

9.1.2.3 If the reanalyzed method blank is acceptable, then the MB and associated samples can be reported.

9.1.2.4 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A non-conformance form must be filled out and the associated data is flagged with a “B” qualifier. See SOP 1.18.

9.2 Spike Blank/Spike Blank Duplicate (SB/SBD)

9.2.1 SB/SBD samples are prepared and analyzed for every extraction batch at a 5% frequency (one SB/SBD pair per extraction batch of 20).

9.2.2 After analysis, calculate the percent recovery (%R) results as follows:

$$\%R = \frac{C_s}{C_n} \times 100$$

Where:
C_s = Measured concentration of the spike sample aliquot
C_n = Nominal (theoretical) concentration of the spike aliquot

9.2.3 If the %R is out of control, corrective action, as follows, must be taken:

9.2.3.1 Recalculate and check for integration or calculation errors.

9.2.3.2 Double check sample volume/weight, final extract volume, amount spiked and the concentration of the spike solution.

9.2.3.3 If a problem still exists, the spike blank should be reanalyzed. If the reanalysis is acceptable, then report the reanalysis.

9.2.3.4 If the spike blank is still out of control, then the associated samples must be re-extracted and reanalyzed.

9.2.3.5 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A non-conformance form must be filled out and the associated data is flagged with an "I" qualifier. See SOP 1.18.

9.2.4 Control limits for spike blank %R values shall be calculated yearly on actual sample data using SOP 1.22.

9.2.5 After analysis, calculate the relative percent difference (RPD) on the SB/SBD results as follows:

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$

Where:
C_1 = Measured concentration of the first sample aliquot
C_2 = Measured concentration of the second sample aliquot

9.2.6 If the RPD is out of control, corrective action, as follows, must be taken:

9.2.6.1 Recalculate and check for integration or calculation errors.

9.2.6.2 Double check sample volume/weight, final extract volume, amount spiked and the concentration of the spike solution.

9.2.6.3 If the RPD value is still out of control, then the analyst should use professional judgement to determine a course of action. Document the nonconformance and the resolution using SOP 1.18.

9.2.7 Control limits for SB/SBD RPDs shall be calculated yearly on actual sample data using SOP 1.22.

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

9.3.1 MS/MSD samples are prepared and analyzed for every extraction batch at a 5% frequency (one MS/MSD pair per extraction batch of 20).

9.3.2 After analysis, calculate the percent recovery (%R) on the wet weight results as follows:

$$\%R = \frac{C_s - C_u}{C_n} \times 100$$

Where:
C_s = Measured concentration of the spike sample aliquot
C_u = Measured concentration of the unspiked sample aliquot
C_n = Nominal (theoretical) concentration of the spike aliquot

9.3.3 If the %R is out of control, corrective action, as follows, must be taken:

9.3.3.1 Recalculate and check for integration or calculation errors.

9.3.3.2 Double check sample volume/weight, final extract volume, amount spiked and the concentration of the spike solution.

9.3.3.3 If the MS/MSD %R value cannot be calculated due to a large number of coeluting peaks, the MS/MSD results are reported and all %R outliers will be flagged with the “V” qualifier.

9.3.3.4 If the sample concentration exceeds more than four to five times what was spiked, the %R value is statistically meaningless. Flag any %R outliers with the “A” qualifier.

9.3.3.5 If a problem still exists, then the spike blank should be evaluated. If the %R values in the spike blank are acceptable, then document the nonconformance and one of the following resolutions using SOP 1.18:

9.3.3.5.1 If the %R value is out of control similarly in both the MS and the MSD, then the problem can be attributed to a matrix effect. Flag the %R outliers with the “V” qualifier.

9.3.3.5.2 If the %R value is out in one of the samples but not in the other one, then the analyst should use professional judgement to determine a course of action.

9.3.3.6 If the spike blank %R value is out of control, then the spike blank and the MS/MSD pair should be reanalyzed. If the %R values are acceptable, then the results from the reanalysis only should be reported. If the spike blank still fails, then the entire extraction batch associated with this QC set should be re-extracted and reanalyzed.

9.3.3.7 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A non-conformance form must be filled out and the associated data must be flagged with an “I” qualifier. See SOP 1.18.

9.3.4 Control limits for MS/MSD %R values shall be calculated yearly on actual sample data using SOP 1.22.

9.3.5 After analysis, calculate the relative percent difference (RPD) on the wet weight results as follows:

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$

Where:
C_1 = Measured concentration of the first sample aliquot
C_2 = Measured concentration of the second sample aliquot

9.3.6 If the RPD is out of control, corrective action, as follows, must be taken:

9.3.6.1 Recalculate and check for integration or calculation errors.

9.3.6.2 Double check sample volume/weight, final extract volume, amount spiked and the concentration of the spike solution.

9.3.6.3 If the RPD value is still out of control, then the analyst should use professional judgement to determine a course of action. Document the nonconformance and the resolution using SOP 1.18.

9.3.7 Control limits for MS/MSD RPDs shall be calculated yearly on actual sample data using SOP 1.22.

9.4 Surrogates

9.4.1 Decachlorobiphenyl (DCB) is used as a surrogate for this analysis. Surrogate recovery is monitored to assess method performance on the particular matrix. Surrogates are added to all samples and quality control samples prior to extraction and analysis.

9.4.2 Calculate the percent recovery (%R) as:

$$\%R = \frac{C_s}{C_n} \times 100$$

Where:
C_s = Measured concentration of the surrogate in the sample
C_n = Nominal (theoretical) concentration of the surrogate spiked into the sample

9.4.3 If the surrogate %R value is out of control, corrective action must be taken:

9.4.3.1 Recalculate and check for integration or calculation errors.

9.4.3.2 Double check sample volume/weight, final extract volume, amount spiked and the concentration of the spike solution.

9.4.3.3 If the surrogate %R value cannot be calculated due to a large number of coeluting peaks, the sample is reported and the %R outliers flagged with the “F” qualifier.

9.4.3.4 If the surrogate %R value cannot be calculated due to a large dilution of the sample, the sample is reported and flagged with the “S” qualifier.

9.4.3.5 If a problem still exists, then the sample must be re-extracted and reanalyzed. Document the nonconformance and one of the following resolutions using SOP 1.18:

9.4.3.5.1 If the surrogate %R value is acceptable upon reanalysis, then this data should be reported.

9.4.3.5.2 If the surrogate %R value is still out of control, the original sample data should be reported and the surrogate outlier flagged with the “Q” qualifier. The case narrative should document that the poor surrogate recovery was confirmed and is due to the sample matrix.

9.4.3.6 If insufficient sample volume or expired sample holding time prevents re-extraction, then the data can be reported. A nonconformance form must be filled out and the associated data flagged with a “Q” qualifier. See SOP 1.18.

9.4.4 Control limits for surrogate %R values shall be calculated yearly on actual sample data using SOP 1.22.

10.0 Calibration and Standardization

10.1 Initial Calibration (ICAL)

10.1.1 A calibration curve requires at least five points. Six points of Aroclors 1016 and 1260 are typically analyzed at concentrations of at 0.05, 0.25, 0.50, 0.75, 1.0, and 2.0 μg/mL.

10.1.2 Analyze each calibration standard and create a calibration curve using the heights of the five largest peaks in each Aroclor in the mix (1016 and 1260) versus the concentration of the standard using the ChemStation software.

10.1.3 The ChemStation software can be set to model the external standard calibration procedure (Section 11.4.2) outlined in Method 8000D. The percent relative standard deviation (%RSD) for each compound must not exceed 20%.

10.1.4 Alternatively, linear regression can be used to generate the initial calibration. The initial calibration must meet the following criteria while using linear regression to compute the best fit line through the data points:

10.1.4.1 The coefficient of determination (r^2) must be at least 0.990 (correlation coefficient (r) >0.995).

10.1.5 Calibration standards for Aroclors 1221, 1232, 1242, 1248,1254,1262, and 1268 are needed for pattern recognition and to provide single-point quantitation for each of these Aroclors. These mixtures are quantitated using the heights of five major peaks the same day 1016 and 1260 Aroclors curves are calibrated.

10.2 Initial Calibration Verification (ICV)

10.2.1 After linearity is established and the initial calibration meets method criteria, a second-source initial calibration verification (ICV) standard must be analyzed as a check on the initial curve and calibration standards. All analytes on both columns must be within ±15% of the true value before the calibration curve can be used.

10.3 Continuing Calibration Verification (CCV)

10.3.1 Analyze a continuing calibration verification standard before samples are run, after every twenty injections (ten is recommended to minimize the number of samples that need to be reanalyzed if the CCV fails), and at the end of the sequence. Intervals between CCVs should not exceed 12 hours.

10.3.2 The percent recovery for each analyte should not exceed ±20 percent difference. If this criterion is exceeded for any analyte, analysis may proceed if any of the following occur:

10.3.2.1 If a CCV percent difference is greater than 20% (high bias) for an analyte and the samples it brackets are non-detect for that analyte.

10.3.2.2 If an analyte on one column exceeds the ±20 percent difference criterion but passes on the other, a sample hit is reported on the passing column. However, the column from which the analyte is reported must have an average less than ±20 percent difference across all analytes.

10.3.3 When the CCVs do not pass, corrective action needs to be taken. This includes:

10.3.3.1 Remaking the standard.

10.3.3.2 Rinsing or changing the liner in the injection port.

10.3.3.3 Cleaning or changing the inlet seal.

10.3.3.4 Clipping a loop of the guard column and solvent rinsing the injection port.

10.3.4 Once the instrument is performing optimally after corrective action, all samples bracketed by failing CCVs must be reanalyzed.

10.4 Retention Time Windows

10.4.1 Retention Time Windows shall be established yearly using SOP 1.24.

11.0 Procedure

11.1 Instrument Operation

11.1.1 The recommended GC temperature program is located in Appendix A.

11.2 Glassware Preparation

11.2.1 Refer to SOP 8.14 Glassware Cleaning and Washing for specific instructions.

11.3 Soil Extraction Procedure

11.3.1 Refer to SOP 3.07 Ultrasonic Extraction procedure for specific instructions

11.4 Water Extraction Procedure

11.4.1 Refer to SOP 3.08 Separatory Funnel Extraction procedure for specific instructions.

11.5 Oil Extraction Procedure

11.5.1 Refer to SOP 3.06 Waste (Product) Dilution procedure for specific instructions.

11.6 Wipe Extraction Procedure

11.6.1 Prepare a method blank, spike blank, and spike blank duplicate by placing new gauze pads into clean, dry 4-ounce jars with Teflon-lined lids.

11.6.2 Place wipe sample in a 4-ounce jar with a Teflon-lined lid.

11.6.3 Add 40 mL of hexane to the jar.

11.6.4 Add 200 µL of the soil surrogate solution to all samples. Cap and shake well.

11.6.5 Add 200 µL of the soil matrix spike solution to the spike blank and spike blank duplicate samples.

11.6.6 Place in sonic bath for 5 minutes.

11.6.7 Perform an acid cleanup on the extract using SOP 3.00.

11.6.8 Quantitatively transfer the extract into a GC vial.

11.7 Cleanups

11.7.1 Other cleanups can be performed at the discretion of the chemist.

11.7.1.1 Refer to SOP 3.03 Silica Gel Cleanup for specific instructions.

11.7.1.2 Refer to SOP 3.05 Mercury Cleanup Procedure for specific instructions.

11.7.2 If a cleanup is employed, the method blank must also be processed using the cleanup procedure.

12.0 Data Reduction and Calculation

12.1 After analyzing each sample, the ChemStation software will automatically integrate the chromatogram and calculate the concentrations (in the extract) of any peaks within the retention time window for each target analyte. The analyst should review the integration for each positive result to verify that the peak was properly integrated. Reintegrate the peak manually, if necessary, using SOP 1.12 to correct for improper integration. The analyst must initial and date all manual integrations.

12.2 The ChemStation has the ability to incorporate dilution factors, sample volumes and dry weight into its calculation. These features are not used. The concentration reported by the ChemStation software is the concentration (in µg/mL) found in the sample extract, not the sample itself.

12.3 If Aroclors are present in a sample, they must first be qualitatively identified by comparing the pattern of the sample to those of the Aroclor standards. The main criteria for pattern matching are the absolute retention times of the five predominant peaks exclusive to the Aroclor on both the primary and secondary columns. The detected concentrations between the two columns should agree with an RPD of less than 40%. If the RPD between the results is greater than 40%, the reported result is flagged with a "P".

12.4 If a mixture of PCBs is identified in the sample, each Aroclor should be quantitated separately. In cases in which the Aroclors overlap, several options may be considered. These include:

12.4.1 Running a calibration curve of a composite standard if the ratio and identification of the components in the mixture is known.

12.4.2 Adjusting the summation area of the individual Aroclors to allow for exclusive quantitation of each component. This option may not be appropriate depending on the amount of overlap present.

12.5 In certain cases, interferences may be present in the samples that will artificially increase the calculated concentration of an analyte present in the sample. These interferences must be excluded from the total response of the analyte during quantitation. With dual column analysis, the result that exhibits the least interference should be reported.

12.6 To calculate the concentration (in ppb for waters, total μg for wipes, and in ppm for soils and oils) in the actual sample, the chemist enters the following information into a spreadsheet which performs the following calculation:

For Soil and Oil:

$$C_s = \frac{(C_{ex})(V_t)(DF)}{(V_s)(DW)}$$

For Waters:

$$C_s = \frac{(C_{ex})(V_t)(DF)(1000)}{(V_s)}$$

For Wipes:

$$C_s = (C_{ex})(V_t)(DF)$$

Where:
C_{ex} = Concentration (in μg/mL) reported for the final extract
V_t = Total volume of the concentrated final extract (in mL)
DF = Dilution factor (dimensionless). Use a value of 1 if no dilution is performed.
V_s = Initial sample volume or mass extracted (in milliliters or grams)
DW = Dry weight of soil (use a value of 1 for water, oil or wipe samples)

12.7 Report the results for the unknown samples in μg/L for waters and mg/kg for soil and oil samples. Round the results to two significant figures.

12.8 Wipe samples can be reported as either total ug/wipe or μg/100cm^2 if the surface area wiped is known. The formula in section 12.6 is set to give the total μg extracted from the wipe sample.

12.9 Results that exceed the linear range of the calibration curve must be diluted and re-analyzed. The dilution should be made such that the concentration of the dilution falls within the upper half of the calibration curve.

13.0 Method Performance

13.1 Method Detection Limits/Lower Limits of Quantitation

13.1.1 Method detection limit (MDL) studies and Lower Limit of Quantitation (LLOQ) studies are conducted concurrently and are performed yearly or whenever a significant change in the system or method has occurred.

13.1.2 SOP 1.20 details how to conduct an MDL/LLOQ study.

13.2 This method is validated through successful ongoing annual single blind performance evaluation samples.

14.0 Pollution Prevention

14.1 This SOP and other similar published analytical methods have been carefully reviewed for possible ways to prevent unnecessary pollution. The following waste streams were identified for consideration:

14.1.1 Incoming client water samples

14.1.1.1 These samples are usually sampled by the client in duplicate or triplicate in case the sample is compromised in transit or during analysis. Reducing the number of sample containers is not feasible since remobilization for resampling is usually cost prohibitive for the client.

14.1.1.2 Since the samples either are consumed in analysis or the unanalyzed samples are disposed of according to the waste management plan (SOP 1.08), adequate protection of the environment has already been maximized.

14.1.2 Incoming client soil samples

14.1.2.1 OnSite Environmental provides its clients with 4-ounce containers instead of 8-ounce containers to minimize the amount of potentially contaminated soil entering the laboratory that will have to be disposed of according to the waste management plan (SOP 1.08).

14.1.2.2 Two-ounce containers were considered, as it would reduce the amount of soil that would remain after analysis. However, it was determined that multiple analyses, quality control samples, or re-extraction of the sample may deplete the sample before it could be successfully analyzed. Since remobilization for resampling is usually cost prohibitive for the client, the four-ounce container was an acceptable compromise.

14.1.3 The solvents used in this method pose little threat to the environment when managed properly.

14.1.4 Standards should be prepared in volumes consistent with laboratory use to minimize the volume of expired standards to be disposed.

15.0 Waste Management

15.1 The appropriate disposal of waste streams from this procedure is addressed in SOP 1.08.

16.0 References

16.1 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 8000D - Determinative Chromatographic Separations*, Rev. 4, July 2014.

16.2 U.S. Environmental Protection Agency*, SW-846 Test Methods for Evaluating Solid Waste: Method 8082A, Polychlorinated Biphenyls (PCBs) by Gas Chromatography”,* 3rd Edition, Rev. 1, February 2007.

16.3 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 3510C - Separatory Funnel Liquid-Liquid Extraction*, 3rd Edition, Rev. 3, December 1996.

16.4 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 3550C - Ultrasonic Extraction*, 3rd Edition, Rev. 3, February 2007.

Appendix A

Instrument Parameters

5890 Series II (Capillary columns, Restek Rtx-CLPesticides and Rtx-CLPesticides II)

Initial Temperature:	120°C
Initial Time:	0 minute
Ramp:	26°C/minute
Final Temperature:	300°C
Final Time:	3 minutes
Injector Temperature:	220°C
Detector Temperature:	320°C
Hydrogen Reg. Pressure:	80 psi (when Hydrogen generator is not in use)
Argon/Methane:	80 psi
Inlet Pressure Program:	Constant flow, 12.8 psi @ 120°C
Carrier flow:	4.27 mL/minute (Hydrogen)
Make-up gas flow:	34 mL/minute (5% Methane/95% Argon)
Split flow:	16 mL/minute
Purge flow:	3 mL/minute

6890 (Capillary columns, Restek Rtx-CLPesticides and Rtx-CLPesticides II)

Initial Temperature:	120°C
Initial Time:	0 minute
Ramp:	26°C/minute
Final Temperature:	300°C
Final Time:	3 minutes
Injector Temperature:	220°C
Detector Temperatures:	320°C
Hydrogen Reg. Pressure:	80 psi (when Hydrogen generator is not in use)
Argon/Methane:	80 psi
Inlet Pressure Program:	Constant pressure, 20 psi @ 120°C
Carrier flow:	8.4 mL/minute (Hydrogen)
Make-up gas flow:	60 mL/minute (5% Methane/95% Argon)
Purge flow to Split vent:	40 mL/minute

7890A (Capillary columns, Restek Rtx-CLPesticides and Rtx-CLPesticides II)

Initial Temperature:	120°C
Initial Time:	0 minute
Ramp:	26°C/minute
Final Temperature:	300°C
Final Time:	3 minutes
Injector Temperature:	220°C
Detector Temperatures:	320°C
Hydrogen Reg. Pressure:	80 psi (when Hydrogen generator is not in use)
Nitrogen:	80 psi
Inlet Pressure Program:	Constant pressure, 12.78 psi @ 120°C
Carrier flow:	4.6 mL/minute (Hydrogen)
Make-up gas flow:	30 mL/minute (Nitrogen)
Purge flow to Split vent:	40 mL/minute

OnSite Environmental Inc.
Redmond, Washington

Semivolatile Organic Compounds by GC/MS – Method 8270D

Prepared by: ______________________ Date: ____________
Zeus Thornton, Analytical Chemist

Reviewed by: ______________________ Date: ____________
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Approved by: ______________________ Date: ____________
Stacey Duran, Laboratory QA/QC Officer

Revision History

Origination Date: 11/08/2000

Revision 4.03.01 is currently promulgated by SOP 1.00.01.

Revision 12/04/2002
SOP revised to new format. SOP officially revised using SOP 1.00.02 to revision 4.03.02.

Revision 3.0 08/09/2005
SOP revised to include new internal standard spiking concentrations and new initial calibration concentration levels. These items were changed to make sure the concentrations injected on the instrument fell within the linear range of the instrument and did not overload the column.

The use of acetone in the extraction solvent was also removed so that soil samples were extracted with 100% methylene chloride.

The column film thickness was updated to 0.50, which is what is currently being used.

The calibration standards were changed to reflect the use of a new manufacturer.

The TCLP Spike volume was adjusted from 500 μL to 100 μL so that the spike concentration in the extract fell in the linear range of the curve.

Updated Instrument Setpoints

Revision 4.0 (05/04/06)
SOP revised to include rinsing of filter paper and concentration tubes. The amount of sodium sulfate to be added to the filter funnel is now specified.

Revision 5.0 (10/02/06)
SOP revised to comply with Method 8270D.

1. The mean %RSD changed from 15% to 20%.
2. The %RSD for any single target compound changed from 15% to 20%.
3. Edited Appendix C with updated criteria.
4. Added tailing factor with calculations (Figure 1).
5. Updated References with Method 8270D.
6. Edited out System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC). No longer needed with new Method 8270D.
7. Added Benzoic Acid to Appendix A, E, and F.
8. Changed calibration curve points from 8 to 7 (1, 2, 5, 10, 20, 35 and 50 ppm).
9. Added to the calibration specifications that 10% of compounds can not exceed 20% RSD.
10. Updated Table of Contents.

Revision 6.0 (11/29/07)

1. SOP revised to add DryVap alternative to N-Evap.
2. Updated column brand.
3. Edited surrogate and spiking solutions.
4. Added reference for DryVap.

Revision 7.0 (03/25/10)

1. Updated column brand.
2. Added SOP references to extraction procedure.
3. Updated References.
4. Changed N-evap to RapidVap N2.
5. Changed calibration curve points from 7 to 8 (1, 2, 5, 10, 20, 35, 50 and 60ppm).
6. Updated Appendix B to change the temperature on the GC/MS oven from 40°C to 45°C and the inlet temperature from 250°C to 280°C. The hold time on the run was reduced from 11 min. to 8 min., which decreased the run time from 30 min. to 26.67min.
7. Updated Appendix A with current reporting limits.

Revision 8.0 (09/14/11)

1. Added sub-sections 10.2.5.4 and 10.4.5 to comply with WDOE request to stress comparison of response factors with Table 4 of method EPA 8270D.

Revision 9.0 (11/21/12)

1. Added microwave extraction (SOP 3.16) to soils.
2. Added reference to SOP 8.14 for glassware cleaning instructions.
3. The column used for GC/MS Corey changed to DB-8270D 20m x .18mm x .18uf replacing DB-8270D 30m x .25mm x 50uf. This cuts run time to 14 mins.
4. Changed parameters in Appendix B to accommodate the new column.

Revision 10.0 (11/12/13)

1. Added extraction and curve information for sediments.
2. Updated Appendix A to current reporting limits and added sediment PQLs.

Revision 11.0 (09/04/14)

1. Changed Ottawa sand and muffled sodium sulfate to Washed and Ignited Purified Sand and Sodium sulfate, anhydrous powder certified ACS granular in the soil extraction procedure for overall better results.
2. Changed the water extraction procedure to state an MS/MSD is extracted only on client’s request.

Revision 12.0 (04/25/16)

1. Added references to Spike Blank Duplicate throughout SOP.
2. Updated order of sections in body and on TOC to conform to other SOPs.
3. Added specific solvents to Section 6.0 – Safety.
4. Added new GC/MS (Jessie) to Section 7.0 and Appendix B.
5. Changed “pesticide grade” to “analytical grade” in Section 8.0.
6. Removed sodium hydroxide, sulfuric acid, granular sodium sulfate, and purified sand from Section 8.0 as these are for specific extractions that this SOP now directs you to for detailed instructions.
7. Replaced step-by-step procedures in Section 11.0 with direction to specific SOPs for soil and water extractions.
8. Updated References.
9. Updated reporting limits in Appendix A to match our current MDLs.
10. Changed the initial GC oven temperature to 50 degrees in Appendix B.

Revision 13.0 (07/05/17)

Added Lower Limit of Quantitation information.

Table of Contents

1.0 Scope and Application

1.1 The purpose of this method is to quantitatively determine concentrations of semivolatile organics in water and soil.

1.2 The reporting limits for semivolatile organics in water and soil are summarized in Appendix A.

1.3 The practical quantitation limits (PQLs) established for the polynuclear aromatic hydrocarbons (PAHs) using this method do not meet the Model Toxic Control Act (MTCA) requirements. In order to provide our clients with the required MTCA detection limits for the PAH compounds, 8270 extracts extracted by this procedure are routinely reanalyzed using GC/MS with Single Ion Monitoring (SIM). See SOP 4.11 for analytical procedures.

2.0 Summary of Method

2.1 Water samples are extracted by measuring out 1000 mL of sample and extracting it six times (three times acidic (pH<2) and three times basic (pH>12)) with methylene chloride using a separatory funnel.

2.2 Soil/sediment samples are extracted by measuring out 30g of soil into a beaker and 50g of sediment into a beaker. Dry the sample with sodium sulfate, anhydrous powder certified ACS granular, and extract it three times with methylene chloride using a sonicator.

2.3 Soil samples can also be extracted by microwave extraction. The extraction uses microwave energy to produce analyte recovery equivalent to sonication.

2.4 The extracts are concentrated under a stream of nitrogen. Water and soil extracts are concentrated to a 1.0 mL final volume. A sub-aliquot of each extract is then spiked with internal standards and analyzed by GC/MS.

3.0 Definitions

3.1 Reagent Water – Water free of target analytes or interferences greater than the reporting limits for this SOP. Also referred to as deionized water.

3.2 Method Blank (MB) – A sample aliquot (usually reagent water or purified sand) free from target analytes is treated exactly as a sample including exposure to all glassware, equipment, solvents and surrogates. The method blank is used to determine if method analytes or other interferences are present in the laboratory environment, the solvents or the equipment.

3.3 Spike Blank/Spike Blank Duplicate (SB/SBD) – Sample aliquots (usually reagent water or purified sand) free from target analytes to which known quantities of method analytes are added. The SB and SBD are treated exactly as a sample. The SB and SBD are used to determine whether the methodology is in control and to indicate the accuracy and precision associated with laboratory procedures. Also referred to as a Laboratory Control Sample (LCS).

3.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD) – Two aliquots of the same sample to which known quantities of the method analytes are added. The MS and MSD are treated exactly like any other sample. The MS and MSD are used to determine whether the sample matrix contributes bias to the sample results and to indicate the precision associated with laboratory procedures.

3.5 %R: Percent Recovery

3.6 RPD: Relative Percent Difference

3.7 SOP: Standard Operating Procedure

3.8 GC: Gas Chromatograph

3.9 MS: Mass Spectrometer

3.10 ICV: Initial Calibration Verification

3.11 CCV: Continuing Calibration Verification

3.12 MDL: Method Detection Limit

3.13 CCRF: Continuing Calibration Response Factor

4.0 Sample Handling and Preservation

4.1 Water samples are collected in unpreserved, one-liter amber containers.

4.2 Soil samples are collected in 4-ounce jars.

4.3 All samples should be shipped and stored at 4°C ± 2°C.

4.4 The holding time (from collection) for extraction of semivolatiles is 7 days for waters and 14 days for soils. Holding time for analysis of the extract is 40 days.

5.0 Interferences

5.1 Interferences by phthalate esters can pose a major problem in semivolatile determinations because phthalates are target compounds. Flexible plastics contain varying amounts of phthalates. These phthalates are easily extracted or leached from such materials during laboratory operations. Avoid contact with any plastic materials. Samples can also be contaminated by phthalate esters from an inverted septum during handling of the loaded GC vials. Use Teflon squeeze bottles and non-plasticized tubing where necessary.

5.2 Samples may be cross-contaminated by using a dirty scoopula or by poor rinsing of the sonicator tip between samples. The latter can be avoided by rinsing the tip with methylene chloride between samples.

5.3 Highly contaminated samples can cause carryover contamination on the gas chromatograph. Running solvent blanks after samples suspected of being highly contaminated can prevent this carryover.

5.4 All glassware used for semivolatile analysis must be scrupulously cleaned prior to use. This includes soap and solvent washes.

5.5 The DryVap can be a source of carryover contamination. The coils must be cleaned prior to use.

6.0 Safety

6.1 All reagents and standards must be handled with extreme care due to their possible deleterious health effects. All applicable personal safety equipment must be used at all times when handling chemicals.

6.2 Acetone: Potentially carcinogenic. Avoid skin contact. Causes damage to kidneys, liver and central nervous system.

6.3 Methylene Chloride: Potentially carcinogenic. Inhalation and ingestion are harmful and may be fatal. Causes damage to skin, cardiovascular system, central nervous system and eyes.

7.0 Equipment and Supplies

7.1 Apparatus – GC/MS (Instrument Ralph)

7.1.1 Hewlett Packard 5890 Series II Plus Gas Chromatograph equipped with electronic pressure control (EPC) (Serial #3336A55281)

7.1.2 Hewlett Packard Mass Selective Detector – Model 5972 (Serial #3434A01677)

7.1.3 Capillary column:

7.1.3.1 Agilent DB-8270D: 30 meter by 0.25 mm ID by 0.50 μm film thickness

7.1.4 HP ChemStation for data acquisition and data processing

7.1.5 Carrier gas – Helium

7.2 Apparatus – GC/MS (Instrument Corey)

7.2.1 Hewlett Packard 6890 Series Gas Chromatograph equipped with electronic pressure control (EPC) (Serial #US00007773)

7.2.2 Hewlett Packard Mass Selective Detector – Model 5973 (Serial #US82321650)

7.2.3 Capillary columns:

7.2.3.1 Agilent DB-8270D: 20 meter by 0.18 mm ID by 0.18 μm film thickness

7.2.4 HP ChemStation for data acquisition and data processing

7.2.5 Carrier gas – Helium

7.3 Apparatus – GC/MS (Instrument Jessie)

7.3.1 Hewlett Packard 6890 Series Gas Chromatograph equipped with electronic pressure control (EPC) (Serial #US00033566)

7.3.2 Hewlett Packard Mass Selective Detector – Model 5973 (Serial #US94260049)

7.3.3 Capillary columns:

7.3.3.1 Agilent DB-8270D (or equivalent): 30 meter by 0.25 mm id by 0.50 μm film thickness

7.3.4 HP ChemStation for data acquisition and data processing

7.3.5 Carrier gas – Helium

8.0 Reagents and Standards

8.1 Reagents

8.1.1 Methylene chloride, analytical grade

8.1.2 Acetone, analytical grade

8.1.3 Water, Organic Free (Reagent Water)

8.1.3.1 The deionized water generator has an activated carbon column designed to remove organic compounds from the water.

8.1.3.2 Depletion of the carbon filter may be indicated by a breakthrough of any organic compound. If this occurs, refer to SOP 8.10 for maintaining the generator.

8.2 Standards

8.2.1 Initial Calibration Standards (ICAL)

8.2.1.1 Semivolatile Initial Calibration Stock Standard:

8.2.1.1.1 The initial calibration standard (MegaMix) is ordered from Restek at a concentration of 1000 ppm in methylene chloride.

8.2.1.1.2 Dilute with methylene chloride to a final volume of 2.5 mL to achieve a standard with a concentration of 200 ppm.

8.2.1.1.3 Mix the standard well and transfer the standard into a properly labeled mininert vial.

8.2.1.2 Custom Initial Calibration Stock Standard:

8.2.1.2.1 The MegaMix standard does not quite contain all of the desired target analytes. A custom mix is ordered from AccuStandard that contains the following compounds:

8.2.1.2.1.1 N-Decane

8.2.1.2.1.2 2,3-Dichloroaniline

8.2.1.2.1.3 N-Octadecane

8.2.1.2.1.4 Benzidine

8.2.1.2.1.5 3,3’-Dichlorobenzidine.

8.2.1.2.2 Surrogate Standard (8270-SS) and Benzoic Acid are also added to the custom calibration stock.

8.2.1.2.3 The concentration of this custom mix is 1000 ppm in methylene chloride. The concentration 8270-SS is 4000 ppm in methylene chloride and Benzoic Acid is 2000 ppm in methylene chloride.

8.2.1.2.4 Benzidines are not stable in the presence of some of the other target analytes in the MegaMix.

8.2.1.2.5 Dilute with methylene chloride to a final volume of 2.5 mL to achieve a standard with a concentration of 200 ppm.

8.2.1.2.6 Mix the standard well and transfer the standard into a properly labeled mininert vial.

8.2.2 Continuing Calibration Verification Standards (CCV)

8.2.2.1 The stock standards mentioned in 8.2.1.1 and 8.2.1.2 are diluted to a concentration of 20 ppm in methylene chloride.

8.2.3 Initial Calibration Verification Standards (ICV)

8.2.3.1 The ICV standards are made using the exact same procedure as the ICAL standards except that a different MegaMix lot number is used to prepare the standard.

8.2.4 Tuning Standard

8.2.4.1 The tuning solution containing decafluorotriphenylphosphine (DFTPP), pentachlorophenol, DDT, and benzidine is purchased as a certified stock.

8.2.4.2 This standard is diluted to a concentration of 50 ppm in methylene chloride.

8.2.5 Internal Standard

8.2.5.1 Internal Standard Stock solution is purchased as a certified standard. The stock contains 6 dueterated compounds: 1,4-dichlorobenzene-d4, naphthalene-d8, acenaphthene-d10, phenanthrene-d10, chrysene-d12, and perylene-d12.

8.2.5.2 This standard is diluted to a concentration of 500 ppm in methylene chloride.

8.2.6 Surrogate

8.2.6.1 A surrogate mix containing 2-fluorophenol, phenol-d6, nitrobenzene-d5, 2-fluorobiphenyl, 2,4,6-tribromophenol and terphenyl-d14 is purchased as a certified stock standard.

8.2.6.2 Semivolatile Soil and Water Surrogate – Surrogate mix is diluted to a working concentration of 80 ppm in acetone.

8.2.7 SB/SBD and MS/MSD Spiking Solutions

8.2.7.1 Semivolatile Matrix Spike solution is purchased as a certified stock standard. The stock solution contains the following base/neutral compounds: 1,4-dichlorobenzene, N-nitroso-di-n-propylamine, 1,2,4-trichlorobenzene, acenaphthene, 2,4-dinitrotoluene, and pyrene. The stock solution contains the following acid compounds: phenol, 2-chlorophenol, 4-chloro-3-methylphenol, 4-nitrophenol, and pentachlorophenol.

8.2.7.2 Semivolatile Soil and Water Spike – The stock standard is diluted so that the base/neutral compounds are at a concentration of 40 ppm in acetone while the acid compounds are at a concentration of 80 ppm in acetone.

8.2.7.3 Semivolatile TCLP Spike Standard is purchased as a certified stock standard. The spike contains all TCLP compounds (see Appendix D). The spike standard is diluted to 200 ppm in acetone.

8.2.8 Standard Handling

8.2.8.1 Purchased standards expire on the manufacturer’s date or one year from the date of opening, whichever comes first.

8.2.8.2 Stock standards prepared internally expire one year after preparation or on the manufacturer’s date, whichever comes first.

8.2.8.3 Working surrogate, spike, internal standard, tuning standard, daily and initial calibration standards expire six months after preparation or on the manufacturer’s date, whichever comes first.

8.2.8.4 These expiration dates hold if no observed degradation of the solutions has taken place. All expired or degraded standards shall be properly disposed to avoid accidental use.

8.2.8.5 Stock and working standards should be kept at –20ºC or according to manufacturer’s recommendation when not in use.

9.0 Quality Control

9.1 Method Blank (MB)

9.1.1 Method blanks are prepared and analyzed for every extraction batch at a 5% frequency (one method blank per extraction batch of 20). The method blank must not contain any target analytes greater than the reporting limit.

9.1.2 Corrective action for contaminated method blanks:

9.1.2.1 If the method blank contains target analytes greater than the reporting limit, the method blank must be reanalyzed.

9.1.2.2 If the method blank is contaminated after reanalysis, corrective action must be taken to identify and eliminate the source of the problem. In this case, the samples may have to be re-extracted prior to reanalysis depending upon the source of the contamination.

9.1.2.3 As mentioned in Section 5.1, phthalate esters are a common laboratory contaminant. If there is low-level phthalate contamination in the method blank (*i.e.* less than 25 ppm at the instrument), the reporting limit may be raised for the entire extraction batch to above the level of contamination if allowed by the quality assurance project plan.

9.1.2.4 If the reanalyzed method blank is acceptable, then the method blank and associated samples can be reported.

9.1.2.5 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A non-conformance form must be filled out and the associated data is flagged with a “B” qualifier. See SOP 1.18.

9.2 Spike Blank/Spike Blank Duplicate (SB/SBD)

9.2.1 SB/SBDs are prepared and analyzed for every extraction batch at a 5% frequency (one SB/SBD pair per extraction batch of 20).

9.2.2 After analysis, calculate the percent recovery (%R) results as follows:

$$\%R = \frac{C_s}{C_n} \times 100$$

Where:
C_s = Measured concentration of the spike sample aliquot
C_n = Nominal (theoretical) concentration of the spike aliquot

9.2.3 If the %R is out of control, corrective action, as follows, must be taken:

9.2.3.1 Recalculate and check for integration or calculation errors.

9.2.3.2 Double check sample volume/weight, final extract volume, amount spiked and the concentration of the spike solution.

9.2.3.3 If a problem still exists, the spike blank should be reanalyzed. If the reanalysis is acceptable, then report only the reanalysis.

9.2.3.4 If the spike blank is still out of control, then the associated samples must be re-extracted and reanalyzed.

9.2.3.5 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A non-conformance form must be filled out and the associated data must be flagged with an “I” qualifier. See SOP 1.18.

9.2.4 Control limits for spike blank %R values shall be calculated yearly on actual sample data using SOP 1.22.

9.2.5 After analysis, calculate the relative percent difference (RPD) on the wet weight results as follows:

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$

Where:
C_1 = Measured concentration of the first sample aliquot
C_2 = Measured concentration of the second sample aliquot

9.2.6 If the RPD is out of control, corrective action, as follows, must be taken:

9.2.6.1 Recalculate and check for integration or calculation errors.

9.2.6.2 Double check sample volume/weight, final extract volume, amount spiked and the concentration of the spike solution.

9.2.6.3 If the RPD value is still out of control, then the analyst should use professional judgement to determine a course of action. Document the nonconformance and the resolution using SOP 1.18.

9.2.7 Control limits for SB/SBD RPDs shall be calculated yearly on actual sample data using SOP 1.22.

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

9.3.1 MS/MSD samples are prepared and analyzed for every extraction batch at a 5% frequency (one MS/MSD pair per extraction batch of 20).

9.3.2 After analysis, calculate the percent recovery (%R) on the wet weight results as follows:

$$\%R = \frac{C_s - C_u}{C_n} \times 100$$

Where:
C_s = Measured concentration of the spike sample aliquot
C_u = Measured concentration of the unspiked sample aliquot
C_n = Nominal (theoretical) concentration of the spike aliquot

9.3.3 If the %R is out of control, corrective action, as follows, must be taken:

9.3.3.1 Recalculate and check for integration or calculation errors.

9.3.3.2 Double check sample volume/weight, final extract volume, amount spiked and the concentration of the spike solution.

9.3.3.3 If the sample concentration exceeds more than four to five times what was spiked, the %R value is statistically meaningless. Flag any %R outliers with an “A” qualifier.

9.3.3.4 If a problem still exists, then the spike blank should be evaluated. If the %R values in the spike blank are acceptable, then document the nonconformance and one of the follow resolutions using SOP 1.18:

9.3.3.4.1 If the %R value is out of control similarly in both the MS and the MSD, then the problem can be attributed to a matrix effect. Qualify the %R outliers with the “V” qualifier.

9.3.3.4.2 If the %R value is out in one of the samples but not in the other one, then the analyst should use professional judgement to determine a course of action.

9.3.3.5 If the spike blank %R value is out of control, then the spike blank and the MS/MSD pair should be reanalyzed. If the %R values are acceptable, then the results from the reanalysis only should be reported. If the spike blank still fails, then the entire extraction batch associated with this QC set should be re-extracted and reanalyzed.

9.3.3.6 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A non-conformance form must be filled out and the associated data must be flagged with an “I” qualifier. See SOP 1.18.

9.3.4 Control limits for MS/MSD %R values shall be calculated yearly on actual sample data using SOP 1.22.

9.3.5 After analysis, calculate the relative percent difference (RPD) on the wet weight results as follows:

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$

Where:
C_1 = Measured concentration of the first sample aliquot
C_2 = Measured concentration of the second sample aliquot

9.3.6 If the RPD is out of control, corrective action, as follows, must be taken:

9.3.6.1 Recalculate and check for integration or calculation errors.

9.3.6.2 Double check sample volume/weight, final extract volume, amount spiked and the concentration of the spike solution.

9.3.6.3 If the RPD value is still out of control, then the analyst should use professional judgement to determine a course of action. Document the nonconformance and the resolution using SOP 1.18.

9.3.7 Control limits for MS/MSD RPDs shall be calculated yearly on actual sample data using SOP 1.22.

9.4 Surrogates

9.4.1 2-Fluorophenol, phenol-d6, nitrobenzene-d5, 2-fluorobiphenyl, 2,4,6-tribromophenol, and terphenyl-d14 are used as surrogates for this analysis. Surrogate recovery is monitored to assess method performance on the particular matrix. Surrogates are added to all samples and quality control samples prior to extraction and analysis.

9.4.2 Calculate the percent recovery (%R) as follows:

$$\%R = \frac{C_s}{C_n} \times 100$$

Where:
C_s = Measured concentration of the surrogate in the sample
C_n = Nominal (theoretical) concentration of the surrogate spiked into the sample

9.4.3 If the surrogate %R values are out of control, corrective action, as follows, must be taken:

9.4.3.1 Recalculate and check for integration or calculation errors.

9.4.3.2 Double check sample volume/weight, final extract volume, amount spiked and the concentration of the spike solution.

9.4.3.3 If the surrogate %R value cannot be calculated due to a large dilution of the sample, the sample is reported and flagged with the “S” qualifier.

9.4.3.4 It is acceptable for one surrogate per acid and base/neutral group to be out of control (as long as the percent recovery is greater than 10%) without requiring re-extraction. Document the nonconformance using SOP 1.18.

9.4.3.5 If more than the maximum number of surrogates is out of control, then the sample must be re-extracted and/or reanalyzed. Document the nonconformance using SOP 1.18 and follow one of the resolutions below:

9.4.3.5.1 If the surrogate %R value is acceptable upon reanalysis, then this data should be reported.

9.4.3.5.2 If the surrogate %R value is still out of control upon reanalysis, the sample must be re-extracted.

9.4.3.5.3 If upon re-extraction the surrogate %R value is acceptable, report the re-extraction data and document the nonconformance using SOP 1.18.

9.4.3.5.4 If upon re-extraction the surrogate %R value is still out of control, the original sample data should be reported and the surrogate outlier flagged with the “Q” qualifier. The case narrative should document that the poor surrogate recovery was confirmed due to the sample matrix.

9.4.3.6 If insufficient sample volume or expired sample holding time prevents re-extraction, then the data can be reported. A non-conformance form must be filled out and the associated data flagged with a “Q” qualifier. See SOP 1.18.

9.4.4 Control limits for surrogate %R values shall be calculated yearly on actual sample data using SOP 1.22.

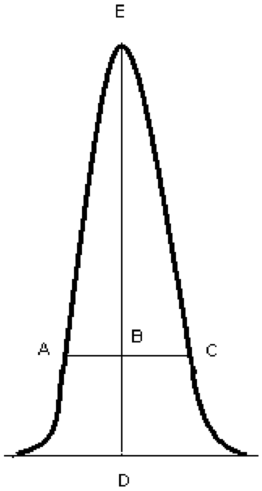
10.0 Calibration and Standardization

10.1 Tuning Standard (DFTPP)

10.1.1 Before the initial calibration (ICAL) or continuing calibration verification (CCV) is analyzed, the GC/MS system must be tuned with decafluorotriphenylphosphine (DFTPP). The resulting mass spectrum must meet the abundance requirements listed in Appendix C.

10.1.2 The GC/MS tuning standard (DFTPP) should also be used to assess GC column performance and injection port inertness. Benzidine and pentachlorophenol should not exceed a tailing factor of 2 given by the equation in Figure 1.

Figure 1.



Tailing Factor = BC/AB

10.1.3 All QC samples and client samples must be injected within 12 hours after the injection of the DFTPP tuning standard.

10.2 Semivolatile Initial Calibration (ICAL)

10.2.1 A calibration curve requires at least five points. Eight points are typically analyzed at concentrations of 1, 2, 5, 10, 20, 35, 50 and 60 ppm.

10.2.2 For sediment samples the calibration curve starts at 0.5, 1, 2, 5, 10, 20, 35, 50 and 60 ppm.

10.2.3 Refer to Appendix E for a list of which internal standard is used for each target compound and Appendix F for a table of primary and secondary ions used.

10.2.4 Analyze each calibration standard and create a calibration curve using the internal standard approach. Use peak areas versus the concentrations of the standard and the appropriate internal standard using the ChemStation software.

10.2.5 The ChemStation software should be set to model the internal standard calibration procedure outlined in Method 8270D (Sections 11.3.3 through 11.3.6).

10.2.6 The Initial Calibration (ICAL) must meet the following specifications before analysis can proceed:

10.2.6.1 The mean %RSD for all compounds must be less than 20%.

10.2.6.2 If the percent relative standard deviation (%RSD) for any single target compound should exceed 20%, then the response factor should not be used and the ChemStation software should be set to use one of the alternative calibration procedures outlined in Method 8000.

10.2.6.2.1 For linear regression techniques, the correlation coefficient (r) must be equal to or greater than 0.990. Do not force the line through the origin (0,0).

10.2.6.2.2 For non-linear (quadratic) techniques, the coefficient of determination (r^2) must be equal to or greater than 0.990 using a minimum of six calibration points. Do not force the curve through the origin (0,0).

10.2.6.3 If more than 10% of the compounds included with the initial calibration exceed the 20% RSD limit, the chromatographic system is considered too reactive for analysis to begin. Clean or replace the injector liner and/or column, then repeat the calibration procedure.

10.2.6.4 The response factors of the compounds (where applicable) should be checked against the minimum response factors listed in Table 4 of method EPA 8270D to ensure that they are behaving as expected. The response factors of the lowest calibration standard in particular should be checked against the values in the table to ensure adequate sensitivity is being achieved.

10.3 Semivolatile Initial Calibration Verification (ICV)

10.3.1 After the Initial Calibration meets method criteria, a second-source initial calibration verification (ICV) standard must be analyzed as a check on the initial curve and calibration standards.

10.3.2 The percent difference (or percent drift as appropriate) for all compounds must be within ±30%.

10.4 Semivolatile Continuing Calibration Verification (CCV)

10.4.1 Analyze a continuing calibration verification standard every 12 hours immediately following the DFTPP tuning standard but before QC samples and client samples are analyzed.

10.4.2 If a project calls for a subset of the analyte list, then only the subset compounds, surrogates, and spikes need to pass the calibration verification.

10.4.3 The %RSD for all compounds must be less than 20%.

10.4.3.1 If a compound's %RSD is greater than +20% it may still be reported as non-detect. For situations when the failed compound is present, the concentrations must be reported as estimated values.

10.4.3.2 If a compound's %RSD is between –50% and –20% it may still be reported as non-detect if the PQL is doubled. For situations when the failed compound is present, the concentrations must be reported as estimated values.

10.4.3.3 The mean %RSD for all compounds must be less than 20%.

10.4.4 If more than 10% of the compounds are out, then action must be taken prior to the analysis of samples. This may include making new internal standards or a new CCV standard or recalibrating.

10.4.5 The CCRFs should be checked against the values in Table 4 of EPA 8270D to ensure the analytes are behaving as expected. This can be done automatically by going to ConCal>Report Continuing Calibration to Screen in the ChemStation menu bar and checking the CCRF column for any outliers.

10.4.6 The Extracted Ion Current Profile (EICP) area for all of the internal standards must be within a factor of 2 (-50% to +100%) of the mid-point standard level of the most recent ICAL.

10.4.7 When the EICPs do not pass, corrective action needs to be taken. This includes:

10.4.7.1 Remaking the standard.

10.4.7.2 Changing the liner in the injection port.

10.4.7.3 Cleaning or changing the inlet seal.

10.4.7.4 Clipping a loop of the column and solvent rinsing the injection port.

10.4.7.5 Checking for leaks.

10.4.7.6 If the above steps do not resolve the problem, then a new initial calibration must be analyzed. If the EICPs still don't pass, a new column may be necessary before recalibrating the instrument.

11.0 Procedure

11.1 Instrument Operation

11.1.1 The recommended GC temperature and pressure programs are located in Appendix B.

11.2 Glassware Preparation

11.2.1 Refer to SOP 8.14 Glassware Cleaning and Washing for specific instructions.

11.3 Ultrasonic Soil Extraction Procedure

11.3.1 Refer to SOP 3.07 Ultrasonic Extraction for specific instructions on sample extraction.

11.3.2 Refer to SOP 3.11 DryVap Procedure and Maintenance or SOP 3.12 RapidVap N2 Procedure and Maintenance for specific instructions on concentrating the extract.

11.4 Microwave Soil Extraction Procedure

11.4.1 Refer to SOP 3.16 Microwave Extraction for specific instructions on sample extraction.

11.4.2 Refer to SOP 3.11 DryVap Procedure and Maintenance or SOP 3.12 RapidVap N2 Procedure and Maintenance for specific instructions on concentrating the extract.

11.5 Water Extraction Procedure – Separatory Funnel Extraction

11.5.1 Refer to SOP 3.08 Separatory Funnel Extraction for specific instructions on sample extraction.

11.5.2 Refer to SOP 3.11 DryVap Procedure and Maintenance for specific instructions on concentrating the extract.

11.6 TCLP Extraction

11.6.1 Refer to SOP 3.08 Separatory Funnel Extraction for specific instructions on sample extraction.

11.6.2 Refer to SOP 3.11 DryVap Procedure and Maintenance for specific instructions on concentrating the extract.

11.7 Pre-Analysis Sample Preparation

11.7.1 Using a clean syringe, transfer a 200-µL aliquot of the sample extract to a GC vial equipped with an insert.

11.7.2 Alternatively, dilute the sample extract as necessary based on the sample matrix.

11.7.3 Add 10 µL of internal standard for every 200 µL of extract.

11.7.4 Cap the vial and invert three times to mix the extract well.

11.7.5 Label the vial and analyze on a calibrated instrument.

12.0 Data Reduction and Calculation

12.1 After analyzing each sample, the ChemStation software will automatically integrate the chromatogram and calculate the concentration (in the extract) of any peaks within the retention time window for each target analyte. The analyst should review the integration for each positive result to verify that the peak was properly integrated. Reintegrate the peak manually, if necessary, using SOP 1.12 to correct for improper integration. The analyst must initial and date all manual integrations.

12.2 Compounds are identified by the following criteria:

12.2.1 The relative retention time of a compound is within ±0.06 minutes of the same compound in the CCV.

12.2.2 The relative intensities of the characteristic ions should agree within 30% of the relative intensities of these ions in the reference spectrum.

12.2.3 The experience of the analyst determines that the compound is present despite interferences from coeluting compounds.

12.3 If the area response of any of the internal standards in the sample extracts differs by a factor of two (-50% to +100%) from that of the calibration verification standard, the following corrective actions must be taken:

12.3.1 Check for integration errors.

12.3.2 Verify that the internal standard solution has not concentrated by evaporation during use by checking the internal standard area counts of the method blank versus the CCV standard. Remake the internal standard solution if this is indicated.

12.3.3 Remake and reanalyze the sample extract.

12.3.3.1 If the reanalysis yields acceptable internal standard response, report the reanalyzed data. It is not necessary to document the nonconformance.

12.3.3.2 If the internal standard response is still out of control, the compounds associated with that internal standard may be calculated based on the nearest internal standard that is in control. Alternately, the sample may be diluted and reanalyzed.

12.3.3.2.1 The response factor (RF) for the compound using the new internal standard must first be calculated from the continuing calibration verification using the formula:

$$\mathrm{RF} = \frac{(\mathrm{A_S})(\mathrm{C_{IS}})}{(\mathrm{A_{IS}})(\mathrm{C_S})}$$

Where:
A_S = Peak area of the analyte
A_{IS} = Peak area of the internal standard
C_S = Concentration of the analyte
C_{IS} = Concentration of the internal standard

12.3.3.2.2 The concentration of the compounds can then be recalculated manually using the new internal standard and the response factor established above.

$$C_s = \frac{(A_S)(C_{IS})}{(A_{IS})(RF)}$$

12.4 The QDEL function should be used to remove any false positives from the quantitation report before the report is generated.

12.5 The concentration reported by the ChemStation software is the concentration (in µg/mL) found in the sample extract, not the sample itself.

12.6 To calculate the concentration (in ppb for waters and ppm for soils) in the actual sample, the chemist electronically links the ChemStation data file (detail.xls) to an Excel spreadsheet to avoid transposition errors associated with hand entering data. The chemist enters the sample volume, final volume and dry weight and the spreadsheet performs the following calculation for each analyte:

Soil:

$$C_s = \frac{(C_{ex})(V_t)(DF)}{(V_s)(DW)}$$

Water:

$$C_s = \frac{(C_{ex})(V_t)(DF)(1000)}{(V_s)}$$

Where:

C_{ex}	= Concentration (in μg/mL) reported for the final extract
V_t	= Total volume of the concentrated final extract (in mL)
DF	= Dilution factor (dimensionless). Use a value of 1 if a dilution is not performed.
V_s	= Initial volume or mass of sample extracted (in mL or g)
DW	= Dry weight of soil (use a value of 1 for water samples)

12.7 Report the results for the unknown samples in μg/L for waters and mg/kg for soils. Round the results to two significant figures.

12.8 Results that exceed the linear range of the calibration curve must be diluted and reanalyzed.

13.0 Method Performance

13.1 Method Detection Limits/Lower Limits of Quantitation

13.1.1 Method detection limit (MDL) studies and Lower Limit of Quantitation (LLOQ) studies are conducted concurrently and are performed yearly or whenever a significant change in the system or method has occurred.

13.1.2 SOP 1.20 details how to conduct an MDL/LLOQ study.

13.2 This method is validated through successful ongoing annual single blind performance evaluation samples.

14.0 Pollution Prevention

14.1 This SOP and other similar published analytical methods have been carefully reviewed for possible ways to prevent unnecessary pollution.

14.2 The solvents used in this method pose little threat to the environment when managed properly.

14.3 Standards should be prepared in volumes consistent with laboratory use to minimize the volume of expired standards to be disposed.

15.0 Waste Management

15.1 The appropriate disposal of waste streams from this procedure is addressed in SOP 1.08.

16.0 References

16.1 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 8000D - Determinative Chromatographic Separations*, 3rd Edition, Rev. 4, July 2014.

16.2 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 8270D – Semivolatile Organic Compounds By Gas Chromatography/Mass Spectrometry (GC/MS)*, 3rd Edition, Rev. 4, February 2006.

Appendix A

Reporting Limits
*(wet weight basis)

COMPOUND	WATER (µg/L)	SOIL (mg/kg)*	SEDIMENT (mg/kg)*	COMPOUND	WATER (µg/L)	SOIL (mg/kg)*	SEDIMENT (mg/kg)*
n-Nitrosodimethylamine	1.0	0.033	0.020	Acenaphthylene	1.0	0.033	0.020
Pyridine	1.0	0.33	0.20	3-Nitroaniline	1.0	0.033	0.020
Phenol	1.0	0.033	0.020	2,4-Dinitrophenol	5.0	0.17	0.20
Aniline	5.0	0.17	0.10	Acenaphthene	1.0	0.033	0.020
bis(2-Chloroethyl)ether	1.0	0.033	0.020	4-Nitrophenol	5.0	0.033	0.020
2-Chlorophenol	1.0	0.033	0.020	2,4-Dinitrotoluene	1.0	0.033	0.020
1,3-Dichlorobenzene	1.0	0.033	0.020	Dibenzofuran	1.0	0.033	0.020
1,4-Dichlorobenzene	1.0	0.033	0.020	2,3,5,6-Tetrachlorophenol	1.0	0.033	0.020
Benzyl alcohol	1.0	0.17	0.10	2,3,4,6-Tetrachlorophenol	1.0	0.033	0.020
1,2-Dichlorobenzene	1.0	0.033	0.020	Diethylphthalate	1.0	0.17	0.10
2-Methylphenol	1.0	0.033	0.020	4-Chlorophenyl-phenylether	1.0	0.033	0.020
bis(2-Chloroisopropyl)ether	1.0	0.033	0.020	4-Nitroaniline	1.0	0.033	0.020
(3+4)-Methylphenol	1.0	0.033	0.020	Fluorene	1.0	0.033	0.020
n-Nitroso-di-n-propylamine	1.0	0.033	0.020	4,6-Dinitro-2-methylphenol	5.0	0.17	0.10
Hexachloroethane	1.0	0.033	0.020	n-Nitrosodiphenylamine	1.0	0.033	0.020
Nitrobenzene	1.0	0.033	0.020	1,2-Diphenylhydrazine	1.0	0.033	0.020
Isophorone	1.0	0.033	0.020	4-Bromophenyl-phenylether	1.0	0.033	0.020
2-Nitrophenol	1.0	0.033	0.020	Hexachlorobenzene	1.0	0.033	0.020
2,4-Dimethylphenol	1.0	0.033	0.020	Pentachlorophenol	5.0	0.17	0.020
bis(2-Chloroethoxy)methane	1.0	0.033	0.020	Phenanthrene	1.0	0.033	0.020
Benzoic Acid	5.0	0.17	0.10	Anthracene	1.0	0.033	0.020
2,4-Dichlorophenol	1.0	0.033	0.020	Carbazole	1.0	0.033	0.020
1,2,4-Trichlorobenzene	1.0	0.033	0.020	Di-n-butylphthalate	1.0	0.033	0.020
Naphthalene	1.0	0.033	0.020	Fluoranthene	1.0	0.033	0.020
4-Chloroaniline	1.0	0.17	0.10	Benzidine	5.0	0.33	0.20
Hexachlorobutadiene	1.0	0.033	0.020	Pyrene	1.0	0.033	0.020
4-Chloro-3-methylphenol	1.0	0.033	0.020	Butylbenzylphthalate	1.0	0.033	0.020
2-Methylnaphthalene	1.0	0.033	0.020	bis-2-Ethylhexyladipate	5.0	0.033	0.020
1-Methylnaphthalene	1.0	0.033	0.020	3,3'-Dichlorobenzidine	1.0	0.17	0.10
Hexachlorocyclopentadiene	1.0	0.033	0.020	Benzo[a]anthracene	1.0	0.033	0.020
2,4,6-Trichlorophenol	1.0	0.033	0.020	Chrysene	1.0	0.033	0.020
2,3-Dichloroaniline	1.0	0.033	0.020	bis(2-Ethylhexyl)phthalate	1.0	0.033	0.020
2,4,5-Trichlorophenol	1.0	0.033	0.020	Di-n-octylphthalate	1.0	0.033	0.020
2-Chloronaphthalene	1.0	0.033	0.020	Benzo[b]fluoranthene	1.0	0.033	0.020
2-Nitroaniline	1.0	0.033	0.020	Benzo[k]fluoranthene	1.0	0.033	0.020
1,4-Dinitrobenzene	1.0	0.033	0.020	Benzo[a]pyrene	1.0	0.033	0.020
Dimethylphthalate	1.0	0.033	0.020	Indeno[1,2,3-cd]pyrene	1.0	0.033	0.020
1,3-Dinitrobenzene	1.0	0.033	0.020	Dibenz[a,h]anthracene	1.0	0.033	0.020
2,6-Dinitrotoluene	1.0	0.033	0.020	Benzo[g,h,i]perylene	1.0	0.033	0.020
1,2-Dinitrobenzene	1.0	0.033	0.020				

Appendix B
Instrument Setpoints

5890 Series II (Ralph)

Initial Temperature:	50°C
Initial Time:	1 minute
Ramp L1:	15°C/minute
Final Temperature L1:	100°C
Ramp L2:	20ºC/minute
Final Temperature L2:	240°C
Ramp L3	10°C/minute
Final Temperature L3	310°C
Final Time:	8 minutes
Injector Temperature:	280°C
Detector Temperature:	195°C
Helium Reg. Pressure:	85 psi
Inlet Initial Pressure:	9.2 psi
Carrier flow:	1.2 mL/minute
Purge flow to Split vent:	50 mL/minute
Auxiliary Pressure:	E, 60 psi
EM Voltage	Relative – 0 eV

6890 (Jessie)

Initial Temperature:	50°C
Initial Time:	1 minute
Ramp L1:	15°C/minute
Final Temperature L1:	100°C
Ramp L2:	20ºC/minute
Final Temperature L2:	240ºC
Ramp L3	10°C/minute
Final Temperature L3	310°C
Final Time:	8 minutes
Injector Temperature:	280°C
Detector Temperature:	230°C
Helium Reg. Pressure:	85 psi
Inlet Initial Pressure:	12.38 psi
EM Voltage	Relative – 0 eV

6890 (Corey)

Initial Temperature:	50°C
Initial Time:	1 minute
Ramp L1:	27°C/minute
Final Temperature L1:	100°C
Ramp L2:	36ºC/minute
Final Temperature L2:	240ºC
Ramp L3	18°C/minute
Final Temperature L3	310°C
Final Time:	3.89 minutes
Injector Temperature:	280°C
Detector Temperature:	230°C
Helium Reg. Pressure:	85 psi
Inlet Initial Pressure:	35.63 psi
EM Voltage	Relative – 0 eV

Appendix C

DFTPP Mass Ion Abundance Criteria

m/e	ION ABUNDANCE CRITERIA
51	10-80% of mass 198
68	Less than 2% of mass 69
70	Less that 2% of mass 69
127	10-80% of mass base peak
197	Less than 2% of mass 198
198	Base Peak, or >50% of mass 442
199	5 to 9% of mass 198
275	10-60% of base peak
365	Greater than 1% of mass 198
441	Present, but less than 24% of mass 442
442	Base peak or >50% of mass 198
443	15-24% of mass 442

Appendix D

TCLP Compounds and Reporting Limits

Compound	**Reporting Limit (μg/L)**
1,4-Dichlorobenzene	10
2-Methylphenol	10
Hexachloroethane	10
4-Methylphenol	10
Nitrobenzene	10
Hexachlorobutadiene	10
2,4,6-Trichlorophenol	100
2,4,5-Trichlorophenol	100
2,4-Dinitrotoluene	100
Hexachlorobenzene	10
Pentachlorophenol	250
Pyridine	50

Appendix E

Internal Standards with Corresponding Analytes Assigned for Quantitation

1,4-Dichlorobenzene-d4	Naphthalene-d8	Acenaphthene-d10
N-Nitrosodimethylamine	Nitrobenzene-d5	Hexachlorocyclopentadiene
Pyridine	Nitrobenzene	2,4,6-Trichlorophenol
2-Fluorophenol	Isophorone	2,3-Dichloroaniline
Phenol-d6	2-Nitrophenol	2,4,5-Trichlorophenol
Phenol	2,4-Dimethylphenol	2-Fluorobiphenyl
Aniline	bis(2-Chloroethoxy)methane	2-Chloronaphthalene
bis(2-Chloroethyl)ether	Benzoic Acid	2-Nitroaniline
2-Chlorophenol	2,4-Dichlorophenol	1,4-Dinitrobenzene
n-Decane	1,2,4-Trichlorobenzene	Dimethylphthalate
1,3-Dichlorobenzene	Naphthalene	1,3-Dinitrobenzene
1,4-Dichlorobenzene	4-Chloroaniline	2,6-Dinitrotoluene
Benzyl Alcohol	Hexachlorobutadiene	1,2-Dinitrobenzene
1,2-Dichlorobenzene	4-Chloro-3-methylphenol	Acenaphthylene
2-Methylphenol	2-Methylnaphthalene	3-Nitroaniline
bis(2-Chloroisopropyl)ether	1-Methylnaphthalene	2,4-Dinitrophenol
(3+4)-Methylphenol		Acenaphthene
N-Nitroso-di-n-propylamine		4-Nitrophenol
Hexachloroethane		2,4-Dinitrotoluene
		Dibenzofuran
		2,3,4,6-Tetrachlorophenol
		2,3,5,6-Tetrachlorophenol
		Diethylphthalate
		4-Chlorophenyl-phenylether
		4-Nitroaniline
		Fluorene

Phenanthrene-d10	Chrysene-d12	Perylene-d12
4,6-Dinitro-2-methylphenol	Benzidine	Benzo[b]fluoranthene
N-Nitrosodiphenylamine	Pyrene	Benzo[k]fluoranthene
1,2-Diphenylhydrazine	Terphenyl-d14	Benzo[a]pyrene
2,4,6-Tribromophenol	Butylbenzylphthalate	Indeno[1,2,3-cd]pyrene
4-Bromophenyl-phenylether	bis-2-Ethylhexyladipate	Dibenz[a,h]anthracene
Hexachlorobenzene	3,3'-Dichlorobenzidine	Benzo[g,h,i]perylene
Pentachlorophenol	Benzo[a]anthracene	
n-Octadecane	Chrysene	
Phenanthrene	bis(2-Ethylhexyl)phthalate	
Anthracene	Di-n-octylphthalate	
Carbazole		
Di-n-butylphthalate		
Fluoranthene		

Appendix F

Characteristic Ions for Analytes

Analyte	Primary	Secondary Ion(s)	Analyte	Primary	Secondary Ion(s)
1,4-Dichlorobenzene-d4	152	115, 150	1,2-Dinitrobenzene	168	63, 76
N-Nitrosodimethylamine	42	44, 74	Acenaphthylene	152	151, 153
Pyridine	79	52	3-Nitroaniline	138	92, 108
2-Fluorophenol	112	64	2,4-Dinitrophenol	184	63, 154
Phenol-d6	99	42, 71	Acenaphthene	154	152, 153
Phenol	94	65, 66	4-Nitrophenol	139	65, 109
Aniline	93	65, 66	2,4-Dinitrotoluene	165	63, 89
bis(2-Chloroethyl)ether	93	63, 95	Dibenzofuran	168	139
2-Chlorophenol	128	64, 130	2,3,4,6-Tetrachlorophenol	232	131, 168
n-Decane	43	57, 71	2,3,5,6-Tetrachlorophenol	232	131, 166
1,3-Dichlorobenzene	146	111, 148	Diethylphthalate	149	150, 177
1,4-Dichlorobenzene	146	111, 148	4-Chlorophenyl-phenylether	204	141, 206
Benzyl alcohol	108	77, 79	4-Nitroaniline	138	65, 92, 108
1,2-Dichlorobenzene	146	111, 148	Fluorene	166	165, 167
2-Methylphenol	107	77, 79, 108	Phenanthrene-d10	188	94
bis(2-Chloroisopropyl)ether	45	77, 121	4,6-Dinitro-2-methylphenol	198	51, 105
(3+4)-Methylphenol	107	77, 79, 108	N-Nitrosodiphenylamine	169	167, 168
N-Nitroso-di-n-propylamine	70	42, 101, 130	1,2-Diphenylhydrazine	182	77, 105
Hexachloroethane	117	199, 201	2,4,6-Tribromophenol	330	141, 332
Naphthalene-d8	136	68	4-Bromophenyl-phenylether	248	141, 250
Nitrobenzene-d5	82	54, 128	Hexachlorobenzene	284	142, 249
Nitrobenzene	77	65, 123	Pentachlorophenol	266	264, 268
Isophorone	82	95, 138	n-Octadecane	43	57, 71, 85
2-Nitrophenol	139	65, 109	Phenanthrene	178	176, 179
2,4-Dimethylphenol	122	107. 121	Anthracene	178	176, 179
bis(2-Chloroethoxy)methane	93	95, 123	Carbazole	167	139
Benzoic Acid	122	105, 77	Di-n-butylphthalate	149	104, 150
2,4-Dichlorophenol	162	98, 164	Fluoranthene	202	101, 203
1,2,4-Trichlorobenzene	180	145, 182	Chrysene-d12	240	120, 236
Naphthalene	128	127, 129	Benzidine	184	92, 185
4-Chloroaniline	65	92, 127, 129	Pyrene	202	200, 203
Hexachlorobutadiene	225	223, 227	Terphenyl-d14	244	122, 212
4-Chloro-3-methylphenol	107	142, 144	Butylbenzylphthalate	149	91, 206
2-Methylnaphthalene	142	141	bis-2-Ethylhexyladipate	129	112, 147
1-Methylnaphthalene	142	141	3,3'-Dichlorobenzidine	252	126, 254
Acenaphthene-d10	164	160, 162	Benzo[a]anthracene	228	226, 229
Hexachlorocyclopentadiene	237	235, 272	Chrysene	228	226, 229
2,4,6-Trichlorophenol	196	198, 200	bis(2-Ethylhexyl)phthalate	149	167, 279
2,3-Dichloroaniline	161	196	Di-n-octylphthalate	149	43, 167
2,4,5-Trichlorophenol	196	198, 200	Perylene-d12	264	260, 265
2-Fluorobiphenyl	172	171	Benzo[b]fluoranthene	252	125, 253
2-Chloronaphthalene	162	127, 164	Benzo[k]fluoranthene	252	125, 253
2-Nitroaniline	65	92, 138	Benzo[a]pyrene	252	125, 253
1,4-Dinitrobenzene	168	64, 75	Indeno[1,2,3-cd]pyrene	276	138, 227
Dimethylphthalate	163	164, 194	Dibenz[a,h]anthracene	278	139, 279
1,3-Dinitrobenzene	168	50, 75	Benzo[g,h,i]perylene	276	138, 277
2,6-Dinitrotoluene	165	63, 89			

OnSite Environmental Inc.
Redmond, Washington

Semivolatile Petroleum Hydrocarbons by GC/FID
Method NWTPH-Dx

Prepared by: ______________________ Date: ____________
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Revision History

Origination Date: **05/04/01**

Revision 2.0 **01/08/03**
SOP revised to new format. SOP officially revised using SOP 1.00.02 to revision 4.06.02.

Revision 3.0 **04/21/08**
SOP revised to update the amount of Methylene Chloride used in water extractions (section 11.4.13) and to update Appendix D ranges.

Revision 4.0 **12/15/09**
SOP revised to include instructions for the extraction of one-liter water samples, to remove 1-Chlorooctadecane as a surrogate, to add instrument Vigo, and to add ICV information.

Streamlined “Procedure” section to direct reader to parent SOPs for specific instruction.

Revision 5.0 **05/05/16**

- Changed hydrocarbon range in “Scope and Application” section.
- Added microwave option to “Summary of Method” section.
- Added acetone to “Safety” section.
- Updated “Equipment and Supplies” section.
- Changed solvent grade from pesticide to analytical in “Reagents” section.
- Updated “Reagents and Standards” section.
- Added mineral oil to “Calibration and Standardization” section.
- Updated “Procedure” section to defer to specific extraction SOPs for details.
- Updated “Data Reduction and Calculation” section with correct ranges and added a reference to a mineral oil/lube oil split.
- Updated “References” section.

Revision 6.0 **07/05/17**

- Updated CCV standard concentration in Section 8.2.3.
- Added Lower Limit of Quantitation information.
- Updated Appendix C.

*A review of this SOP in March 2018 determined no revisions were necessary. Therefore OnSite Environmental opted to not create a new revision number for this SOP solely to state this fact.

Table of Contents

1.0 Scope and Application

1.1 The purpose of this method is to quantitatively determine concentrations of semivolatile petroleum hydrocarbons from *n*-C_9 to *n*-C_{40} in water, soil, and product.

1.2 The reporting limits for NWTPH-Dx are located in Appendix A.

2.0 Summary of Method

2.1 Extract water samples by measuring out 500 mL of sample and extracting it three times with methylene chloride using a separatory funnel.

2.2 Extract soil samples by measuring out 20g of soil into a beaker, drying the sample with sodium sulfate, and extracting it three times with methylene chloride using a sonicator.

2.3 Alternatively, soil samples may be extracted by way of microwave extraction by measuring out 5g of soil into a vessel, drying the sample with sodium sulfate, and adding methylene chloride.

2.4 Product samples are diluted directly into methylene chloride.

2.5 Extracts may be cleaned using silica gel and/or sulfuric acid.

2.6 The extracts are concentrated and then analyzed by GC/FID.

3.0 Definitions

3.1 Reagent Water – Water free of target analytes or interferences greater than the reporting limits for this SOP. Also referred to as deionized water.

3.2 Method Blank (MB) – A sample aliquot (usually reagent water or Ottawa sand) free from target analytes is treated exactly as a sample including exposure to all glassware, equipment, solvents and surrogates. The MB is used to determine if method analytes or other interferences are present in the laboratory environment, the solvents or the equipment.

3.3 Spike Blank (SB) – A sample aliquot (usually reagent water or Ottawa sand) free from target analytes to which known quantities of method analytes are added. The spike blank is treated exactly as a sample. The spike blank is used to determine whether the methodology is in control and to indicate the accuracy associated with laboratory procedures. Also referred to as a Laboratory Control Sample (LCS).

3.4 %R: Percent Recovery

3.5 RPD: Relative Percent Difference

3.6 SOP: Standard Operating Procedure

3.7 GC: Gas Chromatograph

3.8 FID: Flame Ionization Detector

3.9 ICV: Initial Calibration Verification

3.10 CCV: Continuing Calibration Verification

3.11 MDL: Method Detection Limit

3.12 LLOQ: Lower Limit of Quantitation

4.0 Sample Handling and Preservation

4.1 Water samples are collected in pre-preserved 500 mL amber containers to a pH<2 with 1:1 hydrochloric acid (HCl).

4.2 Soil samples are collected in 4-ounce jars.

4.3 All samples should be shipped and stored at 4°C ± 2°C.

4.4 The holding time for soil samples is 14 days from the date of collection.

4.5 The holding time for aqueous samples that have been preserved to pH<2 is 14 days from the date of collection. If aqueous samples have not been preserved, the holding time is 7 days from the date of collection.

4.6 The holding time for sample extracts is 40 days from the date of extraction to the date of analysis.

5.0 Interferences

5.1 Interferences by phthalates can pose a major problem in semivolatile determinations because phthalates are target compounds. Flexible plastics contain varying amounts of phthalates. These phthalates are easily extracted or leached from such materials during laboratory operations. Avoid contact with any plastic materials. Samples can also be contaminated by phthalate esters from an inverted septum during handling of the loaded GC vials. Use Teflon squeeze bottles and non-plasticized tubing where necessary.

5.2 Samples may be cross-contaminated by using a dirty scoopula or by poor rinsing of the sonicator tip between samples. The latter can be avoided by rinsing the tip with methylene chloride between samples.

5.3 Highly contaminated samples can cause carryover contamination on the gas chromatograph. Running solvent blanks after samples suspected of being highly contaminated can prevent this carryover.

5.4 All glassware used for semivolatile analysis must be scrupulously cleaned prior to use. This includes soap and solvent washes.

6.0 Safety

6.1 All reagents and standards must be handled with extreme care due to their possible deleterious health effects. All applicable personal safety equipment must be used at all times when handling chemicals.

6.2 Methylene Chloride: Potentially carcinogenic. Inhalation and ingestion are harmful and may be fatal. Causes damage to skin, cardiovascular system, central nervous system and eyes.

6.3 Acetone: Potentially carcinogenic. Avoid skin contact. Causes damage to kidneys, liver and central nervous system.

7.0 Equipment and Supplies

7.1 Apparatus – GC (Instrument Teri)

- 7.1.1 AT 6890N Network GC System - dual autosamplers
- 7.1.2 OI Flame Ionization Detectors (2)
- 7.1.3 Capillary columns (recommended): J&W DB-5 or Restek Rtx-5 30m, 0.32mm id, with 0.25μm film thickness
- 7.1.4 HP ChemStation for data acquisition and data processing.
- 7.1.5 Carrier gas – Helium, high purity
- 7.1.6 FID Gases
  - 7.1.6.1 Hydrogen, high purity
  - 7.1.6.2 Compressed breathing Air

7.2 Apparatus – GC (Instrument Vigo)

- 7.2.1 AT 7890A GC System – dual autosamplers
- 7.2.2 OI Flame Ionization Detectors (2)
- 7.2.3 Capillary columns (recommended): J&W DB-5 or Restek Rtx-5 30m, 0.32mm id, with 0.25μm film thickness

7.2.4 HP ChemStation for data acquisition and data processing.

7.2.5 Carrier gas – Helium, high purity

7.2.6 FID Gases

7.2.6.1 Hydrogen, high purity

7.2.6.2 Compressed breathing Air

7.3 Apparatus - Extractions

7.3.1 See specific extraction SOP for required equipment and supplies.

7.3.2 Analytical balance capable of measuring accurately to 0.0001g

7.3.3 Syringes - various sizes

7.3.4 Vials - various sizes with Teflon-lined caps

7.3.5 Volumetric flasks - various sizes

8.0 Reagents and Standards

8.1 Reagents

8.1.1 Methylene chloride, analytical grade

8.1.2 Acetone, analytical grade

8.1.3 Sulfuric acid

8.1.4 Water, Organic Free (Reagent Water)

8.1.4.1 The deionized water generator has an activated carbon column designed to remove organic compounds from the water.

8.1.4.2 Depletion of the carbon filter may be indicated by a breakthrough of any organic compound. If this occurs, refer to SOP 8.10 for maintaining the generator.

8.1.5 Ottawa Sand

8.2 Standards

8.2.1 Initial Calibration (ICAL) Standards

8.2.1.1 Diesel Fuel #2 (DF2)

8.2.1.1.1 Diesel Fuel #2 is purchased as a reagent grade neat.

8.2.1.1.2 A 10,000 ppm diesel fuel #2 stock standard is prepared by diluting 0.500g of the neat standard to a final volume of 50 mL in methylene chloride.

8.2.1.2 Diesel Fuel #1 (DF1)

8.2.1.2.1 Diesel Fuel #1 is purchased through AccuStandard at a concentration of 20,000 ppm contained in 1ml ampules.

8.2.1.3 Lube Oil

8.2.1.3.1 Lube oil is purchased as both 30 and 40 weight motor oil.

8.2.1.3.2 Equal amounts of each weight are mixed together to make a 1:1 neat standard mixture.

8.2.1.3.3 A 10,000 ppm lube oil stock standard is prepared by diluting 0.500g of the neat standard to a final volume of 50 mL in methylene chloride.

8.2.1.4 Lube Oil (acid cleaned)

8.2.1.4.1 Prepare the lube oil standard as in 8.2.1.3.

8.2.1.4.2 Thoroughly acid clean the lube oil standard with 1:1 sulfuric acid.

8.2.1.5 Mineral Oil (Transformer Oil)

8.2.1.5.1 Mineral Oil is purchased as a reagent grade neat.

8.2.1.5.2 A 10,000 ppm mineral oil stock standard is prepared by diluting 0.500g of the neat standard to a final volume of 50 mL in methylene chloride.

8.2.2 Initial Calibration Verification (ICV) Standard (DF2 only)

8.2.2.1 Diesel Fuel #2 is purchased as a reagent grade neat from a source other than the one used in 8.2.1.1.1.

8.2.2.2 A 10,000 ppm diesel fuel #2 ICV stock standard is prepared by diluting 0.500g of the ICV neat standard to a final volume of 50 mL in methylene chloride.

8.2.2.3 A working diesel fuel #2 ICV standard is prepared by diluting an aliquot of the stock standard to a concentration of 100 ppm in methylene chloride.

8.2.3 Continuing Calibration Verification (CCV) Standard

8.2.3.1 An aliquot of the diesel fuel #2 ICAL stock standard (8.2.1.1.2) is diluted to a concentration of 100 ppm in methylene chloride.

8.2.3.2 An aliquot of the lube oil ICAL stock standard (8.2.1.3.3) is diluted to a concentration of 200 ppm in methylene chloride.

8.2.3.3 An aliquot of the mineral oil ICAL stock standard (8.2.1.5.2) is diluted to a concentration of 100 ppm in methylene chloride.

8.2.4 Alkane Retention Time Standard

8.2.4.1 The *n*-alkanes retention time standard is purchased through AccuStandard at a concentration of 500 ppm in hexane and contains every even alkane peak from octane (n-C_8) to tetracontane (n-C_{40}).

8.2.4.2 Nonane (n-C_9) is purchased separately as a neat compound.

8.2.4.3 The retention time standard can be run straight or diluted 1:1 in methylene chloride.

8.2.4.4 Nonane needs to be diluted by adding 1 drop into a GC vial full of methylene chloride.

8.2.5 Surrogate Standard

8.2.5.1 *o*-Terphenyl is purchased as a reagent grade neat.

8.2.5.2 The neat is diluted into two working concentrations of 2,500 ppm and 10,000 ppm, both in acetone. The 2,500 ppm concentration is used for microwave extractions and the 10,000 ppm concentration is used for sonication extractions.

8.2.5.3 The 10,000 ppm concentration is used for calibration purposes.

8.2.6 Spike Standard

8.2.6.1 A 10,000 ppm diesel fuel #2 spike standard is prepared by diluting 0.500g of the ICAL neat standard (8.2.1.1.1) to a final volume of 50 mL in acetone.

8.2.7 Reference Standards

8.2.7.1 Prepare individual petroleum product reference standards such as kerosene, mineral spirits, etc. from purchased reagent grade neats or certified stocks.

8.2.7.2 Dilute 5 to 10 drops of the neats or stocks to a final volume of 10 mL in methylene chloride and analyze like a sample.

8.2.7.3 These standards will be used qualitatively in the identification of petroleum products by chromatographic pattern matching.

8.2.8 Standard Handling

8.2.8.1 Purchased standards expire on the manufacturer’s date or one year from the date of opening, whichever comes first.

8.2.8.2 Stock standards prepared internally expire one year after preparation or on the manufacturer’s date, whichever comes first.

8.2.8.3 Working surrogate, spike, daily and initial calibration standards expire six months after preparation or on the manufacturer’s date, whichever comes first.

8.2.8.4 These expiration dates hold if no observed degradation of the solutions has taken place. All expired or degraded standards shall be properly disposed to avoid accidental use.

8.2.8.5 Stock and working standards should be kept at –20ºC or according to manufacturer’s recommendation when not in use.

9.0 Quality Control

9.1 Method Blank (MB)

9.1.1 Method blanks are prepared and analyzed for every extraction batch at a 5% frequency (one method blank per extraction batch of 20). The method blank must not contain any target analytes greater than the reporting limit.

9.1.2 Corrective action for contaminated method blanks:

9.1.2.1 If the method blank contains target analytes greater than the reporting limit, the method blank must be reanalyzed.

9.1.2.2 If the method blank is contaminated after reanalysis, corrective action must be taken to identify and eliminate the source of the problem. In this case, the samples may have to be re-extracted prior to reanalysis depending upon the source of the contamination.

9.1.2.3 If the reanalyzed method blank is acceptable, then the method blank and associated samples can be reported.

9.1.2.4 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A non-conformance form must be filled out and the associated data flagged with a "B" qualifier. See SOP 1.18.

9.1.2.5 Baseline subtraction is not allowed when quantitating samples.

9.2 Spike Blank (SB)

9.2.1 Spike blanks are prepared and analyzed for every extraction batch at a 5% frequency (one spike blank per extraction batch of 20).

9.2.2 After analysis, calculate the percent recovery (%R) results as follows:

$$\%R = \frac{C_s}{C_n} \times 100$$

Where:
C_s = Measured concentration of the spike sample aliquot
C_n = Nominal (theoretical) concentration of the spike aliquot

9.2.3 If the %R is out of control, corrective action, as follows, must be taken:

9.2.3.1 Recalculate and check for integration or calculation errors.

9.2.3.2 Double check sample volume/weight, final extract volume, amount spiked and the concentration of the spike solution.

9.2.3.3 If a problem still exists, the spike blank should be reanalyzed. If the reanalysis is acceptable, then report only the reanalysis.

9.2.3.4 If the spike blank is still out of control, then the associated samples must be re-extracted and reanalyzed.

9.2.3.5 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A nonconformance form must be filled out and the associated data flagged with an “I” qualifier. See SOP 1.18.

9.2.4 Control limits for spike blank %R values shall be calculated yearly on actual sample data using SOP 1.22.

9.3 Duplicates

9.3.1 Sample duplicates are prepared and analyzed for every extraction batch at a 10% frequency (one duplicate per extraction batch of 10).

9.3.2 After analysis, calculate the relative percent difference (RPD) on the wet weight results as follows:

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$

Where:
C_1 = Measured concentration of the first sample aliquot
C_2 = Measured concentration of the second sample aliquot

9.3.3 There are no control limits applied to duplicate sample results although the RPD of the duplicate is reported to the client.

9.4 Surrogates

9.4.1 Surrogate recovery is monitored to assess method performance on the particular matrix. Surrogates are added to all samples and quality control samples during extraction and prior to analysis.

9.4.2 Calculate the percent recovery (%R) as follows:

$$\%\mathrm{R} = \frac{\mathrm{Y}}{\mathrm{Z}} \times 100$$

Where:
Y = Surrogate concentration observed in the sample
Z = True concentration of the surrogate added to the sample

9.4.3 The method default control limits of 50-150% will be used.

9.4.4 If the surrogate %R value is out of control, corrective action, as follows, must be taken:

9.4.4.1 Recalculate and check for integration or calculation errors.

9.4.4.2 Double check sample volume/weight, final extract volume, dilution factor, amount spiked and the concentration of the spike solution.

9.4.4.3 If the surrogate %R value cannot be calculated due to a large number of coeluting peaks, the sample may be reported as is and qualified with the “F” qualifier.

9.4.4.4 If the surrogate %R value cannot be calculated due to a large dilution of the sample, the sample may be reported as is and qualified with the “S” qualifier.

9.4.4.5 If a problem still exists, then the sample should be re-extracted and reanalyzed. Document the nonconformance and one of the following resolutions using SOP 1.18:

9.4.4.5.1 If the surrogate %R value is acceptable upon reanalysis, then this data should be reported.

9.4.4.5.2 If the surrogate %R value is still out or there was insufficient sample to reanalyze the sample, then the original data should be reported and the poor surrogate %R value should be flagged with the “Q” qualifier. The case narrative should explain the steps that were taken to try to resolve the problem and that the problem is attributed to the sample matrix.

9.4.4.6 If insufficient sample volume or expired sample holding time prevents re-extraction, then the data can be reported. A nonconformance form must be filled out and the associated data flagged with a “Q” qualifier. See SOP 1.18.

10.0 Calibration and Standardization

10.1 Initial Calibration (ICAL)

10.1.1 Analyze an alkane standard to establish retention time windows (see Appendix B).

10.1.2 Prepare and analyze the calibration working standards for the petroleum product(s) to be quantitated. The diesel fuel #1, diesel fuel #2, lube oil, surrogate, and mineral oil calibration ranges are summarized in Appendix C.

10.1.3 After analyzing each calibration standard, create a calibration curve using peak area versus the concentration of the standard using the ChemStation software.

10.1.3.1 Using linear regression, the coefficient of determination (r^2) must be 0.990 or greater.

10.1.3.2 In addition to the coefficient of determination criteria, each point in the initial calibration may not vary from the true value by more than 15%.

10.1.3.3 For the surrogates, calibrate using peak area by linear regression. Surrogates are identified by their absolute retention times.

10.2 Initial Calibration Verification (ICV)

10.2.1 A second-source Initial Calibration Verification (ICV) standard must be analyzed after the initial curve to verify the validity of the curve. The result must be within 15% of the true value.

10.3 Continuing Calibration Verification (CCV)

10.3.1 Analyze a diesel fuel #2 CCV standard before samples are analyzed, after every twenty injections (ten is recommended to minimize the number of samples that need to be reanalyzed if the CCV fails), and at the end of the sequence. Intervals between CCVs should not exceed 12 hours.

10.3.2 The percent recovery for each analyte should not exceed ±15 percent difference. If this criterion is exceeded for any analyte, analysis may proceed if any of the following occur:

10.3.2.1 If a CCV percent difference is greater than 15% (high bias) for an analyte and the samples it brackets are non-detect for that analyte.

10.3.3 When the CCVs do not pass, corrective action must be taken. This includes:

10.3.3.1 Reanalyzing the standard.

10.3.3.2 Remaking the standard.

10.3.3.3 Changing the liner in the injection port.

10.3.3.4 Cleaning or changing the inlet seal.

10.3.3.5 Clipping a loop of the column and solvent rinsing the injection port.

10.3.3.6 If the above steps do not resolve the problem, then a new initial calibration must be analyzed.

11.0 Procedure

11.1 Instrument Operation

11.1.1 The gas chromatograph should be set to the parameters located in Appendix D.

11.2 Glassware preparation

11.2.1 Glassware and equipment for this procedure should be cleaned using SOP 8.14.

11.3 Soil Extraction Procedure

11.3.1 Refer to SOP 3.07 Ultrasonic Extraction for specific instructions on sample extraction.

11.3.2 Refer to SOP 3.16 Microwave Extraction for specific instructions on sample extraction.

11.4 Water Extraction Procedure

11.4.1 Refer to SOP 3.08 Separatory Funnel Extraction for specific instructions on sample extraction.

11.5 Product preparation

11.5.1 Refer to SOP 3.06 Waste (Product) Dilution for specific instructions on product extraction.

11.6 Sulfuric acid cleanup procedure

11.6.1 The sulfuric acid cleanup is optional unless the client or QAPP requires it or the chemist is suspicious that the material present is a biogenic or biological interferent.

11.6.2 Refer to SOP 3.00 Acid Cleanup of Semivolatile Extracts for specific instructions.

11.7 Silica gel cleanup procedure

11.7.1 The silica gel cleanup is optional unless the client or QAPP requires it or the chemist is suspicious that the material present is a biogenic or biological interferent.

11.7.2 Refer to SOP 3.03 Silica Gel Cleanup for specific instructions.

12.0 Data Reduction and Calculation

12.1 After analyzing each sample, the ChemStation software will automatically integrate the chromatogram and calculate the concentrations (in the extract) of the target analytes and the surrogate within the retention time windows for each target analyte. The analyst should review the integration for each result to verify that the peak(s) was properly integrated. Reintegrate the peak manually, if necessary, using SOP 1.12 to correct for improper integration. The analyst must initial and date all manual integrations.

12.2 The ChemStation has the ability to incorporate dilution factors, sample volumes and dry weight into its calculation. These features are not used. The concentration reported by the ChemStation software is the concentration found in the sample extract, not necessarily the sample itself.

12.3 To calculate the concentration (in ppm for waters and soils) in the actual sample, the chemist enters the following information into a spreadsheet which performs the following calculation:

$$C_s = \frac{(C_{ex})(V_t)(DF)}{(V_s)(DW)}$$

Where:

C_{ex} = Concentration (in µg/mL) reported for the final extract
V_t = Total volume of the final extract (in mL)
DF = Dilution factor (dimensionless). Use a value of 1 if no dilution is done.
V_s = Initial sample volume or mass extracted (in milliliters or grams)
DW = Dry weight of soil (use a value of 1 for water samples)

12.4 Report the results for the unknown samples in mg/L for waters and mg/Kg for soil samples. Round the results to two significant figures.

12.5 Results where any target analyte exceeds the linear range of the calibration curve must be diluted and reanalyzed. The dilution should be made such that the concentration of the dilution falls within the upper half of the calibration curve.

12.6 For samples that contain diesel fuel #2 and lube oil mixtures, the quantitation can be split to better reflect the components of the mixture. During initial calibration, the diesel fuel #2 range is quantitated from C_{10} to C_{22} and the lube oil range is quantitated from C_{22} to C_{40} so no range overlap exists.

12.7 A similar split exists for mineral oil and lube oil. Instead of being split at a specific carbon, the split is found by dividing the overlap of the two ranges by 2.

12.8 The experience of the analyst is very important when “fingerprinting” petroleum hydrocarbons. Retention time of the product, the shape of the product “hump”, the presence or lack of distinct alkane peaks, and the ratios of C_{17} and C_{18} to pristine and phytane are all factors in hydrocarbon identification. It is also very important to have a library of hydrocarbon patterns to match against unknowns in samples.

13.0 Method Performance

13.1 Method Detection Limits/Lower Limits of Quantitation

13.1.1 Method detection limit (MDL) studies and Lower Limit of Quantitation (LLOQ) studies are conducted concurrently and are performed yearly or whenever a significant change in the system or method has occurred.

13.1.2 SOP 1.20 details how to conduct an MDL/LLOQ study.

13.2 Demonstration of Capability

13.2.1 Each new chemist performing extractions or analyzing samples for this method must complete a Demonstration of Capability as outlined in SOP 1.21 to demonstrate that they can achieve documented levels of acceptable precision and accuracy with this method.

13.3 Performance Evaluation Samples

13.3.1 This method is validated through successful ongoing annual single blind performance evaluation samples.

13.4 Ongoing Precision and Accuracy

13.4.1 SOP 1.22 details the procedure necessary to generate QC limits and how to control chart data.

14.0 Pollution Prevention

14.1 This SOP and other similar published analytical methods have been carefully reviewed for possible ways to prevent unnecessary pollution.

14.2 The solvents used in this method pose little threat to the environment when managed properly.

14.3 Standards should be prepared in volumes consistent with laboratory use to minimize the volume of expired standards to be disposed.

15.0 Waste Management

15.1 The appropriate disposal of waste streams from this procedure is addressed in SOP 1.08.

16.0 References

16.1 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 8000D - Determinative Chromatographic Separations*, 3rd Edition, Rev. 4, July 2014.

16.2 Washington State Department of Ecology, *Analytical Methods for Petroleum Hydrocarbons*, Publication # ECY97-602, June 1997.

Appendix A

NWTPH-Dx Reporting Limits

Analyte	**Water (mg/L)**	**Soil/Product (mg/kg)**
Diesel Range	0.25	25
Lube Oil Range	0.40	50

Appendix B

Quantitation Ranges

Diesel Fuel # 1	C_9 – C_{20} (peak starts)
Diesel Fuel # 2	C_{10} - C_{24} (peak starts)
Lube Oil	C_{20} – C_{40} (peak starts)
Lube Oil Acid Cleaned	C_{20} – C_{40} (peak starts)
DF2/Lube Oil as DF2	C_{10} - C_{22} (peak starts)
DF2/Lube Oil as Lube Oil	C_{22} – C_{40} (peak starts)
Mineral Oil	C_{14} – C_{28} (peak starts)
Bunker C (Fuel Oil #6)	C_{10} – C_{40} (peak starts)

Appendix C

Initial Calibration Requirements

	Level	Amount of Stock	Final Volume	Final Concentration
Diesel Fuel #1	1	50 µL (2000 ppm)	10 mL	10 ppm
	2	100 µL (2000 ppm)	10 mL	20 ppm
	3	50 µL	10 mL	100 ppm
	4	250 µL	10 mL	500 ppm
	5	500 µL	10 mL	1000 ppm
	6	1000 µL	10 mL	2000 ppm
	7	2500 µL	10 mL	5000 ppm

	Level	Amount of Stock	Final Volume	Final Concentration
Diesel Fuel #2	1	10 µL	10 mL	10 ppm
	2	20 µL	10 mL	20 ppm
	3	100 µL	10 mL	100 ppm
	4	500 µL	10 mL	500 ppm
	5	1000 µL	10 mL	1000 ppm
	6	2500 µL	10 mL	2500 ppm
	7	5000 µL	10 mL	5000 ppm

	Level	Amount of Stock	Final Volume	Final Concentration
Lube Oil & ACU	1	40 µL	10 mL	40 ppm
	2	100 µL	10 mL	100 ppm
	3	250 µL	10 mL	250 ppm
	4	500 µL	10 mL	500 ppm
	5	1000 µL	10 mL	1000 ppm

	Level	Amount of Stock	Final Volume	Final Concentration
Surrogate	1	10 µL	25 mL	4 ppm
	2	20 µL	25 mL	8 ppm
	3	50 µL	25 mL	20 ppm
	4	100 µL	25 mL	40 ppm
	5	200 µL	25 mL	80 ppm
	6	500 µL	25 mL	200 ppm

	Level	Amount of Stock	Final Volume	Final Concentration
Mineral Oil	1	20 µL	10 mL	20 ppm
	2	100 µL	10 mL	100 ppm
	3	500 µL	10 mL	500 ppm
	4	1000 µL	10 mL	1000 ppm
	5	2500 µL	10 mL	2500 ppm
	6	5000 µL	10 mL	5000 ppm

Appendix D

GC Program

GC	AT 6890N (Teri)	AT 7890A (Vigo)
Initial Temperature:	50°C	50°C
Initial Time:	4 minutes	4 minutes
Ramp:	14°C/minute to 300ºC	14°C/minute to 300ºC
Final Time:	13 minutes	14 minutes
Injector Temperature:	320°C	320°C
Detector Temperatures:	320°C	320°C
Hydrogen Flow:	40 mL/minute	40 mL/minute
Make-up Flow:	24.7 mL/minute	25 mL/minute
Air Flow:	450 mL/minute	450 mL/minute
Column head pressure:	approx. 20 psi	37-38 psi

OnSite Environmental Inc.
Redmond, Washington

Polynuclear Aromatic Hydrocarbons by GC/MS using Single Ion Monitoring (SIM)
Method 8270-SIM

Prepared by: ____________________ Date: __________
Zeus Thornton, Analytical Chemist

Reviewed by: ____________________ Date: __________
Karl Hornyik, Lab Manager

Approved by: ____________________ Date: __________
Stacey Duran, QA/QC Officer

Revision History

Origination Date: 11/27/2000

Revision 2.0 (12/10/02)
SOP revised to new format. SOP officially revised using SOP 1.00.02 to revision 4.11.02.

Revision 3.0 (06/16/03)

1. SOP updated with new spiking levels. Waters were being spiked at too high of a concentration.
2. References to "reporting limit" were changed to "practical quantitation limit" as was suggested by the Weston audit.
3. Instrument serial numbers were included as suggested by Weston audit.
4. Internal standard concentration and spiking volumes were adjusted to what is currently being done. Changed procedure so that soils and waters are spiked the same to avoid confusion.
5. Changed column to 0.50 μf film thickness that is currently being used.
6. Small editing changes throughout to correct hard to read or confusing sentences.
7. ICAL standard concentrations changed to 10, 20, 50, 100, 200, 500, 1000, 5000 ppb.
8. ICV/CCV concentration changed to 500 ppb.
9. Alumina column cleanup steps added.
10. DFTPP now analyzed with same GC program as all standards and samples.
11. Edited Appendix B with updated GC parameters.
12. Added injection port information (drilled Uniliner with glass wool) to equipment list.

Revision 4.0 (08/18/03)
SOP revised to use a SB/MS/MSD standard spike concentration of 5 ppm in acetone. Amount spiked into soil extractions was reduced from 1 mL to 500 μL.

PQLs were changed from 0.0087 mg/kg to 0.0067 mg/kg for PAH soils.

Revision 5.0 (05/04/06)
SOP revised to remove 50:50 methylene chloride/acetone mix reference and to add the rinsing of the filter paper to the extraction procedure.

Revision 6.0 (09/29/06)
SOP revised to comply with Method 8270D.

1. The mean %RSD changed from 15% to 20%.
2. The %RSD for any single target compound changed from 15% to 20%.
3. Edited Appendix C with updated criteria.
4. Added tailing factor with calculations (Figure 1).
5. Updated References with Method 8270D.

Revision 7.0 (11/27/07)

1. SOP revised to add Solid Phase Extraction (SPE) for waters.
2. SOP revised to add DryVap alternative to N-evap.
3. Updated column brand.
4. Edited surrogate/spiking solution.
5. Added references for DryVap and SPE.
6. Added Surrogate Pyrene-d10 to surrogate list and Appendices D and E.

Revision 8.0 (11/28/12)

1. Under Summary of Method, changed ethylacetate to acetone in the water SPE summary.
2. The column used for GC/MS Corey changed to DB-8270D 20m x .18mm x .18uf replacing DB-8270D 30m x .25mm x 50uf. This cuts the run time to 14 mins.
3. Streamlined Procedures section by removing explicit details for specific apparatuses and referring to the SOP governing each specific apparatus.
4. In the Procedures section, added microwave extraction (SOP 3.16) for soil extractions.
5. Added reference to SOP 8.14 for glassware cleaning instructions.
6. Changed Appendix B as follows:
    - Changed the GC oven temperature from 40°C to 45°C;
    - Changed the GC inlet temperature from 250°C to 280°C; and
    - Reduced the hold time on the run from 11 min. to 8 min., thereby decreasing the run time from 30 min. to 26.67 min.
    - Changed parameters for Corey (6890) to accommodate the new column.
7. Updated references to reflect current methods.

Revision 9.0 (04/17/14)

1. Changed the alumina cleanup to a recommended step rather than a required one.

Revision 10.0 (01/13/16)

1. Added new GC/MS (Jessie) to Section 6.0 and Appendix B.
2. Changed “pesticide grade” to “analytical grade” in Section 7.0.
3. Replaced step-by-step procedures in Section 11.0 with direction to specific SOPs for soil and water extractions.
4. Changed the initial GC oven temperature to 50 degrees in Appendix B.

Revision 11.0 (07/05/17)

Added Lower Limit of Quantitation information.

Revision 12.0 (01/31/18)

- Changed Section 10.1.1 to reference Appendix C.
- Updated “References” section.

Table of Contents

1.0 Scope and Application

1.1 The purpose of this method is to quantitatively determine concentrations of polynuclear aromatic hydrocarbons (PAHs) in water and soil.

1.2 The practical quantitation limits (PQLs) for PAHs in water and soil are summarized in Appendix A.

2.0 Summary of Method

2.1 Water samples without heavy sediment are extracted by Solid Phase Extraction (SPE). This extraction is accomplished by pressure-pulling the sample through an extraction disk and then using acetone and methylene chloride to rinse the sample disk, under vacuum pressure, into a concentrator tube.

2.2 Water samples with heavy sediment are extracted by measuring out 1000 mL and extracting it three times with methylene chloride using a separatory funnel.

2.3 Soil samples are extracted by measuring out 30g of soil into a beaker, drying the sample with sodium sulfate, and extracting it three times with methylene chloride using a sonicator.

2.4 Soil samples can also be extracted by microwave extraction. The extraction uses microwave energy to produce analyte recovery equivalent to sonication.

2.5 The extracts are concentrated under a stream of nitrogen. Water extracts are concentrated to a 1.0 mL final volume. Soil extracts are concentrated to a 5.0 mL final volume. A sub-aliquot of each extract is then spiked with internal standards and analyzed by GC/MS using the single ion monitoring (SIM) technique.

3.0 Definitions

3.1 Reagent Water – Water free of target analytes or interferences greater than the reporting limits for this SOP. Also referred to as deionized water.

3.2 Method Blank (MB) – A sample aliquot (usually reagent water or Ottowa sand) free from target analytes is treated exactly as a sample including exposure to all glassware, equipment, solvents and surrogates. The method blank is used to determine if method analytes or other interferences are present in the laboratory environment, the solvents or the equipment.

3.3 Spike Blank (SB) – A sample aliquot (usually reagent water or Ottowa Sand) free from target analytes to which known quantities of method analytes are added. The spike blank is treated exactly as a sample. The spike blank is used to determine whether the methodology is in control and to indicate the accuracy associated with laboratory procedures. Also referred to as a Laboratory Control Sample (LCS).

3.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD) – Two aliquots of the same sample to which known quantities of the method analytes are added. The MS and MSD are treated exactly like any other sample. The MS and MSD are used to determine whether the sample matrix contributes bias to the sample results and to indicate the precision associated with laboratory procedures.

3.5 %R: Percent Recovery

3.6 RPD: Relative Percent Difference

3.7 SOP: Standard Operating Procedure

3.8 GC: Gas Chromatograph

3.9 MS: Mass Spectrometer

3.10 ICV: Initial Calibration Verification

3.11 CCV: Continuing Calibration Verification

3.12 MDL: Method Detection Limit

3.13 PAH: Polynuclear Aromatic Hydrocarbons

3.14 SPE: Solid Phase Extraction

4.0 Interferences

4.1 Samples may be cross-contaminated by using a dirty scoopula or by poor rinsing of the sonicator tip between samples. The latter can be avoided by rinsing the tip with methylene chloride between samples.

4.2 Highly contaminated samples can cause carryover contamination on the gas chromatograph. Running reagent blanks after samples suspected of being highly contaminated can prevent this carryover.

4.3 All glassware used for PAH analysis must be scrupulously cleaned prior to use. This includes soap and solvent washes.

4.4 Sodium sulfate must be muffled before use in semivolatile samples. Bake in a muffle oven at 400°C for at least four hours.

4.5 The DryVap can be a source of carryover contamination. The coils must be cleaned prior to use.

5.0 Safety

5.1 All reagents and standards must be handled with extreme care due to their possible deleterious health effects. All applicable personal safety equipment must be used at all times when handling chemicals.

5.2 Acetone: Potentially carcinogenic. Avoid skin contact. Causes damage to kidneys, liver and central nervous system.

5.3 Methylene Chloride: Potentially carcinogenic. Inhalation and ingestion are harmful and may be fatal. Causes damage to skin, cardiovascular system, central nervous system and eyes.

6.0 Equipment and Supplies

6.1 Apparatus – GC/MS (Instrument Ralph)

6.1.1 Hewlett Packard 5890 Series II Plus Gas Chromatograph equipped with electronic pressure control (EPC) (Serial #3336A55281)

6.1.2 Hewlett Packard Mass Selective Detector – Model 5972 (Serial #3434A01677)

6.1.3 Capillary column:

6.1.3.1 Agilent DB-8270D (or equivalent): 30 meter by 0.25 mm id by 0.50 μm film thickness

6.1.4 HP ChemStation for data acquisition and data processing

6.1.5 Carrier gas – Helium

6.1.6 Injection port:

6.1.6.1 Uniliner with a drilled hole for use with EPC, silanized

6.1.6.2 Silanized glass wool

6.1.6.3 Gold seal

6.2 Apparatus – GC/MS (Instrument Corey)

6.2.1 Hewlett Packard 6890 Series Gas Chromatograph equipped with electronic pressure control (EPC) (Serial #US00007773)

6.2.2 Hewlett Packard Mass Selective Detector – Model 5973 (Serial #US82321650)

6.2.3 Capillary columns:

6.2.3.1 Agilent DB-8270D (or equivalent): 20 meter by 0.18 mm id by 0.18 µm film thickness

6.2.4 HP ChemStation for data acquisition and data processing

6.2.5 Carrier gas – Helium

6.2.6 Injection port:

6.2.6.1 Uniliner with a drilled hole for use with EPC, silanized

6.2.6.2 Silanized glass wool

6.2.6.3 Gold seal

6.3 Apparatus – GC/MS (Instrument Jessie)

6.3.1 Hewlett Packard 6890 Series Gas Chromatograph equipped with electronic pressure control (EPC) (Serial #US00033566)

6.3.2 Hewlett Packard Mass Selective Detector – Model 5973 (Serial #US94260049)

6.3.3 Capillary columns:

6.3.3.1 Agilent DB-8270D (or equivalent): 30 meter by 0.25 mm id by 0.50 µm film thickness

6.3.4 HP ChemStation for data acquisition and data processing

6.3.5 Carrier gas – Helium

6.3.6 Injection port:

6.3.6.1 Uniliner with a drilled hole for use with EPC, silanized

6.3.6.2 Silanized glass wool

6.3.6.3 Gold seal

7.0 Reagents and Standards

7.1 Reagents

7.1.1 Methylene chloride, analytical grade

7.1.2 Acetone, analytical grade

7.1.3 Water, Organic Free (Reagent Water)

7.1.3.1 The deionized water generator has an activated carbon column designed to remove organic compounds from the water.

7.1.3.2 Depletion of the carbon filter may be indicated by a breakthrough of any organic compound. If this occurs, refer to SOP 8.10 for maintaining the generator.

7.1.4 Sodium sulfate, anhydrous powder

7.1.4.1 Muffle furnace sodium sulfate for 4 hours at 400°C before using.

7.1.5 Sulfuric acid, 1:1

7.2 Standards

7.2.1 Initial Calibration Standards

7.2.1.1 PAH Initial Calibration Stock Standard: PAH compound mix is purchased as a certified stock. This standard is combined with the surrogate mix to form a single stock standard at a concentration of 10 ppm in methylene chloride.

7.2.1.2 PAH CCV Standard: The stock standard is diluted to a concentration of 0.5 ppm in methylene chloride.

7.2.2 Initial Calibration Verification Standard

7.2.2.1 PAH ICV Stock Standard: PAH compound mix is purchased as a certified stock from a source other than the initial calibration. The stock standard is diluted to 10 ppm in methylene chloride.

7.2.2.2 PAH ICV Standard: The ICV stock standard is diluted to a concentration of 0.5 ppm in methylene chloride.

7.2.3 Tuning Standard

7.2.3.1 Stock Tuning Standard: The tuning solution containing decafluoro-triphenylphosphine (DFTPP), pentachlorophenol (PCP), DDT, and benzidine in methylene chloride is purchased as a certified stock standard.

7.2.3.2 Working Tuning Standard: The stock solution is diluted to a concentration of 50 ppm in methylene chloride so that a 1 µL injection delivers 50 ng of each analyte as required by the reference method.

7.2.4 Internal Standard

7.2.4.1 Internal Standard Stock Standard: The internal standard solution is purchased as a certified standard. The standard contains 6 deuterated compounds: 1,4-dichlorobenzene-d4, naphthalene-d8, acenaphthene-d10, phenanthrene-d10, chrysene-d12, and perylene-d12.

7.2.4.2 Internal Standard Working Standard: The working standard is prepared by diluting the stock solution to a concentration of 40 ppm in methylene chloride.

7.2.5 Surrogate Standard

7.2.5.1 Surrogate Standard Stock Standard: A surrogate mix containing nitrobenzene-d5, 2-fluorobiphenyl, pyrene-d10, and terpehenyl-d14 is purchase as a certified stock standard. Nitrobenzene-d5 is not used.

7.2.5.2 Surrogate Standard Working Standard: The working standard is prepared by diluting the stock solution to a concentration of 10 ppm in acetone.

7.2.6 Spiking Solution

7.2.6.1 Spike Stock Solution: A PAH compound mix containing all PAH compounds (2-methylnaphthalene and 1-methylnaphthalene are not reported) is purchased as a certified stock.

7.2.6.2 Intermediate Spike Stock Solution: The certified spike stock solution is diluted to an intermediate Spike Stock Solution of 100 ppm in methylene chloride.

7.2.6.3 Spike Working Solution: The working solution is prepared by diluting the intermediate spike stock solution to a concentration of 5 ppm in acetone.

7.2.7 Standard Handling

7.2.7.1 Purchased standards expire on the manufacturer’s date or one year from the date of opening, whichever comes first.

7.2.7.2 Stock standards prepared internally expire one year after preparation or on the manufacturer’s date, whichever comes first.

7.2.7.3 Working surrogate, spike, internal standard, tuning standard, daily and initial calibration standards expire six months after preparation or on the manufacturer’s date, whichever comes first.

7.2.7.4 These expiration dates hold if no observed degradation of the solutions has taken place. All expired or degraded standards shall be properly disposed to avoid accidental use.

7.2.7.5 Stock and working standards should be kept in the standards freezer or according to manufacturer's recommendation when not in use.

8.0 Sample Collection, Preservation and Storage

8.1 Water samples are collected in unpreserved, one-liter amber containers.

8.2 Soil samples are collected in 4-ounce jars.

8.3 All samples should be shipped and stored at 4°C ± 2°C.

8.4 The holding time (from collection) for extraction of PAHs is 7 days for waters and 14 days for soils. Holding time for analysis of the extract is 40 days.

9.0 Quality Control

9.1 Method Blank (MB)

9.1.1 Method blanks are prepared and analyzed for every extraction batch at a 5% frequency (one method blank per extraction batch of 20). The method blank must not contain any target analytes greater than the reporting limit.

9.1.2 Corrective action for contaminated method blanks:

9.1.2.1 If the method blank contains target analytes greater than the reporting limit, the method blank must be reanalyzed.

9.1.2.2 If the method blank is contaminated after reanalysis, corrective action must be taken to identify and eliminate the source of the problem. In this case, the samples may have to be re-extracted prior to reanalysis depending upon the source of the contamination.

9.1.2.3 If the reanalyzed method blank is acceptable, then the method blank and associated samples can be reported.

9.1.2.4 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A nonconformance form must be filled out, and the associated data is flagged with a "B" qualifier. See SOP 1.18.

9.2 Spike Blank (SB)

9.2.1 Spike blanks are prepared and analyzed for every extraction batch at a 5% frequency (one spike blank per extraction batch of 20).

9.2.2 After analysis, calculate the percent recovery (%R) results as follows:

$$\%R = \frac{C_s}{C_n} \times 100$$

Where:
C_s = Measured concentration of the spike sample aliquot
C_n = Nominal (theoretical) concentration of the spike aliquot

9.2.3 If the %R is out of control, corrective action, as follows, must be taken:

9.2.3.1 Recalculate and check for integration or calculation errors.

9.2.3.2 Double check sample volume/weight, final extract volume, amount spiked and the concentration of the spike solution.

9.2.3.3 If a problem still exists, the spike blank should be reanalyzed. If the reanalysis is acceptable, then report only the reanalysis.

9.2.3.4 If the spike blank is still out of control, then the associated samples must be re-extracted and reanalyzed.

9.2.3.5 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A nonconformance form must be filled out, and the associated data is flagged with an “I” qualifier. See SOP 1.18.

9.2.4 Control limits for spike blank %R values shall be calculated yearly on actual sample data using SOP 1.22.

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

9.3.1 MS/MSD samples are prepared and analyzed for every extraction batch at a 5% frequency (one MS/MSD pair per extraction batch of 20).

9.3.2 An SB/SBD will be prepared in lieu of an MS/MSD if the client submits insufficient sample volume to analyze an MS/MSD.

9.3.3 After analysis, calculate the percent recovery (%R) on the wet weight results as follows:

$$\%R = \frac{C_s - C_u}{C_n} \times 100$$

Where:

C_s = Measured concentration of the spike sample aliquot
C_u = Measured concentration of the unspiked sample aliquot
C_n = Nominal (theoretical) concentration of the spike aliquot

9.3.4 If the %R is out of control, corrective action, as follows, must be taken:

9.3.4.1 Recalculate and check for integration or calculation errors.

9.3.4.2 Double check sample volume/weight, final extract volume, amount spiked and the concentration of the spike solution.

9.3.4.3 If the sample concentration exceeds more than four to five times what was spiked, the %R value is statistically meaningless. Flag any %R outliers with the “A” qualifier.

9.3.4.4 If a problem still exists, then the spike blank should be evaluated. If the %R values in the spike blank are acceptable, then document the non-conformance and one of the following resolutions using SOP 1.18:

9.3.4.4.1 If the %R value is out of control similarly in both the MS and the MSD, then the problem can be attributed to a matrix effect. Qualify the %R outliers with the “V” qualifier.

9.3.4.4.2 If the %R value is out in one of the samples but not in the other one, then the analyst should use professional judgement to determine a course of action.

9.3.4.5 If the spike blank %R value is out of control, then the spike blank and the MS/MSD pair should be reanalyzed. If the %R values are acceptable, then the results from the reanalysis only should be reported. If the spike blank still fails, then the entire extraction batch associated with this QC set should be re-extracted and reanalyzed.

9.3.4.6 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A nonconformance form must be filled out, and the associated data must be flagged with an “I” qualifier. See SOP 1.18.

9.3.5 Control limits for MS/MSD %R values shall be calculated yearly on actual sample data using SOP 1.22.

9.3.6 After analysis, calculate the relative percent difference (RPD) on the wet weight results as follows:

$$RPD = \frac{\left|C_1 - C_2\right|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$

Where:
C_1 = Measured concentration of the first sample aliquot
C_2 = Measured concentration of the second sample aliquot

9.3.7 If the RPD is out of control, corrective action, as follows, must be taken:

9.3.7.1 Recalculate and check for integration or calculation errors.

9.3.7.2 Double check sample volume/weight, final extract volume, amount spiked and the concentration of the spike solution.

9.3.7.3 If the RPD value is still out of control, then the analyst should use professional judgement to determine a course of action. Document the nonconformance and the resolution using SOP 1.18.

9.3.8 Control limits for MS/MSD RPDs shall be calculated yearly on actual sample data using SOP 1.22.

9.4 Surrogates

9.4.1 Nitrobenzene-d5, 2-fluorobiphenyl, pyrene-d10, and terphenyl-d14 are used as surrogates for this analysis. (Nitrobenzene-d5 is not used.) Surrogate recovery is monitored to assess method performance on the particular matrix. Surrogates are added to all samples and quality control samples prior to extraction and analysis.

9.4.2 Calculate the percent recovery (%R) as:

$$\%R = \frac{C_s}{C_n} \times 100$$

Where:
C_s = Measured concentration of the surrogate in the sample
C_n = Nominal (theoretical) concentration of the surrogate spiked into the sample

9.4.3 If the surrogate %R value is out of control, corrective action must be taken:

9.4.3.1 Recalculate and check for integration or calculation errors.

9.4.3.2 Double check sample volume/weight, final extract volume, amount spiked and the concentration of the spike solution.

9.4.3.3 If the surrogate %R value cannot be calculated due to a large dilution of the sample, the sample is reported and flagged with the “S” qualifier.

9.4.3.4 It is acceptable for one surrogate to be out of control (as long as the percent recovery is greater than 10%) without requiring re-extraction. Document the nonconformance using SOP 1.18.

9.4.3.5 If more than one surrogate is out of control, then the sample must be re-extracted and/or reanalyzed. Document the non-conformance using SOP 1.18 and follow one of the resolutions:

9.4.3.5.1 If the surrogate %R value is acceptable upon reanalysis, then this data should be reported.

9.4.3.5.2 If the surrogate %R value is still out of control upon reanalysis, the sample must be re-extracted.

9.4.3.5.3 If upon re-extraction the surrogate %R value is acceptable, report the re-extraction data and document the nonconformance using SOP 1.18.

9.4.3.5.4 If upon re-extraction the surrogate %R value is still out of control, the original sample data should be reported and the surrogate outlier flagged with the “Q” qualifier. The case narrative should document that the poor surrogate recovery was confirmed due to the sample matrix.

9.4.3.6 If insufficient sample volume or expired sample holding time prevents re-extraction, then the data can be reported. A nonconformance form must be filled out and the associated data flagged with a “Q” qualifier. See SOP 1.18.

9.4.4 Control limits for surrogate %R values shall be calculated yearly on actual sample data using SOP 1.22.

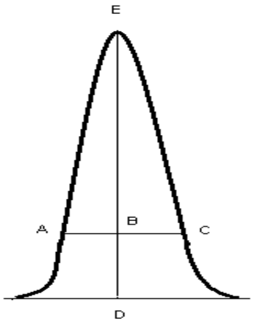
10.0 Calibration and Standardization

10.1 Tuning Standard (DFTPP)

10.1.1 Before the initial calibration (ICAL) or continuing calibration verification (CCV) is analyzed, the GC/MS system must be tuned with decafluorotriphenylphosphine (DFTPP). The resulting mass spectrum must meet the abundance requirements listed in Appendix C.

10.1.2 The standard is diluted to a working concentration of 5 ppm in acetone. The GC/MS tuning standard (DFTPP) should also be used to assess GC column performance and injection port inertness. Benzidine and pentachlorophenol should not exceed a tailing factor of 2 given by the equation in Figure 1.

Figure 1 .



Tailing Factor = BC/AB

10.1.3 All QC samples and client samples must be injected within 12 hours after the injection of the DFTPP tuning standard.

10.2 Initial Calibration (ICAL)

10.2.1 A calibration curve requires at least five points. Eight points are typically analyzed at concentrations of 0.010, 0.020, 0.050, 0.100, 0.200, 0.500, 1.0, and 5.0 ppm.

10.2.2 Refer to Appendix D for a list of which internal standard is associated with each target compound and Appendix E for a table of primary ions used.

10.2.3 Analyze each calibration standard and create a calibration curve using the internal standard approach. Use peak areas versus the concentrations of the standard and the appropriate internal standard using the ChemStation software.

10.2.4 The ChemStation software can be set to model the internal standard calibration procedure (Sections 11.3.3 through 11.3.6) outlined in Method 8270D.

10.2.5 The Initial Calibration (ICAL) must meet the following specifications before analysis can proceed:

10.2.5.1 The mean %RSD for all compounds must be less than 20%.

10.2.5.2 If the percent relative standard deviation (%RSD) for any single target compound should exceed 20%, then the response factor should not be used and the ChemStation software should be set to use one of the alternative calibration procedures outlined in Method 8000.

10.2.5.3 For linear regression techniques, the correlation coefficient (r) must be equal to or greater than 0.990.

10.2.5.4 For non-linear (quadratic) techniques, the coefficient of determination (r^2) must be equal to or greater than 0.990 using a minimum of six calibration points.

10.3 Initial Calibration Verification (ICV)

10.3.1 After the initial calibration meets method criteria, a second-source initial calibration verification (ICV) standard must be analyzed as a check on the initial curve and calibration standards.

10.3.2 The percent difference (or percent drift as appropriate for the calibration technique) for all compounds must be within 30%.

10.4 Continuing Calibration Verification (CCV)

10.4.1 Analyze a continuing calibration verification standard every 12 hours immediately following the DFTPP tuning standard but before QC samples and client samples are analyzed.

10.4.1.1 Each PAH compound must have a percent difference (or drift) equal to or less than 20%.

10.4.2 When the CCV does not pass, corrective action needs to be taken. This may include:

10.4.2.1 Remaking the standard.

10.4.2.2 Changing the liner in the injection port.

10.4.2.3 Cleaning or changing the inlet seal.

10.4.2.4 Clipping a loop off the column and solvent rinsing the injection port.

10.4.2.5 If the above steps do not resolve the problem, then a new initial calibration must be analyzed.

11.0 Procedure

11.1 Instrument Operation

11.1.1 The recommended GC temperature and pressure programs are located in Appendix B.

11.2 Glassware Preparation

11.2.1 Refer to SOP 8.14 Glassware Cleaning and Washing for additional instructions.

11.3 Ultrasonic Soil Extraction Procedure

11.3.1 Refer to SOP 3.07 Ultrasonic Extraction for specific instructions on sample extraction.

11.3.2 Refer to SOP 3.11 DryVap Procedure and Maintenance or SOP 3.12 RapidVap N2 Procedure and Maintenance for specific instructions on concentrating the extract.

11.3.3 Refer to SOP 3.02 Alumina Cleanup for PAHs for specific instructions for extract cleanup.

11.4 Microwave Soil Extraction Procedure

11.4.1 Refer to SOP 3.16 Microwave Extraction for specific instructions on sample extraction.

11.4.2 Refer to SOP 3.11 DryVap Procedure and Maintenance or SOP 3.12 RapidVap N2 Procedure and Maintenance for specific instructions on concentrating the extract.

11.4.3 Refer to SOP 3.02 Alumina Cleanup for PAHs for specific instructions for extract cleanup.

11.5 Water Extraction Procedure - Solid Phase Extraction (SPE)

11.5.1 Refer to SOP 3.10 Solid Phase Extraction for specific instructions on sample extraction.

11.5.2 Use the separatory funnel procedure for water samples with heavy sediment.

11.5.3 Refer to SOP 3.11 DryVap Procedure and Maintenance for specific instructions on concentrating the extract.

11.6 Water Extraction Procedure – Separatory Funnel Extraction

11.6.1 Refer to SOP 3.08 Separatory Funnel Extraction for specific instructions on sample extraction.

11.6.2 Refer to SOP 3.11 DryVap Procedure and Maintenance for specific instructions on concentrating the extract.

11.7 Pre-analysis Sample Preparation

11.7.1 Using a clean syringe, transfer a 200 µL aliquot of the sample extract to a GC vial equipped with an insert.

11.7.2 Alternatively, dilute the sample extract as necessary based on the sample matrix.

11.7.3 Add 10 µL of internal standard for every 200 µL of extract.

11.7.4 Cap the vial and invert three times to mix the extract well.

11.7.5 Label the vial and analyze on a calibrated instrument.

12.0 Data Reduction and Calculation

12.1 After analyzing each sample, the ChemStation software will automatically integrate the chromatogram and calculate the concentration (in the extract) of any peaks within the retention time window for each target analyte. The analyst should review the integration for each positive result to verify that the peak was properly integrated. Reintegrate the peak manually, if necessary, using SOP 1.12 to correct for improper integration. The analyst must initial and date all manual integrations.

12.2 Compounds are identified by the following criteria:

12.2.1 The relative retention time of a compound is within ±0.06 minutes of the same compound in the CCV.

12.2.2 The experience of the analyst determines that the compound is present despite interferences from coeluting compounds.

12.3 If the area response of any of the internal standards in the sample extracts differs by a factor of two (-50% to +100%) from that of the calibration verification standard, the following corrective actions must be taken:

12.3.1 Check for integration errors.

12.3.2 Verify that the internal standard solution has not concentrated by evaporation during use by checking the internal standard area counts of the method blank versus the CCV standard. Remake the internal standard solution if this is indicated.

12.3.3 Remake and reanalyze the sample extract.

12.3.3.1 If the reanalysis yields acceptable internal standard response, report the reanalyzed data. It is not necessary to document the nonconformance.

12.3.3.2 If the internal standard response is still out of control, the compounds associated with that internal standard may be calculated based on the nearest internal standard that is in control. Alternately, the sample may be diluted and reanalyzed to eliminate the interference.

12.3.3.2.1 The response factor (RF) for the compound using the new internal standard must first be calculated from the continuing calibration verification using the formula:

$$\mathrm{RF} = \frac{(\mathrm{A_S})(\mathrm{C_{IS}})}{(\mathrm{A_{IS}})(\mathrm{C_S})}$$

Where:
$\mathrm{A_S}$ = Peak area of the analyte
$\mathrm{A_{IS}}$ = Peak area of the internal standard
$\mathrm{C_S}$ = Concentration of the analyte
$\mathrm{C_{IS}}$ = Concentration of the internal standard

12.3.3.2.2 The concentration of the compounds can then be recalculated manually using the new internal standard and the response factor established above.

$$C_s = \frac{(A_S)(C_{IS})}{(A_{IS})(RF)}$$

12.4 The QDEL function should be used to remove any false positives from the quantitation report before the report is generated.

12.5 The concentration reported by the ChemStation software is the concentration (ng/mL) found in the sample extract, not the sample itself.

12.6 To calculate the concentration (ppb for waters and ppm for soils) in the actual sample, the chemist electronically links the ChemStation data file to an Excel spreadsheet to avoid transposition errors associated with hand entering data. The chemist enters the sample volume, final volume and dry weight and the spreadsheet performs the following calculation for each analyte:

Soil:

$$C_s = \frac{(C_{ex})(V_t)(DF)}{(V_s)(DW)(1000)}$$

Water:

$$C_s = \frac{(C_{ex})(V_t)(DF)}{(V_s)}$$

Where:
C_{ex} = Concentration (in ng/mL) reported for the final extract
V_t = Total volume of the concentrated final extract (in mL)
DF = Dilution factor (dimensionless). Use a value of 1 if no dilution is performed.
V_s = Initial volume or mass of sample extracted (in mL or g)
DW = Dry weight of soil

12.7 Report the results for the unknown samples in μg/L for waters and mg/kg for soils. Round the results to two significant figures.

12.8 Results that exceed the linear range of the calibration curve must be diluted and reanalyzed.

13.0 Method Performance

13.1 Demonstration of Capability:

13.1.1 Each new chemist performing extractions or analyzing samples for this method must complete a Demonstration of Capability as outlined in SOP 1.21 to demonstrate that they can achieve documented levels of acceptable precision and accuracy with this method.

13.2 Method Detection Limits/Lower Limits of Quantitation

13.2.1 Method detection limit (MDL) studies and Lower Limit of Quantitation (LLOQ) studies are conducted concurrently and are performed yearly or whenever a significant change in the system or method has occurred.

13.2.2 SOP 1.20 details how to conduct an MDL/LLOQ study.

13.3 Performance Evaluation Samples:

13.3.1 This method is validated through successful ongoing annual single blind performance evaluation samples.

13.4 Ongoing Precision and Accuracy:

13.4.1 Spike blank samples (also known as Laboratory Control Samples (LCS)) are analyzed with each extraction batch to track the ongoing precision and accuracy of the method. Percent recovery (%R) QC limits (upper control limits and lower control limits) are statistically derived (3 sigma) as outlined in SW-846.

13.4.2 Control charts are generated to look for undesirable trends in the percent recovery values of QC samples.

13.4.3 SOP 1.22 details the procedures necessary to generate QC limits and how to control chart data.

14.0 Pollution Prevention

14.1 This SOP and other similar published analytical methods have been carefully reviewed for possible ways to prevent unnecessary pollution.

14.2 The solvents used in this method pose little threat to the environment when managed properly.

14.3 Standards should be prepared in volumes consistent with laboratory use to minimize the volume of expired standards to be disposed.

15.0 Waste Management

15.1 The appropriate disposal of waste streams from this procedure is addressed in SOP 1.08.

16.0 References

16.1 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 8270D – Semivolatile Organic Compounds By Gas Chromatography/Mass Spectrometry (GC/MS)*, 3rd Edition, Rev. 5, July 2014.

16.2 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 8000D - Determinative Chromatographic Separations*, 3rd Edition, Rev. 4, July 2014.

16.3 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 3510C - Separatory Funnel Liquid-Liquid Extraction*, 3rd Edition, Rev. 3, December 1996.

16.4 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 3550C - Ultrasonic Extraction*, 3rd Edition, Rev. 3, February 2007.

16.5 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 3535A, Solid-Phase Extraction (SPE)*, 3rd Edition, Revision 1, February 2007.

16.6 J.T. Baker, *Application Note SPD-002*.

16.7 Horizon Technology, *DryVap User's Guide Manual*, Rev. E0906.

Appendix A

Practical Quantitation Limits

COMPOUND	WATER (ug/L)	SOIL (mg/kg)
Naphthalene	0.10	0.0067
2-Methylnaphthalene	0.10	0.0067
1-Methylnaphthalene	0.10	0.0067
Acenaphthylene	0.10	0.0067
Acenaphthene	0.10	0.0067
Fluorene	0.10	0.0067
Phenanthrene	0.10	0.0067
Anthracene	0.10	0.0067
Fluoranthene	0.10	0.0067
Pyrene	0.10	0.0067
Benzo[a]anthracene	0.010	0.0067
Chrysene	0.010	0.0067
Benzo[b]fluoranthene	0.010	0.0067
Benzo[j,k]fluoranthene	0.010	0.0067
Benzo[a]pyrene	0.010	0.0067
Indeno[1,2,3-c,d]pyrene	0.010	0.0067
Dibenz[a,h]anthracene	0.010	0.0067
Benzo[g,h,i]perylene	0.010	0.0067

Appendix B

Instrument Setpoints

5890 Series II (Ralph)

Initial Temperature:	50°C
Initial Time:	1 minute
Ramp L1:	15°C/minute
Final Temperature L1:	100°C
Ramp L2:	20ºC/minute
Final Temperature L2:	240°C
Ramp L3	10°C/minute
Final Temperature L3	310°C
Final Time:	8 minutes
Injector Temperature:	280°C
Detector Temperature:	195°C
Helium Reg. Pressure:	85 psi
Inlet Initial Pressure:	9.2 psi
Carrier flow:	1.2 mL/minute
Purge flow to Split vent:	50 mL/minute
Auxiliary Pressure:	E, 60 psi
EM Voltage	Relative – 0 eV

6890 (Jessie)

Initial Temperature:	50°C
Initial Time:	1 minute
Ramp L1:	15°C/minute
Final Temperature L1:	100°C
Ramp L2:	20ºC/minute
Final Temperature L2:	240ºC
Ramp L3	10°C/minute
Final Temperature L3	310°C
Final Time:	8 minutes
Injector Temperature:	280°C
Detector Temperature:	230°C
Helium Reg. Pressure:	85 psi
Inlet Initial Pressure:	12.38 psi
EM Voltage	Relative – 0 eV

6890 (Corey)

Initial Temperature:	50°C
Initial Time:	1 minute
Ramp L1:	27°C/minute
Final Temperature L1:	100°C
Ramp L2:	36ºC/minute
Final Temperature L2:	240ºC
Ramp L3	18°C/minute
Final Temperature L3	310°C
Final Time:	3.89 minutes
Injector Temperature:	280°C
Detector Temperature:	230°C
Helium Reg. Pressure:	85 psi
Inlet Initial Pressure:	35.63 psi
EM Voltage	Relative – 0 eV

Appendix C

DFTPP Mass Ion Abundance Criteria

m/e	ION ABUNDANCE CRITERIA
51	10-80% of mass 198
68	Less than 2% of mass 69
70	Less that 2% of mass 69
127	10-80% of mass base peak
197	Less than 2% of mass 198
198	Base Peak, or >50% of Mass 442
199	5 to 9% of mass 198
275	10-60% of base peak
365	Greater than 1% of mass 198
441	Present, but less than 24% of mass 442
442	Base peak or >50% of mass 198
443	15-24% of mass 442

CLP tuning criteria has been used as allowed by Method 8270D (Section 11.3.1).

Appendix D

Internal Standards with Corresponding Analytes Assigned for Quantitation

Naphthalene-d8	Acenaphthene-d10	Phenanthrene-d10
Nitrobenzene-d5 (surr)	2-Fluorobiphenyl (surr)	Phenanthrene
Naphthalene	Acenaphthylene	Anthracene
2-Methylnaphthalene	Acenaphthene	Fluoranthene
1-Methylnaphthalene	Fluorene	

Chrysene-d12	Perylene-d12
Pyrene	Benzo[b]fluoranthene
Terphenyl-d14 (surr)	Benzo[j,k]fluoranthene
Benzo[a]anthracene	Benzo[a]pyrene
Chrysene	Indeno[1,2,3-cd]pyrene
Pyrene-d10 (surr)	Dibenz[a,h]anthracene
	Benzo[g,h,i]perylene

Appendix E

Characteristic Ions for Analytes

Analyte	Primary Ion
Naphthalene-d8 (istd)	136
Nitrobenzene-d5 (surr)	82
Naphthalene	128
2-Methylnaphthalene	142
1-Methylnaphthalene	142
Acenaphthene-d10 (istd)	164
2-Fluorobiphenyl (surr)	172
Acenaphthylene	152
Acenaphthene	154
Fluorene	166
Phenanthrene-d10 (istd)	188
Phenanthrene	178
Anthracene	178
Fluoranthene	202
Chrysene-d12 (istd)	240
Pyrene	202
Pyrene-d10 (surr)	212
Terphenyl-d14 (surr)	244
Benzo[a]anthracene	228
Chrysene	228
Perylene-d12 (istd)	264
Benzo[b]fluoranthene	252
Benzo[j,k]fluoranthene	252
Benzo[a]pyrene	252
Indeno[1,2,3-cd]pyrene	276
Dibenz[a,h]anthracene	278
Benzo[g,h,i]perylene	276

OnSite Environmental Inc.
Redmond, Washington

Gasoline by GC-PID – Method NWTPH-Gx

Prepared by: ______________________________ Date: ______________
Ben Wellsfry, Analytical Chemist

Reviewed by: ______________________________ Date: ______________
Karl Hornyik, Laboratory Manager

Approved by: ______________________________ Date: ______________
Stacey Duran, Laboratory QA/QC Officer

Revision History

Origination Date: Unknown

Revision 05/04/01
Electronic and paper copies of revision 5.00.01 cannot be found. SOP was revised to 5.00.01.1. These revisions predate SOP 1.00.02 and were not kept controlled as required by SOP 1.00.02. Version 1.00.01.2 never fully promulgated but exists in hardcopy form.

Revision 10/18/02
SOP revised to new format. SOP officially revised using SOP 1.00.02 to revision 5.00.02.

Revision 03/06/03
SOP revised to version 3.0 to reflect the change from using the PID detector to quantitate gasoline to using the FID detector to quantitate gasoline. The PID detector will still be an option for quantitation.

Revision 10/17/06
SOP revised to revision 4.0 to reflect the addition of Method 5035A requirements.

Revision 4.0 also reflects alterations to instrument Hope. Since instrument Hope no longer has a flame ionization detector, the SOP was revised to reflect the change from using the FID to quantitate gasoline to using the PID to quantitate gasoline. The FID will still be an option for quantitation on instrument Daryl.

Revision 4.0 also removes the requirement that continuing calibration verification standards be analyzed every twelve hours since the method states standards shall be analyzed once at the beginning of the run and once at the end of the run.

Revision 09/13/07
SOP revised to revision 5.0 to reflect changes to the gasoline integration range (envelope) as required by the State of Oregon. This range must, at a minimum, include toluene through naphthalene.

Revision 5.0 also adds the procedure for air analysis.

Revision 02/12/08
SOP revised to revision 6.0 to reflect updates to Appendix A.

Revision 7.0 03/13/09
SOP revised to include the water miscible solvent calculation specified in section 11.10.5 of EPA 8000C.

Revision 8.0 09/21/16
- SOP revised in response to WDOE audit findings to specify a minimum r^2 value of 0.990.
- Updated “Equipment and Supplies” section.
- Updated calibration procedure.
- Continuing Calibration Verification standards are to be analyzed only at the opening and closing of the analytical sequence.
- Updated extraction procedure for air samples.
- Updated sample preparation for instrument Hope.

Revision 9.0 07/25/17
- Added to “Definitions” section.
- Updated instructions on making surrogate calibration curve standards.

- Added Lower Limit of Quantitation information.

Revision 10.0 04/13/18

- Added the use of freezers in section “Sample Handling and Preservation.”
- Revised section “Reagents and Standards” to reflect the surrogate concentration used, its preparation, and determination for instrument Hope’s automated surrogate addition.

Table of Contents

1.0 Scope and Application

1.1 The purpose of this method is to quantitatively determine concentrations of gasoline or other volatile petroleum hydrocarbons in soil, water, air, product and oil. Product and oil analyses are addressed in SOP 3.06 - Waste Dilution.

1.2 The reporting limit for soils is 5.0 ppm and for waters is 0.10 ppm by the purge and trap procedure.

1.3 This method may be combined with EPA 8021B (SOP 5.04) to determine concentrations of benzene, toluene, ethylbenzene, *m,p*-xylenes and *o*-xylene (BTEX) in samples.

2.0 Summary of Method

2.1 For water samples, a 5.0 mL aliquot of sample is spiked with surrogate and then purged on a purge and trap device to capture the volatile constituents for chromatographic analysis using a photoionization detector (GC/PID). A flame ionization detector (GC/FID) is also allowed.

2.2 Soil samples are field-collected into pre-weighed VOA vials. At the lab, the sample is reweighed to determine the weight of the soil, and a 5-mL Luer-lock gas-tight syringe is used to inject 5 mL of surrogated purge and trap grade methanol into the VOA. The sample is vortexed to extract the volatile constituents into the methanol phase. A subsample of this methanol extract is then diluted with reagent water, and the aqueous sample is then purged on a purge and trap device to capture the volatile constituents for chromatographic analysis using a photoionization detector (GC/PID). A flame ionization detector (GC/FID) is also allowed.

2.3 Soil samples can be field-preserved by extracting the soil into pre-weighed VOA vials containing purge and trap grade methanol. At the lab, the sample will be reweighed to determine the weight of the soil, spiked with surrogate, and vortexed. A subsample of the methanol extract is then diluted with reagent water, and the aqueous sample is then purged on a purge and trap device.

2.4 If the soil samples are not field collected, the laboratory measures out 5 grams of soil into a 40 mL VOA vial and adds 5 mL of purge and trap grade methanol. The sample is spiked with surrogate and vortexed to extract the volatile constituents into the methanol phase. A subsample of this methanol extract is then diluted with reagent water, and the aqueous sample is then purged on a purge and trap device.

2.5 Air samples are collected into Tedlar bags. The laboratory loads the sparge tube with 2-3 mL of surrogated reagent water, extracts 5 mL of the air into a 5 mL Luer-lock gas-tight syringe, and injects the air directly into the sparge tube. The sample is then purged on a purge and trap device to capture the volatile constituents for chromatographic analysis using a photoionization detector (GC/PID). A flame ionization detector (GC/FID) is also allowed.

2.6 After analysis, the sample is quantitated against known concentrations of gasoline analyzed in the same manner as the samples. Quantitation is performed by integration of the entire chromatographic envelope. The range is state specific. For the states of Washington and Oregon the envelope from toluene through naphthalene is integrated. The area of the surrogate peaks is subtracted from the total area before comparing it to the calibration curve. The concentration reported at the instrument is then converted to the concentration of the sample by factoring in the sample volume used and any dilutions that may have been made. Soil samples are further reported on a dry weight basis unless the client specifically requests the value be reported on a wet weight basis.

3.0 Definitions

3.1 Reagent Water – Water free of volatile constituents or interferences greater than the reporting limits for this SOP. Also referred to as deionized water.

3.2 Method Blank (MB) – A sample aliquot (usually reagent water or Ottawa sand) free from target analytes is treated exactly as a sample including exposure to all glassware, equipment, solvents and surrogates. The MB is used to determine if method analytes or other interferences are present in the laboratory environment, the solvents or the equipment.

3.3 %R: Percent Recovery

3.4 RPD: Relative Percent Difference

3.5 SOP: Standard Operating Procedure

3.6 GC: Gas Chromatograph

3.7 PID: Photoionization Detector

3.8 ICV: Initial Calibration Verification

3.9 CCV: Continuing Calibration Verification

3.10 MDL: Method Detection Limit

3.11 LLOQ: Lower Limit of Quantitation

3.12 BFB: Bromofluorobenzene. A surrogate used in this method.

3.13 FB: Fluorobenzene. A surrogate used in this method.

4.0 Sample Handling and Preservation

4.1 Water samples are collected in 40-mL volatile containers pre-preserved with 1:1 hydrochloric acid. Non-preserved samples are also acceptable, but the holding time is reduced from 14 days to 7 days if the sample has not been preserved in the field.

4.2 Water samples should be shipped and stored at 4°C ± 2°C.

4.3 Soil samples are field collected in pre-weighed VOA vials. A 4-ounce jar is collected to perform a dry weight analysis.

4.4 Soil samples can be field preserved by collecting the soil into pre-weighed VOA vials containing purge and trap grade methanol. A 4-ounce jar is collected to perform a dry weight analysis.

4.5 All field-preserved samples should be shipped and stored at 4°C ± 2°C. If the samples are not field preserved, they should be stored at 4°C ± 2°C and shipped to be received by the laboratory within 48 hours of collection for laboratory preservation. The holding time for all soils is 14 days.

4.6 Air samples are collected in Tedlar bags. The samples should be shipped and stored at 4°C ± 2°C. The holding time for air samples is 3 days.

4.7 Whenever possible, volatile samples should be stored separately from other samples in the volatiles department refrigerators and freezers to avoid contamination from other samples or from the extractions department.

4.8 Headspace in water samples should be noted as a nonconformity using SOP 1.18.

5.0 Interferences

5.1 Carryover contamination can occur when highly contaminated samples are followed by clean or lightly contaminated samples.

5.1.1 When a suspected highly contaminated sample is analyzed, it should be followed by an analysis of reagent water (purge blank) to check for carryover contamination.

5.1.2 Any purge and trap position used to analyze a highly contaminated sample should be cleaned the following day by rinsing the position with methanol followed by reagent water. Alternatively, the sparge tube can be replaced and the contaminated sparge tube can be cleaned and baked out at 120°C for at least two hours to remove the contamination.

5.2 Syringe cross-contamination can occur when a highly contaminated sample or a high-level standard is followed by a clean or lightly contaminated sample or a low-level standard. Rinsing the syringe at least three times with methanol between samples can prevent this contamination.

5.3 Samples may be cross-contaminated by using a dirty scoopula or glassware during sample preparation. Care in cleaning the scoopula and glassware will prevent this contamination.

5.4 Sample injection line carryover contamination can be prevented by daily rinsing of the sample injection lines with approximately 2.5 mL of methanol followed by 5.0 mL reagent water. A 3-minute purge of the sparge tubes associated with rinsed injection lines should be performed after the rinsing.

5.5 The trap and other parts of the purge and trap system are subject to contamination.

5.5.1 Frequent trap bake out at 260°C for 10 minutes may be necessary.

5.5.2 Daily bake out of the GC column is required to eliminate overnight contamination. Optimum oven settings for this are between 100°C and 180°C for at least 30 minutes.

5.6 Samples can be contaminated by diffusion of volatile organics through the septum during shipment and storage. A field sample blank prepared from reagent water and carried through sampling and subsequent storage and handling can serve as a check on such contamination.

5.7 The purge and trap grade methanol has at times been shown to contain contaminants. The methanol lot is tested upon receipt and is monitored by running a soil method blank containing methanol whenever soil samples are extracted and analyzed.

6.0 Safety

6.1 All reagents and standards must be handled with extreme care due to their possible deleterious health effects. All applicable personal protective safety equipment must be used at all times when handling chemicals.

6.2 Methanol: Vapor is harmful. It may be fatal or cause blindness if swallowed. Avoid contact. Causes damage to lungs and central nervous system. Flammable.

7.0 Equipment and Supplies

7.1 Instrument Daryl

7.1.1 Apparatus-Tekmar Purge and Trap

7.1.1.1 Tekmar LSC 2000 equipped with a Tenax trap

7.1.1.2 ALS 2016 and ALS 2032 Auto Samplers

7.1.1.3 5 mL fritted spargers

7.1.2 Apparatus-GC

7.1.2.1 Hewlett Packard 5890 Series II Gas Chromatograph

7.1.2.2 Photoionization Detector: OIG, 10.0 eV

7.1.2.3 Flame Ionization Detector, Model 4410

7.1.2.4 DB-VRX 75 m length, 2.55 µm film, 0.45 mm I.D. GC column: J&W Scientific

7.1.2.5 Data Station: HP ChemStation Version B.02.05

7.2 Instrument Hope

7.2.1 Apparatus-Tekmar Purge and Trap

7.2.1.1 Tekmar LSC 2000 equipped with a Tenax trap

7.2.1.2 Varian Archon Purge and Trap Auto Sampler

7.2.1.3 5 mL fritted sparger

7.2.2 Apparatus-GC

7.2.2.1 Hewlett Packard 5890 Series II Gas Chromatograph

7.2.2.2 Photoionization Detector: OIG, 10.0 eV

7.2.2.3 DB-VRX 75 m length, 2.55 µm film, 0.45 mm I.D. GC column: J&W Scientific

7.2.2.4 Data Station: HP ChemStation Version B.02.05

7.3 Apparatus-Extractions

7.3.1 Gas tight micro syringes - various sizes

7.3.2 5 mL Luer-lock syringe

7.3.3 Hypodermic needle attachment for 5 mL Luer-lock syringe

7.3.4 20 mL and 40 mL VOA vials

7.3.5 Top loading balance capable of measuring accurately to 0.01g

7.3.6 Analytical balance capable of measuring accurately to 0.0001g

7.3.7 Scoopulas

7.3.8 Vortexer

7.3.9 Volumetric flasks - various sizes

7.3.10 Methanol autopipettor

7.3.11 Dry weight tins

7.3.12 pH paper

8.0 Reagents and Standards

8.1 Reagents

8.1.1 Methanol, analytical grade

8.1.2 Water, Volatile Free (Reagent Water)

8.1.2.1 The deionized water generator has an activated carbon column designed to remove volatile organic compounds from the water.

8.1.2.2 Depletion of the carbon filter may be indicated by a breakthrough of any volatile compound greater than 1.0 ppb. If this occurs, refer to SOP 8.10 for maintaining the generator.

8.2 Standards

8.2.1 Gasoline

8.2.1.1 The 50,000 ppm gasoline stock standard is prepared by combining equal parts of the three different types of local non-oxygenated gasoline product (regular unleaded, unleaded plus, and unleaded supreme) in a 20 mL VOA vial. A 1.25 ± 0.0025g aliquot of the combined product (neat) is then diluted with methanol in a volumetric flask to a final volume of 25 mL to make a 50,000 ppm stock in methanol.

8.2.1.2 A 5,000 ppm gasoline working standard is prepared by diluting 1.0 mL of the 50,000 ppm gasoline stock standard in a volumetric flask to final volume of 10 mL of methanol.

8.2.1.3 A 5,000 ppm gasoline second-source Initial Calibration Verification (ICV) working standard should also be prepared. Obtain three different types of local non-oxygenated gasoline product (regular unleaded, unleaded plus, and unleaded supreme) from a different gas station than in 8.2.1.1. Follow 8.2.1.1 to prepare a “neat” solution and a 50,000 ppm stock and 8.2.1.2 to prepare a 5,000 ppm second-source standard.

8.2.2 Surrogate

8.2.2.1 Bromofluorobenzene (BFB) and Fluorobenzene (FB) are purchased as neat certified standards.

8.2.2.2 A 12,500 ppm surrogate stock standard is prepared by diluting 0.3125 ± 0.0025 grams of Bromofluorobenzene (BFB) and 0.3125 ± 0.0025 grams of Fluorobenzene (FB) with methanol into a volumetric flask to a final volume of 25 mL. Store standard in a 20 mL VOA vial.

8.2.2.3 Instrument Daryl

8.2.2.3.1 The working surrogate solution is made at two different concentrations. Water samples use a working standard made at 40 ppm while soil samples use a working standard made at 200 ppm. (See 8.2.2.5 and 8.2.2.6.)

8.2.2.4 Instrument Hope

8.2.2.4.1 Water samples use a working surrogate standard made at 220 ppm, which is automatically added by the autosampler to a sample from a standard reservoir. (See 8.2.2.7.) For soil samples, the 200 ppm surrogate is added during the extraction process. (See 8.2.2.6.)

8.2.2.4.2 The working surrogate concentration of 220 ppm is normally used; however, as the volume of surrogate that is automatically added may vary over time, a different concentration may be used to maintain a consistent %R.

8.2.2.4.3 If the 220 ppm working surrogate concentration must be modified, determine the proper concentration as follows:

8.2.2.4.3.1 Make ten hand-made surrogated blanks by adding 50 μL of the 40 ppm surrogate working standard in a volumetric flask to a final volume of 50 mL of reagent water. After inverting the flask three times, transfer the solution to a 40-mL VOA, ensuring no headspace. Repeat nine times. Place the VOA vials into numbered slots in the Archon auto sampler. Once programmed, the auto sampler will retrieve the sample, draw 5.0 mL into the syringe, and inject the contents into the sparger.

8.2.2.4.3.2 Analyze ten machine-made surrogated water blanks by placing ten 40-mL sample vials containing reagent water into numbered slots in the Archon auto sampler. Once programmed, the auto sampler will retrieve the sample, draw 5.0 mL into the syringe, add surrogate, and inject contents into the sparger.

8.2.2.4.3.3 Determine the average concentrations for each set of ten blanks.

8.2.2.4.3.4 Divide the average of the hand-made blanks by the average of the machine-made blanks to determine the percent difference.

8.2.2.4.3.5 Adjust the concentration of the surrogate added by the Archon by the above percentage.

8.2.2.5 The 40 ppm standard is made by diluting 80 µL of 12,500 ppm stock standard in a volumetric flask to a final volume of 25 mL of methanol. Store in a 20-mL VOA vial.

8.2.2.6 The 200 ppm working standard is made by diluting 800 µL of 12,500 ppm stock standard in a volumetric flask to a final volume of 50 mL of methanol. Store in a 40-mL VOA vial.

8.2.2.7 The 220 ppm working standard is made by diluting 880 µL of 12,500 ppm stock standard in a volumetric flask to a final volume of 50 mL of methanol. Store in a 40-mL VOA vial.

8.2.3 Standard Handling

8.2.3.1 Purchased standards expire on the manufacturer’s date or one year from the date of opening, whichever comes first.

8.2.3.2 Stock standards prepared internally expire one year after preparation or on the manufacturer’s date, whichever comes first.

8.2.3.3 Working surrogate and daily and initial calibration standards expire six months after preparation or on the manufacturer’s date, whichever comes first.

8.2.3.4 These expiration dates hold if no observed degradation of the solutions has taken place. All expired or degraded standards shall be properly disposed to avoid accidental use.

8.2.3.5 Stock and working standards should be kept at –20ºC or according to manufacturer’s recommendation when not in use.

9.0 Quality Control

9.1 Method Blank

9.1.1 Method blanks are prepared and analyzed for every extraction batch at a 10% frequency (two method blanks per extraction batch of 20).

9.1.2 Method blanks are matrix dependent and should be extracted and analyzed the same as any other sample.

9.1.3 The first method blank of the analytical sequence should be analyzed immediately after the continuing calibration. This method blank must be less than the reporting limit before samples can be analyzed.

9.1.4 Other method blanks run during the analytical sequence may be analyzed during non-business hours. Since the analyst may not be present when an out-of-control event occurs, some form of corrective action will be necessary the following shift if any of these method blanks are found to be greater than the reporting limit.

9.1.5 Corrective action for contaminated method blanks:

9.1.5.1 If the problem is observed prior to analyzing samples, the problem must be resolved and an acceptable method blank must be analyzed before beginning to analyze the samples.

9.1.5.2 If one of the method blanks fails during the middle of the analytical sequence, the method blank should be reanalyzed.

9.1.5.3 If this method blank is acceptable, the associated samples less than the reporting limit can be reported.

9.1.5.4 Associated samples that are greater than the reporting limit need to be carefully evaluated by the analyst. The samples should be reanalyzed unless the analyst can demonstrate that the problem with the method blank was an isolated incident.

9.1.5.5 If the method blank is contaminated after reanalysis, then the reagent water, surrogate solution, methanol, VOA vials, transfer lines, etc. should be suspected as contaminated and a process of elimination should be used to identify the source of the contamination. In this case the samples may have to be re-extracted prior to reanalysis depending on the source of the contamination.

9.1.5.6 If insufficient sample prevents reanalysis, then the data can be reported as is, but a nonconformance form must be filled out using SOP 1.18 and the associated data must be flagged with a “B” qualifier.

9.2 Sample Duplicate

9.2.1 Sample duplicates are prepared and analyzed for every extraction batch at a 10% frequency (two duplicates per extraction batch of 20).

9.2.2 After analysis, calculate the relative percent difference (RPD) on the wet weight results as follows:

$$RPD = \frac{|X_1 - X_2|}{(X_1 + X_2)/2} \times 100$$

Where X_1 and X_2 are the first and second values obtained for the analysis, respectively.

9.2.3 If the RPD is out of control, corrective action, as follows, must be taken:

9.2.3.1 Recalculate and check for integration or calculation errors.

9.2.3.2 Double check sample volume/weight and the final extract volume for errors.

9.2.3.3 If the sample concentration is not greater than five times the reporting limit, the RPD value is not statistically meaningful. Document the situation using SOP 1.18, and flag the data with the “C” qualifier.

9.2.3.4 If the above checks do not resolve the issue and/or the concentration in the sample exceeds five times the reporting limit, the sample and duplicate alone should be re-extracted and reanalyzed. Document the nonconformance and one of the following resolutions using SOP 1.18:

9.2.3.4.1 If the RPD is acceptable upon reanalysis, this data should be reported.

9.2.3.4.2 If the RPD is still out, the original data should be reported and the sample should be flagged as being non-homogenous using the “K” qualifier.

9.2.4 Control limits for sample duplicate RPDs shall be calculated yearly on actual sample data using SOP 1.22.

9.3 Surrogates

9.3.1 Bromofluorobenzene and Fluorobenzene are used as surrogates for this analysis. Surrogate recovery is monitored to assess method performance on the particular matrix. Surrogates are added to all samples and quality control samples during extraction and prior to analysis. However, only Fluorobenzene is utilized for quality control purposes.

9.3.2 Calculate the percent recovery (%R) as:

$$\%R = \frac{C_s}{C_n} \times 100$$

Where:
C_s = Measured concentration of the surrogate in the sample
C_n = Nominal (theoretical) concentration of the surrogate spiked into the sample

9.3.3 If the surrogate %R value is out of control, corrective action, as follows, must be taken:

9.3.3.1 Recalculate and check for integration or calculation errors.

9.3.3.2 Double check sample volume/weight, final extract volume, amount spiked and the concentration of the spike solution.

9.3.3.3 If the surrogate %R value cannot be calculated due to a large number of coeluting peaks, the sample may be reported as is and qualified with the “F” qualifier.

9.3.3.4 If the surrogate %R value cannot be calculated due to a large dilution of the sample, the sample may be reported as is and qualified with the “S” qualifier.

9.3.3.5 If a problem still exists, the sample should be re-extracted and reanalyzed. Document the nonconformance and one of the following resolutions using SOP 1.18:

9.3.3.5.1 If the surrogate %R value is acceptable upon reanalysis, then this data should be reported.

9.3.3.5.2 If the surrogate %R value is still out or there was insufficient sample to reanalyze the sample, then the original data should be reported and the poor surrogate %R value should be flagged with the “Q” qualifier. The case narrative should explain the steps that were taken to try to resolve the problem and that the problem is attributed to the sample matrix.

9.3.4 Control limits for surrogate percent recovery values shall be calculated yearly on actual sample data using SOP 1.22 and are not to exceed 50-150%.

10.0 Calibration and Standardization

10.1 Instrument Preparation

10.1.1 The gas chromatograph should be set to the parameters located in Appendix A.

10.1.2 The purge and trap instrumentation is set to the parameters located in Appendix B.

10.2 Gasoline Initial Calibration

10.2.1 From the 50,000 ppm gasoline stock standard prepared per 8.2.1.1, prepare a 5,000 ppm calibration standard as in 8.2.1.2.

10.2.2 Prepare a 2,500 ppm calibration standard by diluting 500 µL of the 50,000 ppm gasoline standard stock standard in a volumetric flask to a final volume of 10 mL of methanol.

10.2.3 Prepare a 500 ppm calibration standard by diluting 100 µL of the 50,000 ppm gasoline stock standard in a volumetric flask to final volume of 10 mL of methanol.

10.2.4 Prepare a 50 ppm calibration standard by 100 µL of the 5,000 ppm gasoline calibration standard in a volumetric flask to a final volume of 10 mL methanol.

10.2.5 Calibration points are analyzed at 0.1, 0.5, 1.0, 2.5, 5.0, 7.5 and 10 ppm to produce a calibration curve.

10.2.6 Instrument Daryl

10.2.6.1 Draw 5 mL of reagent water into a Luer-lock syringe, add the appropriate volume of standard for each concentration as follows, and inject the contents into the sparger:

Cal. Std.	Std. Vol.	Final Vol.	Final Conc.
50 ppm	10 µL	5 mL	0.10 ppm
500 ppm	5.0 µL	5 mL	0.50 ppm
500 ppm	10 µL	5 mL	1.0 ppm
2,500 ppm	5.0 µL	5 mL	2.5 ppm
5,000 ppm	5.0 µL	5 mL	5.0 ppm
2,500 ppm	15 µL	5 mL	7.5 ppm
5,000 ppm	10 µL	5 mL	10 ppm

10.2.7 Instrument Hope

10.2.7.1 Add the appropriate volume of standard for each concentration as follows in a volumetric flask to a final volume of 50 mL of reagent water. After inverting the flask three times, transfer the solution to a 40-mL VOA, ensuring no headspace. Place the VOA into a numbered slot in the Archon auto sampler. Once programmed, the auto sampler will retrieve the sample, draw 5.0 mL into the syringe, and inject the contents into the sparger.

10.2.7.2

Cal. Std.	Std. Vol.	Final Vol.	Final Conc.
50 ppm	100 µL	50 mL	0.10 ppm
500 ppm	50 µL	50 mL	0.50 ppm
500 ppm	100 µL	50 mL	1.0 ppm
2,500 ppm	50 µL	50 mL	2.5 ppm
5,000 ppm	50 µL	50 mL	5.0 ppm
2,500 ppm	150 µL	50 mL	7.5 ppm
5,000 ppm	100 µL	50 mL	10 ppm

10.2.8 To be valid, the gasoline initial calibration must meet the following criteria while using linear regression to compute the best fit line through the data points:

10.2.8.1 The coefficient of determination (r^2) must be at least 0.990 (correlation coefficient (r) >0.995).

10.2.8.2 Each calibration level must be within 15% of its true value when quantitated using the newly established calibration curve.

10.3 Surrogate Initial Calibration

10.3.1 From the 200 ppm surrogate standard prepared per 8.2.2.6, prepare working calibration standards of 1.0, 10, and 40 ppm as follows:

Stock Conc.	Stock Vol.	Final Vol.	Final Conc.
200 ppm	10 µL	2.0 mL	1.0 ppm
200 ppm	100 µL	2.0 mL	10 ppm
200 ppm	400 µL	2.0 mL	40 ppm

10.3.2 Calibration points are analyzed at 1, 5, 10, 20, 40 and 80 ppb to produce a calibration curve.

10.3.3 Instrument Daryl

10.3.3.1 Draw 5 mL of reagent water into a Luer-lock syringe, add the appropriate volume of standard for each concentration as follows, and inject the contents into the sparger.

Cal. Std.	Std. Vol.	Final Vol.	Final Conc.
1.0 ppm	5.0 µL	5 mL	1.0 ppb
1.0 ppm	25 µL	5 mL	5.0 ppb
10 ppm	5.0 µL	5 mL	10 ppb
10 ppm	10 µL	5 mL	20 ppb
40 ppm	5.0 µL	5 mL	40 ppb
40 ppm	10 µL	5 mL	80 ppb

10.3.4 Instrument Hope

10.3.4.1 Add the appropriate volume of standard for each concentration as follows in a volumetric flask to a final volume of 50 mL of reagent water. After inverting the flask three times, transfer the solution to a 40-mL VOA, ensuring no headspace. Place the VOA into a numbered slot in the Archon auto sampler. Once programmed, the auto sampler will retrieve the sample, draw 5.0 mL into the syringe, and inject the contents into the sparger.

Cal. Std.	Std. Vol.	Final Vol.	Final Conc.
1.0 ppm	50 µL	50 mL	1.0 ppb
10 ppm	25 µL	50 mL	5.0 ppb
10 ppm	50 µL	50 mL	10 ppb
10 ppm	100 µL	50 mL	20 ppb
40 ppm	50 µL	50 mL	40 ppb
40 ppm	100 µL	50 mL	80 ppb

10.3.5 For surrogates, the ChemStation software can be set to model the external standard calibration procedure (Section 7.4.2.1) outlined in Method 8000D. The percent relative standard deviation (%RSD) for each surrogate compound must not exceed 20%.

10.3.6 Alternatively, linear regression can be used to generate the surrogate initial calibration. The initial calibration must meet the following criteria while using linear regression to compute the best fit line through the data points:

10.3.6.1 The coefficient of determination (r^2) must be at least 0.990 (correlation coefficient (r) >0.995).

10.3.6.2 Each calibration level must be within 15% of its true value when quantitated using the newly established calibration curve.

10.4 Initial Calibration Verification (ICV)

10.4.1 A second-source Initial Calibration Verification (ICV) standard (8.2.1.3) must be analyzed after the initial curve to verify the validity of the curve. The result must be within 20% of the true value.

10.5 Continuing Calibration Verification

10.5.1 Analyze a continuing calibration verification standard (5 ppm) before samples are analyzed and at the end of the sequence.

10.5.2 The percent difference for gasoline should not exceed ±20 percent. If this criterion is exceeded, analysis may proceed only if the following occurs:

10.5.2.1 If the CCV percent difference is greater than 20% (high bias) for gasoline and the samples it brackets are non-detect for gasoline.

10.5.3 When the CCVs do not pass, corrective action needs to be taken. This includes:

10.5.3.1 Remaking the standard

10.5.3.2 Rinsing and cleaning the sparger

10.5.3.3 Recalibrating the instrument

10.5.4 Once the instrument is performing optimally after corrective action, all samples bracketed by failing CCVs must be reanalyzed.

11.0 Procedure

11.1 Sample Preparation (Instrument Daryl)

11.1.1 Water samples

11.1.1.1 Samples should be analyzed without dilution unless heavily contaminated.

11.1.1.1.1 Draw 5.0 mL of sample into a Luer-lock syringe.

11.1.1.1.2 Add 5.0 μL of 40 ppm surrogate through the end of the syringe.

11.1.1.1.3 Inject the contents of the Luer-lock into the sparger.

11.1.1.2 If the sample is heavily contaminated, a 1:10, 1:100 or even greater dilution may be required.

11.1.1.2.1 Draw 5.0 mL of reagent water into a Luer-lock syringe.

11.1.1.2.2 Add 5.0 μL of 40 ppm surrogate through the end of the syringe.

11.1.1.2.3 Add 500 μL of sample for a 1:10 dilution or 50 μL for a 1:100 dilution to the syringe.

11.1.1.2.4 Inject the contents of the Luer-lock into the sparger.

11.1.1.3 If a single 40-mL VOA vial is received for analysis, reserve half of the sample by pouring it into a 20-mL VOA vial (no headspace), and analyze the remaining sample. The reserved 20-mL VOA vial can be used for reanalysis if necessary.

11.1.1.4 Test all water samples for pH by placing a drop of the sample on a pH test strip. Record the pH value in the water extraction logbook. If the sample pH is not at 2 or below and more than seven days have passed since sampling, the sample will be analyzed outside of the established holding time. Document the nonconformance with SOP 1.18.

11.1.1.5 Record the appropriate sample identification, volume, and dilution information in the extraction and instrument run logbooks.

11.1.1.6 Unused water samples are stored in the refrigerator for one month.

11.1.2 Soil samples from Washington state should be field extracted in any of the following three manners:

11.1.2.1 Preserved extraction

11.1.2.1.1 Approximately 5g of sample is added to a previously weighed VOA vial containing 5 mL of analytical grade methanol. The sample is stored on ice at 4°C±2°C until the lab receives it.

11.1.2.1.2 Once checked in at the lab, the sample is stored at 4°C±2°C.

11.1.2.1.3 At the time of analysis, the sample will be warmed to room temperature, reweighed to determine the exact weight of the soil sample, spiked with 50 µL of 200 ppm surrogate, and vortexed.

11.1.2.2 Non-preserved extraction into VOA vials

11.1.2.2.1 Approximately 5g of sample is added to a previously weighed VOA vial. The sample is stored on ice at 4°C±2°C until the lab receives it.

11.1.2.2.2 The lab <u>must</u> receive the samples within 48 hours of sampling. The lab will preserve the samples by freezing them to <-7°C.

11.1.2.2.3 At the time of analysis, the sample will be warmed to room temperature and reweighed to determine the exact weight of the soil sample.

11.1.2.2.4 Samples are injected with 5 mL of analytical grade methanol containing 50 μL of 200 ppm surrogate, vortexed, and vented.

11.1.2.3 Non-preserved extraction in EnCore Sampler

11.1.2.3.1 The sample is field extracted using an EnCore Sampler. The cap is replaced on the Sampler and the Sampler is sealed in a collection bag. The sample is stored on ice at 4°C±2°C until the lab receives it.

11.1.2.3.2 The lab <u>must</u> receive the samples within 48 hours of sampling. The lab will transfer the soil plugs from the EnCore Samplers into pre-weighed VOA vials. The lab will then preserve the samples by freezing them to <-7°C.

11.1.2.3.3 At the time of analysis, the sample will be warmed to room temperature and reweighed to determine the exact weight of the soil sample.

11.1.2.3.4 Samples are injected with 5 mL of analytical grade methanol containing 50 μL of 200 ppm surrogate, vortexed, and vented.

11.1.3 Soil samples that are not field extracted as above or are not from Washington state are prepared as follows:

11.1.3.1 Remove top layer of soil.

11.1.3.2 Weigh 5.0g of sample into a 40-mL VOA vial.

11.1.3.3 Add 5.0 mL of analytical grade methanol.

11.1.3.4 Add 50 μL of 200 ppm surrogate.

11.1.3.5 Vortex for 60 seconds. Vortex clay-like samples longer to break up any lumps.

11.1.4 For all soil samples after the vortex step:

11.1.4.1 If there is an insufficient quantity of liquid readily available for analysis, centrifuging the sample for three minutes may help.

11.1.4.2 Draw 5.0 mL of reagent water into a Luer-lock syringe.

11.1.4.3 Clean samples are analyzed at a 1:50 dilution. Samples with gasoline and/or other odors are analyzed at a 1:250 or a 1:1000 dilution. Add the appropriate amount of extract through the end of the Luer-lock syringe as follows:

Dilution level	Amount added
1:50	100 μL
1:250	20 μL
1:1000	5 μL

11.1.4.4 Inject the contents of the Luer-lock syringe into the sparger.

11.1.4.5 Record the appropriate sample identification, weight, and dilution information in the extraction and instrument run logbooks.

11.1.4.6 Store extracts in the refrigerator for one month.

11.1.5 Air samples

11.1.5.1 The air sample should be at room temperature prior to analysis.

11.1.5.2 Draw 2 mL of reagent water into a Luer-lock syringe.

11.1.5.3 Add 5.0 μL of 40 ppm surrogate through the end of the syringe.

11.1.5.4 Inject the contents of the Luer-lock into the sparger and start purging.

11.1.5.5 Rinse the Luer-lock syringe with methanol and reagent water.

11.1.5.6 Draw 0.5 mL of reagent water into the Luer-lock syringe.

11.1.5.7 For the method blank, draw 5 mL of air from the lab atmosphere into the Luer-lock syringe and inject it into the sparger containing the purging 2 mL of surrogated, analyte-free water.

11.1.5.8 For the sample, affix a methanol-rinsed hypodermic needle attachment to the Luer-lock syringe. Puncture the septum on the Tedlar bag and draw up 5 mL of sample into the syringe. Remove the needle and quickly inject the 5 mL of sample into the sparger containing the purging 2 mL of surrogated, analyte-free water.

11.1.5.9 Record the room temperature in the benchsheet.

11.1.5.10 Rinse the syringe and needle with methanol between samples.

11.1.5.11 Store the Tedlar bags in the refrigerator for one month.

11.2 Sample Preparation (Instrument Hope)

11.2.1 Water samples

11.2.1.1 Samples should be analyzed without dilution unless heavily contaminated.

11.2.1.1.1 Place the 40-mL sample vial into a numbered slot in the Archon auto sampler. Once programmed, the auto sampler will retrieve the sample, draw 5.0 mL into the syringe, add surrogate, and inject contents into the sparger.

11.2.1.2 If the sample is heavily contaminated, a 1:10, 1:100 or even greater dilution may be required.

11.2.1.2.1 Dilutions must be hand-made by sub-sampling from the original sample vial, diluting the aliquot into a 50-mL volumetric flask with analyte-free water, and transferring to a clean 40-mL VOA vial with no headspace.

11.2.1.3 If a single 40-mL VOA vial is received for analysis, the sample must be analyzed on Daryl per 11.1.1.3.

11.2.1.4 Test all water samples for pH by placing a drop of the sample on a pH test strip. Record the pH value in the water extraction logbook. If the sample pH is not at 2 or below and more than seven days have passed since sampling, the sample will be analyzed outside of the established holding time. Document the nonconformance with SOP 1.18.

11.2.1.5 Record the appropriate sample identification, volume, and dilution information in the extraction and instrument run logbooks.

11.2.1.6 Unused water samples are stored in the refrigerator for one month.

11.2.2 For soil samples, see Daryl procedures from 11.1.2 through 11.1.3.5.

11.2.3 For all soil samples after the vortex step:

11.2.3.1 If there is an insufficient quantity of liquid readily available for analysis, centrifuging the sample for three minutes may help.

11.2.3.2 Fill a 50-mL volumetric flask with approximately 45 mL of reagent-free water.

11.2.3.3 Clean samples are analyzed at a 1:50 dilution. Samples with gasoline and/or other odors are analyzed at a 1:250 or a 1:1000 dilution. Add the appropriate amount of extract to the volumetric flask as follows:

Dilution level	Amount added
1:50	1.0 mL
1:250	200 μL
1:1000	50 μL

11.2.3.4 Fill the flask to the line with reagent-free water. Cap the flask, invert and swirl three times to homogenize the sample.

11.2.3.5 Transfer the sample to a clean 40-mL VOA vial, ensuring no headspace.

11.2.3.6 Place the VOA into a numbered slot in the Archon auto sampler. Once programmed, the auto sampler will retrieve the sample, draw 5.0 mL into the syringe, and inject the contents into the sparger.

11.2.3.7 Record the appropriate sample identification, weight, and dilution information in the extraction and instrument run logbooks.

11.2.3.8 Store extracts in the refrigerator for one month.

11.2.4 Air samples

11.2.4.1 The air sample should be at room temperature prior to analysis.

11.2.4.2 Fill a 40-mL VOA vial with reagent water and cap.

11.2.4.3 Place the vial into a numbered slot on the Archon auto sampler. Program the Archon to withdraw 2 mL of water from the vial and add surrogate.

11.2.4.4 Once the 2 mL of surrogated water has started purging, draw 0.50 mL of reagent water into a Luer-lock syringe.

11.2.4.5 For the method blank, draw 5 mL of air from the lab atmosphere into the Luer-lock syringe and inject it into the sparger containing the purging 2 mL of surrogated, analyte-free water.

11.2.4.6 For the sample, affix a methanol-rinsed hypodermic needle attachment to the Luer-lock syringe. Puncture the septum on the Tedlar bag and draw up 5 mL of sample into the syringe. Remove the needle and quickly inject the 5 mL of sample into the sparger containing the purging 2 mL of surrogated, analyte-free water.

11.2.4.7 Record the room temperature in the benchsheet.

11.2.4.8 Rinse the syringe and needle with methanol between samples.

11.2.4.9 Store the Tedlar bags in the refrigerator for one month.

12.0 Data Reduction and Calculation

12.1 After analyzing each sample, the ChemStation software will automatically integrate the chromatogram and calculate the concentrations (in the extract) of the gasoline hydrocarbon envelope and the surrogate within the retention time windows for each target analyte. The analyst should review the integration for each result to verify that the peak(s) was properly integrated. Reintegrate the peak manually, if necessary, using SOP 1.12 to correct for improper integration. The analyst must initial and date all manual integrations.

12.2 The ChemStation has the ability to incorporate dilution factors, sample volumes and dry weight into its calculation. These features are not used. The ChemStation software reports the concentration in the sample extract, not necessarily the sample itself.

12.3 To calculate the concentration (in ppb for waters and in ppm for soils) in the actual sample, the chemist enters the following information into a spreadsheet which performs the following calculation:

For Soil:

$$C_s = \frac{(C_{ex})(V_t)(DF)}{(V_s)(DW)}$$

For Water:

$$C_s = (C_{ex})(DF)(1000)$$

Where:

C_{ex}	= Concentration (in µg/mL) reported for the final extract
V_t	= Total volume of the final extract (in mL)
DF	= Dilution factor (dimensionless). Use a value of 1 if no dilution is performed.
V_s	= Initial sample volume or mass extracted (in milliliters or grams)
DW	= Dry weight of soil (use a value of 1 for water samples)

12.4 When extracting soil samples with methanol (MeOH), the final volume (V_t) needs to be corrected for the amount of moisture present in the solid sample. This is because water and MeOH are miscible; any water contained in the soil combines with the MeOH and effectively increases the total volume of the extract. If this correction is not applied, the sample results will be biased low. The amount of error increases as the percent moisture increases. The final volume is adjusted according to the following equation:

$$Vt(corrected) = \left(\frac{\%Moisture * Vs}{100} \right) + Vt$$

Where:
V_t = Total methanol volume of the final extract (mL)
V_s = Initial sample weight (grams)

Thus, a 5 gram sample with a 25% dry weight extracted with 5 mL of MeOH will have an adjusted total volume of 6.25 mL for the final extract.

These calculations take place automatically in the spreadsheets.

12.5 Report the results for the unknown samples in µg/L for waters and mg/kg for soil samples. Round the results to two significant figures.

12.6 Results that exceed the linear range of the calibration curve must be diluted and reanalyzed. The dilution should be made such that the concentration of the dilution falls within the upper half of the calibration curve.

12.7 Common data qualifiers seen using this method are as follows:

12.7.1 O – Hydrocarbons indicative of heavier fuels are present in the sample and are impacting the gasoline result.

12.7.2 T – The sample chromatogram is not similar to a typical gasoline.

12.7.3 Z – The sample chromatogram is similar to mineral spirits.

12.7.4 Z – The NWTPH-Gx result is attributed to a single peak.

13.0 Method Performance

13.1 Method Detection Limits/Lower Limits of Quantitation

13.1.1 Method detection limit (MDL) studies and Lower Limit of Quantitation (LLOQ) studies are conducted concurrently and are performed yearly or whenever a significant change in the system or method has occurred.

13.1.2 SOP 1.20 details how to conduct an MDL/LLOQ study.

13.2 This method is validated through successful ongoing annual single blind performance evaluation samples.

14.0 Pollution Prevention

14.1 This SOP and other similar published analytical methods have been carefully reviewed for possible ways to prevent unnecessary pollution. The following waste streams were identified for consideration:

14.1.1 Incoming client water samples

14.1.1.1 The client usually samples in duplicate or triplicate. Duplicate and triplicate samples are necessary in case the sample is compromised in transit or during analysis. Reducing the number of sample containers is not feasible since remobilization for resampling is usually cost prohibitive for the client.

14.1.1.2 Since the samples either are consumed in analysis or the unanalyzed samples are disposed of according to the waste management plan (SOP 1.08), adequate protection of the environment has already been maximized.

14.1.2 Incoming client soil samples

14.1.2.1 For Method 5035A, the client usually samples two VOAs per sample. Since the samples are either consumed in analysis or the unanalyzed samples are disposed of according to the waste management plan (SOP 1.08), adequate protection of the environment has already been maximized.

14.1.2.2 For non-Method 5035A and dry weight analysis, OnSite Environmental provides our clients with 4-ounce containers instead of 8-ounce containers to minimize the amount of potentially contaminated soil entering the laboratory that will have to be disposed of according to the waste management plan (SOP 1.08).

14.1.2.3 Two-ounce containers were considered as it would reduce the amount of soil that would remain after analysis, but it was determined that multiple analyses, quality control samples or re-extraction of the sample may deplete the sample before it could be successfully analyzed. Since remobilization for resampling is usually cost prohibitive for the client, the four-ounce container was an acceptable compromise.

14.1.3 The solvents used in this method pose little threat to the environment when managed properly.

14.1.4 Standards should be prepared in volumes consistent with laboratory use to minimize the volume of expired standards disposal.

15.0 Waste Management

15.1 The appropriate disposal of waste streams from this procedure is addressed in SOP 1.08.

16.0 References

16.1 Washington State Department of Ecology, *Analytical Methods for Petroleum Hydrocarbons: Method NWTPH-Gx - Volatile Petroleum Products Method for Soil and Water*, June 1997.

16.2 Oregon State Department of Environmental Quality, *Total Petroleum Hydrocarbons: Method TPH-G - Gasoline in Soils*, December 1990.

16.3 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 5030C - Purge-and-Trap for Aqueous Samples*, 3rd Edition, Rev. 3, May 2003.

16.4 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 8000D - Determinative Chromatographic Separations*, 3rd Edition, Rev. 4, July 2014.

16.5 U.S. Environmental Protection Agency*, SW-846 Test Methods for Evaluating Solid Waste: Method 5035 – Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples*, 1st Edition, Rev. 2, December 1996.

16.6 U.S. Environmental Protection Agency*, SW-846 Test Methods for Evaluating Solid Waste: Method 5035A – Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples*, 1st Edition, Draft Rev. 1 (7/02), December 1996.

16.7 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 5000 – Sample Preparation for Volatile Organic Compounds*, 1st Edition, Rev. 2, December 1996.

Appendix A

Instrument Parameters

Temperature Program

Initial temperature	37°C (Daryl), 40°C (Hope)
Hold Time	2 minutes
Ramp	10°C /minute to 200°C
Final Hold	10 minutes
Column flow (Helium):	11 mL/minute
GC head pressure:	35 psi
Makeup gas (Helium) flow:	50 mL/minute
Detector temperature	240°C

Appendix B

Purge and Trap Parameters

Purge gas flow (Helium):	40 mL/minute
Purge time:	11 minutes
Purge temperature:	Ambient
Dry purge time:	2 minutes
Desorb time:	2 minutes
Desorb temperature:	260°C
Bake time:	12 minutes
Bake temperature:	260°C

OnSite Environmental Inc.
Redmond, Washington

Volatile Organic Compounds by GC/MS
Method 8260C

Prepared by: ______________________________ Date: ______________
Stacey Duran, Analytical Chemist

Reviewed by: ______________________________ Date: ______________
Karl Hornyik, Laboratory Manager

Approved by: ______________________________ Date: ______________
Stacey Duran, Laboratory QA/QC Officer

Revision History

Origination Date: 11/08/2000

Revision 4.03.01 is currently promulgated by SOP 1.00.01.

Revision 2.0 01/14/03

SOP revised to new format. SOP officially revised using SOP 1.00.02 to revision 5.01.02.

Revision 3.0 04/17/06

SOP officially revised to revision 5.01.03 to reflect alterations to instrument Jessie; changes in the concentrations of the stock standards and volumes used for the initial calibration; the addition of air, product, and oil analyses; and the addition of Method 5035A requirements.

Revision 4.0 09/26/08

SOP revised to include the water miscible solvent calculation specified in section 11.10.5 of EPA 8000C. The order of the major sections was also changed to conform to the standard OSE SOP template.

Revision 5.0 06/08/17

- Revised SOP to align with EPA Methods 8000D and 8260C.
- Added new instruments Morris and Waldo.
- Removed instrument Jessie.
- Added information for Acrylonitrile, (trans) 1,4-Dichloro-2-butene, oxygenates and SIM (single ion monitoring) analyses.
- Generally updated entire SOP.

Revision 6.0 04/06/18

- Added sample duplicate to “Definitions” section.
- Added the use of sample storage freezers to section 4.7 in “Sample Handling and Preservation.”
- Added Instrument Quagmire and updated Instrument Morris in “Equipment and Supplies” and “Procedures” sections.
- Added to section 7.5 in “Equipment and Supplies.”
- Added purchased stock standard concentrations to section “Reagents and Standards.”
- Updated all appendices.

Table of Contents

1.0 Scope and Application

1.1 The purpose of this method is to quantitatively determine concentrations of volatile organics in water, soil, product, oil, and air. Product and oil analyses are addressed in SOP 3.06 - Waste Dilution.

1.2 The reporting limits for volatile organics in water and soil are summarized in Appendix A.

1.3 A limited number of recurring projects require practical quantitation limits (PQLs) below those established in Appendix A for a small number of analytes. In these limited instances, the sample is concurrently analyzed using GC/MS with Single Ion Monitoring (SIM) for these analytes. The reporting limits for the SIM analytes are summarized at the end of Appendix A.

2.0 Summary of Method

2.1 Water samples are sparged by subsampling 25 mLs of sample from a 40 mL VOA vial and transferring it to a fritted sparge tube. Helium is then passed through the sample in the sparge tube to separate the analytes of interest from the water matrix.

2.2 Soil samples are field-collected into pre-weighed VOA vials containing stir bars. At the lab, the sample is reweighed to determine the weight of the soil, a 5 mL Luer-lock gas-tight syringe is used to inject 5 mLs of reagent water into the VOA, and the VOA is vortexed. The sample is then needle sparged with helium while being heated and stirred.

2.3 Soil samples can be field-preserved by extracting the soil into pre-weighed VOA vials containing stir bars, water, and sodium bisulfate. At the lab, the sample will be reweighed to determine the weight of the soil, vortexed, and needle sparged with helium while being heated and stirred.

2.4 If the soil samples are not field collected, the laboratory measures out 5 grams of soil into a 40 mL VOA vial, adds a magnetic stir bar and 5 mLs of reagent water, caps the vial and vortexes. The sample is then needle sparged with helium while being heated and stirred.

2.5 Samples with a high concentration of target analytes, product samples, and oil samples are diluted in methanol. An aliquot of the extract is then transferred to a 40 mL VOA vial containing 5 mLs of reagent water and a stir bar and capped. This dilution is then needle sparged with helium while being heated and stirred.

2.6 Air samples are collected into Tedlar bags. The laboratory loads the sparge tube with 20 mLs of surrogated reagent water, extracts 5 mLs of the air into a 5 mL Luer-lock gas-tight syringe, and injects the air directly into the sparge tube. Helium is then passed through the sample in the sparge tube, separating out the analytes of interest.

2.7 The effluent from the sparging process is passed through an absorbent trap to collect the analytes of interest. Once the sparging is complete, the analytes on the trap are desorbed and transferred to the GC/MS system for analysis.

3.0 Definitions

3.1 Reagent Water – Water free of target analytes or interferences greater than the reporting limits for this SOP. Also referred to as deionized water.

3.2 Method Blank (MB) – A sample aliquot (usually reagent water or Ottowa sand) free from target analytes is treated exactly as a sample including exposure to all glassware, equipment, solvents and surrogates. The method blank is used to determine if method analytes or other interferences are present in the laboratory environment, the solvents or the equipment.

3.3 Spike Blank (SB) – A sample aliquot (usually reagent water or Ottowa Sand) free from target analytes to which known quantities of method analytes are added. The SB is treated exactly as a sample. It is used to determine whether the methodology is in control and to indicate the accuracy associated with laboratory procedures. Also referred to as a Laboratory Control Sample (LCS).

3.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD) – Two aliquots of the same sample to which known quantities of the method analytes are added. The MS and MSD are treated exactly like any other sample. The MS and MSD are used to determine whether the sample matrix contributes bias to the sample results and to indicate the precision associated with laboratory procedures.

3.5 Sample Duplicate (DUP): A duplicate is only performed on air samples. The duplicate is used to determine the precision of the analysis.

3.6 %R: Percent Recovery

3.7 RPD: Relative Percent Difference

3.8 SOP: Standard Operating Procedure

3.9 GC: Gas Chromatograph

3.10 MS: Mass Spectrometer

3.11 ICV: Initial Calibration Verification

3.12 CCV: Continuing Calibration Verification

3.13 EICP: Extracted Ion Current Profile

3.14 MDL: Method Detection Limit

3.15 LLOQ: Lower Limit of Quantitation

4.0 Sample Handling and Preservation

4.1 Water samples are collected in 40-mL VOA vials pre-preserved with 1:1 hydrochloric acid. Non-preserved samples are also acceptable, but the holding time is reduced from 14 days to 7 days if the sample has not been preserved in the field.

4.2 Water samples should be shipped and stored at 4°C ± 2°C.

4.3 Soil samples are field collected in pre-weighed VOA vials with stir bars for the low-level method and without stir bars for the high-level method. A 4-ounce jar is collected to perform a dry weight analysis.

4.4 Soil samples can be field preserved by collecting the soil into pre-weighed VOA vials containing stir bars, water, and sodium bisulfate for the low-level method and into VOA vials containing methanol for the high-level method. A 4-ounce jar is collected to perform a dry weight analysis.

4.5 All field-preserved samples should be shipped and stored at 4°C ± 2°C. If the samples are not field-preserved, they should be stored at 4°C ± 2°C and shipped to be received by the laboratory within 48 hours of collection for laboratory preservation. The holding time for all soils is 14 days.

4.6 Air samples are collected in Tedlar bags. The samples should be shipped and stored at 4°C ± 2°C. The holding time for air samples is 3 days.

4.7 Whenever possible, volatile samples should be stored separately from other samples in the volatiles department refrigerators and freezers to avoid contamination from other samples or from the extractions department.

4.8 Headspace larger than 6 mm (large pea-sized bubble) in water samples should be noted as a nonconformity using SOP 1.18.

5.0 Interferences

5.1 The laboratory uses large amounts of methylene chloride and acetone. The presence of fumes of these solvents in the atmosphere of the laboratory can cause significant interference. Steps are taken to minimize this interference, but it cannot be completely eliminated. Data that is interfered with in this fashion must be qualified.

5.2 Soil matrices that include bulk organic matter (*i.e.* peat, bark, root mass, etc.) or samples with high moisture content can severely impact the recovery of internal standards and surrogates. If these interferences are evident, reanalysis of the sample to confirm matrix effect is required.

5.3 For low-level soil analysis, soil grit between the VOA lip and VOA cap septum has been shown to cause leaks in the sealed VOA environment and therefore low internal standard recovery. If a second field-extracted low-level VOA was provided, reanalyze the sample. When all field-extracted low-level VOAs have been exhausted, the client is contacted to determine whether the sample should be extracted from the 4-ounce jar or analyzed via the high-level method using a field-extracted high-level VOA.

5.4 The 40-mL VOA vials have been shown to have contaminants on occasion. Each new lot of VOA vials is checked to make sure no contaminants are present. Also, empty VOA vials are stored in the sample freezer and the trailer and used for method blanks to make sure these environments are not contaminated.

5.5 Highly contaminated samples can cause carryover contamination on the gas chromatograph. Running water blanks after samples suspected of being highly contaminated can prevent this carryover.

6.0 Safety

6.1 All reagents and standards must be handled with extreme care due to their possible deleterious health effects. All applicable personal safety equipment must be used at all times when handling chemicals.

6.2 Methanol: Vapor is harmful. It may be fatal or cause blindness if swallowed. Avoid contact. Causes damage to lungs and central nervous system. Flammable.

7.0 Equipment and Supplies

7.1 Apparatus – GC/MS (Instrument Albert)

7.1.1 Varian Archon soil/water autosampler

7.1.2 Hewlett Packard LSC-7695 concentrator with Supelco VOCARB 3000 trap

7.1.3 Hewlett Packard 5890 Series II Plus Gas Chromatograph equipped with electronic pressure control (EPC)

7.1.4 Hewlett Packard Mass Selective Detector – Model 5972A

7.1.5 J&W DB-624 capillary column: 20 meter by 0.18 mm id by 1.0 μm film thickness

7.1.6 HP EnviroQuant ChemStation for data acquisition and data processing

7.1.7 Carrier gas – high-purity Helium

7.2 Apparatus – GC/MS (Instrument Morris)

7.2.1 EST Analytical Centurion Purge & Trap Autosampler

7.2.2 EST Analytical Encon Evolution concentrator with EST VOCARB 3000 trap

7.2.3 Agilent 7890A Series Gas Chromatograph equipped with electronic pressure control (EPC)

7.2.4 Agilent Mass Selective Detector – Model 5975C

7.2.5 J&W DB-624 capillary column: 20 meter by 0.18 mm id by 1.0 μm film thickness

7.2.6 Agilent Environmental ChemStation for data acquisition and data processing

7.2.7 Carrier gas – high-purity Helium

7.3 Apparatus – GC/MS (Instrument Waldo)

7.3.1 EST Analytical Centurion Purge & Trap Autosampler

7.3.2 EST Analytical Encon Evolution concentrator with EST VOCARB 3000 trap

7.3.3 Agilent 7890A Series Gas Chromatograph equipped with electronic pressure control (EPC)

7.3.4 Agilent Mass Selective Detector – Model 5975C

7.3.5 J&W DB-624 capillary column: 20 meter by 0.18 mm id by 1.0 μm film thickness

7.3.6 Agilent Environmental ChemStation for data acquisition and data processing

7.3.7 Carrier gas – high-purity Helium

7.4 Apparatus – GC/MS (Instrument Quagmire)

7.4.1 Teledyne Tekmar SolaTek 72 Multi-Matrix Vial Autosampler

7.4.2 Teledyne Tekmar Stratum concentrator with Teledyne VOCARB 3000 trap

7.4.3 Agilent 6890N Series Gas Chromatograph equipped with electronic pressure control (EPC)

7.4.4 Agilent Mass Selective Detector – Model 5973

7.4.5 J&W DB-624 capillary column: 20 meter by 0.18 mm id by 1.0 μm film thickness

7.4.6 Agilent Environmental ChemStation for data acquisition and data processing

7.4.7 Carrier gas – high-purity Helium

7.5 Apparatus – Sample Preparation

7.5.1 40 mL VOA vials with caps and septa

7.5.2 Magnetic stir bars

7.5.3 Top loading balance capable of measuring accurately to 0.01 grams

7.5.4 Scoopulas

7.5.5 5 mL Luer-lock syringe with needle attachment

7.5.6 Gas tight micro syringes - various sizes

7.5.7 Pasteur pipets

7.5.8 Amber GC vials

7.5.9 Mininert vials and valves – various sizes

7.5.10 Vortexer

7.5.11 Volumetric flasks – various sizes

7.5.12 Dry weight tins

7.5.13 Broad range pH paper

8.0 Reagents and Standards

8.1 Reagents

8.1.1 Methanol, purge and trap grade

8.1.2 Water, Organic Free (Reagent Water): drawn from Barnstead Nanopure water system, then boiled to 70-75% of original volume to remove VOC contamination.

8.1.2.1 The Nanopure water system has an activated carbon column designed to remove organic compounds from the water.

8.1.2.2 Depletion of the carbon filter may be indicated by a breakthrough of any organic compound. If this occurs, refer to SOP 8.10 for maintaining the generator.

8.2 Standards

8.2.1 Normal VOC analysis

8.2.1.1 Initial Calibration Standards (ICAL)

8.2.1.1.1 Volatile ICAL Stock Standards: Volatile organic compound mixes are purchased as certified stocks (liquids, gases, and additions) at 2,000 μg/mL. The liquid and gas standards are combined to form a single stock standard at concentrations of 1 μg/mL, 5 μg/mL, 10 μg/mL, 50 μg/mL, and 250 μg/mL in purge and trap grade methanol. The additions standard is prepared separately at the same concentrations.

8.2.1.1.2 Volatile ICAL Standards: The ICAL stock standards are used to create the calibration standards in VOA vials filled with reagent water (and stir bar, if applicable) according to Appendix C. The autosampler adds the internal standard and the surrogate standard.

8.2.1.2 Continuing Calibration Verification Standard (CCV)

8.2.1.2.1 Volatile CCV Stock Standards: The volatile organic compound mixes mentioned in 8.2.1.1.1 are combined to form two stock standards at a concentration of 50 μg/mL in purge and trap grade methanol, one a mixture of liquids and gases, the other solely additions.

8.2.1.2.2 Volatile CCV Standard: The CCV stock standards are used to create the continuing calibration standard in a VOA vial with reagent water (and stir bar, if applicable) at the midpoint concentration of the initial calibration being verified. The autosampler adds the internal standard and surrogate standard.

8.2.1.3 Initial Calibration Verification Standards (ICV)

8.2.1.3.1 Volatile ICV Stock Standards: Volatile organic compound mixes are purchased as certified stocks (liquids, gases, and additions) at 2,000 μg/mL from a source other than the initial calibration. The same source may be used as long as a different lot number is ordered. These standards are combined to form two stock standards at a concentration of 50 μg/mL in purge and trap grade methanol, one a mixture of liquids and gases, the other solely additions.

8.2.1.3.2 Volatile ICV Standard: The ICV stock standards are used to create a standard at the midpoint concentration of the initial calibration to be verified. The standard is prepared in a VOA vial with reagent water (and stir bar, if applicable). The autosampler adds the internal standard and surrogate standard.

8.2.2 VOC-SIM Analysis

8.2.2.1 Initial Calibration Standards (ICAL)

8.2.2.1.1 VOC-SIM ICAL Stock Standards: See Section 8.2.1.1.1. For a water calibration curve an additional liquid/gas stock standard concentration of 0.10 µg/mL must be prepared. For a soil calibration curve an additional liquid/gas stock standard concentration of 0.05 µg/mL must be prepared.

8.2.2.1.2 VOC-SIM ICAL Standards: The ICAL stock standards are used to create the calibration standards in VOA vials filled with reagent water (and stir bar, if applicable) according to Appendix C. The autosampler adds the internal standard and the surrogate standard.

8.2.2.2 Continuing Calibration Verification Standard (CCV)

8.2.2.2.1 VOC-SIM CCV Stock Standards: See Section 8.2.1.2.1.

8.2.2.2.2 VOC-SIM CCV Standard: See Section 8.2.1.2.2.

8.2.2.3 Initial Calibration Verification Standards (ICV)

8.2.2.3.1 VOC-SIM ICV Stock Standards: See Section 8.2.1.3.1.

8.2.2.3.2 VOC-SIM ICV Standard: See Section 8.2.1.3.2.

8.2.3 Acrylonitrile and (trans) 1,4-Dichloro-2-butene Analysis

8.2.3.1 Initial Calibration Standards (ICAL)

8.2.3.1.1 ICAL Stock Standards: Acrylonitrile and (trans) 1,4-Dichloro-2-butene are purchased as certified stocks at 100 µg/mL and 2,000 µg/mL, respectively. The standards are combined to form a single stock standard at concentrations of 2.5 µg/mL, 5 µg/mL, 25 µg/mL, and 50 µg/mL in purge and trap grade methanol.

8.2.3.1.2 ICAL Standards: The ICAL stock standards are used to create the calibration standards in VOA vials filled with reagent water according to Appendix C. The autosampler adds the internal standard and the surrogate standard.

8.2.3.2 Continuing Calibration Verification Standard (CCV)

8.2.3.2.1 CCV Stock Standards: The volatile organic compounds mentioned in 8.2.3.1.1 are combined to form one stock standard at a concentration of 25 μg/mL in purge and trap grade methanol.

8.2.3.2.2 CCV Standard: The CCV stock standard is used to create the continuing calibration standard in a VOA vial with reagent water at the midpoint concentration of the initial calibration being verified. The autosampler adds the internal standard and surrogate standard.

8.2.3.3 Initial Calibration Verification Standards (ICV)

8.2.3.3.1 ICV Stock Standards: Acrylonitrile and (trans) 1,4-Dichloro-2-butene are purchased as certified stocks at 100 μg/mL and 2,000 μg/mL, respectively, from a source other than the initial calibration. The same source may be used as long as a different lot number is ordered. These standards are combined to form one stock standard at a concentration of 25 μg/mL in purge and trap grade methanol.

8.2.3.3.2 ICV Standard: The ICV stock standard is used to create a standard at the midpoint concentration of the initial calibration to be verified. The standard is prepared in a VOA vial with reagent water. The autosampler adds the internal standard and surrogate standard.

8.2.4 Oxygenates Analysis

8.2.4.1 Initial Calibration Standards (ICAL)

8.2.4.1.1 Oxygenates ICAL Stock Standard: An oxygenates standard is purchased as a certified stock at 10,000/2,000 μg/mL. The standard is diluted to form a stock standard at concentrations of 25/5 μg/mL, 50/10 μg/mL, 250/50 μg/mL, and 1,250/250 μg/mL in purge and trap grade methanol.

8.2.4.1.2 Oxygenates ICAL Standards: The ICAL stock standards are used to create the calibration standards in VOA vials filled with reagent water (and stir bar, if applicable) according to Appendix C. The autosampler adds the internal standard and the surrogate standard.

8.2.4.2 Continuing Calibration Verification Standard (CCV)

8.2.4.2.1 Oxygenates CCV Stock Standard: The stock standard mentioned in 8.2.4.1.1 is used to prepare a stock standard at a concentration of 250/50 μg/mL in purge and trap grade methanol.

8.2.4.2.2 Oxygenates CCV Standard: The CCV stock standard is used to create the continuing calibration standard in a VOA vial with reagent water (and stir bar, if applicable) at the midpoint concentration of the initial calibration being verified. The autosampler adds the internal standard and surrogate standard.

8.2.4.3 Initial Calibration Verification Standards (ICV)

8.2.4.3.1 Oxygenates ICV Stock Standard: An oxygenates standard is purchased as a certified stock at 10,000/2,000 μg/mL from a source other than the initial calibration. The same source may be used as long as a different lot number is ordered. This standard is used to prepare a stock standard at a concentration of 250/50 μg/mL in purge and trap grade methanol.

8.2.4.3.2 Oxygenates ICV Standard: The ICV stock standard is used to create a standard at the midpoint concentration of the initial calibration to be verified. The standard is prepared in a VOA vial with reagent water (and stir bar, if applicable). The autosampler adds the internal standard and surrogate standard.

8.2.5 Tuning Standard

8.2.5.1 The surrogate solution, which contains the tune compound 4-Bromofluorobenzene (BFB), is purchased as a certified stock at 2,000 μg/mL. This standard is prepared at a concentration of 50 μg/mL in purge and trap grade methanol.

8.2.5.2 This solution is used to prepare a standard in a VOA vial filled with reagent water at 10 ng/mL for instruments Albert and Quagmire. This standard is used to validate the tune of the MS.

8.2.5.3 Instruments Waldo and Morris are programmed to prepare a tune standard via the autosampler surrogate solution and analyze this standard. This standard is used to validate the tune of the MS.

8.2.6 Internal Standard

8.2.6.1 Internal Standard Stock solution is purchased as a certified standard at 2,000 µg/mL. The stock contains 4 compounds: Pentafluorobenzene, 1,4-Difluorobenzene, Chlorobenzene-d5, and 1,4-Dichlorobenzene-d4. The standard is diluted to a concentration of 250 µg/mL for instrument Albert and 50 µg/mL for instruments Morris, Waldo, and Quagmire.

8.2.7 Surrogate

8.2.7.1 A surrogate mix containing Dibromofluoromethane, Toluene-d8 and 4-Bromofluorobenzene is purchased as a certified stock standard at 2,000 µg/mL. The standard is diluted to a concentration of 250 µg/mL for instrument Albert and 50 µg/mL for instruments Morris, Waldo, and Quagmire.

8.2.8 SB/SBD & MS/MSD Spiking Solution

8.2.8.1 Volatile Matrix Spike solution is purchased as a certified stock standard at 2,500 µg/mL. The stock solution contains 1,1-Dichloroethene, Benzene, Trichloroethene, Toluene and Chlorobenzene. This solution is diluted to a working concentration of 50 µg/mL.

8.2.9 Standard Handling

8.2.9.1 Standards expire on the manufacturer's date or one year from the date of opening, whichever comes first.

8.2.9.2 Stock standards prepared internally expire one year after preparation.

8.2.9.3 Working surrogate, spike, internal standard, tuning standard, and daily and initial calibration standards expire six months after preparation.

8.2.9.4 These expiration dates hold if no observed degradation of the solutions has taken place. All expired or degraded standards shall be properly disposed of to avoid accidental use.

8.2.9.5 Stock and working standards should be kept at –20ºC or according to manufacturer’s recommendation when not in use.

9.0 Quality Control

9.1 Method Blank (MB)

9.1.1 Method blanks are prepared and analyzed for every extraction batch at a 5% frequency (one method blank per extraction batch of 20). The method blank must not contain any target analytes greater than the reporting limit.

9.1.2 Corrective action for contaminated method blanks:

9.1.2.1 If the method blank contains target analytes greater than the reporting limit, the method blank must be reanalyzed.

9.1.2.2 If the method blank is contaminated after reanalysis, corrective action must be taken to identify and eliminate the source of the problem.

9.1.2.3 As mentioned in Section 5.1, methylene chloride and acetone are common laboratory contaminants. If there is low-level contamination for either of these compounds in the method blank, the reporting limit may be raised for the entire analysis batch to above the level of contamination if allowed by the quality assurance project plan.

9.1.2.4 If the reanalyzed method blank is acceptable, then analysis of client samples may proceed.

9.1.2.5 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A nonconformance form must be filled out and the associated data is flagged with a “B” qualifier. See SOP 1.18.

9.2 Spike Blank (SB)

9.2.1 Spike blanks are prepared and analyzed for every analysis batch at a 5% frequency (one spike blank per extraction batch of 20).

9.2.2 After analysis, calculate the percent recovery (%R) results as follows:

$$\%R = \frac{C_s}{C_n} \times 100$$

Where:
C_s = Measured concentration of the spike sample aliquot
C_n = Nominal (theoretical) concentration of the spike aliquot

9.2.3 If the %R is out of control, corrective action, as follows, must be taken:

9.2.3.1 Recalculate and check for integration or calculation errors.

9.2.3.2 Double check sample volume/weight, final extract volume, amount spiked and the concentration of the spike solution.

9.2.3.3 If a problem still exists, the spike blank should be reanalyzed. If the reanalysis is acceptable, then report only the reanalysis.

9.2.3.4 If the spike blank is still out of control, then analysis of client samples may not proceed.

9.2.3.5 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A nonconformance form must be filled out and the associated data is flagged with an "I" qualifier. See SOP 1.18.

9.2.4 Control limits for spike blank %R values shall be calculated yearly on actual sample data using SOP 1.22.

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

9.3.1 MS/MSD samples are prepared and analyzed for every analysis batch at a 5% frequency (one MS/MSD pair per extraction batch of 20).

9.3.2 If insufficient sample is provided to analyze an MS/MSD, a spike blank and spike blank duplicate may be analyzed in lieu of the MS/MSD.

9.3.3 After analysis, calculate the percent recovery (%R) on the wet weight results as follows:

$$\%R = \frac{C_s - C_u}{C_n} \times 100$$

Where:
C_s = Measured concentration of the spike sample aliquot
C_u = Measured concentration of the unspiked sample aliquot
C_n = Nominal (theoretical) concentration of the spike aliquot

9.3.4 If the %R is out of control, corrective action, as follows, must be taken:

9.3.4.1 Recalculate and check for integration or calculation errors.

9.3.4.2 Double check sample volume/weight, final extract volume, amount spiked and the concentration of the spike solution.

9.3.4.3 If the sample concentration exceeds more than four to five times what was spiked, the %R value is statistically meaningless. Flag any %R outliers with the “A” qualifier. See SOP 1.18.

9.3.4.4 If a problem still exists, then the spike blank should be evaluated. If the %R values in the spike blank are acceptable, then document the nonconformance and one of the following resolutions using SOP 1.18:

9.4.4.4.1 If the %R value is out of control similarly in both the MS and the MSD, then the problem can be attributed to a matrix effect. Qualify the %R outliers with the “V” qualifier.

9.4.4.4.2 If the %R value is out in one of the samples but not in the other one, then the analyst should use professional judgement to determine a course of action.

9.3.4.5 If the spike blank %R value is out of control, then the spike blank and the MS/MSD pair should be reanalyzed. If the %R values are acceptable, then the results from the reanalysis only should be reported. If the spike blank still fails, then the entire analysis batch associated with this QC set should be reanalyzed.

9.3.4.6 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A nonconformance form must be filled out and the associated data must be flagged with an “I” qualifier. See SOP 1.18.

9.3.5 Control limits for MS/MSD %R values shall be calculated yearly on actual sample data using SOP 1.22.

9.3.6 After analysis, calculate the relative percent difference (RPD) on the wet weight results as follows:

$$RPD = \frac{\left|C_1 - C_2\right|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$

Where:
C_1 = Measured concentration of the first sample aliquot
C_2 = Measured concentration of the second sample aliquot

9.3.7 If the RPD is out of control, corrective action, as follows, must be taken:

9.3.7.1 Recalculate and check for integration or calculation errors.

9.3.7.2 Double check sample volume/weight, final extract volume, amount spiked and the concentration of the spike solution.

9.3.7.3 If the RPD value is still out of control, then the analyst should use professional judgement to determine a course of action. Document the nonconformance and the resolution using SOP 1.18.

9.3.8 Control limits for MS/MSD RPDs shall be calculated yearly on actual sample data using SOP 1.22.

9.4 Surrogates

9.4.1 Dibromofluoromethane, Toluene-d8 and 4-Bromofluorobenzene are used as surrogates for this analysis. Surrogate recovery is monitored to assess method performance on the particular matrix. Surrogates are added to all samples and quality control samples prior to analysis.

9.4.2 Calculate the percent recovery (%R) as:

$$\%R = \frac{C_s}{C_n} \times 100$$

Where:
C_s = Measured concentration of the surrogate in the sample
C_n = Nominal (theoretical) concentration of the surrogate spiked into the sample

9.4.3 If the surrogate %R values are out of control, corrective action must be taken:

9.4.3.1 Recalculate and check for integration or calculation errors.

9.4.3.2 Double check sample volume/weight, final extract volume, amount surrogated and the concentration of the surrogate solution.

9.4.3.3 If any surrogate is out of control, then the sample must be re-analyzed. Document the nonconformance using SOP 1.18 and follow one of the resolutions below.

9.5.3.3.1 If the surrogate %R value is acceptable upon re-analysis, then this data should be reported.

9.5.3.3.2 If upon reanalysis the surrogate %R value is still out of control, the original sample data should be reported and the surrogate outlier flagged with the “Q” qualifier. The case narrative should document that the poor surrogate recovery was confirmed due to the sample matrix.

9.4.3.4 If insufficient sample volume or expired sample holding time prevents reanalysis, then the data can be reported. A nonconformance form must be filled out and the associated data flagged with a “Q” qualifier. See SOP 1.18.

9.4.4 Control limits for surrogate %R values shall be calculated yearly on actual sample data using SOP 1.22.

9.5 Sample Duplicate

9.5.1 Sample duplicates are only performed on air samples because there is no meaningful way to spike the air samples.

9.5.2 Sample duplicates are analyzed for every analysis batch at a 10% frequency (one sample/sample duplicate pair per analysis batch of 10).

9.5.3 After analysis, calculate the relative percent difference (RPD) as follows:

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$

Where C_1 and C_2 are the first and second values obtained for the analysis, respectively.

9.5.4 If the RPD is out of control, corrective action, as follows, must be taken:

9.5.4.1 Recalculate and check for integration or calculation errors.

9.5.4.2 Double check sample volume and the final volume for errors.

9.5.4.3 If the sample concentration is not greater than five times the reporting limit, the RPD value is not statistically meaningful. Document the situation using SOP 1.18, and flag the data with the “C” qualifier.

9.5.4.4 If a problem still exists and the concentration in the samples exceeds five times the reporting limit, the sample and duplicate should be reanalyzed. Document the nonconformance and one of the following resolutions using SOP 1.18:

9.5.4.4.1 If the RPD is acceptable upon reanalysis, this data should be reported.

9.6.4.4.2 If the RPD value is still out of control, then the analyst should use professional judgement to determine a course of action. Document the nonconformance and the resolution using SOP 1.18.

9.5.5 The sample duplicate RPD control limit is set at 30.

10.0 Calibration and Standardization

10.1 Tuning Standard (BFB)

10.1.1 Before the initial calibration (ICAL) or continuing calibration verification (CCV) is analyzed, the tune of the GC/MS system must be verified with 4-Bromofluorobenzene (BFB). The resulting mass spectrum must meet the abundance requirements listed in Appendix D.

10.1.2 All QC samples and client samples must be injected within 12 hours after the injection of the BFB tuning standard.

10.2 Volatile Initial Calibration (ICAL)

10.2.1 Calibration standards are analyzed at the concentrations listed in Appendix C depending on matrix.

10.2.2 Refer to Appendix E for a table of primary and secondary ions used. All target analytes are to be quantitated using the nearest (by retention time) internal standard.

10.2.3 Analyze each calibration standard and create a response list for each compound. Use peak areas versus the concentrations of the standard and the appropriate internal standard using the ChemStation software.

10.2.4 The ChemStation software should be set to model the internal standard calibration procedure outlined in Method 8260C (Sections 11.3.3 to 11.3.5).

10.2.5 The ICAL must meet the following specifications before analysis can proceed:

10.2.5.1 If the percent relative standard deviation (%RSD) for any single target compound is 20% or less, then that compound is set to quantitate using the average response factor method. (A minimum of five calibration levels must be analyzed.)

10.2.5.2 For compounds with a %RSD greater than 20%, quantitation is by linear regression as long as the correlation coefficient (r) is greater than 0.990. Do not use the force through the origin (0,0) option. (A minimum of five calibration levels must be analyzed.)

10.2.5.3 For compounds where neither average response nor linear regression is suitable, quadratic regression is used. The coefficient of determination (r^2) must be equal to or greater than 0.990. Do not use the force through the origin (0,0) option. (A minimum of six calibration levels must be analyzed.) This option should rarely, if ever, need to be employed.

10.2.5.4 If compounds fail to meet the above criteria, the associated concentrations may still be determined, but they must be reported as estimates.

10.2.5.5 If more than 10% of the compounds exceed the 20% RSD limit and do not meet the minimum correlation coefficient for alternate curve fits, then the chromatographic system is considered too imprecise for analysis to begin. Perform routine maintenance (i.e. replace the trap, clean the source, etc.) and repeat the calibration procedure.

10.3 Volatile Initial Calibration Verification (ICV)

10.3.1 After the ICAL meets method criteria, a second-source, initial calibration verification (ICV) standard must be analyzed as a check on the initial curve and calibration standards. ICV standards are run with internal standard and surrogate standard addition.

10.3.2 The percent difference (or percent drift as appropriate) for all compounds must be within ±30%. Any analytes that fail this criterion may only be reported as an estimated value.

10.4 Continuing Calibration Verification (CCV)

10.4.1 Analyze a CCV standard every 12 hours immediately following the BFB tuning standard but before QC samples and client samples are analyzed. CCV standards are run with internal standard and surrogate standard addition.

10.4.2 If the percent difference or percent drift for an analyte is less than or equal to 20%, then the initial calibration for that analyte is assumed to be valid.

10.4.3 For analytes that fail the 20% rule, they can be reported as non-detect with the Practical Quantitation Limit (PQL) adjusted for the percent difference. When a failed analyte is present in the sample, the concentration can be reported as an estimated value.

10.4.4 If a project calls for a subset of the analyte list, then only the subset compounds and spikes need to be less than or equal to 20%.

10.4.5 If more than 20% of the analytes have a percent difference or percent drift greater than 20%, then corrective action must be taken prior to the analysis of samples.

10.4.5.1 Remake the standard.

10.4.5.2 Check for leaks.

10.4.5.3 If the above steps do not resolve the problem, then a new initial calibration must be analyzed.

10.4.6 The Extracted Ion Current Profile (EICP) area for all of the internal standards must be within a factor of 2 (-50% to +100%) of the mid-point standard level of the most recent ICAL.

10.4.7 If the EICP area for any of the internal standards changes by more than a factor of 2, corrective action needs to be taken.

10.4.7.1 Remake the standard.

10.4.7.2 Check for leaks.

10.4.7.3 If the above steps do not resolve the problem, then a new initial calibration must be analyzed.

10.4.8 If the retention time for any internal standard changes by more than 10 seconds from that in the mid-point standard level of the most recent ICAL, the system must be inspected and corrections made, as necessary. If corrections are made, reanalysis of samples associated with that CCV is required.

11.0 Procedure

11.1 Instrument Operation

11.1.1 The recommended GC temperature and pressure programs are located in Appendix B.

11.2 Autosampler Setup (Albert)

11.2.1 Standard vials on the Archon autosampler are filled with surrogate standard (left) and internal standard (right).

11.2.1.1 To fill the vials, shut off the helium supply using the shutoff valve located to the far right of the vials.

11.2.1.2 Park the robotic arm at the front by accessing the ‘standard control’ section under 'system>maintenance' on the Archon keypad.

11.2.1.3 Once the robotic arm is parked at the front, loosen the nut holding the standard vial, remove the vial, dispose of any standard currently in the vial, and make new solution directly in the vial. Invert the vial 3 times to mix. Replace the vial and tighten the nut.

11.2.1.4 Turn the helium supply back on.

11.2.1.5 Press ‘enter’ on the Archon keypad to prime standard loop 1 or 2 as needed and then park the robotic arm at the rear. Exit this section by pressing ‘system’ until the Archon startup screen reappears.

11.2.2 The purge and trap system is programmed by pressing the 'method' button on the Archon keypad, selecting the method number desired and pressing enter, and pressing enter a second time to edit the selected method. Typically method 1 is for the BFB tune and method 10 is for soils. The LSC concentrator is operated through the autosampler and need not be programmed separately.

11.2.3 The 'edit method' screen presents a list of operating parameters. The only parameters which need to be changed are:

11.2.3.1 Sample type (water or soil)

11.2.3.2 First vial

11.2.3.3 Last vial

11.2.3.4 Sample volume (5 for the BFB tune and 8 for soils)

11.2.3.5 Standard 1 (yes or no)

11.2.3.6 Standard 2 (yes or no)

11.2.3.7 Link to method (if needed)

11.2.4 All of the samples that can be analyzed with the same parameters are programmed into one method. If there are samples that require different parameters (for instance, soils with surrogate and soils without surrogate (MDLs)) then a different method must be set up for each group of samples. The individual methods are then linked together (using the link to method parameter) to create the final program. To avoid the possibility of a closed programming loop, always link a method to a higher numbered method.

11.2.5 To start, press 'auto', enter the appropriate method, and start run.

11.3 Autosampler Setup (Morris)

11.3.1 Standard vials on the Centurion autosampler are filled with surrogate standard (left) and internal standard (right).

11.3.1.1 To fill the vials, shut off the helium supply using the shutoff valve located on the back of the unit.

11.3.1.2 A computer and keyboard are attached to the autosampler. Park the robotic arm at the front by selecting the diagnostics screen, then 'manual functions', 'internal standards', and 'front park'.

11.3.1.3 Once the robotic arm is parked at the front, loosen the nut holding the standard vial, remove the vial, dispose of any standard currently in the vial, and make new solution directly in the vial. Invert the vial 3 times to mix. Replace the vial and tighten the nut.

11.3.1.4 Turn the helium supply back on.

11.3.1.5 On the diagnostics screen select 'manual functions', 'internal standards', 'prime', check which standards to prime, then press 'prime'. Once it is finished, press 'exit'.

11.3.1.6 Park the robotic arm at the rear by selecting 'manual functions', 'internal standards', and 'rear park'.

11.3.2 The purge and trap system is programmed by starting on the sequence screen.

11.3.2.1 At the top of the screen is a drop down box. Enter the box and select 'default'. Clear the new screen, if necessary.

11.3.2.2 Near the bottom right is another drop down box titled 'select method'. Select the desired run type (i.e. tune, soil with both standards, etc.).

11.3.2.3 If necessary, use the "dilution" drop down box to select the desired dilution.

11.3.2.4 Type in the start vial number (the positions are numbered on the autosampler), enter the number of vials, and press 'insert'.

11.3.3 To add onto the sequence, click the line number that corresponds with the spot on the autosampler where the new vial will be added, then change the parameters in 11.3.2.2 through 11.3.2.4 as needed and press 'insert'.

11.3.4 To start the sequence, go to the run status screen and hit 'start'.

11.3.5 The Encon Evolution concentrator is operated through the autosampler and need not be programmed separately.

11.4 Autosampler Setup (Waldo)

11.4.1 Standard vials on the Centurion autosampler are filled with surrogate standard (left) and internal standard (right).

11.4.1.1 To fill the vials, shut off the helium supply using the shutoff valve located on the back of the unit.

11.4.1.2 A computer and keyboard are attached to the autosampler. Park the robotic arm at the front by selecting the diagnostics screen, then 'manual functions', 'internal standards', and 'front park'. Move the computer screen out of the way of the robotic arm.

11.4.1.3 Once the robotic arm is parked at the front, loosen the nut holding the standard vial, remove the vial, dispose of any standard currently in the vial, and make new solution directly in the vial. Invert the vial 3 times to mix. Replace the vial and tighten the nut.

11.4.1.4 Turn the helium supply back on.

11.4.1.5 On the diagnostics screen select ‘manual functions’, ‘internal standards’, ‘prime’, check which standards to prime, then press ‘prime’. Once it is finished, press ‘exit’.

11.4.1.6 Park the robotic arm at the rear by selecting ‘manual functions’, ‘internal standards’, and ‘rear park’.

11.4.2 The purge and trap system is programmed by starting on the sequence screen.

11.4.2.1 At the top of the screen is a drop down box. Enter the box and select ‘default’. Clear the new screen, if necessary. (Pre-filled sequences may also be used, such as ‘tune’, etc.)

11.4.2.2 Near the bottom right is another drop down box titled ‘select method’. Select the desired run type (i.e. tune, soil with both standards, etc.).

11.4.2.3 Type in the start vial number (the positions are numbered on the autosampler), enter the number of vials, and press ‘insert’.

11.4.3 To add onto the sequence, click the line number that corresponds with the spot on the autosampler where the new vial will be added, then change the parameters in 11.4.2.3 as needed and press ‘insert’.

11.4.4 To start the sequence, go to the run status screen and hit ‘start’.

11.4.5 The Encon Evolution concentrator is operated through the autosampler and need not be programmed separately.

11.5 Autosampler Setup (Quagmire)

11.5.1 The SOLATek autosampler is equipped with three standard vials. Currently only two vials are in use: standard vial 1 is filled with surrogate and standard vial 2 is filled with internal standard.

11.5.1.1 To fill the vials, loosen the nut holding the vial while firmly grasping the vial. The pressure will release with a pop that will drop the vial onto the floor of the autosampler if it is not held onto firmly.

11.5.1.2 Remove the vial and pour the solution into the vial. Replace the vial and tighten the nut.

11.5.1.3 The autosampler is controlled by the SOLATek 72 Teklink program on the computer. Click on ‘tools’, then ‘prime’, and then pick which vial is to be primed and follow the directions.

11.5.2 The purge and trap system is programmed in the Teklink program on the main computer. Start on a clear screen and then hit ‘file’, ‘new’, and ‘schedule’. A blank schedule will appear.

11.5.2.1 Set the method type (water).

11.5.2.2 Set the amount of standard to be added from each standard vial. Typically this is 5 µL from standard 1 (surrogate) and 5 µL from standard 2 (internal standard). (No surrogate addition for BFB tune.)

11.5.2.3 Enter the sample volume to use. This is typically 5 mL for the BFB tune, 25 mL for waters, and 20 mL for air samples.

11.5.2.4 Enter the dilution, if applicable.

11.5.2.5 Enter a start position and a stop position. The positions are numbered on the autosampler.

11.5.2.6 Press ‘overwrite’, ‘make active’, and attach it to a file name (i.e. tune, waters, etc.).

11.5.2.7 Press start when ready.

11.5.3 To add onto the sequence, simply change the parameters in 11.5.2.1 through 11.5.2.5 as needed, press ‘add’, and then ‘make active’.

11.5.4 The Stratum concentrator is operated through the autosampler and need not be programmed separately.

11.6 GC/MS Setup (Albert)

11.6.1 The MS data system must be separately programmed to run the samples and acquire data.

11.6.1.1 Select ‘Sequence>Save’ from the MSTop window.

11.6.1.1.1 Save the sequence as the date you are running the instrument. The date (YYMMDD) will be preceded by ‘A’ for Albert and end with an extension ‘.s’ (i.e. A170218.s). Press ‘OK’.

11.6.1.2 Select 'Sequence>Edit Sample Log Table' from the MSTop window.

11.6.1.3 Each sample/standard to be analyzed must have a separate line.

11.6.1.3.1 The 'Type' field is 'Sample'.

11.6.1.3.2 The 'Vial' field should correspond to the location in the autosampler tray.

11.6.1.3.3 The 'Data File' field is the first letter of the instrument being used, two-digit month, two-digit day, and three-digit sample number (i.e. A0218001, A0218002, A0218003, etc.).

11.6.1.3.4 The 'Method' field is the date the latest initial calibration imbedded in the method was run with the instrument initial at the beginning and an 'S' at the end designating a 'Soil' method (i.e. 'AYYMMDDS').

11.6.1.3.5 The 'Sample Name' field is the name of what will run (i.e. 50ng bfb mass tune, CCV, SB, SBD, MB, or OnSite sample number). The CCV, SB, SBD, and MB are followed by the date, matrix, and number (i.e. SB0218W1). The OnSite sample number is followed by any necessary information (dilution, MS, MSD, etc.).

11.6.1.3.6 The Miscellaneous field is the Lab ID for the standard used in the case of the BFB tune, CCV, and SB/SBD or MS/MSD.

11.6.1.3.7 Press 'OK'.

11.6.1.4 Select 'Sequence>Save>OK' to save the new sequence.

11.6.1.5 Select 'Sequence>Run' and update the data file directory to reflect the current date. Press 'OK' to ensure the data will go to the appropriate directory.

11.6.1.6 Select 'Sequence>Run>Run Sequence' to connect the data system with the GC/MS.

11.7 GC/MS Setup (Morris, Waldo, and Quagmire)

11.7.1 The MS data system must be separately programmed to run the samples and acquire data.

11.7.1.1 Select 'Sequence>Save Sequence As' from the MSTop window.

11.7.1.1.1 Save the sequence as the date you are running the instrument. The date (YYMMDD) will be preceded by ‘M’ for Morris, ‘W’ for Waldo, or ‘Q’ for Quagmire and end with an extension ‘.s’ (i.e. M170218.s). Press ‘OK’.

11.7.1.2 Select 'Sequence>Edit Sequence' from the MSTop window.

11.7.1.3 Each sample/standard to be analyzed must have a separate line.

11.7.1.3.1 The ‘Type’ field is ‘Sample’.

11.7.1.3.2 The ‘Vial’ field should correspond to the location in the autosampler tray.

11.7.1.3.3 The ‘Data File’ field is the first letter of the instrument being used, two-digit month, two-digit day, and three-digit sample number (i.e. M0218001, M0218002, M0218003, etc.).

11.7.1.3.4 The ‘Method’ field is the date the latest initial calibration imbedded in the method was run with the instrument initial at the beginning and an ‘S’, ‘W’, ‘O’, ‘SIM’, or ‘G’ at the end designating a ‘Soil’, ‘Water’, ‘Oxygenate’, ‘SIM’, or Gas method (i.e. 'WYYMMDDS' for soils and ‘MYYMMDDW’ for waters, etc.).

11.7.1.3.5 The ‘Sample’ field is the name of what will run (i.e. 50ng bfb mass tune, CCV, SB, SBD, MB, or OnSite sample number). The CCV, SB, SBD, and MB are followed by the date, matrix, and number (i.e. SB0218W1). The OnSite sample number is followed by any necessary information (dilution, MS, MSD, etc.).

11.7.1.3.6 The ‘Comment’ field is the Lab ID for the standard used in the case of the BFB tune, CCV, and SB/SBD or MS/MSD.

11.7.1.3.7 Press ‘OK’.

11.7.1.4 Select ‘Sequence>Save Sequence’ to save the new sequence.

11.7.1.5 Select ‘Sequence>Run Sequence’ and update the data file directory to reflect the current date. Press ‘OK’ to ensure the data will go to the appropriate directory.

11.7.1.6 Select ‘Sequence>Run Sequence>Run Sequence’ to connect the data system with the GC/MS.

11.8 Sample Preparation

11.8.1 Water samples are either analyzed as received or are diluted prior to analysis. The Centurion autosampler for Waldo does not perform dilutions; therefore, any dilutions must be hand-made by sub-sampling from the original sample vial and diluting the aliquot into a clean VOA vial filled with analyte-free water. Dilutions can be performed by the Centurion autosampler for Morris for dilutions up to 1:50 and the SOLATek autosampler (Quagmire) for dilutions up to 1:250. Higher dilutions must be hand-made. Samples are run with internal standard and surrogate standard addition.

11.8.2 Soil samples from Washington state should be field extracted in any of the following three manners:

11.8.2.1 Preserved extraction

11.8.2.1.1 For low-level analysis, approximately 5g of sample is added to a previously weighed VOA vial containing a stir bar, 5 mL analyte-free water, and sodium bisulfate. The sample is stored on ice at 4°C±2°C until it is received by the lab.

11.8.2.1.2 For high-level analysis, approximately 5g of sample is added to a previously weighed VOA vial containing 5 mL of purge and trap grade methanol. The sample is stored on ice at 4°C±2°C until it is received by the lab.

11.8.2.1.3 Once checked in at the lab, the sample is stored at 4°C±2°C.

11.8.2.1.4 At the time of analysis, the samples will be warmed to room temperature and reweighed to determine the exact weight of the soil.

11.8.2.1.5 Samples for low-level analysis are loaded into the autosampler tray and run with standard addition.

11.8.2.1.6 Samples for high-level analysis are diluted by taking a portion of the extract and transferring it to a VOA vial containing a stir bar and 5 mL analyte-free water. The VOA is capped and loaded into the autosampler tray and run with standard addition.

11.8.2.2 Non-preserved extraction into VOA vials

11.8.2.2.1 For low-level analysis, approximately 5g of sample is added to a previously weighed VOA vial containing a stir bar. The sample is stored on ice at 4°C±2°C until it is received by the lab.

11.8.2.2.2 For high-level analysis, approximately 5g of sample is added to a previously weighed VOA vial. The sample is stored on ice at 4°C±2°C until it is received by the lab.

11.8.2.2.3 The lab <u>must</u> receive the samples within 48 hours of sampling. The lab will preserve the samples by freezing them to <-7°C.

11.8.2.2.4 At the time of analysis, the sample will be warmed to room temperature and reweighed to determine the exact weight of the soil.

11.8.2.2.5 Samples for low-level analysis are injected with 5 mL of analyte-free water, vortexed, loaded into the autosampler tray, and run with standard addition.

11.8.2.2.6 Samples for high-level analysis are injected with 5 mL of purge and trap grade methanol, vortexed, and vented. The sample is diluted by taking a portion of the extract and transferring it to a VOA vial containing a stir bar and 5 mL analyte-free water. The VOA is capped and loaded into the autosampler tray and run with standard addition.

11.8.2.3 Non-preserved extraction in En Core Sampler

11.8.2.3.1 The sample is field extracted using an En Core Sampler. The cap is replaced on the Sampler and the Sampler is sealed in a collection bag. The sample is stored on ice at 4°C±2°C until it is received by the lab.

11.8.2.3.2 The lab <u>must</u> receive the samples within 48 hours of sampling. The lab will transfer the soil plugs from the En Core Samplers into pre-weighed VOA vials with or without stir bars, depending on the chosen analysis. The lab will then preserve the samples by freezing them to <-7°C.

11.8.2.3.3 At the time of analysis, the sample will be warmed to room temperature and reweighed to determine the exact weight of the soil.

11.8.2.3.4 Samples for low-level analysis are injected with 5 mL of analyte-free water, vortexed, loaded into the autosampler tray, and run with standard addition.

11.8.2.3.5 Samples for high-level analysis are injected with 5 mL of purge and trap grade methanol, vortexed, and vented. The sample is diluted by taking a portion of the extract and transferring it to a VOA vial containing a stir bar and 5 mL analyte-free water. The VOA is capped and loaded into the autosampler tray and run with standard addition.

11.8.3 Soil samples that are not field-extracted as above or are not from Washington state are prepared by weighing 5g of sample into a VOA vial with a stir bar in it, adding 5 mL of analyte-free water, capping the vial, and vortexing. These vials are then loaded into the autosampler tray. Samples are run with standard addition.

11.8.4 For samples, other than waters, which are inappropriate for direct purge and trap analysis (i.e. samples with very high concentrations of target analytes, oily soils, sludges, etc.) a methanol extraction step is included before analysis.

11.8.4.1 Five grams of the sample is weighed into a 40 mL VOA vial and 5 mL of purge and trap grade methanol is added. The vial is capped and vortexed until the sample matrix breaks apart and disperses into the methanol. Vent the sample once while vortexing.

11.8.4.2 After being allowed to settle, a portion of the extract (correlating to the dilution deemed necessary) is transferred to a VOA vial containing a stir bar and 5 mL analyte-free water. The VOA vial is capped and loaded into the autosampler tray. Samples are run with standard addition.

11.8.5 For oil or product samples, a methanol extraction step is included before analysis.

11.8.5.1 See SOP 3.06 – Waste Dilution for further instruction.

11.8.6 For air samples, a 1:5 dilution is automatically performed.

11.8.6.1 One 40 mL VOA vial is filled with reagent water and capped for each method blank, air sample, and duplicate. The vials are loaded into the autosampler tray. Air samples use the water method. Instrument Waldo cannot alter the amount of water that is added to the sparger, so it will use the normal water sequence. Instruments Morris and Quagmire should be set up to run a sample volume of 20 mL with standard addition.

11.8.6.2 For the method blank, draw 5 mL of air from the lab atmosphere and inject it into the sparger containing the purging analyte-free water.

11.8.6.3 The Tedlar bag containing the air sample is allowed to warm to room temperature. Draw approximately 0.3 mL of analyte free water into a 5 mL Luer-lock syringe.

11.8.6.4 Attach a needle to the 5 mL Luer-lock syringe and pierce the septum of the Tedlar bag, drawing out 5 mL of air.

11.8.6.5 Inject the 5 mL of air into the sparger containing the purging analyte-free water.

11.9 QA/QC Samples

11.9.1 A method blank must be analyzed for each matrix included in an analytical batch. The method blank is prepared in exactly the same way as a sample except the matrix is either clean reagent water or methanol, as appropriate. The method blank is analyzed after the spike blank(s) and is used to determine if method analytes or other interferences are present in the laboratory environment, the solvents or the equipment.

11.9.2 A spike blank (also known as a laboratory control sample) must be analyzed for each matrix included in an analytical batch. The spike blank is prepared in exactly the same way as a matrix spike (see 11.9.3 below) except that the matrix is either clean reagent water or Ottawa sand, as appropriate. The spike blank is analyzed immediately following the CCV and before the method blank and the recovery of the spike compounds is evaluated using QC acceptance criteria for the correct matrix.

11.9.3 A matrix spike and matrix spike duplicate must be analyzed for each sample matrix run in an analytical batch or a minimum of one MS/MSD set per 20 samples of each sample matrix.

11.9.3.1 Three identically prepared sample vials are required for the sample chosen for MS/MSD analysis. Two of these vials are used for the matrix spike and matrix spike duplicate. The third vial is used for analysis of the unspiked sample.

11.9.3.2 All three vials are prepared normally as analytical samples. The two vials chosen for MS/MSD analysis are then spiked with matrix spike solution to a concentration of 10 ng/mL or 50 ng/g (depending on matrix). All three vials are analyzed as analytical samples of the appropriate matrix.

11.9.3.3 It is not unusual to have insufficient sample for MS/MSD analysis. In this case it is acceptable (though not preferred) to analyze a spike blank and spike blank duplicate. An SB/SBD is merely an MS/MSD prepared from analyte-free water instead of a sample matrix. In all other respects it is identical to an MS/MSD.

11.9.4 A duplicate is only analyzed for air samples at a minimum of one duplicate per ten air samples.

11.9.4.1 Prepare the duplicate exactly like the analytical sample.

12.0 Data Reduction and Calculation

12.1 After analyzing each sample, the ChemStation software will automatically integrate and calculate the concentrations of any peaks within the retention time window for each target analyte. The analyst should review the integration for each positive result to verify that the peak was properly identified and integrated. Reintegrate the peak manually, if necessary, using SOP 1.12 to correct for improper integration. The analyst must initial and date all manual integrations.

12.2 Compounds are identified by the following criteria:

12.2.1 The relative retention time of a compound is within ±0.06 minutes of the same compound in the CCV.

12.2.2 The relative intensities of the characteristic ions should agree within 30% of the relative intensities of these ions in the reference spectrum.

12.2.3 The experience of the analyst determines that the compound is present despite interferences from coeluting compounds.

12.3 If the integrated area of any of the four internal standards in the samples differs by a factor of 2 (-50% to +100%) from that of the continuing calibration verification (CCV) standard, the following corrective actions must be taken:

12.3.1 Check for integration errors.

12.3.2 Verify that the sample analysis was not compromised by mechanical or electronic failure in any part of the analytical system. If there was a failure then the data is rejected outright. If no sample remains, the client must be informed that the analysis failed. The client must then decide whether to resample or not.

12.3.3 Otherwise reanalyze the sample.

12.3.3.1 If the reanalysis yields acceptable internal standard response, report the reanalysis data. It is not necessary to document the nonconformance.

12.3.3.2 If the internal standard response is still out of control, then this is confirmation of matrix effect. The data may be used, but must be qualified.

12.3.4 For low-level soil samples, if all four internal standards do not meet the acceptance criteria it is because there is soil grit between the VOA lip and VOA cap septum causing leaks in the sealed VOA environment. If a second field-extracted low-level VOA vial was provided, reanalyze the sample. When all field-extracted low-level VOA vials have been exhausted, the client is contacted to determine whether the sample should be extracted from the 4-ounce jar or analyzed via the high-level method using a field-extracted high-level VOA.

12.4 The QDEL function should be used to remove any false positives from the quantitation report before the report is generated.

12.5 To calculate the concentration (in ppb for waters and ppm for soils) in the actual sample, the chemist electronically links the ChemStation data file to an Excel spreadsheet to avoid transposition errors associated with hand-entering data. The chemist enters the sample matrix, sample volume/mass, dilution factor and dry weight and the spreadsheet performs the following calculation for each analyte:

Soil:

$$C_s = \frac{(C_{ex})(5\ grams)}{(V_s)(DW)(1000)}$$

Water:

$$C_s = (C_{ex})(DF)$$

Where:

C_{ex} = Concentration (in ng/mL or ng/g) reported by the data system.
DF = Dilution factor (dimensionless). Use a value of 1 if no dilution is performed.
V_s = Initial volume or mass of sample extracted (in mL or g).
DW = Dry weight of soil. Use a value of 1 for water samples.

12.6 When extracting soil samples with methanol (MeOH), the final volume (V_t) needs to be corrected for the amount of moisture present in the solid sample. This is because water and MeOH are miscible; any water contained in the soil combines with the MeOH and effectively increases the total volume of the extract. If this correction is not applied, the sample results will be biased low. The amount of error increases as the percent moisture increases. The final volume is adjusted according to the following equation:

$$Vt(corrected) = \left(\frac{\%Moisture * Vs}{100}\right) + Vt$$

Where:

V_t = Total methanol volume of the final extract (mL)
V_s = Initial sample weight (grams)

Thus, a 5 gram sample with a 25% dry weight extracted with 5mL of MeOH will have an adjusted total volume of 6.25 mL for the final extract.

These calculations take place automatically in the spreadsheets.

12.7 Report the results for the unknown samples in µg/L for waters and mg/kg for soils. Round the results to two significant figures.

12.8 Results that exceed the linear range of the calibration curve must be diluted and re-analyzed.

12.9 Common data qualifiers seen using this method are as follows:

12.9.1 Y—The calibration verification for this analyte exceeded the 20% drift specified in Method 8260C; therefore, the reported result should be considered an estimate. The overall performance of the calibration verification standard met the acceptance criteria of the method.

12.9.2 Q—Surrogate recovery is outside of control limits.

12.9.3 H—The analyte indicated is a common laboratory solvent that may have been introduced during sample preparation and thereby be impacting the sample result.

12.9.4 E—The value reported exceeds the quantitation range and is therefore an estimate.

13.0 Method Performance

13.1 Method Detection Limits/Lower Limits of Quantitation

13.1.1 Method detection limit (MDL) studies and Lower Limit of Quantitation (LLOQ) studies are conducted concurrently and are performed yearly or whenever a significant change in the system or method has occurred.

13.1.2 SOP 1.20 details how to conduct an MDL/LLOQ study.

13.2 This method is validated through successful ongoing annual single blind performance evaluation samples.

14.0 Pollution Prevention

14.1 This SOP and other similar published analytical methods have been carefully reviewed for possible ways to prevent unnecessary pollution.

14.2 The solvents used in this method pose little threat to the environment when managed properly.

14.3 Standards should be prepared in volumes consistent with laboratory use to minimize the volume of expired standards to be disposed.

15.0 Waste Management

15.1 The appropriate disposal of waste streams from this procedure is addressed in SOP 1.08.

16.0 References

16.1 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 8000D - Determinative Chromatographic Separations*, 3rd Edition, Rev. 4, July 2014.

16.2 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 8260C – Volatile Organic Compounds By Gas Chromatography/Mass Spectrometry (GC/MS)*, 3rd Edition, Rev. 3, August 2006.

16.3 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 5030C – Purge and Trap for Aqueous Samples*, 3rd Edition, Rev. 3, May 2003.

16.4 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 5035 – Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples*, 1st Edition, Rev. 2, December 1996.

16.5 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 5035A – Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples*, 1st Edition, Draft Rev. 1 (7/02), December 1996.

16.6 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 5000 – Sample Preparation for Volatile Organic Compounds*, 1st Edition, Rev. 2, December 1996.

Appendix A

Reporting Limits 8260C
(wet weight basis)

COMPOUND	WATER (μg/L)	SOIL (mg/kg)	COMPOUND	WATER (μg/L)	SOIL (mg/kg)
Dichlorodifluoromethane	0.20	0.0010	2-Hexanone	2.0	0.0050
Chloromethane	1.0	0.0050	Dibromochloromethane	0.20	0.0010
Vinyl Chloride	0.20	0.0010	1,2-Dibromoethane	0.20	0.0010
Bromomethane	0.20	0.0010	Chlorobenzene	0.20	0.0010
Chloroethane	1.0	0.0050	1,1,1,2-Tetrachloroethane	0.20	0.0010
Trichlorofluoromethane	0.20	0.0010	Ethylbenzene	0.20	0.0010
1,1-Dichloroethene	0.20	0.0010	m,p-Xylene	0.40	0.0020
Acetone	5.0	0.0050	o-Xylene	0.20	0.0010
Iodomethane	1.0	0.0050	Styrene	0.20	0.0010
Carbon Disulfide	0.20	0.0010	Bromoform	1.0	0.0010
Methylene Chloride	1.0	0.0050	Isopropylbenzene	0.20	0.0010
Acrylonitrile	0.50	N/A	Bromobenzene	0.20	0.0010
(trans) 1,2-Dichloroethene	0.20	0.0010	1,1,2,2-Tetrachloroethane	0.20	0.0010
Methyl t-Butyl Ether	0.20	0.0010	1,2,3-Trichloropropane	0.20	0.0010
1,1-Dichloroethane	0.20	0.0010	(trans) 1,4-Dichloro-2-butene	0.50	N/A
Vinyl Acetate	1.0	0.0050	n-Propylbenzene	0.20	0.0010
2,2-Dichloropropane	0.20	0.0010	2-Chlorotoluene	0.20	0.0010
(cis) 1,2-Dichloroethene	0.20	0.0010	4-Chlorotoluene	0.20	0.0010
2-Butanone	5.0	0.0050	1,3,5-Trimethylbenzene	0.20	0.0010
Bromochloromethane	0.20	0.0010	tert-Butylbenzene	0.20	0.0010
Chloroform	0.20	0.0010	1,2,4-Trimethylbenzene	0.20	0.0010
1,1,1-Trichloroethane	0.20	0.0010	sec-Butylbenzene	0.20	0.0010
Carbon Tetrachloride	0.20	0.0010	1,3-Dichlorobenzene	0.20	0.0010
1,1-Dichloropropene	0.20	0.0010	p-Isopropylbenzene	0.20	0.0010
Benzene	0.20	0.0010	1,4-Dichlorobenzene	0.20	0.0010
1,2-Dichloroethane	0.20	0.0010	1,2-Dichlorobenzene	0.20	0.0010
Trichloroethene	0.20	0.0010	n-Butylbenzene	0.20	0.0010
1,2-Dichloropropane	0.20	0.0010	1,2-Dibromo-3-chloropropane	1.0	0.0050
Dibromomethane	0.20	0.0010	1,2,4-Trichlorobenzene	0.20	0.0010
Bromodichloromethane	0.20	0.0010	Hexachlorobutadiene	1.0	0.0050
2-Chloroethyl Vinyl Ether	1.0	0.0050	Naphthalene	1.0	0.0010
(cis) 1,3-Dichloropropene	0.20	0.0010	1,2,3-Trichlorobenzene	0.20	0.0010
Methyl Isobutyl Ketone	2.0	0.0050			
Toluene	1.0	0.0050	tert-Butyl Alcohol (TBA)	5.0	25
(trans) 1,3-Dichloropropene	0.20	0.0010	Diisopropyl Ether (DIPE)	1.0	5.0
1,1,2-Trichloroethane	0.20	0.0010	tert-Butyl Ethyl Ether (ETBE)	1.0	5.0
Tetrachloroethene	0.20	0.0010	tert-Amyl Methyl Ether (TAME)	1.0	5.0
1,3-Dichloropropane	0.20	0.0010	tert-Amyl Ethyl Ether (TAEE)	1.0	5.0

RANGE		
Gasoline (Toluene through Napthalene)	100	5.0

Reporting Limits 8260C/SIM
(wet weight basis)

COMPOUND	WATER (ng/L)	SOIL (ng/kg)	COMPOUND	WATER (ng/L)	SOIL (ng/kg)
Vinyl Chloride	20	50	1,1,1-Trichloroethane	N/A	50
1,1-Dichloroethene	20	50	Trichloroethene	N/A	50
(trans) 1,2-Dichloroethene	N/A	50	Tetrachloroethene	N/A	50
(cis) 1,2-Dichloroethene	N/A	50	1,2-Dibromoethane	20	N/A

Appendix B

Instrument Setpoints

GC	Albert	Morris	Waldo	Quagmire
Initial Temperature:	40°C	40°C	40°C	40°C
Initial Time:	2 min	2 min	2 min	2 min
Ramp:	15°C/min	15°C/min	15°C/min	15°C/min
Final Temperature:	220°C	200°C	220°C	220°C
Final Time:	0.50 min	0 min	0.50 min	0.50 min
Injector Temperature:	B, 200°C	200°C	200°C	200°C
Detector Temperature:	B, 250°C	250°C	200°C	200°C
Helium Reg. Pressure:	80 psi	80 psi	80 psi	80 psi
Inlet Pressure:	3 psi	16.5 psi	10 psi	10 psi
Carrier flow:	0.265 mL/min	0.8 mL/min	0.5 mL/min	0.5 mL/min
Purge flow to Split vent:	13.3 mL/min	68 mL/min	32.5 mL/min	32.4 mL/min
Column Velocity	22.7 cm/sec	39.7 cm/sec	31.4 cm/sec	31 cm/sec
Auxiliary Pressure:	E, 5 psi	N/A	N/A	N/A

Concentrator	Albert	Morris	Waldo	Quagmire
Transfer line temperature:	120°C	150°C	150°C	150°C
Valve temperature:	120°C	150°C	150°C	150°C
Purge ready temperature:	41°C	35°C	35°C	45°C
Desorb preheat temperature:	225°C	260°C	260°C	245°C
Desorb temperature:	260°C	265°C	265°C	250°C
Bake temperature:	260°C	260°C	265°C	270°C
Purge time:	11 min	11 min	11 min	11 min
Dry purge time:	1 min	1 min	1 min	1 min
Desorb time:	2 min	0.50 min	0.50 min	0.75 min
Bake time:	6 min	8 min	8 min	4 min
MCS Bake temperature:	180°C	210°C	200°C	175°C
Bake Gas Bypass:	Off	N/A	N/A	N/A

Appendix C

Preparation of Initial Calibration Standards

The standards for a water calibration are prepared by adding the specified amounts of the indicated ICAL stock standards to a 40 mL VOA vial filled with organic free water and then capping the vial and vortexing. Morris, Waldo, and Quagmire analyze water samples. The 50 µg/mL Internal Standard solution and 50 µg/mL Surrogate Standard solution are automatically added from the autosampler standard reservoir vials before purging.

Standard Concentrations for Normal Water ICAL

0.20 ng/mL	9.0 µL each of 1.0 µg/mL Liquid/Gas and Additions Initial Calibration Standards
1.0 ng/mL	9.0 µL each of 5.0 µg/mL Liquid/Gas and Additions Initial Calibration Standards
2.0 ng/mL	9.0 µL each of 10 µg/mL Liquid/Gas and Additions Initial Calibration Standards
5.0 ng/mL	4.5 µL each of 50 µg/mL Liquid/Gas and Additions Initial Calibration Standards
10 ng/mL	9.0 µL each of 50 µg/mL Liquid/Gas and Additions Initial Calibration Standards
25 ng/mL	4.5 µL each of 250 µg/mL Liquid/Gas and Additions Initial Calibration Standards
50 ng/mL	9.0 µL each of 250 µg/mL Liquid/Gas and Additions Initial Calibration Standards
100 ng/mL	18 µL of 250 µg/mL Additions Initial Calibration Standard

Additional Standard Concentrations for SIM Water ICAL (add on to above ICAL)

0.020 ng/mL	9.0 µL of 0.10 µg/mL Liquid/Gas Initial Calibration Standard
0.040 ng/mL	18 µL of 0.10 µg/mL Liquid/Gas Initial Calibration Standard
0.10 ng/mL	4.5 µL of 1.0 µg/mL Liquid/Gas Initial Calibration Standard

Standard Concentrations for Acrylonitrile & (trans) 1,4-Dichloro-2-butene Water ICAL

0.50 ng/mL	9.0 µL of 2.5 µg/mL Initial Calibration Standard
1.0 ng/mL	9.0 µL of 5.0 µg/mL Initial Calibration Standard
2.5 ng/mL	4.5 µL of 25 µg/mL Initial Calibration Standard
5.0 ng/mL	9.0 µL of 25 µg/mL Initial Calibration Standard
10 ng/mL	9.0 µL of 50 µg/mL Initial Calibration Standard
25 ng/mL	22.5 µL of 50 µg/mL Initial Calibration Standard

Standard Concentrations for Oxygenates Water ICAL

5.0/1.0 ng/mL	9.0 µL of 25/5.0 µg/mL Initial Calibration Standard
10/2.0 ng/mL	9.0 µL of 50/10 µg/mL Initial Calibration Standard
25/5.0 ng/mL	4.5 µL of 250/50 µg/mL Initial Calibration Standard
50/10 ng/mL	9.0 µL of 250/50 µg/mL Initial Calibration Standard
125/25 ng/mL	4.5 µL of 1250/250 µg/mL Initial Calibration Standard
250/50 ng/mL	9.0 µL of 1250/250 µg/mL Initial Calibration Standard

Standard Concentrations for Gasoline Water ICAL

0.10 µg/mL	90 µL of 50 µg/mL Initial Calibration Standard
0.50 µg/mL	45 µL of 500 µg/mL Initial Calibration Standard
1.0 µg/mL	90 µL of 500 µg/mL Initial Calibration Standard
2.5 µg/mL	45 µL of 2500 µg/mL Initial Calibration Standard
5.0 µg/mL	45 µL of 5000 µg/mL Initial Calibration Standard
7.5 µg/mL	45 µL each of 2500 and 5000 µg/mL Initial Calibration Standards
10 µg/mL	90 µL of 5000 µg/mL Initial Calibration Standard

The standards for a soil calibration are prepared by adding the specified amounts of the indicated ICAL stock standards to a VOA vial containing a stir bar and 5 mL of organic free water, then capping the vial. Albert, Morris, and Waldo analyze soil samples. The 50 μg/mL Internal Standard solution and 50 μg/mL Surrogate Standard solution (250 μg/mL each for Albert) are added from the autosampler standard reservoir vials before purging.

Standard Concentrations for Normal Soil ICAL

1.0 ng/g	5.0 μL each of 1.0 μg/mL Liquid/Gas and Additions Initial Calibration Standards
5.0 ng/g	5.0 μL each of 5.0 μg/mL Liquid/Gas and Additions Initial Calibration Standards
10 ng/g	5.0 μL each of 10 μg/mL Liquid/Gas and Additions Initial Calibration Standards
20 ng/g	10 μL each of 10 μg/mL Liquid/Gas and Additions Initial Calibration Standards
50 ng/g	5.0 μL each of 50 μg/mL Liquid/Gas and Additions Initial Calibration Standards
100 ng/g	10 μL each of 50 μg/mL Liquid/Gas and Additions Initial Calibration Standards
200 ng/g	4.0 μL each of 250 μg/mL Liquid/Gas and Additions Initial Calibration Standards **(Albert)**
250 ng/g	5.0 μL each of 250 μg/mL Liquid/Gas and Additions Initial Calibration Standards **(Morris/Waldo)**
500 ng/g	10 μL of 250 μg/mL Additions Initial Calibration Standard

Additional Standard Concentrations for SIM Soil ICAL (add on to above ICAL)

0.050 ng/mL	5.0 μL of 0.050 μg/mL Liquid/Gas Initial Calibration Standard
0.10 ng/mL	10 μL of 0.050 μg/mL Liquid/Gas Initial Calibration Standard
0.50 ng/mL	2.5 μL of 1.0 μg/mL Liquid/Gas Initial Calibration Standard

Standard Concentrations for Oxygenates Soil ICAL

25/5.0 ng/mL	5.0 μL of 25/5.0 μg/mL Initial Calibration Standard
50/10 ng/mL	5.0 μL of 50/10 μg/mL Initial Calibration Standard
100/20 ng/mL	2.0 μL of 250/50 μg/mL Initial Calibration Standard
250/50 ng/mL	5.0 μL of 250/50 μg/mL Initial Calibration Standard
500/100 ng/mL	2.0 μL of 1250/250 μg/mL Initial Calibration Standard
1250/250 ng/mL	5.0 μL of 1250/250 μg/mL Initial Calibration Standard

Standard Concentrations for Gasoline Soil ICAL

0.10 μg/mL	10 μL of 50 μg/mL Initial Calibration Standard
0.50 μg/mL	5.0 μL of 500 μg/mL Initial Calibration Standard
1.0 μg/mL	10 μL of 500 μg/mL Initial Calibration Standard
2.5 μg/mL	5.0 μL of 2500 μg/mL Initial Calibration Standard
5.0 μg/mL	5.0 μL of 5000 μg/mL Initial Calibration Standard
7.5 μg/mL	15 μL of 2500 μg/mL Initial Calibration Standard
10 μg/mL	10 μL of 5000 μg/mL Initial Calibration Standard

Appendix D

BFB Mass Ion Abundance Criteria

ALBERT

M/e	ION ABUNDANCE CRITERIA
50	8-40% of mass 95
75	30-60% of mass 95
95	100% relative abundance (base peak)
96	5-9% of mass 95
173	Less than 2% of mass 174
174	50-100% of mass 95
175	5-9% of mass 174
176	95-101% of mass 174
177	5-9% of mass 176

MORRIS

M/e	ION ABUNDANCE CRITERIA
50	15-40% of mass 95
75	30-80% of mass 95
95	100% relative abundance (base peak)
96	5-9% of mass 95
173	Less than 2% of mass 174
174	50-100% of mass 95
175	5-9% of mass 174
176	95-101% of mass 174
177	5-9% of mass 176

WALDO

M/e	ION ABUNDANCE CRITERIA
50	15-40% of mass 95
75	30-60% of mass 95
95	100% relative abundance (base peak)
96	5-9% of mass 95
173	Less than 2% of mass 174
174	50-100% of mass 95
175	5-9% of mass 174
176	95-101% of mass 174
177	5-9% of mass 176

M/e	QUAGMIRE ION ABUNDANCE CRITERIA
50	15-40% of mass 95
75	30-60% of mass 95
95	100% relative abundance (base peak)
96	5-9% of mass 95
173	Less than 2% of mass 174
174	50-100% of mass 95
175	5-9% of mass 174
176	95-101% of mass 174
177	5-9% of mass 176

Appendix E

Characteristic Ions for Analytes

Analyte	Primary Ion	Secondary Ion(s)	Analyte	Primary Ion	Secondary Ion(s)
Pentafluorobenzene	168		Tetrachloroethene	166	168,164
Dichlorodifluoromethane	85	87	1,3-Dichloropropane	76	78
Chloromethane	50	52	2-Hexanone	43	58,71,100
Vinyl Chloride	62	64	Dibromochloromethane	129	127,131
Bromomethane	96	94	1,2-Dibromoethane	107	109
Chloroethane	64	66	Chlorobenzene	112	114
Trichlorofluoromethane	101	103	1,1,1,2-Tetrachloroethane	133	131,135
1,1-Dichloroethene	61	63	Ethylbenzene	91	106
Acetone	43	58	m,p-Xylene	91	106
Iodomethane	142	127	o-Xylene	91	106
Carbon Disulfide	76	78	Styrene	104	
Methylene Chloride	49	51	Bromoform	173	171,175
Acrylonitrile	53	52,51,38	Isopropylbenzene	105	120
(trans) 1,2-Dichloroethene	61	63	4-Bromofluorobenzene	95	174,176
Methyl t-Butyl Ether	73	57,41,43	1,4-Dichlorobenzene-d4	152	154
1,1-Dichloroethane	63	65	Bromobenzene	156	158
Vinyl Acetate	43	86	1,1,2,2-Tetrachloroethane	83	85
2,2-Dichloropropane	77	79	1,2,3-Trichloropropane	75	77
(cis) 1,2-Dichloroethene	61	63	(trans) 1,4-Dichloro-2-butene	53	89
Butanone	43	72	n-Propylbenzene	91	120
Bromochloromethane	130	128,93,49	2-Chlorotoluene	126	128
Chloroform	83	85	4-Chlorotoluene	126	128
1,1,1-Trichloroethane	97	99	1,3,5-Trimethylbenzene	105	120
Dibromofluoromethane	111	113	tert-Butylbenzene	119	134
Carbon Tetrachloride	117	119	1,2,4-Trimethylbenzene	105	120
1,1-Dichloropropene	75	77	sec-Butylbenzene	105	134
Benzene	78	77	1,3-Dichlorobenzene	146	148
1,2-Dichloroethane	62	64	p-Isopropyltoluene	119	134
1,4-Difluorobenzene	114		1,4-Dichlorobenzene	146	148
Trichloroethene	130	132	1,2-Dichlorobenzene	146	148
1,2-Dichloropropane	63	65	n-Butylbenzene	91	134
Dibromomethane	174	172,176	1,2-Dibromo 3-chloropropane	157	155,159
Bromodichloromethane	83	85	1,2,4-Trichlorobenzene	180	182,184
2-Chloroethyl Vinyl Ether	63	106	Hexachlorobutadiene	225	223,227
(cis) 1,3-Dichloropropene	75	77	Naphthalene	128	129
Methyl Isobutyl Ketone	43	58,85,100	1,2,3-Trichlorobenzene	180	182,184
Toluene-d8	98	100	tert-Butyl Alcohol (TBA)	59	41
Toluene	91	92	Diisopropyl Ether (DIPE)	45	43,87
Chlorobenzene-d5	117	119	tert-Butyl Ethyl Ether (ETBE)	59	87,41
(trans) 1,3-dichloropropene	75	77	tert-Amyl Methyl Ether (TAME)	73	43,55
1,1,2-Trichloroethane	97	99	tert-Amyl Ethyl Ether (TAEE)	59	87,73

***PRIMARY IONS AND SECONDARY IONS MAY INTERCHANGE AS NECESSARY.**

OnSite Environmental Inc.
Redmond, Washington

Analysis of Metals by ICP-AES
Method 6010D

Prepared by: ______________________ Date: ____________
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Revision History

Origination Date: **01/14/03**

Revision 2.0 **05/16/06**

SOP officially revised to revision 7.02.02 to reflect new software upgrade. Also updated Appendix A to include all current wavelengths and current detection limits.

Revision 3.0 **02/09/16**

- Updated method version to 6010C.
- Reorganized sections to conform to other SOPs.

Revision 4.0 **07/10/17**

- Added Lower Limit of Quantitation (LLOQ) information, including a daily Lower Limit Verification (LLV) standard.
- Deleted references to LLICV and LLCCV standards.
- Updated method version to 6010D.

Revision 5.0 **12/14/18**

- Updated “Definitions” section.
- Reorganized “Equipment and Supplies” section.
- Added spike standard to “Reagents and Standards” section.
- Added Demonstration of Capability to “Quality Control” section.
- Removed reference to MDLs.

Table of Contents

1.0 Scope and Application

1.1 The purpose of this method is to quantitatively determine concentrations of metals in water and soil.

1.2 Inductively coupled plasma atomic emission spectroscopy (ICP-AES) determines elements including metals in solution. This method is applicable to a large number of metals and matrices. All matrices, including ground water, aqueous samples, TCLP extracts, industrial wastes, soils, sludges, sediments, and other solid wastes, require digestion prior to analysis.

1.3 The estimated reporting limits for metals in soil and water are summarized in Appendix A. Detection limits, sensitivity, and optimum ranges of the metals will vary with the sample matrices.

2.0 Summary of Method

2.1 Prior to analysis, samples must be prepared using an appropriate metals digestion method. These procedures are discussed in their respective standard operating procedures.

2.2 This method describes multi-elemental determination by ICP-AES. The ICP measures element emitted light by optical spectroscopy. Samples are nebulized and the aerosol is transported to the plasma torch. Element specific atomic line emission spectra are produced by radio frequency inductively coupled argon plasma. The spectra are dispersed by echelle and a CCD detector measures the intensity of each spectral line. In simultaneous ICP analysis, all wavelengths are measured on a single detector array. Background correction is required and is measured adjacent to the analyte lines during sample analysis.

3.0 Definitions

3.1 Reagent Water – Water free of target analytes or interferences greater than the reporting limits for this SOP. Also referred to as deionized water.

3.2 Method Blank (MB) – A sample aliquot (usually reagent water) free from target analytes is treated exactly as a sample including exposure to all glassware, equipment, and solvents. The MB is used to determine if method analytes or other interferences are present in the laboratory environment, the solvents, or the equipment.

3.3 Spike Blank (SB) – A sample aliquot (usually reagent water) free from target analytes to which known quantities of method analytes are added. The spike blank is treated exactly as a sample. The spike blank is used to determine whether the methodology is in control and to indicate the accuracy associated with laboratory procedures. Also referred to as a Laboratory Control Sample (LCS).

3.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD) – Two aliquots of the same sample to which known quantities of the method analytes are added. The MS and MSD are treated exactly as a sample. The MS and MSD are used to determine whether the sample matrix contributes bias to the sample results and to indicate the precision associated with laboratory procedures.

3.5 Sample Duplicate (DUP) – A duplicate of a sample is digested and analyzed. The duplicate is used to determine the precision of the analysis and also help identify samples that are potentially non-homogenous.

3.6 Inter-Element Correction Factors (IEC) – An inter-element correction factor is a calculation that corrects for a known interference.

3.7 Lower Limit of Quantitation (LLOQ) check standard – An aliquot of reagent water (free from target analytes) that is spiked at the PQL and is treated exactly as a sample. The LLOQ is the lowest level at which a laboratory can reliably quantitate a given analyte within pre-determined limits.

3.8 %R: Percent Recovery

3.9 RPD: Relative Percent Difference

3.10 SOP: Standard Operating Procedure

3.11 ICV: Initial Calibration Verification

3.12 LLV: Low Level Verification

3.13 ICB: Initial Calibration Blank

3.14 CCV: Continuing Calibration Verification

3.15 CCB: Continuing Calibration Blank

3.16 ICS: Interference Check Sample

3.17 L: Serial Dilution

3.18 PS: Post Digestion Spike

3.19 IEC: Inter-Element Correction Factors

3.20 LRA: Linear Range Analysis

4.0 Sample Handling and Preservation

4.1 Water (Total metals)

4.1.1 Water samples are preserved with nitric acid to a pH <2 in 500 mL plastic containers.

4.2 Water (Dissolved metals)

4.2.1 Water samples should be field filtered and then preserved with nitric acid to a pH <2 in 500 mL plastic containers.

4.2.2 Water samples that are submitted for dissolved metals that have not been field filtered must be submitted in unpreserved 500 mL plastic containers. The samples should be filtered by the laboratory as soon as possible upon receipt and then preserved with nitric acid to a pH <2 in 500 mL plastic containers.

4.3 Soil

4.3.1 Soil samples are collected in 4-ounce jars.

4.4 All samples should be shipped and stored at 4° ± 2°C.

4.5 The holding time (from collection) for digestion and analysis of ICP metals is six months.

5.0 Interferences

5.1 Spectral interferences are caused by (1) overlap of a spectral line from another element; (2) unresolved overlap of molecular band spectra; (3) background contribution from continuous or recombination phenomena; and (4) stray light from the line emission of high concentration elements. Computer correcting the raw data after quantifying the interfering element can compensate for spectral overlap. Unresolved overlap requires the selection of an alternate wavelength. Background contribution and stray light can be compensated for by background correction adjacent to the analyte line.

5.2 Physical interferences are effects associated with the sample nebulization and transport processes. Changes in viscosity and surface tension can cause significant inaccuracies, especially in samples containing high concentrations of dissolved solids or high acid concentrations. If present, these interferences must be removed by sample dilution or by using the method of standard additions.

5.3 Chemical interferences include molecular compound formation, ionization effects, and solute vaporization effects. Normally these effects are not significant with the ICP technique. If observed, they can be minimized by careful selection of operating conditions (power, observation position, and so forth), by buffering of the sample, by matrix matching, and by standard addition procedures. Chemical interferences are highly dependent on matrix type and the specific element.

6.0 Safety

6.1 All reagents and standards must be handled with extreme care due to their possible deleterious health effects. All applicable personal protective safety equipment must be used at all times when handling chemicals including a laboratory coat, gloves, and protective eyewear.

7.0 Equipment and Supplies

7.1 Equipment

7.1.1 Varian Vista-MPX Simultaneous Inductively Coupled Argon Plasma Emission Spectrometer

7.1.2 Varian SP-5 Autosampler

7.1.3 Vista-MPX software, ICP Expert

7.1.4 Water recirculator

7.2 Supplies

7.2.1 Liquid Argon dewer

7.2.2 Class A volumetric pipets

7.2.3 Class A volumetric flasks

8.0 Reagents and Standards

8.1 Reagents

8.1.1 Nitric Acid, concentrated, Trace metals grade

8.1.2 Hydrochloric Acid, concentrated, Trace metals grade

8.1.3 Reagent Water

8.1.3.1 The deionized water generator has cartridge filters designed to remove trace metals and organic and inorganic interferences. Refer to SOP 8.10 for maintaining the generator.

8.2 Standards

8.2.1 Initial Calibration Standards (ICAL)

8.2.1.1 Single-element certified stock standards are purchased from an accredited source.

8.2.1.2 Calibration standards are prepared by diluting these stock standards.

8.2.1.3 Multi-element calibration standards will be made from these stock standards. Standard constituent elements and concentrations will depend on the metals required. See Appendix B for a list of current mixed calibration standards.

Note: The preparation of standards will be documented in the standards logbook, where each standard will be assigned a unique identification number.

8.2.2 Initial Calibration Verification Standard (ICV)

8.2.2.1 Multi-element certified stock standards are purchased from an accredited source.

8.2.2.2 ICV standards must be from a different source than the calibration standards.

8.2.3 Low Level Verification Standard (LLV)

8.2.3.1 The LLV standard is normally the same as the low-level calibration standard.

8.2.4 Continuing Calibration Verification Standard (CCV)

8.2.4.1 The CCV standard is normally the same as the mid-range calibration standard.

8.2.4.2 Standard constituent elements and concentrations will depend on the metals required.

8.2.5 Interference Check Sample A and AB Standards (ICSA) (ICSAB)

8.2.5.1 Single and multi-element certified stock standards are purchased from an accredited source.

8.2.5.2 Analyte and interfering concentrations for the ICSA and ICSAB solutions are listed in Appendix C.

8.2.6 Spike Standard (SB, MS/MSD, PS)

8.2.6.1 The spike standard is prepared from the ICAL stock standards (8.2.1.1).

8.2.6.2 Standard constituent elements and concentrations will depend on the metals required.

8.2.7 Standard Handling

8.2.7.1 Purchased stock standards expire on the manufacturer’s date.

8.2.7.2 Spikes, daily and initial calibration standards expire on the original stock manufacturer’s expiration date.

8.2.7.3 These expiration dates hold if no observed degradation of the solutions has taken place. All expired or degraded standards shall be properly disposed to avoid accidental use.

8.2.7.4 Stock and working standards should be kept according to manufacturer’s recommendation when not in use.

9.0 Quality Control

9.1 Demonstration of Capability

9.1.1 Each new chemist performing digestions or analyzing samples for this method must complete a Demonstration of Capability as outlined in SOP 1.21 to demonstrate that they can achieve documented levels of acceptable precision and accuracy with this method.

9.2 Lower Limit of Quantitation (LLOQ) check standard

9.2.1 The laboratory should establish the LLOQ as the lowest point of quantitation, usually the lowest point of the calibration curve. The LLOQ is initially verified by the analysis of at least 7 replicates spiked at the LLOQ and processed like a sample. The mean recovery should be +/- 35% of the true value and the RSD should be ≤ 20%.

9.2.2 Ongoing LLOQ verification, at a minimum, is on a quarterly basis to validate quantitation capability at low analyte concentration levels. The check standard is spiked at the LLOQ and taken through the entire analytical procedure from digestion through analysis. The result is entered into a spreadsheet.

9.2.3 The quarterly LLOQ must be within 35% of the spiked value to be valid.

9.3 Inter-Element Correction Factors (IEC)

9.3.1 Inter-Element Correction Studies are conducted every six months or whenever a significant change in the system or method has occurred.

9.3.2 Initially each elemental wavelength used is checked against known stock elements without any inter-element correction factors applied.

9.3.3 If interference is found, either positive or negative, then an inter-element correction factor must be determined.

9.3.3.1 Use the IEC wizard to calculate the correction factors using the following solutions:

9.3.3.1.1 A standard solution containing a known concentration of the element.

9.3.3.1.2 A standard solution containing a known concentration of the interfering element (a separate interference standard for each interfering element).

9.3.3.1.3 An analytical blank.

9.3.3.2 Reanalyze the interference standard using the correction factor to make sure the absolute value is below the detection limit. Adjust the correction factor, if necessary.

9.4 Linear Range Analysis (LRA)

9.4.1 The linear range establishes the highest concentration that may be reported without diluting the sample. Following calibration, the laboratory may choose to analyze a standard at a higher concentration than the high standard in the calibration. The standard must recover within 10% of the true value, and if successful establishes the linear range. This standard may be analyzed anywhere within the run.

9.4.2 If a LRA standard is not analyzed, samples that exceed the concentration of the highest calibration standard must be diluted and reanalyzed to fall within the established calibration of the instrument.

9.5 Method Blank (MB)

9.5.1 Method blanks are prepared and analyzed for every digestion batch at a 5% frequency (one method blank per digestion batch of 20). The method blank must not contain any target analytes greater than one half the reporting limit.

9.5.2 Corrective action for contaminated method blanks:

9.5.2.1 If any analyte in the method blank is above the absolute value of the reporting limit, then the concentration of that analyte in the samples must be 10 times the method blank concentration.

9.5.2.2 Any samples that are not 10 times the blank concentration must be redigested and reanalyzed for the element(s) in question.

9.5.2.3 The samples are not to be corrected for the blank value.

9.5.2.4 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A nonconformance form must be filled out and the associated data is flagged with a “B” qualifier. See SOP 1.18.

9.6 Spike Blank (SB)

9.6.1 Spike blanks are prepared and analyzed for every digestion batch at a 5% frequency (one spike blank per digestion batch of 20).

9.6.2 Spike blank percent recoveries must be 80 to 120%

9.6.3 After analysis, calculate the percent recovery (%R) results as follows:

$$\%R = \frac{C_s}{C_n} \times 100$$

Where:
C_s = Measured concentration of the spike sample aliquot
C_n = Nominal (theoretical) concentration of the spike aliquot

9.6.4 If the %R is out of control, corrective action, as follows, must be taken:

9.6.4.1 Recalculate and check for integration or calculation errors.

9.6.4.2 Double check sample volume/weight, final digestion volume, amount spiked, and the concentration of the spike solution.

9.6.4.3 If a problem still exists, the spike blank should be reanalyzed. If the reanalysis is acceptable, then report only the reanalysis.

9.6.4.4 If the spike blank is still out of control, then the associated samples must be redigested and reanalyzed.

9.6.4.5 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A non-conformance form must be filled out and the associated data is flagged with an “I” qualifier. See SOP 1.18.

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

9.7.1 MS/MSD samples are prepared and analyzed for every digestion batch at a 5% frequency (one MS/MSD pair per digestion batch of 20).

9.7.2 MS/MSD percent recoveries must be between 75-125%.

9.7.3 After analysis, calculate the percent recovery (%R) on the wet weight results as follows:

$$\%R = \frac{C_s - C_u}{C_n} \times 100$$

Where:
C_s = Measured concentration of the spike sample aliquot
C_u = Measured concentration of the unspiked sample aliquot
C_n = Nominal (theoretical) concentration of the spike aliquot

9.7.4 If the %R is out of control, corrective action, as follows, must be taken:

9.7.4.1 Recalculate and check for integration or calculation errors.

9.7.4.2 Double check sample volume/weight, final digestate volume, amount spiked, and the concentration of the spike solution.

9.7.4.3 If the sample concentration exceeds more than four times what was spiked, the %R value is statistically meaningless. Flag any %R outliers with the “A” qualifier.

9.7.4.4 If the %R is outside of the control limits the samples should be redigested for the element(s) to prove that there is an adverse matrix effect on the spike.

9.7.4.5 If a problem still exists, then the spike blank should be evaluated. If the %R values for the spike blank are acceptable, then document the nonconformance and one of the following resolutions using SOP 1.18:

9.7.4.5.1 If the %R value is out of control similarly in both the MS and the MSD, then the problem can be attributed to a matrix effect. Qualify the %R outliers with the “V” qualifier.

9.7.4.5.2 If the %R value is out in one of the samples but not in the other one, then the analyst should use professional judgement to determine a course of action.

9.7.4.6 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A non-conformance form must be filled out and the associated data must be flagged with an “I” qualifier. See SOP 1.18.

9.7.5 After analysis, calculate the relative percent difference (RPD) on the wet weight results as follows:

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$

Where:
C_1 = Measured concentration of the first sample aliquot
C_2 = Measured concentration of the second sample aliquot

9.7.6 The RPD must not be greater than 20%.

9.7.7 If the RPD is out of control, corrective action, as follows, must be taken:

9.7.7.1 Recalculate and check for integration or calculation errors.

9.7.7.2 Double check sample volume/weight, final digestate volume, amount spiked, and the concentration of the spike solution.

9.7.7.3 If the RPD is still outside of the control limits for an element(s), the samples should be redigested for the element(s) to prove the sample is non-homogenous.

9.8 Sample Duplicate (DUP)

9.8.1 Duplicate samples are prepared and analyzed for every digestion batch at a 5% frequency (one duplicate per digestion batch of 20).

9.8.2 The RPD must not be greater than 20%.

9.8.3 After analysis, calculate the relative percent difference (RPD) on the wet weight results as follows:

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$

Where:
C_1 = Measured concentration of the first sample aliquot
C_2 = Measured concentration of the second sample aliquot

9.8.4 If the RPD is out of control, corrective action, as follows, must be taken:

9.8.4.1 Recalculate and check for integration or calculation errors.

9.8.4.2 Double check sample volume/weight and final digestate volume.

9.8.4.3 If the RPD is still outside of the control limits for an element(s), the samples should be redigested for the element(s) to prove the sample is non-homogenous.

9.8.4.4 For analyte concentrations less than 5 times the reporting limit, there are no control limits for the RPD and no corrective action is expected.

9.9 Serial Dilution (L)

9.9.1 A serial dilution should be analyzed whenever a new or unusual matrix is encountered.

9.9.2 If the analyte concentration is sufficiently high (minimally a factor of 25 above the LLOQ), an analysis of a 1:5 dilution should agree within ± 20% of the original sample. If not, a chemical or physical interference effect should be suspected.

9.9.3 If the serial dilution is out of control, interference should be suspected. The analyst should try to eliminate the problem by analyzing the sample on a different wavelength, analyzing the sample on a different instrument, or diluting out the interferent.

9.10 Post Digestion Spikes (PS)

9.10.1 A post digestion spike should be analyzed whenever a new or unusual matrix is encountered, if there is no MS\MSD, or if the MS\MSD QC fails two times.

9.10.2 After analysis, calculate the percent recovery (%R) on the wet weight results as follows:

$$\%R = \frac{C_s - C_u}{C_n} \times 100$$

Where:
C_s = Measured concentration of the spike sample aliquot
C_u = Measured concentration of the unspiked sample aliquot
C_n = Nominal (theoretical) concentration of the spike aliquot

9.10.3 The post digestion spike should be recovered between 75-125%.

9.10.4 If the post digestion spike is out of control, interference should be suspected. The analyst should try to eliminate the problem by analyzing the sample on a different wavelength, analyzing the sample on a different instrument, or diluting out the interferent.

10.0 Calibration and Standardization

10.1 Initial Calibration (ICAL)

10.1.1 The ICP must be calibrated at a minimum of once per day.

10.1.2 The initial calibration curve must include a blank and at least three standards for every element analyzed including a sample at or below the PQL.

10.1.3 If the correlation coefficient (r) is greater than 0.995 and all standards are within 20 percent of their true value, then proceed with initial calibration verification. Otherwise, the standards must be reprepared and reanalyzed.

10.1.4 All of the analytes of interest may be combined in the same standard. The concentration of the standards depends on the sensitivity of the analytical line used and the linear range of the line.

10.1.5 Each standard will be assigned a unique ID number when entered into the Standard Prep Logbook.

10.2 Initial Calibration Verification (ICV)

10.2.1 After linearity is established and the initial calibration meets method criteria, a second-source Initial Calibration Verification (ICV) standard must be analyzed as a check on the initial curve and calibration standards. The analyte must be within ±10% of the true value before the calibration curve may be used.

10.3 Initial Calibration Blank (ICB)

10.3.1 The ICB contains the same acid matrix as the standards and the Calibration Blank. The ICB immediately follows the ICV.

10.3.2 The ICB must be below one half the absolute value of the reporting limit before the calibration curve may be used.

10.4 Low Level Verification (LLV)

10.4.1 After the ICB, the LLV is analyzed to verify the lower limit of quantitation (LLOQ). The LLV concentration must be at or below the PQL for the samples. The LLV must be ± 20%.

10.4.2 When the LLV does not pass, corrective action needs to be taken. Recalibration is the first course of action. If this also fails to correct the problem, then the sample introduction system needs to be thoroughly cleaned before trying to recalibrate.

10.5 Continuing Calibration Verification (CCV)

10.5.1 Analyze a continuing calibration verification standard before samples are run, after every ten samples, and at the end of the sequence.

10.5.2 The percent difference (%D) must not exceed ±10% from the true value. Recalibrate and reanalyze any samples that are not bracketed by an acceptable opening and closing CCV.

10.6 Continuing Calibration Blank (CCB)

10.6.1 The CCB contains the same acid matrix as the standards and the Calibration Blank. The CCB is analyzed at the beginning of the run, after every 10 samples, and at the end of the sequence.

10.6.2 If the absolute value of the CCB exceeds the reporting limit, then the ICP must be recalibrated and all samples since the last acceptable CCB must be reanalyzed for the element(s).

10.7 Interference Check Samples (ICSA and ICSAB)

10.7.1 ICP Interference Check Samples must be analyzed before the samples. The solutions are run to verify inter-element and background correction factors.

10.7.2 The Interference Check Samples consist of two solutions: Solution A and Solution AB. Solution A consists of only the interfering elements and solution AB consists of both known concentrations of analytes and interfering elements. Both ICSA and ICSAB solutions are analyzed consecutively for all wavelengths used in a specific ICP analysis. Analyte and interfering concentrations for the ICSA and ICSAB solutions are listed in Appendix C.

10.7.3 The absolute value for the non-spiked analytes in the ICSA analysis must be less than the reporting limit for these elements.

10.7.4 The concentration for the analytes in the ICSAB analysis must fall within +/-20% of the true value for the analytes of interest. Any analyte that does not fall within the control limits must be reanalyzed.

11.0 Procedure

11.1 Warm-Up Instrument

11.1.1 Turn on argon supply.

11.1.2 Turn on water chiller/recirculator.

11.1.3 Check the rinse reservoir and fill with acidified deionized water if necessary.

11.1.4 Check peristaltic pump tubing and replace if necessary.

11.1.5 Turn on monitor and launch ICP Expert software.

11.1.6 Enter Plasma On. The instrument will now go through a start-up routine and will automatically light the plasma. If the plasma does not stay lit on the first attempt, check operating conditions, connections, etc. and retry this step.

11.1.7 Allow the instrument to equilibrate for a minimum of 30 minutes before attempting to analyze samples.

11.2 Wavelength Calibration

11.2.1 Perform a wavelength calibration once per month or when the torch is replaced.

11.2.2 From Instrument Set-up, choose the Wavelength Calibration page. With the wash solution aspirating, select calibrate detector. It will take roughly 1 to 2 minutes to calibrate. This process measures the dark current. You can save the dark current measurement by selecting store dark current.

11.2.3 Next, aspirate the Varian Tuning Solution or an equivalent. Click Wavelength Calibration. The instrument will calibrate automatically. Lower wavelengths can be improved by using the polyboost, but this is not required on a routine basis.

11.3 Inter-Element Correction (IEC)

11.3.1 The Inter-element correction lines will need to be updated periodically to insure that the interfering elements are being read correctly. This can be accomplished by rerunning the single element interferent standards on a current worksheet.

11.4 Sequence Setup

11.4.1 In the ICP Expert software, open a recent worksheet to use as a template. Save this file as a calibration template, using the original file name. This is the only template format that will save IEC data. Other formats available are sequence (saves sequence data and method settings only) and method (saves method settings only).

11.4.2 Create a new worksheet by choosing File, New, then selecting the calibration template that was just saved. Give the file a new name and click Save.

11.4.3 Go to the Sequence page and enter the appropriate sample labels. See Appendix D for the proper analysis sequence.

11.4.4 Run a sequence by loading standards, samples and QC into the autosampler according to the sequence file that was created. From the Worksheet page, choose start analysis. The instrument will now proceed to analyze the standards and samples.

11.5 Make sure the ICV, ICB, LLV, CCV, CCB and ICSA/AB samples pass the method requirements outlined in Section 10.0.

11.6 Up to ten samples may be analyzed before another CCV and CCB must be analyzed. Samples must be bracketed by passing CCV and CCB standards.

11.7 Before terminating a run, review QC samples for compliance with control limits and check client samples for any necessary dilutions. Reanalyze any samples that do not meet QC criteria. A sample will require dilution if it is over the established linear range for any analyte.

11.8 Shut Down the Instrument

11.8.1 Turn off plasma by choosing Plasma Off.

11.8.2 Release pump tubing.

11.8.3 Turn off water chiller/recirculator.

11.8.4 Turn off argon supply.

11.8.5 Do not shut down power to the instrument.

11.8.6 Turn off computer monitor. It is not necessary to exit the software or turn off the computer, although periodic restarting of the computer may reduce software crashes.

12.0 Data Reduction and Calculation

12.1 After analyzing each sample, the ICP software calculates the concentrations corresponding to any peaks within the viewing window for each target analyte. The analyst should review the peaks to verify that the software properly viewed the peak. The ICP software has the ability to incorporate dilution factors and sample volumes into the calculation. These features are not used. The concentration reported from the ICP software is in ug/L found in the sample digestate, not the sample itself.

12.2 To calculate the concentration in the actual sample, the chemist enters the following information into an excel spreadsheet which performs the following calculation:

Water:

$$C_s = \frac{(C_{ex})(V_t)(DF)}{(V_s)(DW)}$$

Soil:

$$C_s = \frac{(C_{ex})(V_t)(DF)}{(V_s)(DW)}$$

Where:

C_{ex} = Concentration (in ug/L) for the final digestate
V_t = Total volume of the digestate (in L)
DF = Dilution factor (dimensionless). Use a value of 1 if no dilution is done.
V_s = Initial volume or mass of sample (in L or grams)
DW = Dry weight of soil (use a value of 1 for water samples)

12.3 Report the results for unknown samples in µg/L for waters and mg/kg for soils. Round the results to two significant figures. Results for QC samples are rounded to three significant figures.

12.4 Results that exceed the linear range of the calibration curve must be diluted and re-analyzed. The dilution should be made such that the concentration of the dilution falls within the upper half of the calibration curve.

13.0 Method Performance

13.1 This method is validated through successful ongoing annual single blind performance evaluation samples.

14.0 Pollution Prevention

14.1 This SOP and other similar published analytical methods have been carefully reviewed for possible ways to prevent unnecessary pollution.

14.2 The acids used in this method pose little threat to the environment when managed properly.

14.3 Standards should be prepared in volumes consistent with laboratory use to minimize the volume of expired standards to be disposed.

15.0 Waste Management

15.1 The appropriate disposal of waste streams from this procedure is addressed in SOP 1.08.

16.0 References

16.1 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 6010D – Inductively Coupled Plasma-Atomic Emission Spectrometry*, Rev. 4, July 2014.

Appendix A

Estimated Detection Limits for Specified Wavelengths

ANALYTE / WAVELENGTH	ESTIMATED DETECTION LIMIT (ug/L)
Aluminum 237.312	50
Aluminum 308.215	50
Antimony 206.834	100
Antimony 217.582	100
Arsenic 188.98	100
Arsenic 193.96	100
Barium 455.403	50
Beryllium 234.861	10
Boron 249.678	50
Cadmium 226.502	10
Cadmium 228.802	10
Calcium 317.933	1000
Chromium 267.716	10
Cobalt 228.615	10
Copper 324.757	10
Copper 327.395	10
Iron 259.94	50
Lead 220.353	100
Magnesium 279.078	1000
Manganese 257.61	10
Molybdenum 202.032	100
Nickel 231.604	50
Potassium 766.491	1000
Selenium 196.026	200
Silver 328.068	10
Sodium 589.592	1000
Strontium 421.552	10
Thallium 351.923	100
Tin 189.927	100
Titanium 334.941	100
Vanadium 292.401	10
Vanadium 311.837	10
Zinc 206.2	50
Zinc 213.857	50

Appendix B

Current Mixed Calibration Standards

ICP Standard 1
Aluminum 50ppm
Barium 10ppm
Beryllium 5ppm
Cadmium 5ppm
Calcium 50ppm
Chromium 5ppm
Cobalt 5ppm
Copper 10ppm
Iron 25ppm
Lead 50ppm
Magnesium 50ppm
Manganese 5ppm
Nickel 10ppm
Potassium 250ppm
Vanadium 5ppm
Zinc 10ppm

ICP Standard 2
Aluminum 25ppm
Barium 5ppm
Beryllium 2.5ppm
Cadmium 2.5ppm
Calcium 25ppm
Chromium 2.5ppm
Cobalt 2.5ppm
Copper 5ppm
Iron 12.5ppm
Lead 25ppm
Magnesium 25ppm
Manganese 2.5ppm
Nickel 5ppm
Potassium 125ppm
Vanadium 2.5ppm
Zinc 5ppm
Antimony 25ppm
Arsenic 25ppm
Boron 12.5ppm
Molybdenum 25ppm
Selenium 25ppm
Silver 2.5ppm
Sodium 125ppm
Strontium 2ppm
Thallium 50ppm
Tin 25ppm
Titanium 12.5ppm

ICP Standard 3/CCV
Aluminum 10ppm
Barium 2ppm
Beryllium 1ppm
Cadmium 1ppm
Calcium 10ppm
Chromium 1ppm
Cobalt 1ppm
Copper 2ppm
Iron 5ppm
Lead 10ppm
Magnesium 10ppm
Manganese 1ppm
Nickel 2ppm
Potassium 50ppm
Vanadium 1ppm
Zinc 2ppm
Antimony 10ppm
Arsenic 10ppm
Boron 5ppm
Molybdenum 10ppm
Selenium 10ppm
Silver 1ppm
Sodium 50ppm
Strontium 1ppm
Thallium 20ppm
Tin 10ppm
Titanium 5ppm

ICP Standard 4
10X of Standard 3

ICP Standard 5
100X of Standard 3

Appendix C

ICP Interference Check Standards

ICSA	(mg/L)
Aluminum	500
Calcium	500
Iron	200
Magnesium	500

ICSAB	(mg/L)
Aluminum	500
Calcium	500
Iron	200
Magnesium	500
Antimony	2.0
Arsenic	2.0
Barium	0.5
Beryllium	0.5
Cadmium	1.0
Chromium	0.5
Cobalt	0.5
Copper	0.5
Lead	1.0
Manganese	0.5
Molybdenum	2.0
Nickel	1.0
Selenium	2.0
Silver	1.0
Strontium	2.0
Thallium	2.0
Tin	2.0
Titanium	2.0
Vanadium	0.5
Zinc	1.0

Appendix D

Analytical Sequence

CAL BLANK
STD 5
STD 4
STD 3
STD 2
STD 1
ICV
ICB
LLV
CCV1
CCB1
ICSA
ICSAB
SAMPLE 3
SAMPLE 4
SAMPLE 5
SAMPLE 6
SAMPLE 7
SAMPLE 8
SAMPLE 9
SAMPLE 10
CCV2
CCB2
SAMPLE 1
.
.
.
10
CCV3
CCB3

OnSite Environmental Inc.
Redmond, Washington

Mercury in Soil - Method 7471B

Prepared by: ____________________ Date: ____________
William Kelsch, Senior Chemist

Reviewed by: ____________________ Date: ____________
Karl Hornyik, Laboratory Manager

Approved by: ____________________ Date: ____________
Stacey Duran, Laboratory QA/QC Officer

Revision History

Origination Date: 01/14/2003

Revision 2.0 07/28/05
Updated with new mercury analyzer and hot block.

Revision 3.0 02/07/13
- Updated from Method 7471A to Method 7471B.
- Changed Section 7.2.2 to reflect a 5 ppm ICV stock standard rather than a 20 ppm ICV stock standard.
- Added spike solution to “Standards” section.
- Updated Section 9.4.2 to reflect a method change for MS/MSD recovery requirements from +/- 25% to +/- 20%.
- Updated the instructions for wetting the GLS center post in Section 11.2.11.
- Added instruction to Section 11.3 on how to spike the SB and MS/MSD.
- Fleshed out “Method Performance” section.

Revision 4.0 01/17/17
Added RPD limits for MS/MSD and duplicate.

Revision 5.0 07/10/17
Added the fact that the standards are digested the same as the samples.

Revision 6.0 12/12/18
- Reorganized “Calibration and Standardization” section.
- Added to “References” section.
- General grammatical changes.

Table of Contents

1.0 Scope and Application

1.1 This method is used to determine total mercury (organic and inorganic) in soils, sediments, bottom deposits, and sludge-type materials. All samples must be subjected to an appropriate dissolution step prior to analysis. Cold vapor atomic absorption is then used to detect the amount of mercury in the resultant digestate.

1.2 The method detection limit for a 0.50g sample is 0.0050 mg/kg on a wet weight basis.

2.0 Summary of Method

2.1 The solid material is digested with nitric acid and hydrochloric acid and then treated with a potassium permanganate solution.

2.2 Analysis using a cold vapor atomic absorption method is based on the absorption of radiation at the 253.7 nm wavelength by mercury vapor. The mercury is reduced to elemental state and aerated from solution in an open system. The mercury vapor passes through a quartz cell positioned in the light path of an atomic absorption spectrometer. Absorbance is measured as a function of mercury concentration.

3.0 Definitions

3.1 Reagent Water – Water free of target analytes or interferences greater than the reporting limits for this SOP. Also referred to as deionized water.

3.2 Method Blank (MB) – A sample aliquot (usually reagent water) free from target analytes is treated exactly as a sample including exposure to all glassware, equipment, solvents and surrogates. The MB is used to determine if method analytes or other interferences are present in the laboratory environment, the solvents or the equipment.

3.3 Spike Blank (SB) – A sample aliquot (usually reagent water) free from target analytes to which known quantities of method analytes are added. The spike blank is treated exactly as a sample. The spike blank is used to determine whether the methodology is in control and to indicate the accuracy associated with laboratory procedures. Also referred to as a Laboratory Control Sample (LCS).

3.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD) – Two aliquots of the same sample to which known quantities of the method analytes are added. The MS and MSD are treated exactly as a sample. The MS and MSD are used to determine whether the sample matrix contributes bias to the sample results and to indicate the precision associated with laboratory procedures.

3.5 %R: Percent Recovery

3.6 RPD: Relative Percent Difference

3.7 SOP: Standard Operating Procedure

3.8 ICV: Initial Calibration Verification

3.9 ICB: Initial Calibration Blank

3.10 CCV: Continuing Calibration Verification

3.11 CCB: Continuing Calibration Blank

3.12 MDL: Method Detection Limit

4.0 Sample Handling and Preservation

4.1 Soil samples are collected in 4-ounce jars.

4.2 All samples should be shipped and stored at 4°C ± 2°C.

4.3 The holding time (from collection) for mercury is 28 days.

5.0 Interferences

5.1 Potassium permanganate is added to eliminate possible interference from sulfide. Concentrations as high as 20 mg/kg of sulfide, as sodium sulfide, do not interfere with the recovery of added inorganic mercury in reagent water.

5.2 Certain volatile organic materials that absorb at this wavelength may also cause interference.

5.3 Copper has been reported to interfere; however, copper concentrations as high as 10 mg/kg had no effect on recovery of mercury from spiked samples.

5.4 During the oxidation step, chlorides are converted to free chlorine that also absorbs radiation at 253 nm. Therefore, samples high in chlorides require additional permanganate (as much as 25 mL).

6.0 Safety

6.1 All reagents and standards must be handled with extreme care due to their possible deleterious health effects. All applicable personal safety equipment must be used at all times when handling chemicals.

7.0 Equipment and Supplies

7.1 Equipment

7.1.1 Apparatus- AA

7.1.1.1 Cetac Quick Trace M-7500 mercury analyzer

7.1.2 Environmental Express hot block

7.1.3 Argon cylinder

7.2 Supplies

7.2.1 Graduated 50 mL plastic tubes

7.2.2 Volumetric pipets, Class A (1 mL, 5 mL and 10 mL)

7.2.3 Volumetric flasks, Class A (100 mL and 500 mL)

8.0 Reagents and Standards

8.1 Reagents

8.1.1 Water, Organic Free (Reagent Water)

8.1.1.1 The deionized water generator has an activated carbon column designed to remove organic compounds from the water.

8.1.1.2 Depletion of the carbon filter may be indicated by a breakthrough of any organic compound. If this occurs, refer to SOP 8.10 for maintaining the generator.

8.1.2 Nitric acid (HNO_3), concentrated

8.1.3 Hydrochloric acid (HCl), concentrated

8.1.4 Stannous chloride (10%) in 7% hydrochloric acid: Weigh 100g of stannous chloride in 1 L bottle, add some reagent water, add 70 mL of hydrochloric acid, and bring the volume to 1000 mL. This mixture is a suspension and should be stirred continuously during use. Prepare a fresh solution if an old solution has turned yellow (oxidized) or precipitated.

8.1.5 Potassium permanganate (5%): Dissolve 50g in 1000 mL of reagent water.

8.1.6 Dry potassium permanganate is used as a mercury vapor trap.

8.1.7 Sodium chloride-hydroxylamine hydrochloride solution (12%): Dissolve 60g of sodium chloride and 60g of hydroxylamine hydrochloride in reagent water and dilute to 500 mL. This solution must be purged before using with argon by adding 100 μg of stannous chloride to 500 mL of the mixture.

8.1.8 Rinsing solution (2% HNO_3, 5% HCl): Fill 2 L rinse bottle with some reagent water. Add 40 mL of concentrated HNO_3 and 100 mL of concentrated HCl and bring the final volume to 2000 mL with reagent water.

8.1.9 Nitric acid (HNO_3), 10%: Dilute 10 mL of concentrated HNO_3 in 100 mL of reagent water.

8.2 Standards

8.2.1 Initial Calibration Standards (ICAL)

8.2.1.1 Stock Standard

8.2.1.1.1 Single-element certified stock mercury standard with a concentration of 1000 mg/L is purchased from an accredited vendor.

8.2.1.2 Mercury Working Standard

8.2.1.2.1 Dilute the 1000 mg/L stock standard to a concentration of 10 mg/L by adding 1 mL of the original standard to 100 mL of reagent water.

8.2.1.2.2 Dilute the 10 mg/L solution to a working concentration of 0.050 mg/L by adding 2.5 mL of the 10 mg/L solution (8.2.1.2.1) to 500 mL of reagent water.

8.2.1.2.3 Acidity of the working standard should be maintained at 7% hydrochloric acid, which means that 7 mL of hydrochloric acid should be added to every 100 mL of reagent water.

8.2.1.3 Initial Standards Preparation

8.2.1.3.1 Transfer 0, 0.050, 0.50, 2.5, 5.0, and 10.0 mL of the 0.050 mg/L mercury working standard (8.2.1.2.2) to a series of tubes.

8.2.1.3.2 Add enough reagent water to give each tube a total volume of 30 mL.

8.2.1.3.3 Add 1.4 mL of concentrated HNO_3 and 2.0 mL of concentrated HCl.

8.2.1.3.4 Add 3 mL of 5% potassium permanganate.

8.2.1.3.5 Initial Standards are digested with the samples (see Section 11.3).

8.2.1.3.6 Add 3 mL of 12% sodium chloride-hydroxylamine hydrochloride solution. Cap tubes and shake until color dissipates.

8.2.1.3.7 Bring the final volume of each tube to 50 mL with reagent water.

8.2.2 Initial Calibration Verification Standard (ICV)

8.2.2.1 A certified mercury stock ICV standard is purchased from an accredited vendor.

8.2.2.2 The ICV mercury standard must be from a different source than the ICAL calibration standards.

8.2.2.3 ICV Mercury Working Standard

8.2.2.3.1 Dilute the 5 mg/L stock standard to a working concentration of 0.050 mg/L by adding 1.0 mL of the standard to 100 mL of reagent water.

8.2.2.3.2 Acidity of the working standard should be maintained at 7% hydrochloric acid: add 7 mL of the acid to 100 mL of the solution.

8.2.2.4 Transfer 5.0 mL of the ICV mercury working standard to a tube and prepare the same as the initial standards (8.2.1.3).

8.2.3 Continuing Calibration Verification Standard (CCV)

8.2.3.1 Transfer 5.0 mL of mercury working standard (8.2.1.2.2) to a tube and prepare the same as the initial standards.

8.2.4 Spike Standard

8.2.4.1 The spike standard is the same as the 0.050 mg/mL mercury working standard (8.2.1.2.2).

8.2.5 Standard Handling

8.2.5.1 Purchased standards expire on the manufacturer’s date.

8.2.5.2 Working standards prepared internally expire on the original stock manufacturer’s expiration date.

8.2.5.3 These expiration dates hold if no observed degradation of the solutions has taken place. All expired or degraded standards shall be properly disposed to avoid accidental use.

8.2.5.4 Stock and working standards should be kept according to manufacturer's recommendation when not in use.

9.0 Quality Control

9.1 Method Blank (MB)

9.1.1 Method blanks are prepared and analyzed for every digestion batch at a 5% frequency (one method blank per digestion batch of 20). The method blank must not contain any mercury greater than the reporting limit.

9.1.2 Corrective action for contaminated method blanks:

9.1.2.1 If any mercury in the method blank is above the absolute value of the reporting limit, then the concentration of the mercury in the samples must be 10 times the method blank concentration.

9.1.2.2 Any samples that are not 10 times the blank concentration must be redigested and reanalyzed.

9.1.2.3 The samples are not to be corrected for the blank value.

9.1.2.4 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A non-conformance form must be filled out and the associated data is flagged with a "B" qualifier. See SOP 1.18.

9.2 Spike Blank (SB)

9.2.1 Spike blanks are prepared and analyzed for every digestion batch at a 5% frequency (one spike blank per digestion batch of 20).

9.2.2 A spike blank duplicate (SBD) may be analyzed if insufficient sample is provided for a matrix spike/matrix spike duplicate.

9.2.3 The SB percent recovery must be 80 to 120% or the associated samples must be redigested and reanalyzed.

9.2.4 After analysis, calculate the percent recovery (%R) results as follows:

$$\%R = \frac{C_s}{C_n} \times 100$$

Where:
C_s = Measured concentration of the spike sample aliquot
C_n = Nominal (theoretical) concentration of the spike aliquot

9.2.5 If the %R is out of control, corrective action, as follows, must be taken:

9.2.5.1 Recalculate and check for integration or calculation errors.

9.2.5.2 Double check sample volume/weight, final digestate volume, amount spiked and the concentration of the spike solution.

9.2.5.3 If the spike blank is out of control, then the associated samples must be redigested and reanalyzed.

9.2.5.4 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A non-conformance form must be filled out and the associated data is flagged with an “I” qualifier. See SOP 1.18.

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

9.3.1 MS/MSD samples are prepared and analyzed for every digestion batch at a 5% frequency (one MS/MSD pair per digestion batch of 20).

9.3.2 The MS/MSD percent recoveries must be 80-120% or the samples should be redigested and reanalyzed. If upon redigestion the percent recoveries are still out of control, the samples may be flagged due to matrix effects.

9.3.3 After analysis, calculate the percent recovery (%R) on the wet weight results as follows:

$$\%R = \frac{C_s - C_u}{C_n} \times 100$$

Where:
C_s = Measured concentration of the spike sample aliquot
C_u = Measured concentration of the unspiked sample aliquot
C_n = Nominal (theoretical) concentration of the spike aliquot

9.3.4 If the %R is out of control, corrective action, as follows, must be taken:

9.3.4.1 Recalculate and check for integration or calculation errors.

9.3.4.2 Double check sample volume/weight, final digestate volume, amount spiked and the concentration of the spike solution.

9.3.4.3 If the sample concentration exceeds more than four times what was spiked, the %R value is statistically meaningless. Flag any %R outliers with the “A” qualifier.

9.3.4.4 If the %R is outside of the control limits the sample should be redigested for the element to prove the sample has an adverse matrix effect on the spike.

9.3.4.5 If a problem still exists, then the spike blank should be evaluated. If the %R value in the spike blank is acceptable, then document the nonconformance and one of the follow resolutions using SOP 1.18:

9.3.4.5.1 If the %R value is out of control similarly in both the MS and the MSD, then the problem can be attributed to a matrix effect. Qualify the %R outliers with the “V” qualifier.

9.3.4.5.2 If the %R value is out in one of the samples but not in the other one, then the analyst should use professional judgement to determine a course of action.

9.3.4.6 If insufficient sample or expired holding time prevents reanalysis of the samples, then the data can be reported. A non-conformance form must be filled out and the associated data must be flagged with an “I” qualifier. See SOP 1.18.

9.3.5 After analysis, calculate the relative percent difference (RPD) on the wet weight results as follows:

$$RPD = \frac{\left|C_1 - C_2\right|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$

Where:
C_1 = Measured concentration of the first sample aliquot
C_2 = Measured concentration of the second sample aliquot

9.3.6 The RPD must not be greater than 20%.

9.3.7 If the RPD is out of control, corrective action, as follows, must be taken:

9.3.7.1 Recalculate and check for integration or calculation errors.

9.3.7.2 Double check sample volume/weight, final digestate volume, amount spiked and the concentration of the spike solution.

9.3.7.3 If the RPD is still outside of the control limits for an element, the samples should be redigested for the element to prove the sample is nonhomogenous.

9.4 Sample Duplicate (DUP)

9.4.1 Duplicate samples are prepared and analyzed for every digestion batch at a 5% frequency (one duplicate per digestion batch of 20).

9.4.2 After analysis, calculate the relative percent difference (RPD) on the wet weight results as follows:

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$

Where:
C_1 = Measured concentration of the first sample aliquot
C_2 = Measured concentration of the second sample aliquot

9.4.3 The RPD must not be greater than 20%.

9.4.4 If the RPD is out of control, corrective action, as follows, must be taken:

9.4.4.1 Recalculate and check for integration or calculation errors.

9.4.4.2 Double check sample volume/weight, final digestate volume, amount spiked and the concentration of the spike solution.

9.4.4.3 If the RPD is still outside of the control limits for an element, the samples should be redigested for the element to prove the sample is nonhomogenous.

9.4.4.4 For analyte concentrations less than 5 times the reporting limit, there are no control limits for the RPD and no corrective action is expected.

10.0 Calibration and Standardization

10.1 Initial Calibration (ICAL)

10.1.1 The AA must be standardized before every run. The calibration curve must include a blank and five standards for mercury.

10.1.2 If the correlation coefficient (r) is greater than 0.995 proceed with the initial calibration verification. Otherwise, the standards must be reprepared and reanalyzed.

10.2 Initial Calibration Verification (ICV)

10.2.1 An ICV must be analyzed after the initial calibration.

10.2.2 The percent recovery of the ICV must be 90-110%. Otherwise, the instrument must be recalibrated.

10.3 Initial Calibration Blank (ICB)

10.3.1 An ICB must be analyzed after the ICV.

10.3.2 The concentration of the ICB should be less than the absolute value of the method detection limit. Otherwise, the instrument must be recalibrated.

10.4 Continuing Calibration Verification (CCV)

10.4.1 A CCV standard must be analyzed at the beginning of the run, after every ten samples, and at the end of the run.

10.4.2 The percent recovery of the CCV must be 80-120%. Otherwise, the instrument must be recalibrated.

10.5 Continuing Calibration Blank (CCB)

10.5.1 A CCB must be analyzed at the beginning of the run, after every ten samples and at the end of the sequence.

10.5.2 The concentration of the CCB must be less than the absolute value of the detection limit. Otherwise, the instrument must be recalibrated.

11.0 Procedure

11.1 Instrument Startup (cold start)

11.1.1 Power up M-7500 and autosampler and open Quick Trace software. If system is to be used for analysis in the ppb range, a minimum of thirty minutes warm-up time with detector stability disabled is required. If system is to be run in the ppt range, the detectors must be allowed to stabilize prior to analysis.

11.2 Instrument Startup (warm start)

NOTE: The instrument and autosampler are on and stable. The units can be left powered up with the lamp and gas off.

11.2.1 Turn on the lamp and carrier gas. A minimum fifteen minutes of warm-up time is required.

11.2.2 Attach the auto-sampler peristaltic rinse pump tubing to the pump and lock the clamps. Place the autosampler rinse tubing into the rinse bottle.

11.2.3 Verify that the sample capillary (inlet insert) is 0.50 mm above the gas/liquid separator (GLS) center post.

11.2.4 Open vents on waste container.

11.2.5 Inspect peristaltic pump tubing for flat spots (replace if necessary). Place the peristaltic pump tubing in their appropriate shoes and holder clips. Do not lock shoe clamps at this time.

11.2.6 Open instrument controls and start autosampler rinse pump if not already operating (click pump on and probe down).

11.2.7 Place the reagent capillary in a beaker of reagent water and start the peristaltic pump at 100% pump speed.

11.2.8 Lock down the peristaltic shoe clamps.

11.2.9 Inspect liquid flows. The GLS drain should be flowing smoothly with no build up or pulsing of liquid. The waste line from the peristaltic pump to the waste container should stay still, without any vibration. If this is not the case upon inspection, stop immediately and change GLS drain line and/or waste line. The autosampler rinse station should have a convex liquid bubble adhering to the sample probe. If this is not the case, check that the rinse reservoir supply tubes are immersed in the rinse. If they are, than check the rinse pump and pump tubing. Replace the tubing if necessary.

11.2.10 Open the front optical cabinet door and loosen the white thumbscrew securing the GLS. Gently slide the GLS down so that ~ 1/4 of the GLS remains above the GLS mounting bracket.

11.2.11 Wet the GLS center post. In instrument controls set the gas flow to 300 mL/min, make sure pump speed is at 100%, Unclamp the bottom two shoe clamps on the peristaltic pump. Let two or three bubbles go to the top of the GLS center post. Clamp down the two open shoe clamps and allow the liquid level to restore itself to normal operating levels before continuing to the next step. If the liquid does not bubble and the overflow sensor activates, then clear the overflow and retry. Restore gas flow back to 100 mL/min.

11.2.12 Slide the GLS up so that ~ ½ of the GLS remains above the GLS mounting bracket. Tighten the white thumbscrew securing the GLS.

11.2.13 Attach GLS exhaust tube to the GLS.

11.2.14 Close the optical cabinet door.

11.2.15 Place the reagent capillary in the reagent bottle.

11.2.16 Open the appropriate worksheet and verify that the gas flow and pump speed in the worksheet matches what is listed in instrument controls. If the flow and speed is not the same, make the necessary change. This will stabilize the instrument prior to zeroing the optics.

11.2.17 Record lamp milliamperes in a daily instrument logbook.

11.2.18 Zero the Quick Trace M-7500 using the auto zero.

11.2.19 In "Method Editor" page, peak profile of the high standard, verify baseline and sample integration times. Record micro-absorbance and concentration of the peak profile standard in a daily instrument logbook. This operation should be performed on the highest standard.

11.2.20 Calibrate instrument and analyze samples.

11.3 Soil Digestion Procedure

11.3.1 Preheat the hot block to 110°C, which equals 95°C for the sample.

11.3.2 Weigh 0.50g of homogenized sample into a tube.

11.3.3 Add 5.0 mL of the 0.050 mg/L mercury working standard (8.2.1.2.2) to the SB and MS/MSD.

11.3.4 Add 30 mL of reagent water.

11.3.5 Add 1.4 mL of concentrated HNO_3 and 2.0 mL of concentrated HCl.

11.3.6 Lay reflux cap on tube, heat in the hot block at 95°C for ten minutes, and cool.

11.3.7 Add 3 mL of 5% the potassium permanganate solution and let stand for fifteen minutes. If sample does not stay purple or brown, add an additional 3 mL of $KMnO_4$ solution to the sample and blanks. If the sample still does not maintain color, than discard set and dilute the sample prior to digestion.

11.3.8 Heat the sample in the hot block at 95°C for thirty minutes then cool.

11.3.9 Add 3 mL of 12% sodium chloride-hydroxylamine hydrochloride solution to reduce the excess of permanganate. Cap the tube and shake. If color does not dissipate, incrementally add 0.50 mL of the solution until color is gone.

NOTE: Do this step in a fume hood, as chlorine gas could be evolved.

11.3.10 Add enough reagent water to give the sample a total volume of 50 mL.

11.4 Sequence Setup

11.4.1 To create a new worksheet from existing template, select “New From” which is located under “File” on the software tool bar. Name the new worksheet, then save.

11.4.2 Open “Sequence” page in the software, than click “Import Sequence Labels” button, which is under “File” and choose the appropriate sequence length. Give ID names to the samples and save.

11.4.3 Load the rest of the standards (the highest standard is already in the rack due to previous peak profile identification), samples and QC into the autosampler, according to the sequence file that was created. From the worksheet page choose “Go” (Begin Analysis). The instrument will now proceed to analyze the standards and samples.

11.5 Instrument Shutdown

11.5.1 Place the reagent capillary in a beaker of 10% HNO_3 and cap the reagent bottle. Rinse the system for a minimum of ten minutes.

11.5.2 Place the reagent capillary in a beaker of reagent water and rinse the system for one minute.

11.5.3 Raise sample probe via instrument/autosampler controls (click probe up and autosampler pump off).

11.5.4 Remove reagent capillary from reagent water.

11.5.5 Allow the drain and waste lines to run completely dry.

11.5.6 Turn off peristaltic pump via instrument/analyzer.

11.5.7 Release peristaltic shoe clamps and release the pump tubing from the tubing bridge, release and relax peristaltic pump tubing.

11.5.8 Close vents on waste container.

11.5.9 Disconnect GLS exhaust line from GLS.

11.5.10 Turn off gas and lamp.

11.5.11 If the instrument is to be used the next day or in the near future, leave the software on the page instrument/autosampler. It will then be ready for a warm start.

11.5.12 If the instrument is not to be used in the near future, then exit the Quick Trace software and turn off the autosampler and Quick Trace M-7500.

12.0 Data Reduction and Calculation

12.1 After analyzing each sample, Quick Trace M-7500 software calculates the mercury concentration (in the digestate) of any peaks within the viewing window. The analyst should review the peaks to verify that the software properly identified the peak. The software has the ability to incorporate dilution factors and sample volumes into the calculation. These features are not used. The software constructs a calibration curve by plotting the micro-absorbance of standards versus parts per billion of mercury. The concentration reported from the spreadsheet is in μg/L mercury found in the sample digestate, not the sample itself.

12.2 To calculate the concentration in the actual sample, the chemist enters the following information into an excel spreadsheet which performs the following calculation:

$$C_s = \frac{(C_{ex})(V_t)(DF)}{(V_s)(DW)(1000)}$$

Where:
C_{ex} = Concentration (in μg/L) reported for the digestion
V_t = Total volume in of the final digestate (in mL)
DF = Dilution factor (dimensionless). Use a value of 1 if no dilution is done.
V_s = Initial volume or mass of sample (in grams)
DW = Dry weight of soil

12.3 Report the results for the unknown samples in mg/kg for soils. Round the results to two significant figures.

12.4 Results that exceed the linear range of the calibration curve must be diluted and reanalyzed.

13.0 Method Performance

13.1 Demonstration of Capability

13.1.1 Each new chemist performing extractions or analyzing samples for this method must complete a Demonstration of Capability as outlined in SOP 1.21 to demonstrate that they can achieve documented levels of acceptable precision and accuracy with this method.

13.2 Method Detection Limits

13.2.1 Method detection limit studies are conducted yearly or whenever a significant change in the system or method has occurred.

13.2.2 SOP 1.20 details how to conduct a method detection limit study.

13.3 Performance Evaluation Samples

13.3.1 This method is validated through successful ongoing annual single blind performance evaluation samples.

14.0 Pollution Prevention

14.1 This SOP and other similar published analytical methods have been carefully reviewed for possible ways to prevent unnecessary pollution.

14.2 The reagents used in this method pose little threat to the environment when managed properly.

14.3 Standards should be prepared in volumes consistent with laboratory use to minimize the volume of expired standards to be disposed.

15.0 Waste Management

15.1 The appropriate disposal of waste streams from this procedure is addressed in SOP 1.08.

16.0 References

16.1 U.S. Environmental Protection Agency, *SW-846 Test Methods for Evaluating Solid Waste: Method 7471B - Mercury in Solid or Semisolid Waste (Manual Cold-Vapor Technique)*, Rev. 2, February 2007.

16.2 *Quick Trace M-7500 Mercury Analyzer Operator Manual*, Version 1.0.2.

16.3 *Quick Trace Mercury Analyzer Software Manual*.

16.4 *Environmental Express Hot Block Mercury Digestion Procedure*.

APPENDIX E

Health and Safety Plan

ARCADIS Design & Consultancy for natural and built assets

USCG

Site Specific Health and Safety Plan

Burrows Island Light Station
Anacortes, Washington

October 22, 2018

SITE SPECIFIC HEALTH AND SAFETY PLAN

Burrows Island Light Station

Anacortes, Washington

Eric Epple

HASP Preparer

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HASP Reviewer

Josh Gravenmier

Project Manager

Prepared by:

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Tel 206 325 5254
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Our Ref.:

B0003010.0006

Date:

October 22, 2018

VERSION CONTROL

This Health and Safety Plan (HASP) must be reviewed annually and revised when conditions on the project site change and the change is not addressed by this HASP or if a new task is conducted that is not addressed by this HASP.

Issue	Revision No	Date Issued	Page No	Description	Reviewed by

Contents

Appendices

ACRONYMS AND ABBREVIATIONS

AST	aboveground storage tanks
CIH	Certified Industrial Hygienist
CoCs	constituents of concern
CMV	commercial motor vehicles
CSP	Certified Safety Professional
EAP	Emergency Action Plan
FHSHB	Field H&S Handbook
GVWR	gross vehicle weight rating
H&S	health and safety
HARC	Hazard Assessment and Risk Control
HASP	Health and Safety Plan
HAZCOM/GHS	Hazard Communication/ Globally Harmonized System
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDW	Investigation Derived Waste
JSA	job safety analysis
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
OSHA	Occupational Safety and Health Administration
PPE	personal protective equipment
ppm	parts per million
ROW TSP	Right-of-Way Traffic Safety Plan
SDS	safety data sheet
SSE	short-service employees
SSO	Site Safety Officer
THA	Task Hazard Analysis
TIP	Task Improvement Process

CULTURE OF CARING CERTIFICATION

Arcadis is committed to a Culture of Caring that ensures each Arcadis employee and contractor goes home at the end of the day free from injury or illness. I certify that the following has been performed with all Arcadis field staff on this project either in person or by Skype:

☐ Reviewed the HASP, including a discussion of hazard identification and controls.

  ☐ If conducting activities deemed by Arcadis to be "High Risk," frontline management has reviewed applicable H&S standards (job safety analyses [JSA] when authorized by H&S) for these activities with field staff.

  ☐ If permit to work is required, frontline management has reviewed the permit(s) with field staff.

☐ Reviewed proactive H&S engagement expectations/injury prevention actions.

☐ Reviewed Stop Work Authority.

☐ Reviewed the incident reporting process and expectations including when WorkCare should be contacted by staff (WorkCare incident intervention for all minor, non-emergency injuries) and that the WorkCare phone number is programmed into field team cell phone.

For short-service employees (SSE) (0-1 years with Arcadis):

☐ Provided coaching and mentoring on Arcadis H&S expectations during project work. Reviewed - in detail - specific hazards and controls and provided a resource who can be contacted if SSE has questions regarding planned or unplanned work tasks.

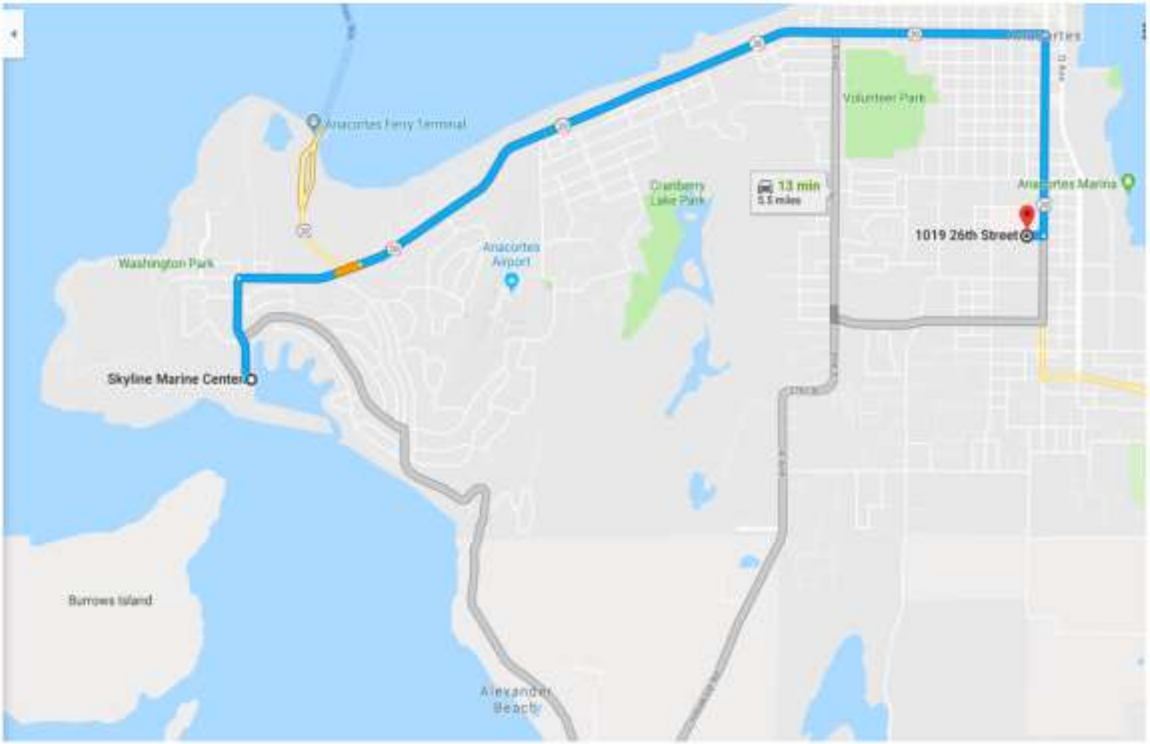
Resource Name:
Phone Number:

____
Signed

1 EMERGENCY ACTION PLAN

1.1 Route to the Hospital

Directions from Skyline Marine Center to Island Hospital (ER entrance is on 26th St.)



Skyline Marine Center
(2011 Skyline Way, Anacortes, WA 98221)

1. Head north on Skyline Way towards Kingsway (0.4 mi)/.
2. Turn right onto Sunset Ave (0.5 mi).
3. Slight right onto WA-20 Spur E (3.1 mi)
4. Turn right onto Commercial Ave (0.8 mi).
5. Turn right onto 26th St. (367 ft).

The ER entrance to Island Hospital is located at 1019 26th St.

1.2 Helicopter Pad Location

The Burrows Island Light Station (Site) has a helicopter pad. Urgent emergencies should call 911 to procure helicopter transport to the hospital, while minor emergencies can use boat transport to reach the Skyline Marine Center before continuing to the hospital by road.

Helicopter pad coordinates: 48.478149, -122.713351

1.3 Hospital Information

The designated hospital for this project is provided below.

Hospital name: Island Hospital

Hospital address: 1211 24th Street, Anacortes, WA 98221

Hospital phone: 360.299.1300

The Emergency Department of Island Hospital can be reached directly at 360.299.1311 and has a separate entrance at 1019 26th St., Anacortes, WA 98221.

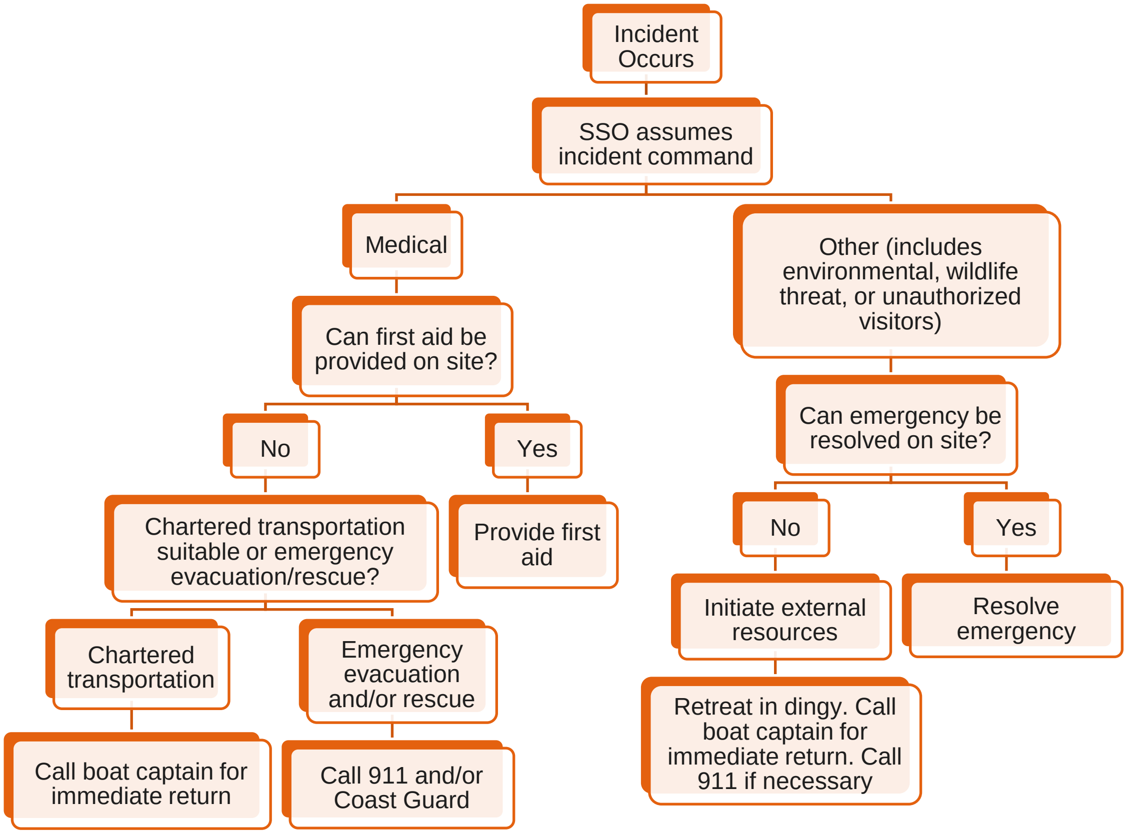
1.3 Emergency Contact Information and Procedures

Local Police	911 and 360.428.3211
Local Ambulance	911
Local Fire Department	911
Local Hospital	360.299.1300 (General) 360.299.1311 (Emergency Dept. Direct)
Local Weather Data	Weather.com
Poison Control	800.222.1222
National Response Center (all spills in reportable quantities)	800.424.8802
Washington State Division of Emergency Management (24-hour response for spills of any quantity)	800.258.5990
U.S. Coast Guard (spills to water or other water emergency)	800.424.8802
Arcadis Project Manager – Josh Gravenmier	707.338.4441 (Cell)
Arcadis Corporate H&S Director – Denis Balcer	614.985.9114

Arcadis Federal H&S Lead-Grey Coppi (SHM)	908.917.6948
Arcadis Site Safety Office (SSO) – Mark Ullery	360.292.8990 (Cell)
Client Primary Contact – James Hall	510.637.5593
Client Backup Contact – Karen Ladd	510.637.5522
Island Express Charters (primary contact: Scott Carden)	360.299.2875 (call or text)
WorkCare	888.449.7787

Use the following notification procedure in the event of an emergency:

- Step 1: Contact the Site Safety Officer (SSO).
- Step 2: SSO will determine the nature of the incident (medical or other).
- Step 3: SSO will ensure that the incident site is safe to enter and secure.
- Step 4: SSO will evaluate the severity of the incident.
- Step 5: If the incident is deemed minor, first aid will be applied as suitable, and WorkCare will be contacted. If the incident is deemed serious, the SSO will contact the chartered boat captain for immediate return to Washington Island or will call 911 and/or the Coast Guard for emergency services.
- Step 6: SSO will contact the Arcadis Project Manager (PM; Josh Gravenmier).
- Step 7: Arcadis PM with contact corporate H&S Director (Denis Balcer).
- Step 8: Arcadis PM will contact client.
- Step 9: SSO will photograph incident site, complete witness statements, and initiate preliminary investigation.


Incident Occurs
SSO assumes incident command
Medical
Other (includes environmental, wildlife threat, or unauthorized visitors)
Can first aid be provided on site?
Can emergency be resolved on site?
No
Yes
Chartered transportation suitable or emergency evacuation/rescue?
Provide first aid
No
Yes
Initiate external resources
Resolve emergency
Chartered transportation
Emergency evacuation and/or rescue
Retreat in dingy. Call boat captain for immediate return. Call 911 if necessary
Call boat captain for immediate return
Call 911 and/or Coast Guard

1.4 Emergency Supplies and Equipment List

Emergency supplies and equipment for specific tasks are presented on job safety analyses (JSAs) for the task. The following supplies and equipment are applicable to all tasks performed on the project.

Emergency Supplies and Equipment		**Location on Project Site**
X	First-Aid Kit (type)	Field Supply Staging Area
X	Fire Extinguisher ABC 10 lb (no less than two units)	Field Supply Staging Area
X	Mobile Phone	Each field staff will have mobile phone
X	Satellite Phone	Field Supply Staging Area
X	Wifi Hotspot	Field Supply Staging Area
X	Water or Other Fluid Replenishment	Field Supply Staging Area
X	Eye Wash Bottle	Field Supply Staging Area
X	Wash and Dry Towelettes	Field Supply Staging Area
X	Sunscreen (SPF 15 or higher)	Field Supply Staging Area
X	Insect Repellent	Field Supply Staging Area
X	*Other (specify):* Personal Floatation Device	Field Supply Staging Area

2 INTRODUCTION

2.1 General

All work on this project will be carried out in compliance with Arcadis' H&S standards, and the Occupational Safety and Health Administration's (OSHA's) Hazardous Waste Operations and Emergency Response (HAZWOPER) regulation. The design of this Health and Safety Plan (HASP) conforms to the requirements of the ARC HSFS010-H&S Plan Standard. Specific H&S information for the project is contained in this HASP. All personnel working on hazardous operations or in the area of hazardous operations shall read and be familiar with this HASP before doing any work. All project personnel shall sign the Certification page acknowledging that they have read and understand this HASP.

Changes in the scope of the project or introduction of new hazards to the project shall require revision of the HASP by the HASP writer and reviewer, and approval by the Project Manager.

2.2 HASP Structure

This HASP contains important information related to this project in appendices. Review of relevant appendix information is important to ensure work is conducted safely on the project site. The following appendices are included in this HASP with a summary of their contents:

- Appendix A – Task Hazard Analysis (THA): This appendix contains an analysis of the hazards and controls to be used for tasks performed on this project.
- Appendix B – Job Safety Analyses and Permits: This appendix contains all the project JSAs and any applicable permits required to perform work on this project. If a H&S Standard is required to be attached to this HASP, the standard will also be located in this appendix.
- Appendix C – Hazard Communication/Globally Harmonized System (HAZCOM/GHS): This appendix contains a list of chemicals used on the project and safety data sheets (SDSs) applicable to the chemicals used on site.
- Appendix D – Field Forms: This appendix contains all the field forms and checklists staff are expected to use on the project.
- Appendix E – Supplemental Plans: This appendix contains all applicable supplemental plans (e.g., Right-of-Way Traffic Safety Plan [ROW TSP], Lone or Remote Worker Plan, Journey Management Plan, Silica Exposure Control Plan.). Shipping Determinations are also included in this appendix.
- Appendix F – Near Miss Reports from Similar USCG/Arcadis Poverty Island Project: This appendix contains three near miss reports for a similar project performed by Arcadis for the USCG at Poverty Island, Fairbanks Township, Michigan.

2.3 Hierarchy of Administrative Controls

This HASP references several documents that might be used in the field which contain requirements specific to project. Arcadis staff utilizing these documents must implement the requirements (PPE, safety equipment, monitoring equipment) based on the hierarchy specified below (in order of decreasing priority):

1. Permits or supplemental plan templates (if applicable to the task or project)
2. JSAs
3. HASP
4. H&S Standards
5. Field H&S Handbook (FHSHB)

During the tailgate safety briefing, the applicable administrative controls to be utilized for the task/project will be identified, communicated to the field staff, and documented. Requirement changes to a lesser control in a lower hierarchy document requires approval of the HASP reviewer or member of the Corporate H&S Department.

3 PROJECT SITE HISTORY AND REQUIREMENTS

3.1 Site Background

The Site is located on Burrows Island, which is approximately 1.5 miles southwest of Anacortes along the Rosario Strait. Burrows Island covers less than one square mile and is densely forested with approximately 4 miles of jagged and rocky coastline. There is no public ferry service or bridge access to the island, making it only accessible by private boat charter or helicopter. The Site contains a light station, consisting of a lighthouse, a boat house (including a staircase descending to a narrow dock), and a duplex residence on the westernmost point of Burrows Island. Two additional residence buildings are included in previous site plans provided by the Northwest Schooner Society but are no longer present based off review of recent aerial images. The light station was established in 1906 and the light house was automated in 1972, after which no USCG personnel occupied the light station. There are also two former pump houses; a former freshwater pump house with associated groundwater seep northwest of the site along the northern coastal edge and a former salt water pump house along the western edge of the Site.

Currently, there are no permanent or part-time residents at the light station, and the remainder of the island is uninhabited. In 2010, custodianship of the Burrows Island Light Station was conferred to the Northwest Schooner Society, with the intention of restoring and ultimately maintaining the buildings on-site for community access and historical preservation.

Previous environmental investigations indicate the presence of elevated levels of lead in shallow soils from lead-based paint. In 2005, various structures were encapsulated to mitigate further environmental impact from lead-based paint on these existing structures. However, the current effectiveness of the encapsulation is uncertain due to the passage of time and, although some investigations and limited soil removal actions for lead were completed, the extent of lead impacts in shallow soil has not been fully defined.

Additionally, there has been a documented historic release of polychlorinated biphenyl (PCB)-containing oil in the vicinity of a former transformer near the lighthouse. Targeted soil removal actions were undertaken to remove the PCB-affected soil; however, additional PCB-impacted soil may remain at the site. The extent of such impacts, if any, are unknown.

Additionally, the site has historically contained diesel and gasoline products in painted aboveground storage tanks (ASTs) and underground storage tanks (USTs) or partially buried tanks and associated piping. No petroleum impacts have been identified at the site other than the PCB-containing oil at the one location discussed above; however, site-wide assessment is not complete to fully rule out there are no petroleum impacts from the former use of petroleum products at the site.

The overarching goal for the project is to complete a Remedial Investigation, Focused Feasibility Study, remedial design, and ancillary documents to allow implementation of a remedial action in accordance with CERCLA requirements. This HASP has been developed for the remedial investigation activities at the site. There will be two field events:

- **Mobilization 1**: An initial site visit will be made with the USCG PM and four Arcadis staff (the Arcadis PM, technical lead, field team lead, and field team assistant). The Arcadis PM and technical lead will be on site for only the first day. The timing of the initial mobilization (October) will help maximize the likelihood of dry conditions and is intended to minimize field screening errors. The tasks conducted during this mobilization include:

  - Assessment of the current site conditions that would help guide the future documents and field efforts.
  - Arcadis will oversee the utility mark out conducted by Geomarkout (Seattle, Washington). The utility location process will involve three lines of evidence for avoidance. Historical drawings from the site will provide one line of evidence. Geomarkout will use two additional lines of evidence, including ground-penetrating radar (GPR), radio detection methods, and/or metal detection, to identify potential subsurface utilities. One day is anticipated for these activities.
    - Utilities will be marked in the field and provided as a georeferenced map.
  - Four appropriately trained Arcadis staff will collect soil screening data utilizing a portable handheld X-Ray Fluorescence (XRF) unit to initially screen the anticipated area of impacts for lead. Where access allows the XRF surface screening locations will be spaced approximately 10 to 20 feet apart from the perimeter of the structures within the assessment area to determine lateral extent. At select surface screening locations, hand tools will be used to dig down to refusal (bedrock is anticipated to be 18 inches below the ground surface). XRF subsurface screening locations will be spaced at approximately 6-inch depth intervals. Four days with four field technicians are anticipated for these activities and do not include delays associated with adverse weather conditions or other access limitations. Arcadis will work with USCG and NWSS to minimize the possibility of any access limitations.
    - Approximately 360 surface XRF samples.
    - Approximately 130 subsurface XRF samples (i.e., one-third of the surface XRF samples). The locations of the subsurface XRF samples will be selected based on the surface XRF sample results.
    - All screening samples shall be returned to the original location thereby no investigation derived waste (IDW) will be generated.
    - The XRF field measurement locations will be surveyed by a Trimble Geo-XT series (or similar) global positioning system (GPS) hand held unit with sub-meter accuracy.
  - The mobilization will need to be planned after evaluating meteorological information regarding recent or forecasted precipitation that could impact soil moisture content.
    - Elevated moisture in the soil can reduce the effectiveness of GPR to identify potential subsurface utilities.
    - Elevated moisture in the soil samples being analyzed for XRF can cause spectral interferences that can cause false elevated concentrations to be reported.

- **Mobilization 2**: Arcadis anticipates that the field work for mobilization #2 will occur in January 2019 occurring over a period of 10 working days and do not include delays associated with adverse weather conditions or other access limitations. Arcadis will work with USCG and NWSS to minimize the possibility of any access limitations. If unanticipated delays are encountered, Arcadis will coordinate with USCG to reschedule the field event and (if needed) Arcadis will provide an updated cost estimate to USCG. The sampling event will be made with five Arcadis staff (the Arcadis technical lead, field team lead, and three field team assistants). The Arcadis technical lead will be on Site for only the first day. The tasks conducted during this mobilization include:

- Paint chip samples will be collected from existing structures and will be submitted under chain of custody to a National Lead Laboratory Accreditation Program (NLLAP) accredited laboratory for lead analysis. Field XRF samples will also be collected from exposed surfaces of the structures to inform the sampling program for the lead-based paint samples. Lead based paint samples will be collected as follows:
    - Lighthouse (101) – 30 samples
    - Duplex Building (103) – 50 samples
    - Boat House (105) – 30 samples
- Soil samples will be collected as either discrete samples or as incremental composite samples (ICS) depending on the area of interest. It is anticipated that ICS sampling will be conducted at the following locations:
    - Lighthouse (101)
    - Former transformer area (near 101)
    - Duplex building (103)
    - Former OIC Building (104)
    - Boathouse (105)
- Discrete soil samples will be collected at other areas and will be refined based on Mobilization #1. Two depth intervals will be collected (when possible) at each location.
- The collected samples will be shipped on ice and under proper chain of custody documentation to OnSite Environmental (Redmond, Washington) and/or other USCG-approved laboratories for chemical analysis. Paint chip samples will be submitted to NVL laboratory (Seattle, Washington) for lead based paint analysis.

3.2 Site Description

	Active		Inactive Industrial	X	Remote Area		Parking Lot/Private Roadway
	Bridge		Active Industrial		Residential		Public Roadway or Right of Way
X	Buildings		Landfill		Retail		Security Risk Site/Location
	Commercial	X	Marine		Service Station		Non-Military Government Installation
	Construction		Mining	X	Utility		
X	Military Installation		Railroad	X	Other: Island		
	Other Specify:						

The contaminants of potential concern are listed below:

Compounds of Concern	Source (soil/water/drum)	Known Concentration Range (ppm, mg/kg, mg/L)	
		Lowest	Highest
Lead	Soil	64 mg/kg	3,470 mg/kg
PCBs	Transformer	Unknown	Unknown
TPH	ASTs	Unknown	Unknown

3.3 List of Project Tasks and Scope of Work

This HASP addresses the following project work tasks:

- Task 1 – Driving
- Task 2 – Mobilization to the island by boat (Island Express Charters)
- Task 3 – Utility Clearance (ULS Services Corp./Geomarkout)
- Task 4 – Building Inspections and Audits (Lead based paint sampling at and around existing painted structures)
- Task 5 – Inspection of Non-building areas (Includes site walk of main area [cleared vegetation] and AST/UST area [forested])
- Task 6 – Soil Sampling with Hand Auger (incremental composite sampling and discrete soil sampling, and removal of vegetation in areas to be sampled)
- Task 7 – Demobilization from the island (including removal of investigation derived waste [IDW])

3.4 Required Health and Safety Training

Arcadis personnel working under this HASP are required to have the following training:

Staff Required to Have Training	Training
All staff	H&S Program Orientation
All Field staff	HAZCOM/GHS/EAP
All Field staff	Arcadis Defensive Driving (Smith On-Line)
At least one field staff	Fire Extinguisher
All field staff	First Aid/CPR
All field staff	Hazwoper 40 Hour
All field staff	Hazwoper 8-Hour Annual Refresher
At least the SSO	Hazwoper Supervisor
All field staff	Lead General Awareness

Staff Required to Have Training	Training
Field staff that operate XRF	Ionizing Radiation - General Awareness
Field staff that operate XRF	Thermo Scientific XRF training
At least one field staff	DOT HazMat #1

4 ARCADIS ORGANIZATION AND RESPONSIBILITIES

4.1 All Personnel

Every person is responsible for completing tasks safely and reporting any unsafe acts or conditions to their supervisor. No person may work in a manner that conflicts with these procedures. Prior to initiating site activities, all Arcadis and subcontractor personnel will receive training in accordance with applicable regulations and be familiar with the requirements and standards referenced in this HASP. In addition, all personnel will attend daily safety meetings (tailgate meetings) to discuss site specific hazards prior to beginning each day's work. Every Arcadis employee, subcontractor, and client representative at the site has the responsibility to stop the work of a coworker or subcontractor if the working conditions or behaviors are considered unsafe.

4.2 Project Manager/Task Manager

The Project Manager is responsible for verifying that project activities are completed in accordance with the requirements of this HASP. The Project Manager is responsible for confirming that the project has the equipment, materials, and qualified personnel to fully implement the safety requirements of this HASP, and/or that subcontractors assigned to this project, meet the requirements established by Arcadis. It is also the responsibility of the Project Manager to:

- Review with project staff the information required in the Culture of Caring Certification included in this HASP or designate an Associate Project Manager or Task Manager to perform this function.
- Review all applicable H&S standards and confirm that project activities conform to all requirements.
- Obtain client-specific H&S information and communicate with the client on H&S issues.
- Communicate with the Site Safety Officer (SSO) on H&S issues.
- Allocate resources for correction of identified unsafe work conditions.
- Confirm that Arcadis site workers have all training necessary for the project.
- Report all injuries, illnesses, and near-misses to the client representative, lead incident investigations, and confirm that any recommendations made are implemented.

4.3 Site Safety Officer

The SSO has overall responsibility for the technical H&S aspects of the project. Inquiries regarding Arcadis H&S standards, project procedures, and other technical or regulatory issues should be addressed to this individual. It is also the responsibility of the SSO to:

- Review and work in accordance with the components of this HASP.
- Make sure that this HASP is available to and reviewed by all site personnel including subcontractors.
- Validate that necessary site-specific training is performed (both initial and "tailgate" safety briefings).
- Confirm site visitors have been informed of the hazards related to Arcadis work.

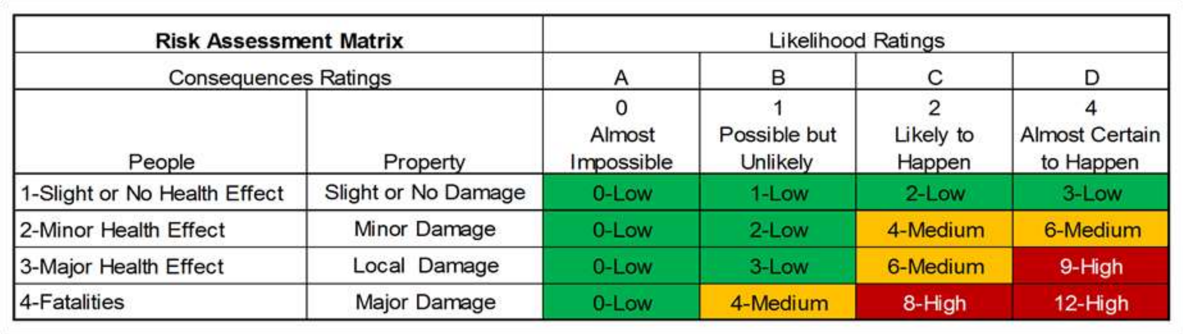
- Confirm that work is performed in a safe manner and has authority to stop work when necessary to protect workers and/or the public.
- Coordinate activities during emergency situations.
- Disseminate to other site personnel all necessary permits and safety information provided by the client and confirm that the material is maintained in an organized manner.
- Communicate with the Project Manager, Associate Project Manager, and/or Task Manager on H&S issues.
- Report all injuries, illnesses, and near-misses to the Project Manager, Associate Project Manager, and/or Task Manager.
- Make sure that necessary safety equipment is maintained and used at the site.

5 PROJECT HAZARDS AND CONTROL MEASURES

5.1 Task Hazard Analysis

The scope of work for this project has been subdivided into tasks and each task has been evaluated for hazards using the Hazard Ranking Chart illustrated in Table 1 in accordance with the Arcadis Hazard Assessment and Risk Control (HARC) Health and Safety Standard (AUS HSMS002). Refer to Appendix A for a detailed THA for this project.

Table 1. Hazard Ranking Chart



Risk Assessment Matrix		Likelihood Ratings			
Consequences Ratings		A	B	C	D
People	Property	0 Almost Impossible	1 Possible but Unlikely	2 Likely to Happen	4 Almost Certain to Happen
1-Slight or No Health Effect	Slight or No Damage	0-Low	1-Low	2-Low	3-Low
2-Minor Health Effect	Minor Damage	0-Low	2-Low	4-Medium	6-Medium
3-Major Health Effect	Local Damage	0-Low	3-Low	6-Medium	9-High
4-Fatalities	Major Damage	0-Low	4-Medium	8-High	12-High

5.2 Job Safety Analyses, Permits, and Health and Safety Standards

5.2.1 Job Safety Analyses

A JSA has been completed for each safety-critical task and is included in Appendix B. Hazards identified in the task hazard analysis (Appendix A) are addressed specifically in the JSAs, as well as control methods to protect employees and property from hazards. The JSA also lists the type of PPE required for the completion of the task or activity. PPE listed in the task-specific JSA will take precedence over PPE requirements listed in Section 5.3.1 of this HASP.

5.2.2 Permits

None of the tasks anticipated for this project will require use of a permit.

5.2.3 H&S Standards

Arcadis H&S Standards addressing safety-critical work activities are listed below. These standards should be reviewed by the Project Manager, Associate Project Manager and/or Task Manager, and site personnel prior to start of the project or applicable task to confirm that all requirements are met.

- ARC HSFS019 – Utility Location
- ARC HSGE004 – First Aid/CPR
- ARC HSIH010 – Lead
- ARC HSIH011 – Radiation (Sealed Source Instruments)

- ARC HSFS002 – Water Operations

5.3 Personal Protective Equipment

5.3.1 General Requirements

PPE requirements are specified in task-specific JSAs and/or permits listed in Appendix B. If the work activity is not performed under a permit or JSA, then all project workers working on site outside of an office must wear, at a minimum:

- Hard hat;
- Safety glasses;
- Safety-toed boot;
- Class II traffic vest;
- Light-colored clothing (to help identify presence of ticks on staff); and
- Type I or II personal flotation device (PFD) when working on or within 6 feet of water.

Regardless of the requirements above, the following PPE marked "R" is required to be available on site for this project:

- Rain gear
- Hard hat
- Traffic Safety Vest (Class II minimum)
- Safety glasses
- Safety boots (steel toe and shank)
- Work gloves (leather)
- Chemical resistant gloves (nitrile and latex)

Subcontractors are required to have the same PPE available on site as the PPE listed above.

5.3.2 Levels of PPE Protection

The following is the level D PPE ensemble which is referenced in this HASP, project-related JSAs/permits, or in H&S Standards:

Level D – Standard work clothing consisting of long pants, shirt with at least a quarter sleeve, hard hat, safety glasses, safety-toed boots, protective gloves, and Class II retroreflective vest (traffic vest).

5.4 Field Health & Safety Handbook

The FHSHB is an Arcadis document containing information about topic-specific H&S requirements for the field. This handbook contains relevant general topics and is used as part of the overall HASP process. To aid in the consistency of the HASP process, the handbook will be used as an informational source in conjunction with this HASP. Relevant sections of the FHSHB include:

II. Health and Safety Administration

- A. ARCADIS Responsibilities
- B. Employee Responsibilities
- C. Visitors
- E. Hazard Identification, Risk Assessment, and Risk Control Process
- F. Near Miss, Incident Reporting and Investigation
- G. Stop Work Authority
- K. Emergency Action Planning
- L. WorkCare

III. General Field Health and Safety Requirements

- A. Daily Safety Meetings/Tailgates
- C. First Aid/Cardiopulmonary Resuscitation
- D. Blood-borne Pathogens
- E. General H&S Rules and Safe Work Permits
- F. General Housekeeping, Personal Hygiene and Field Sanitation
- G. Site Security, Work Zones and Decontamination for HAZWOPER Sites
- I. Severe Weather
- M. Heat and Cold Stress
- N. Biological Hazards
- R. Fatigue Assessment
- S. Personal Protective Equipment
- V. Driving
- Y. Boating Operations Safety

V. Specific Project Sites, Hazards, and Activities

- C. Wilderness
- G. Water Operations Work

6 HAZARD COMMUNICATION / GLOBAL HARMONIZATION SYSTEM

All project-required chemicals must be handled in accordance with the Arcadis-HAZCOM/GHS Standard (ARC HSGE007), and the requirements outlined in the FHSHB. The table in Appendix C lists all chemicals/SDS that will be brought, used, and/or stored on the site by Arcadis or its subcontractors.

All Arcadis staff must be made aware of the location of and have ready access to the SDS information on site. For this project, SDSs will be located:

- HASP located in the Field Staging Area

7 TAILGATE MEETINGS

Tailgate safety briefings must be conducted at least once daily. The tailgate safety briefing must be documented on the form included in Appendix D or documented on an equivalent form and maintained with the project files. Alternatively, the tailgate safety briefing may be documented and stored/archived digitally using Arcadis-approved software. The tailgate safety briefing will serve as a final review for hazard identification and controls to be utilized. JSA and the Arcadis FHSHB controls (including any applicable permit or supplemental plans) should be reviewed as part of the briefing to ensure hazard controls are adequate for planned work. A tailgate safety briefing should be conducted again and documented during the same work shift if site conditions change from anticipated conditions.

8 PERSONAL EXPOSURE MONITORING AND RESPIRATORY PROTECTION

A review of project tasks indicates that PID monitoring should be implemented at the site. Due to unknown concentrations of TPH, a Stop Work threshold is set at the Arcadis administrative exposure limit of 10 ppm for gasoline. While gasoline was chosen as a representative standard for TPH at the Site, the PID will monitor for all volatile hydrocarbons that could pose a risk to human health. The field forms for PID monitoring (Air Monitoring Log and PID Calibration Log) are located in Appendix D. Arcadis staff will utilize stop work if conditions on site change indicating the need to utilize area or personal exposure monitoring. Work will not resume until proper monitoring, engineering controls, and/or PPE upgrades are in place to safely perform work.

Dosimetry Monitoring Program (during Mobilization #1 field event)

1. Designate a few people as “operators”. They will be the main people operating the equipment for the field duration.
    a. Dosimeter badges will be ordered from Sierra Dosimetry.
2. A “visitor” dosimeter badge will be utilized for anyone else standing near the XRF unit during operation or in the event an alternate operator will be needed.
3. A “Control” dosimeter badge will be transported with and carried around with the other dosimeter badges but will isolated from and NOT be exposed to the XRF survey activities.
4. Each XRF team member will wear the dosimeter badge on their vest during field operations with the XRF. Do not wear the dosimeter badges at other times than listed below (including while driving).
    a. Start of the field day – put on dosimeter badge
    b. End of the field day – take off dosimeter badge
    c. Store all personnel dosimeter badges with control.
5. At the end of field work, dosimeters will be sent to Sierra Dosimetry for analysis. Sierra will generate a report for each dosimeter badge and the field team will compare field exposure to the exposure limit (100 mem/yr). Radiation exposure at the Site is anticipated to be extremely low, but Arcadis Health and Safety will be consulted if the analysis results indicate a potential increase in exposure over the action limit. The dosimetry reports will be stored with project files for future reference.

9 MEDICAL SURVEILLANCE

Medical surveillance requirements prescribed by OSHA’s HAZWOPER regulations apply to all tasks on this project. Arcadis’ medical surveillance requirements for HAZWOPER work are outlined in the Arcadis Medical Monitoring Program Standard ARCHSGE010. All medical surveillance requirements as indicated must be completed and site personnel medically cleared before being permitted on the project site.

10 SANITATION

10.1 Potable Water

There is no potable water supply or other utilities (e.g., gas, electric, internet) at the site. Potable water will be purchased and brought to the site in a cooler or other suitable container. The cooler will be located in the field staging area.

10.2 Toilet Facilities

Toilet facilities will be limited at the Site; however, two primitive facilities are present if needed. A “privy” is located on the eastern end of the northern duplex fence and includes a hand washing station. Additionally, a “humanure composting toilet” and sink are available in the boathouse. The field team will communicate with the NW Schooner Society (who manages the Site) prior to arrival to ensure these facilities are prepared.

11 DECONTAMINATION AND SITE CONTROL PROCEDURES

11.1 Decontamination

Site workers should exercise good hygiene practices by washing hands and face with soap and water prior to consumption of food, drink. No smoking will be permitted on the island. Ready access to an adequate supply of potable water, soap, and disposable towels is expected to be maintained on site. Exposed skin in contact with potentially impacted environmental media, site chemicals, decontamination materials or calibration solutions should be promptly washed with soap and water to reduce potential for contamination or skin irritation.

11.2 Site Control

Site control is required for all field work. The primary purpose of site control is to minimize worker exposure to known or potentially harmful contaminants in environmental media, remediation, or process chemicals or waste materials. Site control also serves to protect site workers not involved with the environmental investigation or remediation and members of the public from potential contamination. Finally, site control can be used to prevent theft and vandalism of equipment.

All visitors to the project work area/site are required to sign in and out on the Arcadis Visitor's Log (located in Appendix D) for the project and must receive a safety briefing described in Section 7 of this HASP.

For Level D projects, formal establishment of site control zones is not ordinarily required unless specified by the THA or task-specific JSA. The site is unoccupied and on a remote island. Therefore, traffic control or barricading of the work area to prevent unauthorized access to the work area will not be required.

12 SUPPLEMENTAL PLANS AND REQUIREMENTS

12.1 Supplemental Plans

The following supplemental plans are applicable to this project and are presented in Appendix E:

- Lone or Remote Worker Plan
- Journey Management Plan
- Washington State Heat Prevention Plan

12.2 Hazardous Materials Shipping Determinations

A shipping determination is required for all equipment, chemical, battery, and sample shipments. The completed shipping determinations for this project are included in Appendix E.

12.3 Commercial Motor Vehicles

Vehicles with a gross vehicle weight rating (GVWR) ≥10,001 pounds (alone or when attached to a trailer) are commercial motor vehicles (CMVs) and require driver's to be enrolled in the Arcadis CMV Program. CMV operation is not applicable for this project.

12.4 Tick Hazard Control

Tick exposure is a potential hazard associated with tasks completed on this project.

Arcadis has established a supplemental hazard ranking system for the evaluation of tick hazards. The chart below defines tick hazards as "high," "medium," or "low" based on anticipated site conditions.

Tick Hazard Ranking Guide:

Low	Paved areas; parking lots; well-manicured lawns and fields; no work taking place within 15 feet of vegetated areas; work in regions with no tick populations; sub-freezing temperatures, snow, or ice cover on ground. *
Medium	Brush-hogged fields, wetlands, grasslands; forested areas with little undergrowth; weeds less than knee height; moderately dense foliage; sporadic or moderately vegetated shaded areas; average leaf accumulation and decaying material on the ground; work taking place in fields after application of insecticide; work in regions with a recognized moderate tick population; outdoor work during spring, summer, and fall months. *
High	Uncut fields, wetlands, forested areas, grasslands; weeds taller than knee height; heavy dense foliage; heavily vegetated shaded areas; excessive accumulations of leaves and decaying material on the ground; work in regions with recognized heavy tick populations; areas with posted tick hazard warnings; outdoor work during spring, summer, and fall months. *

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* Cold weather does not eliminate risk of exposure to ticks as they may be active all year in areas that experience subfreezing temperatures.

Work on this project has a medium tick exposure hazard. The following measures will be implemented to reduce the risk and impact of ticks:

- Use insect repellent (permethrin on clothing in combination with 20%-40% DEET on skin)
- Wear light-colored clothing to help identify presence of ticks on staff.
- Complete clothing and exposed skin “buddy checks” periodically throughout the day.
- Keep shirt tails inside pants and pant legs taped to ankle.
- Perform personal self-tick check each day after work is completed.

12.5 Poisonous Plant Hazard Control

Poisonous plant exposure is a potential hazard associated with this project.

Arcadis has established a supplemental hazard ranking system for the evaluation of poisonous plant hazards. The supplemental ranking of “high,” “medium,” or “low” based on anticipated site conditions. As part of the ranking process, staff should consider poisonous plants hazardous throughout the year, including winter months.

Work on this project has a medium poisonous plant exposure hazard. Plan work to avoid areas of identified poisonous plants. Evaluate and implement poisonous plant elimination (mowing, clear cutting) and control, as practicable. Workers known to have a sensitivity to poisonous plants should be assigned tasks that will not have poisonous plant exposure. If unavoidable, workers known to have a sensitivity should use a pre-exposure lotion on exposed skin.

First aid kits must be equipped with post-exposure soap. Inspect work area for presence of hazard prior to initiating work at the location. Wear disposable gloves during work and while removing outer footwear. Use of clothing with long sleeves to protect forearms is an Arcadis expectation. Disposable coveralls are recommended. Potential exposure to plant oils should be managed in a manner consistent with chemical exposure.

13 ARCADIS BEHAVIOR BASED SAFETY PROGRAM

As part of any project, no matter how simple or complex, Task Improvement Processes (TIPs) should be conducted when practical and when able to integrate into normal business activities. TIPs should be scheduled based on the risk of the tasks being performed and should be conducted for different tasks and at different times.

The following tasks are (at a minimum) suitable for TIP activity for the project:

- Driving
- Mobilization
- Soil Sampling

All Arcadis field staff are encouraged to identify and report near misses that could affect H&S of Arcadis employees, our subcontractors, or the public. Near miss reports for a similar project performed by Arcadis for USCG at Poverty Island, Fairbanks Township, Michigan, is included in Appendix F.

14 SUBCONTRACTORS

Subcontractors are responsible for the H&S of their employees at all times and have the authority to stop work if unsafe conditions arise.

A copy of this HASP is to be provided to all subcontractors prior to the start of work so that the subcontractor is informed of the hazards at the site. While the Arcadis HASP will be the minimum H&S requirements for the work completed by Arcadis and its subcontractors, each subcontractor, in coordination with Arcadis H&S personnel, is expected to perform its operations in accordance with its own HASP, policies, and procedures unique to the subcontractor’s work to ensure that hazards associated with the performance of the work activities are properly controlled. Copies of any required safety documentation for a subcontractor's work activities will be provided to Arcadis for review prior to the start of on-site activities.

In the event that the subcontractor’s procedures/requirements conflict with requirements specified in this HASP, the more stringent guidance will be adopted after discussion and agreement between the subcontractor and Arcadis project H&S personnel. Hazards not listed in this HASP but known to the subcontractor or known to be associated with the subcontractor's services, must be identified and addressed to the Arcadis Project Manager, Associate Project Manager and/or Task Manager, and SSO prior to beginning work operations.

When the subcontractor is under contract to Arcadis or if directed by the client to act on the client’s behalf, the Project Manager, Associate Project Manager, and/or Task Manager, along with the SSO (or authorized representative) has the authority to halt the subcontractor’s operations and to remove the subcontractor or subcontractor’s employee(s) from the site for failure to comply with established H&S procedures or for operating in an unsafe manner.

15 PROJECT PERSONNEL HASP CERTIFICATION

All site project personnel will sign the certification signature page provided in this HASP.

APPENDIX A

Task Hazard Analysis

General Task Hazard Assessment and Risk Control (HARC)

General:	Hazards Applicable to All Project Tasks

The 12 hazard category HARC ratings are not available in this General THA. The mitigated and unmitigated ratings for the hazards presented are based on the Risk Assessment Matrix below. Modify hazards and ratings as necessary to meet project needs.

Risk Assessment Matrix		Likelihood Ratings			
Consequences Ratings		A	B	C	D
People	Property	0 Almost Impossible	1 Possible but Unlikely	2 Likely to Happen	3 Almost Certain to Happen
1-Slight or No Health Effect	Slight or No Damage	0-Low	1-Low	2-Low	3-Low
2-Minor Health Effect	Minor Damage	0-Low	2-Low	4-Medium	6-Medium
3-Major Health Effect	Local Damage	0-Low	3-Low	6-Medium	9-High
4-Fatalities	Major Damage	0-Low	4-Medium	8-High	12-High

Hazard #1

Driving - Driver - Injury, death or property damage due to driver distraction, fatigue, etc.

Suggested FHSHB Ref:	III V, AO	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	HIGH	Smith System (on line)
Mitigated Risk:	LOW	JSAs

Comments: Use Smith System "5-Keys" when driving. See Driving JSA for details.

Hazard #2

Gravity - Falls - Injury due to slips and trips

Suggested FHSHB Ref:	III F	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Job Briefing/Site Awareness
Mitigated Risk:	LOW	Housekeeping

Comments: Ensure footwear is appropriate for surface conditions. See HASP PPE section.

Hazard #3

Biological - skin/eye irritation or damage from poisonous plants

Suggested FHSHB Ref:	III N, AE	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Job Briefing/Site Awareness
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)

Comments: Use skin pre-treatment lotions when available.

Hazard #4

Biological - bites or stings from exposure to insects or arachnids

Suggested FHSHB Ref:	III N	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Job Briefing/Site Awareness
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)

Comments: Do body check daily.

Hazard #5

Biological - cuts, scrapes, skin/eye puncture from exposure to physically damaging plants

Suggested FHSHB Ref:	III N, AE	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Job Briefing/Site Awareness
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)

Comments:

General Task HARC (continued)

Hazard #6		
Environmental - Thermal stress - Injury or illness from heat or cold		
Suggested FHSHB Ref:	III M	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Field H&S Handbook (see ref. above)
Mitigated Risk:	LOW	JSAs
Comments:	Use job rotation or rest breaks. Stay hydrated and eat regularly.	
Hazard #7		
Environmental - Inclement weather -Injury or equipment damage from inclement weather		
Suggested FHSHB Ref:	III I	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Weather Monitoring
Mitigated Risk:	LOW	Cont./Emerg. Planning
Comments:	Use 30/30 rule for lightning. See FHSHB for details.	
Hazard #8		
Motion - Musculoskeletal - Injury from lifting, twisting , stooping, or awkward body positions		
Suggested FHSHB Ref:	III AF	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Engineering Controls (specify in comments)
Mitigated Risk:	LOW	Admin. Controls (specify in comments)
Comments:	Use proper lifting techniques. Use job rotation when applicable. See FHSHB for details.	
Hazard #9		
Motion - Musculoskeletal - Injury from repeated work activity or body motion		
Suggested FHSHB Ref:	III AF	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Engineering Controls (specify in comments)
Mitigated Risk:	LOW	Admin. Controls (specify in comments)
Comments:	Use proper lifting techniques. Use job rotation when applicable. See FHSHB for details.	
Hazard #10		
Sound - Noise - Injury or illness due to noise exposure		
Suggested FHSHB Ref:	III L	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Engineering Controls (specify in comments)
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Increase distance from source if possible. Maintain equipment.	
Hazard #11		
None		
Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		
Hazard #12		
None		
Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Task Specific HARC

Task 1:	**Driving - Motor vehicles**

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: III V

Biological	-	Chemical	-	Driving	H	Electrical	-
Environmental	-	Gravity	-	Mechanical	-	Motion	-
Personal Safety	L	Pressure	-	Radiation	-	Sound	-

Hazard #1

Driving - On road - Injury or vehicle damage from motor vehicle accident or incident

Suggested FHSHB Ref:	III V, W, U, AO	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	HIGH	Job Briefing/Site Awareness
Mitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Comments:		

Hazard #2

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #3

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #4

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #5

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #6

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Task Specific HARC (continued)

Task 2:	**Inspections and audits - Buildings**

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: III F

Biological	L	Chemical	L	Driving	L	Electrical	L
Environmental	L	Gravity	L	Mechanical	M	Motion	L
Personal Safety	L	Pressure	L	Radiation	L	Sound	L

Hazard #1

Chemical- solids/particulates - injury or illness from skin absorption

Suggested FHSHB Ref:	III C, F, G, K, S, AG	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	Job Briefing/Site Awareness
Comments:		

Hazard #2

Chemical - solids/particulates, injury or illness from inhalation

Suggested FHSHB Ref:	III C, F, G, K, S, AG	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	Job Briefing/Site Awareness
Comments:		

Hazard #3

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #4

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #5

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #6

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Task Specific HARC (continued)

Task 3:	**Mobilization - Site set up and take down**

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: III F

Biological	-	Chemical	L	Driving	-	Electrical	L
Environmental	L	Gravity	M	Mechanical	L	Motion	M
Personal Safety	L	Pressure	L	Radiation	L	Sound	L

Hazard #1

Motion - Cuts and scrapes - Injury from moving object impacting skin or eye

Suggested FHSHB Ref:	III S	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	First Aid/CPR Training (designated person)
Comments:		

Hazard #2

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #3

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #4

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #5

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #6

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Task Specific HARC (continued)

Task 4: **Sampling - Soil sampling using hand auger or probe**

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: III F

Biological	L	Chemical	L	Driving	-	Electrical	-
Environmental	M	Gravity	M	Mechanical	-	Motion	M
Personal Safety	L	Pressure	L	Radiation	-	Sound	L

Hazard #1

Chemical - solids/particulates, skin or eye irritation/damage/allergy

Suggested FHSHB Ref:	III C, F, G, K, S, AG	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	Job Briefing/Site Awareness
Comments:		

Hazard #2

Chemical - solids/particulates, injury or illness from inhalation

Suggested FHSHB Ref:	III C, F, G, K, S, AG	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	Job Briefing/Site Awareness
Comments:		

Hazard #3

Radiation - Ionizing - Injury or illness due to exposure to ionizing radiation (alpha, beta, gamma, neutron)

Suggested FHSHB Ref:	NA	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Specialized Checklist/Forms
Mitigated Risk:	LOW	H&S Standards
Comments:		

Hazard #4

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	PPE (see HASP "PPE" section)
Mitigated Risk:	Not Ranked	H&S Standards
Comments:		

Hazard #5

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #6

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Task Specific HARC (continued)

Task 5: **Utilities - Clearance**

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: III AN

Biological	L	Chemical	L	Driving	-	Electrical	M
Environmental	L	Gravity	L	Mechanical	M	Motion	M
Personal Safety	L	Pressure	L	Radiation	-	Sound	L

Hazard #1

Environmental - Utilities - Injury or property damage from utility strike/damage

Suggested FHSHB Ref:	III AN	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	HIGH	H&S Standards
Mitigated Risk:	MEDIUM	Permits
Comments:		

Hazard #2

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #3

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #4

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #5

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #6

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Task Specific HARC (continued)

Task 6: **Waste - Containment of IDW in small containment devices greater than 10 gallons bu**

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: III V

Biological	-	Chemical	-	Driving	H	Electrical	-
Environmental	-	Gravity	-	Mechanical	-	Motion	-
Personal Safety	L	Pressure	-	Radiation	-	Sound	-

Hazard #1

Chemical - solids/particulates, skin or eye irritation/damage/allergy

Suggested FHSHB Ref:	III C, F, G, K, S, AG	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:		

Hazard #2

Chemical - solids/particulates, injury or illness from inhalation

Suggested FHSHB Ref:	III C, F, G, K, S, AG	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:		

Hazard #3

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #4

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #5

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #6

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Task Specific HARC (continued)

Task 7:	**Inspections and audits - Nonbuilding including non-secure/non-controlled areas**

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: III F

Biological	L	Chemical	L	Driving	L	Electrical	L
Environmental	L	Gravity	L	Mechanical	M	Motion	L
Personal Safety	L	Pressure	L	Radiation	L	Sound	L

Hazard #1

Biological - skin or eye injury from exposure to mammal, reptile, amphibian, fish, bird or invertebrate bites

Suggested FHSHB Ref:	III N	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	First Aid/CPR Training (designated person)
Comments:		

Hazard #2

Environmental - Wind -Skin injury from sun or wind exposure

Suggested FHSHB Ref:	III M	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	Field H&S Handbook (see ref. above)
Comments:		

Hazard #3

Suggested FHSHB Ref:	#N/A	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	#N/A	Select
Mitigated Risk:	#N/A	Select
Comments:		

Hazard #4

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #5

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #6

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Task Specific HARC (continued)

Task 8:	**Select**

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: III F

Biological	-	Chemical	L	Driving	-	Electrical	L
Environmental	L	Gravity	M	Mechanical	L	Motion	M
Personal Safety	L	Pressure	L	Radiation	L	Sound	L

Hazard #1

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #2

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #3

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #4

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #5

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Hazard #6

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Task Specific HARC (continued)

Task 9: **Select**

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: III F

Biological	L	Chemical	L	Driving	-	Electrical	-
Environmental	M	Gravity	M	Mechanical	-	Motion	M
Personal Safety	L	Pressure	L	Radiation	-	Sound	L

Hazard #1

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select

Comments:

Hazard #2

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select

Comments:

Hazard #3

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select

Comments:

Hazard #4

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select

Comments:

Hazard #5

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select

Comments:

Hazard #6

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select

Comments:

Task Specific HARC (continued)

Task 10:	**Select**

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: III AN

Biological	L	Chemical	L	Driving	-	Electrical	M
Environmental	L	Gravity	L	Mechanical	M	Motion	M
Personal Safety	L	Pressure	L	Radiation	-	Sound	L

Hazard #1

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select

Comments:

Hazard #2

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select

Comments:

Hazard #3

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select

Comments:

Hazard #4

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select

Comments:

Hazard #5

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select

Comments:

Hazard #6

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select

Comments:

APPENDIX B

Job Safety Analyses and Permits

Job Safety Analysis

General

JSA ID	11636	**Status**	(3) Completed
Job Name	Environmental-Other	**Created Date**	10/12/2018
Task Description	Hand Tools (including hammers, screw drivers, power drills, etc.) to be used for basic work procedures	**Completed Date**	10/12/2018
Template	False	**Auto Closed**	False

Client / Project

Client	U.S. Coast Guard
Project Number	B0003010
Project Name	Burrows Island Light Station
PIC	Troy Sclafani
Project Manager	Josh Gravenmier

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Epple, Eric	10/12/2018	10/12/2018	Carmen Vidal	☑
HASP Reviewer	Grey Coppi				☑
Quality Reviewer					☑
Reviewer					☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Conduct Safety Meeting & Perform LPSA	1	Unrecognized Hazards	Attend a daily safety meeting to learn of daily site hazards. Perform an LPSA before each task: Assess, Analyze and Act to mitigate hazards.	Field H&S Handbook Section III-X
2	Inspect Tools	1	Personal Injury	Inspect hand tools prior to use for cracks and/or structural defects. If tools have defects or are damaged, take out of service.	Field H&S Handbook Section III-X
		2	Electrical Shock	Inspect power tools for frays or cuts in cords. If tools have defects or are damaged, take out of service. Tools taken out of service must be tagged and removed from work area.	
3	Set-Up Work Zone	1	Personal Injury and Equipment Damage	Delineate a work zone with cones and caution tape as necessary. If work area is part of a controlled zone, delineation may not be necessary.	ARC Traffic Control Std
4	Use of Hand Tools	1	Electric Shock	Use GFCI for electrical tools and extension cords, do not use power tools in or around water sources	Field H&S Handbook Section III-X
		2	Slips, Trips and Falls	Walk around the work area prior to using tools, remove all travel path hazards, keep cords and tools out of walkways, note and communicate areas of slick and/or uneven ground, exercise caution near shoreline.	
		3	Eye Injury	Wear appropriate eye protection	
		4	injury from Flying Debris	Use face shield during operations requiring protection from flying debris	
		5	Hand Injury	Wear appropriate work gloves (heavy leather and/or Kevlar cut resistant), wear cotton or leather gloves when using power tools to reduce vibration hazards	
		6	Poor Ergonomics	Use correct body positioning and lifting techniques when using tools and/or moving equipment, take frequent breaks.	

		7	Hypothermia	Wear insulated clothing in cold weather.	
		8	Biological Hazards	Be alert for wildlife, if spotted, take cover in structures or vehicles until the wildlife has left the area, be cautious of poisonous plants.	
5	Stowing Hand Tools	1	Inspect Tools	Inspect tools following use for damages caused during work, take damaged equipment out of service	Field H&S Handbook Section III-X

PPE Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	long sleeve shirt/pants	FR Clothing	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	work gloves (specify type)	Leather	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs	For Hammer Use	Required
Miscellaneous PPE	traffic vest--Class II or III		Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
Personal	eye wash (specify type)		Required
	insect repellant		Recommended
	sunscreen		Recommended
Traffic Control	traffic cones		Recommended

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Grey Coppi HASP Reviewer	
Employee: **Role** **Review Type** **Completed Date**		
Employee: **Role** **Review Type** **Completed Date**		

Job Safety Analysis

General

JSA ID	10696	**Status**	(3) Completed
Job Name	Environmental-Other	**Created Date**	10/12/2018
Task Description	Use of power tools at the job site	**Completed Date**	10/12/2018
Template	False	**Auto Closed**	True

Client / Project

Client	U.S. Coast Guard
Project Number	B0003010
Project Name	Burrows Island Light Station
PIC	Troy Sclafani
Project Manager	Josh Gravenmier

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Epple, Eric	10/12/2018	10/12/2018	Vidal, Carmen	☑
HASP Reviewer	Coppi, Grey				☑
Quality Reviewer					☑
Reviewer					☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Training	1	Injury sustained due to improper use of tools	Workers shall have adequate training and be competent in the use of tools provided at the worksite. Where the manufacturer has not developed specific operating procedures, only personnel familiar with the safe operating procedures of that equipment should be permitted to operate it.	Employee Field H&S Handbook Section III, CC. General Field H&S Requirements. Hand and power tools
2	Pre-work tool inspection	1	Electrical shock or fire	Ensure the power tools are in good working condition before operating. Check power cord for any cuts, nicks, cracks, loose connections, etc. If the cord or any other part of the tool is damaged, take the tool out of service and repair the damage or replace the tool. Additionally, make sure the power source is outfitted with a GFCI. If using an extension cord, use a cord that has the proper voltage capacity. Do not operate the tool in or near standing water. Consider using a cordless saw to avoid the hazards associated with using a power cord and external power source. Select the appropriate attachments for the tool and the task. Make sure a fire extinguisher is nearby and easily accessible.	
3	Operating the tools	1	Personal injury	Operate the tools using the manufacturer's recommended operating procedures. Always operate the tools in a safe and controlled manor. Stay focused on the task at hand. Wear the proper PPE including leather gloves, safety glasses, and steel toed boots to protect yourself from all hazards. Take the time to evaluate what is being cut and determine what direction the material could fall once the cut is made. Keep body parts clear of this area. Secure or brace the material on appropriate surface prior to making any cuts if this can prevent the material from falling when the cuts are made.	

4	Storing the tools	1	Injury sustained due to poor housekeeping or improperly maintained equipment	When the tools are not being used they should be placed in a location where it cannot be stepped on or tripped over. If the tools will not be used for an extended period of time, they should be returned to it's storage case. After tasks are completed and before storing, they should be cleaned, inspected, and serviced if needed. Ensure the tools are returned to storage in good working order. The tools should be maintained in accordance with the manufacturer's instructions. If tools are damaged or in need of repair, arrange to have the them repaired or replaced before the next use. Remove tool accessories and wrap up associated power cords for proper storage. Discard any worn accessories. Place the tools and associated parts back in the storage container and return it to the tool storage area.	

PPE Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	long sleeve shirt/pants		Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	work gloves (specify type)	cut-resistant	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs		Recommended
Miscellaneous PPE	traffic vest--Class II or III	Class II	Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Decontamination	Decon supplies (specify type)	towels and/or rags	Recommended
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
Personal	eye wash (specify type)	ANSI compliant	Required
	water/fluid replacement	water and/or electrolyte replacement	Recommended
Traffic Control	traffic cones		Recommended

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**		
Employee: **Role** **Review Type** **Completed Date**		

Job Safety Analysis

General

JSA ID	8398	**Status**	(3) Completed
Job Name	Environmental-Sample cooler handling	**Created Date**	10/12/2018
Task Description	Sample Cooler Handling	**Completed Date**	10/12/2018
Template	False	**Auto Closed**	False

Client / Project

Client	U.S. Coast Guard
Project Number	B0003010
Project Name	Burrows Island Light Station
PIC	Troy Sclafani
Project Manager	Josh Gravenmier

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Epple, Eric	10/12/2018	10/12/2018	Vidal, Carmen	☑
HASP Reviewer	Coppi, Grey				☑
Quality Reviewer					☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Transfer field samples to sample packing area	1	Lifting heavy coolers may result in muscle strain especially to lower back.	Use proper lifting techniques and keep back straight. Use buddy system for large coolers, Use mechanical aids like hand trucks if readily available to move coolers. Do not over fill coolers with full sample containers for temporary movement to the sample prep area. Ensure an adequate supply of sample coolers are in field.	
		2	Hazards to hands from broken glass caused by over tightening lids or improper placement in cooler	Inspect all bottles and bottle caps for cracks/leaks before and after filling container. Do not over tighten sample lids. Clean up any broken bottles immediately, avoid contact with sample preservatives. Wear leather gloves when handling broken glass.	
2	Sample cooler selection	1	Sample coolers with defective handles, lid hinges, lid hasps cracked or otherwise damaged may result in injury (cuts to hands, crushing of feet if handle breaks etc)	Only use coolers that are new or in like new condition, No rope handled coolers unless part of the manufacturer's handle design.	ARCADIS Shipping Guide US-001
		2	Selection of excessively large coolers introduces lifting hazards once the cooler is filled.	Select coolers and instruct lab to only provide coolers of a size appropriate for the material being shipped. For ordinary sample shipping sample coolers should be 48 quart capacity or smaller to reduce lifting hazards.	
3	Pack Samples	1	Pinch points and abrasions to hands from cooler lid closing unexpectedly	Beware that lid could slam shut; block/brace if needed; be wary of packing in strong winds. New coolers may be more prone to self closing, tilt cooler back slightly to facilitate keeping lid open.	
		2	Awkward body positions and contact stress to legs and knees when preparing coolers on irregular or hard ground surfaces.	Plan cooler prep activities. Situate cooler where neutral body positions can be maintained if practical, like truck tailgate. Avoid cooler prep on rough gravel surfaces unless knees and legs protected during kneeling.	
4	Sealing, labeling and Marking Cooler	1	Cuts to hands and forearms from strapping tape placement or removing old	Do not use a fixed, open-blade knife to remove old tags/labels, USE SCISSORS or other safety style cutting device. Only use	

			tape and labels	devices designed for cutting. Do not hurry through task.	
		2	Lifting and awkward body position hazards from taping heavy coolers, dropping coolers on feet during taping.	Do not hurry through the taping tasks, ensure samples in cooler are evenly distributed in cooler to reduce potential for overhanging cooler falling off edge of tailgate/table when taping.	
5	Offering sample cooler to a carrier or lab courier for shipment.	1	Lifting heavy coolers may result in muscle strain especially to lower back.	See lifting hazard controls above.	

PPE Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)	nitrile	Required
	work gloves (specify type)	leather	Required
Head Protection	hard hat		Required
Miscellaneous PPE	traffic vest--Class II or III		Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
	Other	Scissors	Required
Personal	eye wash (specify type)		Required
	insect repellant		Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**		
Employee: **Role** **Review Type** **Completed Date**		

Job Safety Analysis

General

JSA ID	12076	**Status**	(3) Completed
Job Name	Environmental-Boating/water work	**Created Date**	10/12/2018
Task Description	Working near water’s edge or in boat	**Completed Date**	10/12/2018
Template	False	**Auto Closed**	False

Client / Project

Client	U.S. Coast Guard
Project Number	B0003010
Project Name	Burrows Island Light Station
PIC	Troy Sclafani
Project Manager	Josh Gravenmier

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Epple, Eric	10/12/2018	10/12/2018	Vidal, Carmen	☑
HASP Reviewer	Coppi, Grey				☑
Quality Reviewer					☑
Reviewer					☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Working near water's edge	1	Drowning	Wear a USCG approved life jacked/buoyant work vest. Only work near water’s edge when necessary, otherwise maintain a six foot separation if possible. Be aware of possible flash flood conditions.	
		2	Slips/trips/falls on wet/uneven surfaces near the water	Wear anti-slip footwear with ankle support. Plan route and do not hurry through the task	
		3	Unable to get help if needed	The 'buddy system' will be strictly adhered to while working in or near water bodies. Ring buoys with at least 90ft of rope will be provided at least every 200ft along the shoreline for emergency rescue operations.	
2	Prior to boat operation	1	Personal injury or drowning due to boat breakdown or lack of appropriate emergency response equipment.	Inspect boat condition prior to embarking. Check safety equipment -- including PFDs, throw rope and ring buoy, air horn, flares. Insure that there are paddles and an anchor with sufficient rope (100 ft min) onboard in case the motor fails.	
		2	Increased risk of stranding, injuries or drowning due to no one knowing if the team has returned to shore.	File float plan with a responsible person who will not be on the boat and contact them at the end of the day when work is complete.	
3	Operating the boat	1	Capsize	Make sure the vessel is appropriate for the water body type and conditions. Keep loads evenly distributed in the boat at all times. Operate power boats at safe speed using employees trained in powerboat operation and safety. STOP WORK if the water conditions are deemed to be too hazardous.	Field H&S Handbook III(X)
		2	Falls overboard	Avoid leaning over the edge of the boat when collecting samples or retrieving equipment. Wear PFD at all times. Do not work alone on boats.	
		3	Slips trips and falls on the boat while in motion	Remain seated while the boat is in motion. If movement is required, use handrails, hand holds and other supporting devices to maintain stability while walking. Wear shoes	

				with antiskid soles. Always maintain good housekeeping and keep pathways clear.	
		4	Puncture of inflatable watercraft	Avoid using inflatable watercraft when using equipment that generates heat or has sharp edges. Avoid sampling from inflatable watercraft with sample bottles containing preservatives that might affect the integrity of the boat material.	

PPE Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	boots	Good grip sole	Required
	steel-toe boots	Have available for shore work	Required
Hand Protection	work gloves (specify type)	Leather	Required
Miscellaneous PPE	personal flotation device		Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
	walkie talkie		Recommended
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
	Other	air horn and flare	Required
	Other	safety whistle	Recommended
	Other	life ring with 90ft of rope	Required
Personal	eye wash (specify type)	Bottle	Required
	insect repellant		Recommended
	sunscreen		Recommended
	water/fluid replacement		Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**		
Employee: **Role** **Review Type** **Completed Date**		
Employee: **Role** **Review Type** **Completed Date**		
Employee: **Role** **Review Type** **Completed Date**		

Job Safety Analysis

General

JSA ID	11929	**Status**	(3) Completed
Job Name	Environmental-Radiological equipment operation	**Created Date**	10/12/2018
Task Description	XRF operation for lead delineation	**Completed Date**	10/12/2018
Template	False	**Auto Closed**	False

Client / Project

Client	U.S. COAST GUARD
Project Number	B0003010
Project Name	–Burrows Island Light Station
PIC	Troy Sclafani
Project Manager	GRAVENMIER, JOSH

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Epple, Eric	10/12/2018	10/12/2018	Vidal, Carmen	☑
HASP Reviewer	Coppi, Grey				☑
Quality Reviewer					☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Transporting equipment to and from project sites	1	Improper transportation of radiological instruments may lead to regulatory violation, exposure to radiological sources to driver, passengers or the public, and result in fines.	Ensure all license requirements are met, secure device in vehicle, may require a letter of competent authority to transport (consult manufacturer). Sealed source XRF usage is not anticipated for this site but should be considered if changes occur.	Radiation Safety Plan (required), Sealed Source Radiation HS Standard
2	Equipment set up and operation	1	Lifting hazards carrying equipment to work area	Use proper lifting techniques, carry equipment by handles, if provided	
		2	Damage to equipment during operation from site traffic or heavy equipment	Do not leave equipment unattended at any time. Park project vehicle in close proximity. Heavy equipment may have restricted view of ground in nearby operation. Use flagging or other warning devices if necessary.	
		3	Exposure to ionizing radiation	Keep unnecessary workers away from equipment when in operation. Workers using equipment require participation in dosimetry program (consult manufacturer or license for specific requirements). Use concepts of As Low As Reasonably Achievable. Perform any required leak test per manufacturer or license requirements, as required.	
		4	Impact hazards from hammering probe insertion holes (for equipment requiring holes)	Wear leather gloves, use devices designed to assist in proper hole completion, do not hurry hammering operation, use right hammer for the job.	
3	Equipment storage on site	1	Improper storage may violate license requirements resulting in unintentional worker exposure to ionizing radiation, and result in fines	Store equipment in secure location at least 10 ft from any work station, ensure appropriate radiation signage is posted, unless other requirements are stipulated by the manufacturer or license. Keep equipment in storage cases provided by the manufacturer.	

PPE Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	boots	supportive with good tread	Required

	steel-toe boots		Required
Hand Protection	work gloves (specify type)	leather	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs		Recommended
Respiratory Protection	dust mask		Recommended

Supplies

Type	Supply	Description	Required
Miscellaneous	Other	chain and locks to secure equipment	Required
	Other	dosimeter per manufacturer’s instructions	Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**		
Employee: **Role** **Review Type** **Completed Date**		

Job Safety Analysis

General

JSA ID	12468	**Status**	(3) Completed
Job Name	Environment-Other	**Created Date**	10/17/2018
Task Description	Mobilization and Demobilization	**Completed Date**	10/17/2018
Template	False	**Auto Closed**	False

Client / Project

Client	US Coast Guard
Project Number	B0003010
Project Name	USCG/Soil Treatment at Burrows
PIC	SCLAFANI, TROY
Project Manager	GRAVENMIER, JOSH

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Vidonish, Julia	10/17/2018	10/17/2018	Vidal, Carmen	☑
HASP Reviewer	Coppi, Grey	10/17/2018			☐
Reviewer					☐

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Pre-Trip Inspection	1	Failing to perform pre-trip inspections may cause mechanical failure, accident or injury	Perform walk around of vehicle with particular attention to tire inflation and condition. Check lights, wipers, seatbelts for proper operating condition. Properly adjust seat and mirrors prior to vehicle operation. Use or review vehicle inspection checklist as required under the MVSP.	ARC HSGE024 Motor Vehicle Safety Standard (MVSP)
		2	Scrapes, cuts, burns to hand if inspecting engine fluids and/or tires. Eye splash hazard if inspecting engine fluids. Pinch or crush hazards when opening or closing hood, trunk or tailgate.	Wear protective gloves and safety glasses as described below when checking under hood or tires. Use TRACK and keep hands clear when opening/closing hood, trunk, or tailgate to avoid crush or pinch hazard.	
		3	Improperly secured cargo may dislodge creating injury, property damage or road hazard.	Ensure all cargo is properly secured to prevent movement while the vehicle is in opertation. This includes cargo in the cab of the vehicle.	
		4	Excess cargo limiting visibility for the driver and creating additional blind spots.	Ensure that vehicle size is adequate to safely carry the required amount of cargo without impeding vision.	
2	Driving a motor vehicle on public streets	1	Failing to observe traffic flow ahead increases risk of hard braking resulting in potential impact of vehicle ahead, being struck by another vehicle from behind and decreases decision making time.	Use Smith System Key #1, "Aim High in Steering". **Look ahead (15 seconds if possible) to observe traffic flow and traffic signals.** Adjust speed accordingly to keep vehicle moving and avoid frequent braking. Select lane of least traffic and adjust speed based on observed signal timing when possible. Avoid following directly behind large vehicles that obscure view ahead.	Smith System "5-Keys" is a registered trademark of Smith System Driver Improvement Institute, Inc.
		2	Failing to observe vehicles, pedestrians, bicyclists and other relevant objects in vicinity of your vehicle increases risk of side swipes, rear ending, and third party injury.	Use Smith System Key #2, "Get the Big Picture". **Maintain 360 degrees of awareness around vehicle.** Check a mirror every 6-8 seconds, maintain space around the vehicle, choose a lane that avoids being boxed in. Look for pedestrian activity ahead in crosswalks or sidewalks. Watch for construction zone approach signs and act	

				early by executing lane changes and reducing speed.	
		3	Failing to keep your eyes moving increases risk of not seeing relevant vehicles, pedestrians and objects in your vicinity that may impair your ability to make timely and appropriate driving decisions and also increases risk of accident.	Use Smith System Key #3, "Keep Your Eyes Moving". **Move your eyes every 2 seconds and avoid staring while evaluating relevant objects.** Scan major and minor intersections prior to entering them. Check mirrors.	
		4	Failing to maintain space around and in front of your vehicle increases risk of striking another vehicle or being struck by another vehicle. Insufficient space shortens time for effective driving decision making resulting in increased accident risk.	Use Smith System #4, "Leave Yourself an Out". **Use 4 second rule when following a vehicle.** Avoid driving in vehicle clusters by adjusting speed and using lanes that permit maximum space and visibility. When stopped, keep one car length space in front of vehicle ahead or white line.	
		5	Failing to communicate with other drivers and pedestrians increases risk of striking vehicles, pedestrians, or being struck by other vehicles, especially from the rear.	Use Smith System Key #5, "Make Sure They See You". **Brake early and gradually when stopping to reduce potential of being rear ended.** Keep foot on brake while stopped. Use turn signals and horn effectively. Establish eye contact with other drivers and pedestrians to extent practical. Use vehicle positioning that promotes being seen.	
		6	Distractions within the vehicle takes focus off driving, increases risk of accident decreases time for making effective driving decisions.	**Cell phone use (any type or configuration) is prohibited while the vehicle is in motion.** Familiarize yourself with vehicle layout and controls (radio, temperature controls, etc.) prior to operating unfamiliar vehicles. Set controls prior to operating vehicle. Use GPS in unfamiliar areas to avoid use of paper maps/directions while driving. Set GPS prior to vehicle operation. Pull over and stop to modify GPS functions. Avoid consuming food or drink while driving.	
3	Parking	1	Parking vehicle in areas of clustered parked vehicles or near facility entrance may impair visibility to oncoming traffic in lot and increase exposure to pedestrian traffic.	**Use pull through parking or back into parking space when permitted or practical.** When practical and safe to do so, park away from other vehicles and avoid parking near the facility entrance or loading docks. If available, use a spotter to aid in backing activity. Back no further than necessary and back slowly. Get out and look (GOAL) if uncertain of immediate surroundings. Tap horn prior to backing.	
4	Preparing for Boat Travel	1	Slips, trips, falls while transferring equipment from vehicle to boat	Wear anti-slip footwear and used caution when carrying equipment on dock, ask for help carrying and transferring heavy items into boat, use three points of contact when going between the boat and dock.	
		2	Hazardous weather	Verify weather and confirm with boat operator that conditions are suitable for maritime travel. Call PM and reschedule work if forecast calls for adverse conditions.	
5	Arrival and Departure at Burrows Island Dock	1	Slip, trips, and falls while transferring from boat to ladder	Maintain three points of contact on ladder at all times, attempt to plan arrival and departure around high tide when ladders distance is shortest, secure backpacks or bags prior to ascending ladder.	Employee Field H&S Handbook Section III EE, JJ, Ladders H&S Standard ARC HSFS016
		2	Falling while transferring equipment	If possible, carry equipment in a backpack to alleviate the need to it pass to the dock, ask for help carrying heavy items, ensure that at least one person is above and below ladder before transferring equipment, do not overreach, use rope or other means to lower or raise equipment if necessary.	

		3	Slips, trips and falls on stairway from dock to boathouse	Maintain a clear pathway and move equipment to the to of the stairs as soon as possible, do not store anything on the stairway, watch for water, dew or ice on stairs and be conscious of footing.	

PPE Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	long sleeve shirt/pants		Recommended
Eye Protection	safety glasses	While checking engine or tires	Required
Foot Protection	steel-toe boots		Required
Hand Protection	work gloves (specify type)	Leather or equivalent checking engine or tires	Required
Miscellaneous PPE	personal flotation device		Recommended
	traffic vest--Class II or III		Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone	With cell booster or sat phone	Required
	other	Vehicle kit (applies to company trucks)	Required
Miscellaneous	fire extinguisher	Applies to company trucks	Required
	first aid kit	Applies to company trucks	Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**		

Job Safety Analysis

General

JSA ID	12466	**Status**	(3) Completed
Job Name	Environment-Soil sampling/well installation - manual	**Created Date**	10/17/2018
Task Description	Shallow Soil Sampling Using Manual Methods	**Completed Date**	10/17/2018
Template	False	**Auto Closed**	False

Client / Project

Client	US Coast Guard
Project Number	B0003010
Project Name	USCG Burrows Island Light Station
PIC	SCLAFANI, TROY
Project Manager	GRAVENMIER, JOSH

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Vidonish, Julia	10/17/2018	10/17/2018	Vidal, Carmen	☑
HASP Reviewer	Coppi, Grey	10/17/2018			☐
Reviewer					☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Sampling Set-up	1	Underground utilities	Follow the Utility Clearance HS Standard and ensure 3 reliable lines of evidence have been used to identify utilities prior to initiating any soil sampling.	Utility Clearance HS Standard ARCHFS019, Employee Field H&S Handbook Section III N, EE
		2	Lifting or carrying supplies around the site	Use proper lifting techniques by bending and lifting with the knees instead of using your back. Take several trips and don't overload your body. Carry only one heavy tool at a time. Ask for assistance if needed.	
		3	Uneven walking and working surfaces	Maintain awareness when carrying or moving equipment. Make sure the pathway is visible and keep one hand free to maintain balance over rocky terrain and hills. Take multiple trips between the staging area and sample location if necessary. Keep staging area and sampling locations organized to limit potential hazards.	Do not use instruments/ devices while walking. Use care when walking through areas with ivy or ground cover; probe dense areas before stepping.
		4	Ionizing radiation from the XRF	Set-up and maintain proper exclusion zone, use appropriate signage to communicate hazards to others. Do not let those not trained to use the specific model of XRF use the device.	
		5	Stings and bites from insects	Inspect sampling area for insects, especially yellow jacket and wasp nests, prior to setting up equipment and sampling. Maintain safe distance from areas with intense insect activity.	
2	Soil Sample Collection	1	Contact with contaminated soils.	Always wear eye protection, long sleeves and nitrile gloves when collecting soil samples.	Employee Field H&S Handbook, Section III, EE
		2	Pinch points from sharp edges of trowels	Wear Kevlar gloves to protect against cuts, keep fingers clear of sampling area, if roots or other obstructions present, move to another sampling location.	

		3	Containerizing and moving soil sampling	Don't overfill buckets, ask for help carrying heavy items, use appropriate lifting techniques outlined in the Field H&S Handbook.	
		4	Stress and injury to knees from kneeling while sampling	Rocks and contaminated soils can come in contact with your knees while sampling, and the repetitive motion can cause stress. Wear knee pads or use a small padded matt when sampling.	Use kneepads and/or foam pad to protect knees from glass and other refuse in soil near building materials.
3	Decontaminating Tools	1	Contact with contaminated soil	Wear protective gloves as outlined in the HASP, wear safety glasses	Personal Protective Equipment HS Standard ARCHSGE015
		2	Contact with cleaning solutions and contaminated water	Use PPE including nitrile gloves, safety glasses, and long sleeved clothing, try to minimize splashing	
		3	Sharp edges on equipment	Use a brush to clean sharp areas of equipment, keep fingers clear, wear cut resistant gloves to protect against lacerations	

PPE Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	long sleeve shirt/pants		Recommended
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	work gloves (specify type)	nitriles, depending on task	Required
Miscellaneous PPE	traffic vest--Class II or III		Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone	cell phone booster or satellite phone	Required
Decontamination	Decon supplies (specify type)		Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
Personal	eye wash (specify type)		Required
	insect repellent		Recommended
	sunscreen		Recommended

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**		

Job Safety Analysis

General

JSA ID	12462	**Status**	(3) Completed
Job Name	Environment-Other	**Created Date**	10/17/2018
Task Description	Site Inspection/Walkover	**Completed Date**	10/17/2018
Template	False	**Auto Closed**	False

Client / Project

Client	US Coast Guard
Project Number	B0003010
Project Name	USCG/Soil Treatment at Burrows
PIC	SCLAFANI, TROY
Project Manager	GRAVENMIER, JOSH

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Vidonish, Julia	10/17/2018	10/17/2018	Vidal, Carmen	☑
HASP Reviewer	Coppi, Grey	10/17/2018			☐
Reviewer					☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Project Specific Health & Safety Meeting	1	Poor understanding of site specific H&S requirements and hazards	Prior to visiting site, review HASP and become familiar with project specific safety requirements. Ensure everyone working on site is present for safety briefing or tailgate meeting. Verify everyone has donned PPE and met site specific requirements prior to start of work.	Tailgate Health and Safety Meetings HS Standard ARCHSGE001
		2	Poor response to emergency situations	Prior to visiting site, become familiar with project specific emergency procedures and contacts.	
2	Exterior Site Observation/Site Walk	1	Slipping/falling near rocky cliffs, off ladder, or in dock area	Use proper footwear with good traction. Pay attention to where you are walking, including foot placement. Walk in designated areas and on pathways. Maintain safe distance from water or cliffs while walking near banks Maintain 3 points of contact on ladders/stairways and visually/manually check for structural integrity prior to use.	Employee Field H&S Handbook Section III N, JJ Use buddy system at all times when near cliffs and shorelines.
		2	Heat Illness, dehydration, sunburn	If the site walk poses a risk for heat illness (based on temperature, humidity, sunshine), wear work clothing that is appropriate for the conditions. Drink plenty of water, avoid long periods of direct sun exposure. Work in the shade if possible. Use sunscreen.	
		3	Cold and wind exposure	Monitor weather to prepare for site conditions and possible changes in the weather forecast. Schedule rest breaks to warm up in cold conditions. Review health problems associated with weather conditions and watch for symptoms. Wear appropriate clothing for weather conditions. Avoid work in extreme weather conditions. Take shelter in the boat house or lighthouse if an extreme weather event arises.	Winter work at the Site merits extra caution for slippery surfaces due to rain/mist.
		4	Insect stings/bites	Watch for yellow jacket and wasp nests on the ground or above near buildings, relocate work away from insects if possible, ensure that appropriate medical devices are	

APPENDIX C

Hazard Communication/Globally Harmonized System

MATERIAL SAFETY DATA SHEET

PRODUCT **APATITE II**

COMPOSITION	Apatite II $[Ca_{10-x}Na_x(PO_4)_{6-x}(CO_3)_x(OH)_2$ where $x < 1]$, produced from fish bones (U.S. Patent #6,217,775)
APPEARANCE & FORM	Granular, various sizes from powder to gravel
PACKAGING	Bulk
TOXICITY	Ingestion-Nil Eye and skin contact-Nil Inhalation- Classified as nuisance dust only
CORROSION PROPERTIES	Non-corrosive
FIRE RISK	Low. Combustible when subjected to extreme heat
EXPLOSION RISK	None
HANDLING PROCEDURES	When being handled the dust can be a nuisance. This can be improved by extraction or ventilation. No smoking.
PROTECTIVE CLOTHING	Overalls, dust mask, and eye protection if necessary
STORAGE CONDITIONS	Should be stored at ambient temperature in dry metal or concrete bins.

FIRST AID REQUIREMENTS

EYE CONTACT:	Flush eyes with water. Irritating but does not injure eye tissue.
INHALATION:	No hazard under normal conditions. Move victim to fresh air area. Call doctor if breathing is irregular. Low order of toxicity.
SKIN CONTACT:	Skin may become dry from the dust. Wash thoroughly after contact, with soap if available. Low order of toxicity.
INGESTION:	No hazard. If ingested, give large amounts of water. Minimal toxicity.

DISPOSAL OF SPILLAGE AND WASTE

Shut off source without hazard if possible. Sweep up spilled material and place in container to be recycled.

SUPPLEMENTAL INFORMATION

These materials are made from naturally occurring, benign fish bone products and may contain naturally occurring microorganisms. Proper precautions are advised to prevent infection of open wounds. Avoid inhaling excessive amounts of dust. Avoid eye contact. Observe the proper hygiene practices necessary to prevent health hazards from any naturally occurring substance such as soil, bark, etc. Wash hands with soap and water after handling.

The information contained in this MSDS is provided without warranty of any kind, expressed or implied. The information contained here is made available solely for the consideration, investigation and verification by the original recipient. Users should consider this information only as a supplement to other information gathered by or available to them. Users should make independent determinations of the suitability and completeness of information from all sources to assure proper use and disposal of these materials for the safety and health of employees, customers and environment. This hazard information is not a substitute for risk assessment under actual conditions of use. Users have the responsibility to keep currently informed on chemical hazard information, to design and update their own programs, and to comply with all applicable national, federal, state, and local laws and regulations regarding safety, occupational health, right to know, and environmental protection.

www.pimsnw.com
7401 West Grandridge Blvd., Suite 201, Kennewick, WA 99336, 509.420.4015
Rev. 1, 10.2009

Material Safety Data Sheet Collection

Genium group inc.

1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Isobutene
ISO2900

Section 1 - Chemical Product and Company Identification

Material Name: Isobutene **CAS Number:** 115-11-7
Chemical Formula: C_4H_8
Structural Chemical Formula: $(CH_3)_2C{=}CH_2$
EINECS Number: 204-066-3
ACX Number: X1003822-9
Synonyms: Isobutene; ISOBUTYLENE; ASYM-DIMETHYLETHYLENE; GAMMA-BUTYLENE; 1,1-DIMETHYLETHYLENE; ISO-BUTENE; ISOBUTENE; ISOPROPYLIDENEMETHYLENE; LIQUEFIED PETROLEUM GAS; 2-METHYL-1-PROPENE; 2-METHYLPROPENE; 2-METHYLPROPYLENE; 1-PROPENE,2-METHYL-; PROPENE,2-METHYL-; UNSYM. DIMETHYLETHYLENE
General Use: Production of butene polymers used as adhesives, tackifiers, oil additives.
Butyl rubbers, copolymer resins with butadiene, acrylates and methacrylates.
Also to produce anti-oxidants for foods, food supplements, plastics and in production of isooctane and high-octane aviation gasoline.
Used in closed pressurized systems, fitted with safety relief valve.
Vented gas is flammable, denser than air and will spread. Vent path must not contain ignition sources, pilot lights, bare flames.

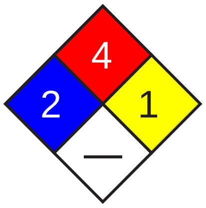
Section 2 - Composition / Information on Ingredients

Name	CAS	%
isobutene	115-11-7	>99

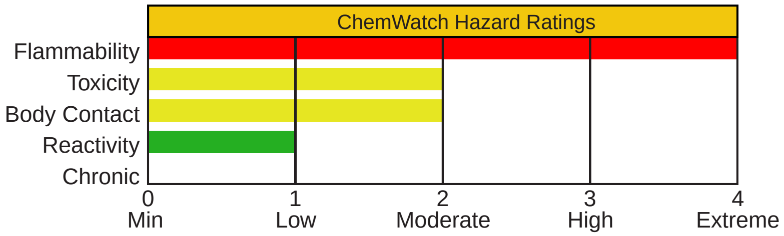
OSHA PEL **NIOSH REL**

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS	
1	Health
4	Flammability
0	Reactivity

ANSI Signal Word

Danger!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless gas. Acute Effects: Simple asphyxiant which can displace available oxygen; initial symptoms: rapid respiration, air hunger, diminished mental alertness, impaired muscular coordination. Can form explosive mixtures in air. Flammable.

Potential Health Effects

Target Organs: None reported
Primary Entry Routes: inhalation
Acute Effects
Inhalation: The gas is a simple asphyxiant (precludes access to oxygen) and is harmful if exposure is prolonged and inhalation may cause loss of consciousness.

Acute effects from inhalation of high concentrations of gas / vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated atmosphere of gas is prolonged this may lead to narcosis, unconsciousness, even coma, and unless resuscitated, death.

Iso-butene is a simple asphyxiant and may have a narcotic action.

Material is highly volatile and may quickly form concentrated atmosphere in confined or unventilated area. Vapor is heavier than air and may displace and replace air in breathing zone, acting as a simple asphyxiant. This may happen with little warning of overexposure.

Hydrocarbons may sensitize the heart to adrenalin and other circulatory catecholamines; as a result cardiac arrhythmias and ventricular fibrillation may occur. Abrupt collapse may produce traumatic injury.

Central nervous system (CNS) depression may be evident early. Symptoms of moderate poisoning may include giddiness, headache, dizziness and nausea.

Serious poisonings may result in respiratory depression and may be fatal.

The paraffin gases C1-4 are practically non-toxic below their lower flammability limits (18000-50000 ppm). Above this level, incidental effects include CNS depression and irritation but these are reversible upon cessation of the exposure. The C3 and iso-C5 hydrocarbons show increasing narcotic properties; branching of the chain also enhances the effect.

The C4 hydrocarbons appear to be more highly neurotoxic than the C3 and C5 members. Several fatalities due to voluntary inhalation of butane have been reported, possibly due to central, respiratory and circulatory effects resulting from anesthesia, laryngeal edema, chemical pneumonia or the combined effects of cardiac toxicity and increased sympathomimetic effects.

Inhalation of petroleum gases may produce narcosis, due in part to olefinic impurities. Displacement of oxygen in the air may cyanosis.

If present in sufficient quantity these gases may reduce the oxygen level to below 18% producing asphyxiation.

Symptoms include rapid respiration, mental dullness, lack of coordination, poor judgement, nausea and vomiting.

The onset of cyanosis may lead to unconsciousness and death.

Eye: The liquid is highly discomforting and may cause severe cold burns and is capable of causing pain and severe conjunctivitis.

Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

The gas is regarded as non-irritating to the eyes.

Skin: Vaporizing liquid causes rapid cooling and contact may cause cold burns, frostbite.The liquid is discomforting to the skin and may rapidly cause severe cold burns.

Bare unprotected skin should not be exposed to this material.

There is no evidence of skin absorption but contact may cause frostbite,

Ingestion: Overexposure is unlikely in this form.

Considered an unlikely route of entry in commercial/industrial environments.

The liquid is highly discomforting if swallowed and may cause severe cold burns.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Chronic overexposure may produce dermatitis.

Section 4 - First Aid Measures

Inhalation: Avoid becoming a casualty and remove to fresh air.

Lay patient down. If breathing is shallow or has stopped, ensure clear airway and apply resuscitation.

If available, medical oxygen should be administered by trained personnel.

Transport to hospital or doctor, without delay.

See DOT ERG

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: In case of cold burns (frost-bite): Bathe the affected area immediately in cold water for 10 to 15 minutes, immersing if possible and without rubbing.

Do not apply hot water or radiant heat. Apply a clean, dry dressing.

Transport to hospital or doctor.

Ingestion: Contact a Poison Control Center. DO NOT induce vomiting. Observe the patient carefully. Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious. Give water (or milk) to rinse out mouth. Then provide liquid slowly and as much as casualty can comfortably drink. Transport to hospital or doctor without delay.

After first aid, get appropriate in-plant, paramedic, or community medical support.

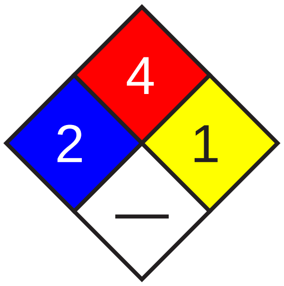
Note to Physicians: For acute or short-term repeated exposures to petroleum distillates or related hydrocarbons:

1.Primary threat to life from pure petroleum distillate ingestion and/or inhalation is respiratory failure.

2.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
3.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
4.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
5.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
6.Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.

Section 5 - Fire-Fighting Measures

See
DOT
ERG



Fire Diamond

Flash Point: -76.111 °C
Autoignition Temperature: 465 °C
LEL: 1.8% v/v
UEL: 9.6% v/v
Extinguishing Media: Water spray or fog; dry chemical powder.
Carbon dioxide.
Foam.
General Fire Hazards/Hazardous Combustion Products: Flammable gas. Liquid and vapor are highly flammable.
Dangerous hazard when exposed to heat, flame and oxidizers.
Gas may form explosive mixtures with air over a wide area.
Decomposes on heating and produces toxic fumes of carbon monoxide (CO) and carbon dioxide (CO_2).
Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Do not extinguish burning gas. If safe to do so, stop flow of gas.
If flow of gas cannot be stopped, leave gas to burn.
Cool fire-exposed containers with water spray from a protected location.
Do not approach cylinders suspected to be hot.
If safe to do so, remove containers from path of fire.
Fight fire from a safe distance, with adequate cover.

Section 6 - Accidental Release Measures

See
DOT
ERG

Small Spills: Avoid breathing vapor and any contact with liquid or gas. Protective equipment including respirator should be used. Do NOT enter confined spaces where gas may have accumulated. Shut of all sources of possible ignition and increase ventilation. Clear area of personnel. Stop leak only if safe to so do. Remove leaking cylinders to safe place. Release pressure under safe controlled conditions by opening valve. Keep area clear of personnel until gas has dispersed.
Large Spills: DO NOT touch the spill material. Shut off all possible sources of ignition and increase ventilation.
Restrict access to area. Clear area of personnel and move upwind.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Avoid spraying water onto liquid pools.
Use extreme caution to avoid a violent reaction.
Stop leak if safe to do so.
DO NOT enter confined places where gas may have collected. Remove leaking cylinders to a safe place. Fit vent pipes. Release pressure under safe, controlled conditions by opening valve. Burn issuing gas at vent pipes.
Do not exert excessive pressure on valve; do not attempt to operate damaged valve.
Keep area clear of personnel until gas has dispersed
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use good occupational work practices. Use in a well-ventilated area.

Obtain a work permit before attempting any repairs.
Do not attempt repair work on lines, vessels under pressure.
Atmospheres must be tested and O.K. before work resumes after leakage.
Wear protective clothing and gloves when handling containers.
No smoking, bare lights, heat or ignition sources.
Use spark-free tools when handling. Ground all lines and equipment.
Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked.
Gas may travel a considerable distance to source of ignition.
Vapor may ignite on pumping or pouring due to static electricity.
Avoid physical damage to containers.
DO NOT transfer gas from one cylinder to another.
Natural gases contain a contaminant, radon-222, a naturally occurring radioactive gas. During subsequent processing, radon tends to concentrate in liquified petroleum streams and in product streams having similar boiling points.
Industry experience indicates that the commercial product may contain small amounts of radon-222 and its radioactive decay products (radon daughters). The actual concentration of radon-222 and radioactive daughters in process equipment (IE lines, filters, pumps and reactor units) may reach significant levels and produce potentially damaging levels of gamma radiation. A potential external radiation hazard exists at or near any pipe, valve or vessel containing a radon enriched stream or containing internal deposits of radioactive material. Field studies, however, have not shown that conditions exist that expose the worker to cumulative exposures in excess of general population limits. Equipment containing gamma-emitting decay products should be presumed to be internally contaminated with alpha- emitting decay products which may be hazardous if inhaled or ingested.
During maintenance operations that require the opening of contaminated process equipment, the flow of gas should be stopped and a four hour delay enforced to allow gamma-radiation to drop to background levels. Protective equipment (including high efficiency particulate respirators (P3) suitable for radionucleotides or supplied air) should be worn by personnel entering a vessel or working on contaminated process equipment to prevent skin contamination or inhalation of any residue containing alpha-radiation.
Airborne contamination may be minimized by handling scale and/or contaminated materials in a wet state.

Recommended Storage Methods: Packaging as recommended by manufacturer.
Check that containers are clearly labeled.
Cylinder fitted with valve protector cap.
Ensure the use of equipment rated for cylinder pressure.
Ensure the use of compatible materials of construction.
Cylinder valve must be closed when not in use or when empty.
Cylinder must be properly secured either in use or in storage.
WARNING: Suckback into cylinder may result in rupture.
Use back-flow preventive device in piping.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated areaIf gas concentrations are high: or If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Used in closed pressurized systems; fitted with temperature and pressure safety relief valves which are vented to allow safe dispersal.
Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Protective gloves eg. leather gloves or gloves with leather facing. Neoprene rubber gloves.
Safety footwear.

Other: Operators should be trained in correct use & maintenance of respirators Ensure that there is ready access to breathing apparatus.
Protective overalls, closely fitted at neck and wrist. Eye-wash unit.
IN CONFINED SPACES:
1. Non-sparking protective boots.
2. Static-free clothing.
3. Ensure availability of lifeline.
Staff should be trained in all aspects of rescue work.
Ensure there is ready access to an emergency shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Easily liquified flammable gas or colorless highly volatile liquid. Packed as liquid under pressure and remains liquid only under pressure. Sudden release of pressure or leakage may result in rapid vaporization with generation of large volume of highly flammable / explosive gas. Strong gasoline odor. Floats and boils on water giving a flammable / explosive, visible cloud. Soluble in alcohol, ether, benzene and sulphuric acid.

Physical State: Liquefied gas

Odor Threshold: 1.3 to 3.0 mg/m^3

Vapor Pressure (kPa): 182 kPa at 10 °C

Vapor Density (Air=1): 2.01

Formula Weight: 56.11

Specific Gravity (H_2O=1, at 4 °C): 0.59

Evaporation Rate: Very rapid

pH: Not applicable

pH (1% Solution): Not applicable.

Boiling Point: -6.9 °C (20 °F)

Freezing/Melting Point: -140.35 °C (-220.63 °F)

Volatile Component (% Vol): 100

Water Solubility: Practically insoluble in water

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid contact with oxidizing agents.

The interaction of alkenes and alkynes with nitrogen oxides and oxygen may produce explosive addition products; these may form at very low temperatures and explode on heating to higher temperatures (the addition products from 1,3-butadiene and cyclopentadiene form rapidly at -150 °C and ignite or explode on warming to -35 to -15 C). These derivatives ("pseudo- nitrosites") were formerly used to characterize terpene hydrocarbons.

Exposure to air must be kept to a minimum so as to limit the build-up of peroxides which will concentrate in bottoms if the product is distilled.

The product must not be distilled to dryness if the peroxide concentration is substantially above 10 ppm (as active oxygen) since explosive decomposition may occur. Distillate must be immediately inhibited to prevent peroxide formation. The effectiveness of the antioxidant is limited once the peroxide levels exceed 10 ppm as active oxygen. Addition of more inhibitor at this point is generally ineffective.

Prior to distillation it is recommended that the product should be washed with aqueous ferrous ammonium sulfate to destroy peroxides; the washed product should be immediately re-inhibited.

A range of exothermic decomposition energies for double bonds is given as 40-90 kJ/mol. The relationship between energy of decomposition and processing hazards has been the subject of discussion; it is suggested that values of energy released per unit of mass, rather than on a molar basis (J/g) be used in the assessment. For example, in "open vessel processes" (with man-hole size openings, in an industrial setting), substances with exothermic decomposition energies below 500 J/g are unlikely to present a danger, whilst those in "closed vessel processes" (opening is a safety valve or bursting disk) present some danger where the decomposition energy exceeds 150 J/g.

Avoid reactions with oxidizing agents, organic acids, inorganic acids halogenated compounds, polymerizable esters, oxygen, cyanohydrins and molten sulphur.

Section 11 - Toxicological Information

Toxicity

Inhalation (rat) LC_{50}: 620000 mg/m^3/4h

Irritation

Nil reported

See *RTECS* UD 0890000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.

Ecotoxicity: No data found.

BCF: no food chain concentration potential

Biochemical Oxygen Demand (BOD): none

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options.

Discharge to burning flare. Return empty cylinders to supplier.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Isobutylene *see also* Petroleum gases, liquefied
ID: UN1055
Hazard Class: 2.1 - Flammable gas
Packing Group:
Symbols:
Label Codes: 2.1 - Flammable Gas
Special Provisions: 19, T50
Packaging: **Exceptions:** 306 **Non-bulk:** 304 **Bulk:** 314, 315
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** 150 kg
Vessel Stowage: **Location:** E **Other:** 40

Shipping Name and Description: Petroleum gases, liquefied *or* Liquefied petroleum gas
ID: UN1075
Hazard Class: 2.1 - Flammable gas
Packing Group:
Symbols:
Label Codes: 2.1 - Flammable Gas
Special Provisions: T50
Packaging: **Exceptions:** 306 **Non-bulk:** 304 **Bulk:** 314, 315
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** 150 kg
Vessel Stowage: **Location:** E **Other:**

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Not listed
- **CERCLA 40 CFR 302.4:** Not listed
- **SARA 40 CFR 372.65:** Not listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

SIGMA-ALDRICH

sigma-aldrich.com

SAFETY DATA SHEET

Version 5.5
Revision Date 01/06/2015
Print Date 01/28/2015

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Alconox® detergent

Product Number : 242985
Brand : Aldrich

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Acute toxicity, Oral (Category 4), H302
Skin irritation (Category 2), H315
Serious eye damage (Category 1), H318
Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335
Acute aquatic toxicity (Category 2), H401
Chronic aquatic toxicity (Category 2), H411

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)

H302	Harmful if swallowed.
H315	Causes skin irritation.
H318	Causes serious eye damage.
H335	May cause respiratory irritation.
H411	Toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.

P273	Avoid release to the environment.
P280	Wear eye protection/ face protection.
P280	Wear protective gloves.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell. Rinse mouth.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P340 + P312	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/ physician if you feel unwell.
P305 + P351 + P338 + P310	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/ physician.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P391	Collect spillage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.2 Mixtures

Hazardous components

Component		Classification	Concentration
Sodium dodecylbenzenesulfonate			
CAS-No. EC-No.	25155-30-0 246-680-4	Acute Tox. 4; Skin Irrit. 2; Eye Dam. 1; STOT SE 3; Aquatic Acute 2; H302, H315, H318, H335, H401	>= 30 - < 50 %
Tetrasodium pyrophosphate			
CAS-No. EC-No.	7722-88-5 231-767-1	Skin Irrit. 2; Eye Irrit. 2A; STOT SE 3; H315, H319, H335	>= 30 - < 50 %
Sodium carbonate			
CAS-No. EC-No. Index-No.	497-19-8 207-838-8 011-005-00-2	Eye Irrit. 2A; H319	>= 10 - < 20 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

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5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Carbon oxides, Sulphur oxides, Oxides of phosphorus, Sodium oxides

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
No data available

---

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.
For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up
Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections
For disposal see section 13.

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7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Avoid contact with skin and eyes. Avoid formation of dust and aerosols.Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.
Provide appropriate exhaust ventilation at places where dust is formed.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Keep container tightly closed in a dry and well-ventilated place.

Keep in a dry place.
Storage class (TRGS 510): Non Combustible Solids

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

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8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Tetrasodium pyrophosphate	7722-88-5	TWA	5.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		TWA	5.000000 mg/m3	USA. NIOSH Recommended Exposure Limits

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

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9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: granular, powder Colour: white
b)	Odour	odourless
c)	Odour Threshold	No data available

d)	pH	9.5 at 10 g/l
e)	Melting point/freezing point	No data available
f)	Initial boiling point and boiling range	No data available
g)	Flash point	No data available
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	No data available
l)	Vapour density	No data available
m)	Relative density	No data available
n)	Water solubility	soluble
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information

No data available

10. STABILITY AND REACTIVITY

10.1 Reactivity

No data available

10.2 Chemical stability

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

No data available

10.4 Conditions to avoid

No data available

10.5 Incompatible materials

No data available

10.6 Hazardous decomposition products

Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
No data available

Inhalation: No data available

Dermal: No data available

No data available

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity
No data available

Carcinogenicity

IARC:	No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
ACGIH:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.
NTP:	No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
OSHA:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
No data available
No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information
RTECS: Not available

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

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12. ECOLOGICAL INFORMATION

12.1 Toxicity
No data available

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential
No data available

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects
An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.
Toxic to aquatic life.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
Not dangerous goods

IMDG
Not dangerous goods

IATA
Not dangerous goods

15. REGULATORY INFORMATION

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards
Acute Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Sodium dodecylbenzenesulfonate	25155-30-0	1993-04-24
Tetrasodium pyrophosphate	7722-88-5	2007-03-01
Pentasodium triphosphate	7758-29-4	1993-04-24

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Sodium dodecylbenzenesulfonate	25155-30-0	1993-04-24
Tetrasodium pyrophosphate	7722-88-5	2007-03-01
Pentasodium triphosphate	7758-29-4	1993-04-24
Sodium carbonate	497-19-8	

New Jersey Right To Know Components

	CAS-No.	Revision Date
Sodium dodecylbenzenesulfonate	25155-30-0	1993-04-24
Tetrasodium pyrophosphate	7722-88-5	2007-03-01
Pentasodium triphosphate	7758-29-4	1993-04-24
Sodium carbonate	497-19-8	

California Prop. 65 Components
This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Eye Dam.	Serious eye damage
Eye Irrit.	Eye irritation
H302	Harmful if swallowed.
H315	Causes skin irritation.
H318	Causes serious eye damage.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.
H401	Toxic to aquatic life.
H411	Toxic to aquatic life with long lasting effects.
Skin Irrit.	Skin irritation
STOT SE	Specific target organ toxicity - single exposure

HMIS Rating

Health hazard:	2
Chronic Health Hazard:	
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 5.5 Revision Date: 01/06/2015 Print Date: 01/28/2015

Triple Superphosphate 0-45-0

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product form : Mixture
Product name : Triple Superphosphate 0-45-0
Product code : M12030

1.2. Relevant identified uses of the substance or mixture and uses advised against

1.3. Details of the supplier of the safety data sheet

JR Simplot Company
Boise, ID 83707
T 1-208-336-2110

1.4. Emergency telephone number

Emergency number : CHEMTREC 1-800-424-9300

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

GHS-US classification

Skin Irrit. 2	H315
Eye Irrit. 2B	H320
STOT SE 3	H335

Full text of H-phrases: see section 16

2.2. Label elements

GHS-US labelling

Hazard pictograms (GHS-US) :

GHS07

Signal word (GHS-US) : Warning

Hazard statements (GHS-US) :
H315 - Causes skin irritation
H320 - Causes eye irritation
H335 - May cause respiratory irritation

Precautionary statements (GHS-US) :
P261 - Avoid breathing dust/fume/gas/mist/vapours/spray
P264 - Wash ... thoroughly after handling
P271 - Use only outdoors or in a well-ventilated area
P280 - Wear protective gloves/protective clothing/eye protection/face protection
P302+P352 - If on skin: Wash with plenty of water/…
P304+P340 - If inhaled: Remove person to fresh air and keep comfortable for breathing
P305+P351+P338 - If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P312 - Call a poison center/doctor/… if you feel unwell
P321 - Specific treatment (see ... on this label)
P332+P313 - If skin irritation occurs: Get medical advice/attention
P337+P313 - If eye irritation persists: Get medical advice/attention
P362 - Take off contaminated clothing and wash before reuse
P403+P233 - Store in a well-ventilated place. Keep container tightly closed
P405 - Store locked up
P501 - Dispose of contents/container to ...

2.3. Other hazards

No additional information available

2.4. Unknown acute toxicity (GHS-US)

No data available

SECTION 3: Composition/information on ingredients

3.1. Substance

Not applicable

3.2. Mixture

Name	Product identifier	%	GHS-US classification
Calcium Phosphate	(CAS No) 7758-23-8		Skin Irrit. 2, H315 Eye Irrit. 2B, H320 STOT SE 3, H335
Dicalcium Phosphate	(CAS No) 7757-93-9		Eye Irrit. 2B, H320

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general	:	Never give anything by mouth to an unconscious person. If you feel unwell, seek medical advice (show the label where possible).
First-aid measures after inhalation	:	Remove to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER/doctor/physician if you feel unwell.
First-aid measures after skin contact	:	Wash with plenty of soap and water. Wash contaminated clothing before reuse. If skin irritation occurs: Get medical advice/attention. Specific treatment (see ... on this label).
First-aid measures after eye contact	:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
First-aid measures after ingestion	:	Rinse mouth. Do NOT induce vomiting. Obtain emergency medical attention.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/injuries after inhalation	:	May cause respiratory irritation.
Symptoms/injuries after skin contact	:	Causes skin irritation.
Symptoms/injuries after eye contact	:	Causes eye irritation.

4.3. Indication of any immediate medical attention and special treatment needed

No additional information available

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media	:	Foam. Dry powder. Carbon dioxide. Water spray. Sand.
Unsuitable extinguishing media	:	Do not use a heavy water stream.

5.2. Special hazards arising from the substance or mixture

Reactivity	:	Stable.

5.3. Advice for firefighters

Firefighting instructions	:	Use water spray or fog for cooling exposed containers. Exercise caution when fighting any chemical fire. Prevent fire-fighting water from entering environment.
Protection during firefighting	:	Do not enter fire area without proper protective equipment, including respiratory protection.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

Emergency procedures	:	Evacuate unnecessary personnel.

6.1.2. For emergency responders

Protective equipment	:	Equip cleanup crew with proper protection.
Emergency procedures	:	Ventilate area.

6.2. Environmental precautions

Prevent entry to sewers and public waters. Notify authorities if liquid enters sewers or public waters.

6.3. Methods and material for containment and cleaning up

Methods for cleaning up	:	On land, sweep or shovel into suitable containers. Minimize generation of dust. Store away from other materials.

6.4. Reference to other sections

See Heading 8. Exposure controls and personal protection.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Provide good ventilation in process area to prevent formation of vapour. Avoid breathing dust/fume/gas/mist/vapours/spray. Use only outdoors or in a well-ventilated area.

Hygiene measures : Wash ... thoroughly after handling.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Keep only in the original container in a cool, well ventilated place away from : Keep container tightly closed.

Incompatible products : Strong bases. Strong acids.

Incompatible materials : Sources of ignition. Direct sunlight.

7.3. Specific end use(s)

No additional information available

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

No additional information available

8.2. Exposure controls

Personal protective equipment : Avoid all unnecessary exposure.

Hand protection : Wear protective gloves.

Eye protection : Chemical goggles or safety glasses.

Skin and body protection : Wear suitable protective clothing.

Respiratory protection : Wear appropriate mask.

Other information : Do not eat, drink or smoke during use.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state : Solid

Appearance : Granules.

Colour : Off-white

Odour : characteristic

Odour threshold : No data available

pH : No data available

pH solution : 1 g to 10 g H_2O: 2.3-3

Relative evaporation rate (butylacetate=1) : No data available

Melting point : No data available

Freezing point : No data available

Boiling point : No data available

Flash point : No data available

Auto-ignition temperature : No data available

Decomposition temperature : No data available

Flammability (solid, gas) : Non-flammable

Vapour pressure : No data available

Relative vapour density at 20 °C : No data available

Relative density : No data available

Solubility : Soluble.
Water: Solubility in water of component(s) of the mixture :
• Calcium Phosphate: 1.8 g/100ml (30 °C) • Dicalcium Phosphate: 0.010 g/100ml

Log Pow : No data available

Log Kow : No data available

Viscosity, kinematic : No data available

Viscosity, dynamic : No data available

Explosive properties : No data available
Oxidising properties : No data available
Explosive limits : No data available

9.2. Other information

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

Stable.

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

Not established.

10.4. Conditions to avoid

Direct sunlight. Extremely high or low temperatures.

10.5. Incompatible materials

Oxidizers. Strong acids. Strong bases. May be corrosive to metals.

10.6. Hazardous decomposition products

NH3, CN, SOx, POx. fume. Carbon dioxide. Carbon monoxide.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity : Not classified

Calcium Phosphate (7758-23-8)	
LD50 oral rat	17500 mg/kg (Rat; Literature)
LD50 dermal rabbit	> 2000 mg/kg (Rabbit; Literature)
ATE US (oral)	17500.00000000 mg/kg bodyweight

Dicalcium Phosphate (7757-93-9)	
LD50 oral rat	10000 mg/kg (Rat)
LD50 dermal rat	7940 mg/kg (Rat)
ATE US (oral)	10000.00000000 mg/kg bodyweight
ATE US (dermal)	7940.00000000 mg/kg bodyweight

Skin corrosion/irritation : Causes skin irritation.
Serious eye damage/irritation : Causes eye irritation.
Respiratory or skin sensitisation : Not classified
Germ cell mutagenicity : Not classified
Carcinogenicity : Not classified

Reproductive toxicity : Not classified
Specific target organ toxicity (single exposure) : May cause respiratory irritation.

Specific target organ toxicity (repeated exposure) : Not classified

Aspiration hazard : Not classified
Potential adverse human health effects and symptoms : Based on available data, the classification criteria are not met.
Symptoms/injuries after inhalation : May cause respiratory irritation.
Symptoms/injuries after skin contact : Causes skin irritation.
Symptoms/injuries after eye contact : Causes eye irritation.

SECTION 12: Ecological information

12.1. Toxicity

No additional information available

12.2. Persistence and degradability

Triple Superphosphate 0-45-0	
Persistence and degradability	Not established.

Calcium Phosphate (7758-23-8)	
Persistence and degradability	Biodegradability: not applicable. Not established.
Biochemical oxygen demand (BOD)	Not applicable
Chemical oxygen demand (COD)	Not applicable
ThOD	Not applicable
BOD (% of ThOD)	Not applicable

Dicalcium Phosphate (7757-93-9)	
Persistence and degradability	Biodegradability: not applicable. Not established.
Biochemical oxygen demand (BOD)	Not applicable
Chemical oxygen demand (COD)	Not applicable
ThOD	Not applicable
BOD (% of ThOD)	Not applicable

12.3. Bioaccumulative potential

Triple Superphosphate 0-45-0	
Bioaccumulative potential	Not established.

Calcium Phosphate (7758-23-8)	
Bioaccumulative potential	No bioaccumulation data available. Not established.

Dicalcium Phosphate (7757-93-9)	
Bioaccumulative potential	Not bioaccumulative. Not established.

12.4. Mobility in soil

No additional information available

12.5. Other adverse effects

Effect on ozone layer : No additional information available

Effect on the global warming : No known ecological damage caused by this product.

Other information : Avoid release to the environment.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste disposal recommendations : Dispose in a safe manner in accordance with local/national regulations.

Ecology - waste materials : Avoid release to the environment.

SECTION 14: Transport information

In accordance with DOT

Not regulated for transport

Additional information

Other information : No supplementary information available.

ADR

Transport document description :

Transport by sea

No additional information available

Air transport

No additional information available

SECTION 15: Regulatory information

15.1. US Federal regulations

All components of this product are listed, or excluded from listing, on the United States Environmental Protection Agency Toxic Substances Control Act (TSCA) inventory

This product or mixture does not contain a toxic chemical or chemicals in excess of the applicable de minimis concentration as specified in 40 CFR §372.38(a) subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

15.2. International regulations

CANADA
No additional information available

EU-Regulations
No additional information available

Classification according to Regulation (EC) No. 1272/2008 [CLP]

Classification according to Directive 67/548/EEC or 1999/45/EC

Not classified

15.2.2. National regulations
No additional information available

15.3. US State regulations

California Proposition 65 - This product does not contain any substances known to the state of California to cause cancer and/or reproductive harm

SECTION 16: Other information

:

Other information : None.

Full text of H-phrases: see section 16:

Eye Irrit. 2B	Serious eye damage/eye irritation, Category 2B
Skin Irrit. 2	Skin corrosion/irritation, Category 2
STOT SE 3	Specific target organ toxicity — Single exposure, Category 3, Respiratory tract irritation
H315	Causes skin irritation
H320	Causes eye irritation
H335	May cause respiratory irritation

SDS US (GHS HazCom 2012)

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Unleaded Petrol
AUT5000

Section 1 - Chemical Product and Company Identification 61

Material Name: Unleaded Petrol **CAS Number:** 8006-61-9
Chemical Formula: Mixture of hydrocarbons
EINECS Number: 232-349-1
ACX Number: X1003056-5
Synonyms: AUTOMOTIVE GASOLINE, LEAD-FREE; GASOLINE; MOTOR FUEL; MOTOR SPIRITS; NATURAL GASOLINE; PETROL; UNLEADED PETROL
General Use: Lead free motor fuel for internal combustion engines, 2-stroke and 4-stroke.

Section 2 - Composition / Information on Ingredients

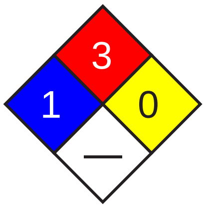
Name	CAS	%
gasoline	8006-61-9	>90
benzene	71-43-2	5 max.

OSHA PEL

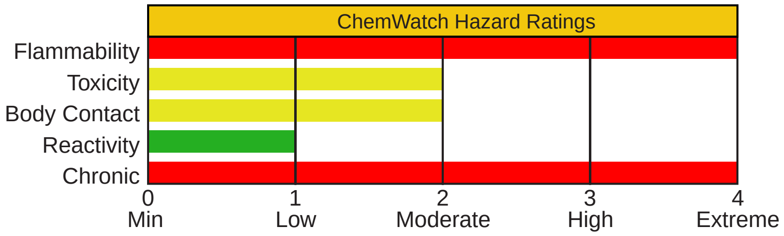
NIOSH REL

ACGIH TLV
TWA: 300 ppm, 890 mg/m^3;
STEL: 500 ppm, 1480 mg/m^3.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
3 Flammability
1 Reactivity

ANSI Signal Word

Danger!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear liquid; distinctive odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: dizziness, drunkenness, unconsciousness. Chronic Effects: dermatitis. Possible cancer hazard. Flammable.

Potential Health Effects

Target Organs: skin, eye, respiratory system, central nervous system (CNS)
Primary Entry Routes: inhalation, ingestion, skin contact

Acute Effects

Inhalation: The vapor is discomforting to the upper respiratory tract and may be harmful if exposure is prolonged. Inhalation hazard is increased at higher temperatures. Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination. If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death. WARNING: Intentional misuse by concentrating/inhaling contents may be lethal. High inhaled concentrations of mixed hydrocarbons may produce narcosis characterized by nausea, vomiting and lightheadedness. Inhalation of aerosols may produce severe pulmonary edema, pneumonitis and pulmonary hemorrhage. Inhalation of petroleum hydrocarbons consisting substantially of low molecular weight species may produce irritation of mucous membranes, incoordination, giddiness, nausea, vertigo, confusion, headache, appetite loss, drowziness, tremors and anesthetic stupor. Massive exposures may produce central nervous system depression with sudden collapse and deep coma; fatalities have been recorded. Irritation of the brain and/or apneic anoxia may produce convulsions. Although recovery following overexposure is generally complete, cerebral micro- hemorrhage of focal post-inflammatory scarring may produce eleptiform seizures some months after the exposure. Pulmonary episodes may include chemical pneumonitis with edema and hemorrhage. The lighter hydrocarbons may produce kidney and neurotoxic effects. Liquid paraffins may produce anesthesia and depressant actions leading to weakness, dizziness, slow and shallow respiration, unconsciousness, convulsions and death. C_{5-7} paraffins may also produce polyneuropathy. Aromatic hydrocarbons accumulate in lipid-rich tissues (typically the brain, spinal cord and peripheral nerves) and may produce functional impairment manifested by nonspecific symptoms such as nausea, weakness, fatigue, vertigo; severe exposures may produce inebriation or unconsciousness. Many of the petroleum hydrocarbons are cardiac sensitizers and may cause ventricular fibrillations.

Eye: The liquid may produce eye discomfort and is capable of causing temporary impairment of vision and/or transient eye inflammation, ulceration. The vapor is discomforting to the eyes. Petroleum hydrocarbons may produce pain after direct contact with the eyes. Slight, but transient, disturbances of the corneal epithelium may also result. The aromatic fraction may produce irritation and lachrymation. The material may produce moderate eye irritation leading to inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The material is moderately discomforting to the skin if exposure is prolonged. The material contains a component that may be absorbed through the skin and may cause drying of the skin, which may lead to dermatitis from repeated exposures over long periods. Toxic effects may result from skin absorption. Open cuts, abraded or irritated skin should not be exposed to this material. The material may accentuate any pre-existing dermatitis condition.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments. The liquid may produce gastrointestinal discomfort and may be harmful if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis. Ingestion of petroleum hydrocarbons may produce irritation of the pharynx, esophagus, stomach and small intestine with edema and mucosal ulceration. Resulting symptoms include a burning sensation in the mouth and throat. Large amounts may produce narcosis with nausea and vomiting, weakness or dizziness, slow and shallow respiration, swelling of the abdomen, unconsciousness and convulsions. Myocardial injury may produce arrhythmias, ventricular fibrillation and electrocardiographic changes. Central nervous system depression may also occur. Light aromatic hydrocarbons produce a warm, sharp, tingling sensation on contact with taste buds and may anesthetize the tongue. Aspiration into the lungs may produce coughing, gagging, and a chemical pneumonitis with pulmonary edema and hemorrhage.

Carcinogenicity: NTP - Not listed; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Not listed; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes. Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following. Chronic poisoning may occur from vapor inhalation or skin absorption. The most significant toxic effect is insidious and irreversible injury to the blood-forming tissue by benzene. Leukemia may develop. Chronic exposure may cause headache, fatigue, loss of appetite and lassitude with incipient blood effects including anemia and blood changes. Gasoline "sniffing" has caused severe nerve damage. Repeated or prolonged exposure to mixed hydrocarbons may produce narcosis with dizziness, weakness, irritability, concentration and/or memory loss, tremor in the fingers and tongue, vertigo, olfactory disorders, constriction of visual field, paresthesias of the extremities, weight loss and anemia and degenerative changes in the liver and kidney. Chronic exposure by petroleum workers to the lighter hydrocarbons has been associated with visual disturbances, damage to the central nervous system, peripheral neuropathies (including numbness and paresthesias), psychological and neurophysiological deficits, bone marrow toxicities (including hypoplasia, possibly due to benzene) and hepatic and renal involvement. Chronic dermal exposure to petroleum hydrocarbons may result in defatting which produces localized dermatoses. Surface cracking and erosion may also increase susceptibility to infection by microorganisms.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air. Lay patient down. Keep warm and rested. If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital, or doctor.

Eye Contact: Immediately hold the eyes open and wash continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids. Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water). Wash affected areas thoroughly with water (and soap if available). Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center. If swallowed, do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short term repeated exposures to petroleum distillates or related hydrocarbons:

1. Primary threat to life from pure petroleum distillate ingestion and/or inhalation is respiratory failure.
2. Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
3. Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
4. A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
5. Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
6. Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.

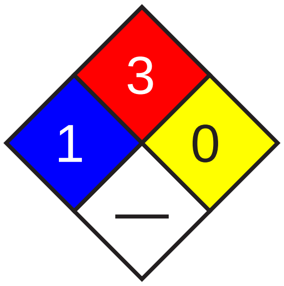
Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: -43 °C
Autoignition Temperature: 280 °C
LEL: 1.4% v/v
UEL: 7.6% v/v

Extinguishing Media: Foam. Dry chemical powder. Bromochlorodifluoromethane (BCF) (where regulations permit). Carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable. Severe fire hazard when exposed to heat, flame and/or oxidizers. Vapor forms an explosive mixture with air. Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition. Heating may cause expansion/decomposition with violent rupture of containers. On combustion, may emit toxic fumes of carbon monoxide (CO).



Fire Diamond

Fire Incompatibility: Avoid contamination with oxidizing agents, i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc., as ignition may result.

Fire-Fighting Instructions: Alert fire department and tell them location and nature of hazard. May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or water ways. If safe, switch off electrical equipment until vapour fire hazard removed. Use water delivered as a fine spray to control fire and cool adjacent area. Avoid spraying water onto liquid pools. Do not approach containers suspected to be hot. Cool fire exposed containers with water spray from a protected location. If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Remove all ignition sources. Clean up all spills immediately. Avoid breathing vapors and contact with skin and eyes. Control personal contact by using protective equipment. Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

Large Spills: Clear area of personnel and move upwind. Alert fire department and tell them location and nature of hazard. May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or water ways. No smoking, naked lights or ignition sources. Increase ventilation. Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite. Use only spark-free shovels and explosion proof equipment. Collect recoverable product into labeled containers for recycling. Absorb remaining product with sand, earth or vermiculite. Collect solid residues and seal in labelled drums for disposal. Wash area and prevent runoff into drains.

If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Avoid all personal contact, including inhalation. Wear protective clothing when risk of exposure occurs. Use in a well-ventilated area. Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked. Avoid smoking, bare lights, heat or ignition sources. When handling, DO NOT eat, drink or smoke. Vapor may ignite on pumping or pouring due to static electricity. DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling. Avoid contact with incompatible materials. Keep containers securely sealed. Avoid physical damage to containers. Always wash hands with soap and water after handling. Work clothes should be laundered separately. Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can, metal drum. Packing as recommended by manufacturer. Check all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear. Use in a well-ventilated area. If inhalation risk of overexposure exists, wear a NIOSH approved organic-vapor respirator. Correct respirator fit is essential to obtain adequate protection. In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus. Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; or as required, chemical goggles.

Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Barrier cream with polyethylene gloves or PVC gloves. Safety footwear. Do NOT use this product to clean the skin.

Respiratory Protection:

Exposure Range >300 to 1000 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >1000 to 15,000 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range >15,000 to 300,000 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >300,000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

Other: Overalls. Ensure that there is ready access to eye wash unit. Ensure there is ready access to an emergency shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Purple, highly flammable, volatile liquid with characteristic sharp odor. Floats on water. Consists of a complex mixture of hydrocarbons with small amounts of residual benzene from the refining operations.

Physical State: Liquid
Odor Threshold: 0.005 ppm
Vapor Pressure (kPa): 53.33 at 20 °C
Vapor Density (Air=1): > 2
Formula Weight: Not applicable.
Specific Gravity (H_2O=1, at 4 °C): 0.72-0.735 at 15 °C
Evaporation Rate: Fast

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 38.89 °C (102 °F)
Freezing/Melting Point: Not available
Volatile Component (% Vol): 100
Decomposition Temperature (°C): Not available.
Water Solubility: Insoluble

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Presence of incompatible materials. Product is considered stable. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 18800 mg/kg

Irritation
Skin (rabbit): 500 mg/24h mild

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: No data found.
Biochemical Oxygen Demand (BOD): 8%, 5 days

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible. Follow all applicable federal, state, and local laws. Incinerate residue at an approved site. Recycle containers where possible, or dispose of in an authorized landfil.
BEWARE: Empty solvent, paint, lacquer and flammable liquid drums present a severe explosion hazard if cut by flame torch or welded. Even when thoroughly cleaned or reconditioned, the drum seams may retain sufficient solvent to generate an explosive atmosphere in the drum.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Gasoline
ID: UN1203
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: 139, B33, B101, T8
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** E **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Not listed
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

APPENDIX D

Field Forms

Task Improvement Process

General

Observed Company:

Observation Type:

TIP Form: H&S Field Multi-Task (General)

Task Observed:

Observee Name:

Observer Name:

Observation Date:

Project Number: B0003010

Project Name: Burrows Island Light StationAnacortes, Washington

Supervisor:

Equipment On Site:

Pertinent Information:

Observation

Task	Correct	Questionable	Comments
General			
PPE worn according to HASP/JLA specifications and inspected before use?			
STOP work authority used where appropriate?			
Body Use/Positioning			
Proper lifting/pushing/pulling techniques used (no awkward positions/posture; no twisting or excessive reaching; no straining; no excessive weight; load under control/stable; etc.)?			
Body parts away from pinch points (clear or protected from being caught between objects/equipment or from contacting sharp objects/edges, etc.)?			
Body parts not in the Line of Fire (protected from being struck by traffic, equipment, falling/flying objects, etc.)?			
Work Procedures/Environment			
Correct type and number of barricades/warning devices/cones?			

Communication with others when necessary (hand signals, flags, etc.)?			
Right tools and equipment selected for the job and inspected before use?			
Tools and equipment used properly?			
Housekeeping performed (work areas and pathways clear of hazards, uneven surfaces addressed, etc.)?			
Slip/trip/fall hazards addressed (path selected and cleared, eyes on path, speed footing, etc.)?			
Proper energy control (electrical systems grounded, lock out/tag out performed, isolated, cords/fixtures in good condition, GFCI inspected and utilized when appropriate and used properly, etc.)?			
Protected from overhead/underground utilities (proper clearance, properly marked, spotters as necessary, etc.)?			
Safe work on/near water (appropriate flotation device, appropriate boat for body of water and operation of boat, etc.)?			
Chemical/Radiation protection (decontamination zones set up properly, air monitoring, completed, and logged, etc.)?			
Fall from elevated height prevention (maintains 3-points of contact, appropriate ladder, mounting/dismounting vehicle/equipment, fall arrest system, etc.)?			
Any additional safety issues identified:			

Tip Summary **Enter details of the TIP and follow up discussion provide details on how any questionable items were resolved.**

Discussion following the TIP led by: ______________________

Date of follow-up discussion: ______________________

Positive Comments:

Discussion Summary Completed:

☐ Supervisor Led
☐ Peer to Peer
☐ Arcadis Employee to Subcontractor

Summary of Questionable Items

Action Items (Optional)

Assign appropriate action items based on the observations made. You can add more than one action item if needed.

Item #	Action Item	Responsible Person	Due Date	Comp. Date
1				
2				
3				

Standard Review

Reviews to be performed after entry of this TIP into 4-Sight.

Quality Review

Quality Reviews to be performed after entry of this TIP into 4-Sight.

Field Validation and Verification

Use the 4-Sight generated copy of this TIP to perform field V&V activities.

ARCADIS Design & Consultancy for natural and built assets

THIS FORM MUST BE COMPLETED IN ENTIRETY PRIOR TO BEGINNING ANY INTRUSIVE WORK

Project: Burrows Island Light Station Anacortes, Washington
Project Number: B0003010
Form Completion Date: ____________ Form Expiration Date: ____________
(15 business days post form completion date)

Pre-Field Work

Required: One Call or "811" notified 48-72 hours in advance of work? #: ____________
Ticket Expiration Date ____________ (Review State Requirements)
Utility companies notified during the One Call process ☐ See attached ticket

List any other utilities requiring notification:
☐ None

Private Locator Contacted ☐ Yes ☐ No

Plan private utility clearance subcontractor assignments, areas, required clearance equipment, depth of clearance needed, types of utilities. When possible re-clear 811 markings to confirm utility locations.

Client provided utility maps or "as built" drawings showing utilities? ☐ Yes ☐ No

Field Work - This must be completed on site, by staff who have a minimum of one year of field experience in identifying utilities. Review check list with PM or designee prior to beginning intrusive work.

List Soil Boring / Well IDs or Excavation Locations applicable to this clearance checklist:

3 Reliable Lines of Evidence Required Prior to Starting any Subsurface Intrusive Work

☐ One Call/"811" (Reliable as a line of evidence when working in public right of way or easement)
Utility Markings Present: ☐ Paint ☐ Pin flags/stakes ☐ Other ☐ None

☐ Client Provided Maps/Drawings **OR** ☐ Maps/Drawings requested but not provided
☐ Client Clearance Name(s)/Affiliation(s) ____________
☐ Interview(s): Name(s)/Affiliation(s) ____________

Did person(s) interviewed indicate depths of any utilities in the subsurface?
☐ Yes, depths provided: ☐ Did not know or refused to answer
Additional Comments:

☐ Site Inspection (**Complete Page 2 & Photo Document Marked Utilities & Utility Structures**)
☐ Public Records / Maps / Asbuilts
☐ Private Locator: (Name and Company) ____________
☐ Ground Penetrating Radar (GPR)
☐ Radiofrequency (RFLoc)
☐ Electromagnetic (EM)
☐ Metal Detector

Soft Dig Methods

☐ Termination Depth ______ft. bgs
☐ Potholing / Vacuum Extraction
☐ Air-Knife or Hydro-Knife
☐ Probing
☐ Hand Auguring

☐ Other: ____________
☐ Marine Locator: (Name and Company) ____________

Tips for Successful Utility Location:

1. Don't forget to look up
2. Be on site with Private Utility Locators
3. Ask Private Locators to "confirm" other's markings
4. Select alternate/backup locations during clearance process
5. Mark out all known utilities. Leave nothing to question
6. No hammering - no pickaxes - no digging bars - no shortcutting
7. No excessive turning or downward force of hand augers/shovels
8. Utilities may run in or directly under asphalt/concrete

During the site inspection look for the following: **("YES" requires additional investigation and the utility must be marked properly prior to beginning subsurface intrusive work)**:

Site Inspection		**Utility Color Codes**	**Present**	
a)	Natural gas line present (evidence of a gas meter)?	Yellow	☐ Yes	☐ No
	i) Feeder Lines to buildings or homes?		☐ Yes	☐ No
b)	Evidence of electric lines:	Red		
	i) Conduits to ground from electric meter or along wall?		☐ Yes	☐ No
	iii) Conduits from power poles running into ground?		☐ Yes	☐ No
	ii) Light poles, electric devices with no overhead lines?		☐ Yes	☐ No
	iii) Overhead electric lines present? (See Section l)		☐ Yes	☐ No
c)	Evidence of sewer drains:	Green		
	i) Restrooms or kitchen on site?		☐ Yes	☐ No
	ii) Sewer cleanouts present?		☐ Yes	☐ No
	iii) Combined sewer/storm lines or multiple sewer lines?		☐ Yes	☐ No
d)	Evidence of water lines:	Blue		
	i) Water meter on site or multiple water lines?		☐ Yes	☐ No
	ii) Fire hydrants in vicinity of work?		☐ Yes	☐ No
	iii) Irrigation systems? (Sprinkler heads, valve boxes, controls in building)		☐ Yes	☐ No
e)	Evidence of storm drains:	Green		
	i) Open curbside or slotted grate storm drains		☐ Yes	☐ No
	ii) Gutter down spouts going into ground		☐ Yes	☐ No
f)	Evidence of telecommunication lines:	Orange		
	i) Fiber optic warning signs in areas?		☐ Yes	☐ No
	iv) Aboveground cable boxes or housings or wires in work area?		☐ Yes	☐ No
g)	Underground storage tanks:			
	i) Tank pit present, tank vent present?		☐ Yes	☐ No
	ii) Product lines running to dispensers/buildings?		☐ Yes	☐ No
h)	Do utilities enter or exit existing structures/buildings?			
	If Yes, confirm the utility markings outside of structure/building match up.		☐ Yes	☐ No
i)	Proposed excavation marked in white?	White	☐ Yes	☐ No
j)	Unclassed utilities / anomalies marked in pink?	Pink	☐ Yes	☐ No
k)	**Overhead** Utilities/Communication Lines - **Look Up**:			
	i) Overhead electrical conduit, pipe chases, cable trays, product lines?		☐ Yes	☐ No
	ii) Overhead fire sprinkler system?		☐ Yes	☐ No
l)	**Overhead** Power lines in or near the work area:			
	i) < 50 kV within 10 ft. of work area?		☐ Yes	☐ No
	ii) >50 - 200 kV within 15 ft. of work area?		☐ Yes	☐ No
	iii) >200-350 kV within 20 ft. of work area?		☐ Yes	☐ No
	iv) >350-500 kV within 25 ft. of work area?		☐ Yes	☐ No
	v) >500-750 kV within 35 ft. or work area?		☐ Yes	☐ No
	vi) >750-1000 kV within 45 ft. of work area?		☐ Yes	☐ No
m)	Other:			
	i) Evidence of linear asphalt or concrete repair?		☐ Yes	☐ No
	ii) Evidence of linear ground subsidence or change in vegetation?		☐ Yes	☐ No
	iii) Unmarked manholes or valve covers in work area?		☐ Yes	☐ No
	iv) Warning signs ("Call Before you Dig", etc.) on or adjacent to site?		☐ Yes	☐ No
	v) Utility color markings not illustrated in this checklist?	Purple	☐ Yes	☐ No
n)	Has the Utilities & Structures Checklist been reviewed by the PM or Designee		☐ Yes	☐ No
	PM or Designee Name: ______________________________			

Name and Signature of person completing the checklist: ______________________________

Date: ____________________ ______________________________

Do not perform **mechanized** intrusive work within 30 inches of a utility marking without receiving pre-approval by Corporate H&S .

Arcadis Weekly Vehicle Inspection Form

Vehicle # / License Plate # ______ **Lease Plan # / Last 6 of Vin #** ______

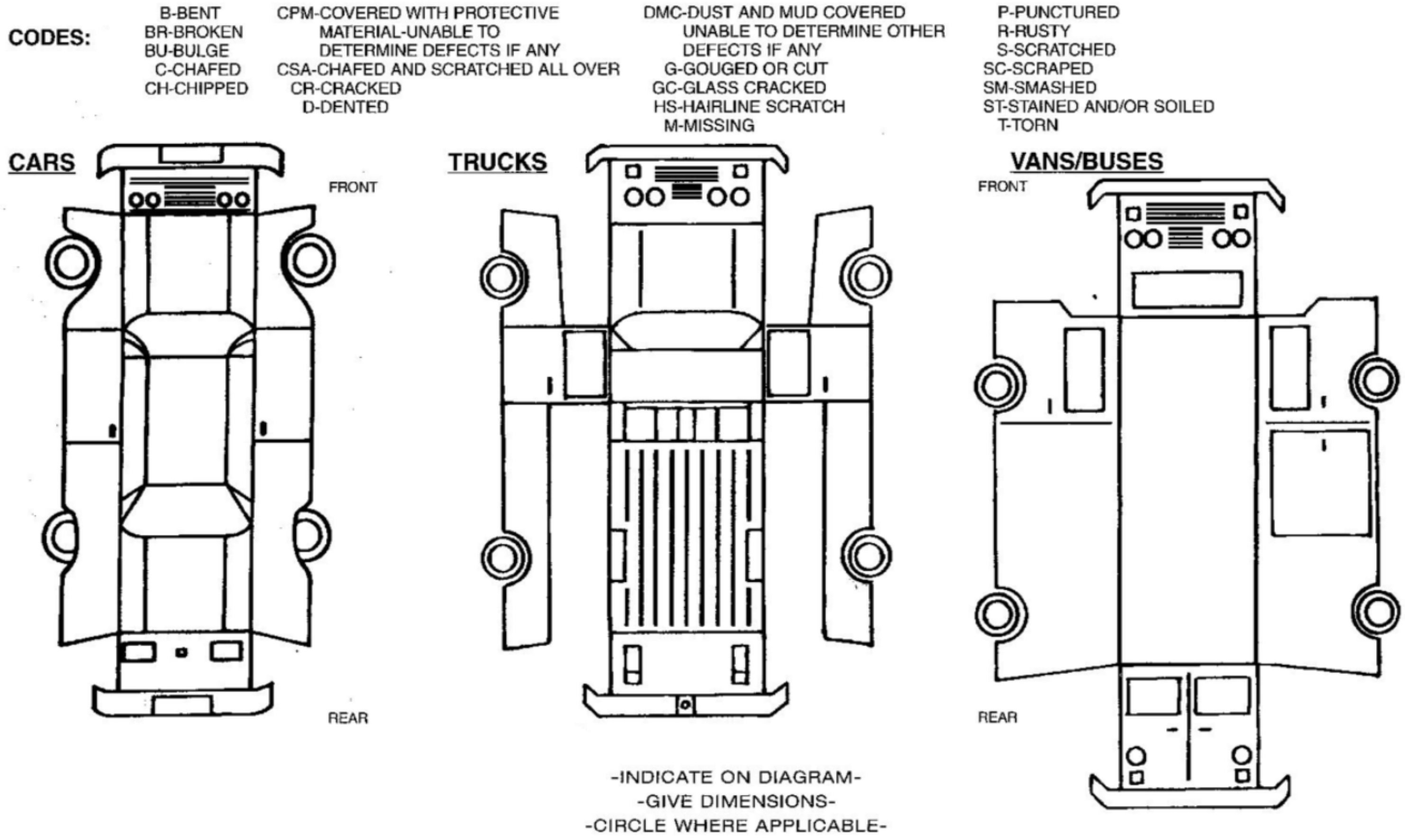
	Inspection Date												
	Odometer reading												
	Driver / Inspector Name												
	Check the appropriate box and enter repair date for identified repairs:	OK	Needs Repair	Repair Date	OK	Needs Repair	Repair Date	OK	Needs Repair	Repair Date	OK	Needs Repair	Repair Date
Interior	Horn operational												
	Door Locks operational												
	Seat Belts in good repair												
	Seats and Seating Controls												
	Steering Wheel - No Excessive Play												
	Interior Lights and Light Controls												
	Instrument Panel/Gauges												
	Wiper Controls operational												
	Heat/Defrost/Air Conditioning working												
	Rear View Mirror present												
	Backup Camera/Sensors working												
	Jack and Lug Wrench present												
Exterior[1]	Lights and Signals operational												
	ires properly inflated/good tread depth												
	Spare Tire properly inflated												
	Doors operational												
	Windows Not Cracked/Damaged												
	Side View Mirrors												
	Body Panels and Bumpers												
Engine & Brakes	Engine Start & Running Smoothly												
	Fluid Levels, No Noticeable Leaks												
	Belts tight, no cracks												
	Brakes operational, no squeaking												
Emergency Equipment[2]	First Aid Kit, inspected weekly												
	Fire Extinguisher properly secured												
	Fire Extinguisher inspected weekly												
	range/Yellow emergency warning light												
	Roadside Assistance Information												
	Recommend spotter cones available												
Cargo	Cargo Secure and Properly Distributed												
	Securing Devices in Good Condition												
Registration	License Plate /Tags												
	Registration and Insurance												
	City/State Inspection Decal												
	Lease Plan information/Fuel Card												

[1] **Note all damages to the vehicle on the back of this page**

[2] **Emergency Equipment required per Motor Vehicle Standard ARC HSGE024**

Note All Vehicle Damage Below

All Vehicle Damage must be reported to Sue Berndt (Corporate Legal), Andrew McDonald (Corporate H&S), and Roger Elliot (Corporate Fleet Manger)



Notes:

____

____

____

Tread guide: If a tread gauge is not available coins may be used to determine remaining tread. 2/32" is the minimum by law in most states (top of Lincoln's head on penny), 4/32" is minimum recommended for wet surfaces (top of Washington's head on quarter), 6/32" is minimum recommended for snowy surfaces (top of Lincoln Memorial on penny).Vehicle tires should be replaced if the tread depth is less than 6/32".

2/32" remaining 4/32" remaining 6/32" remaining

Reference JSA 10907 For Weekly Vehicle Inspection

Arcadis Visitor Acknowledgement and Acceptance of HASP Signature Form

By signing below, I waive, release, and discharge the owner of the site and Arcadis and their employees from any future claims for bodily and personal injuries which may result from my presence at, entering, or leaving the site and in any way arising from or related to any and all known and unknown conditions on the site.

Printed Name	Signature	Company	Date/Time On Site	Date/Time Off Site

Control Number: TSM- B0003010

TSM + project number plus date as follows: xxxxxxxx.xxxx.xxxxx - dd/mm/year

ARCADIS Design & Consultancy for natural and built assets

TAILGATE HEALTH & SAFETY MEETING FORM

Project Name:

Project Location:

Date:

Time:

Conducted by:

Signature/Title:

Issues or concerns from previous day's activities:

Task anticipated to be performed today:

☐ Additional permits/checklists attached

USE TRACK! Evaluate the hazards (h) for the tasks being performed today and rank as Low (L), Medium (M) or High (H). Use relevant JSAs, FHSHB, permit or other work standard to communicate controls (c) to be used to eliminate or mitigate identified hazards.

☐ Gravity (i.e., ladder, trips) (L M H)
h:
c:

☐ Electrical (i.e., utilities) (L M H)
h:
c:

☐ Chemical (i.e., fuel, acid, paint) (L M H)
h:
c:

☐ Sound (i.e., machinery) (L M H)
h:
c:

☐ Motion (i.e., traffic, machinery) (L M H)
h:
c:

☐ Pressure (i.e., gas cyl., wells) (L M H)
h:
c:

☐ Biological (i.e., ticks, poison ivy) (L M H)
h:
c:

☐ Personal (i.e. alone, night) (L M H)
h:
c:

☐ Mechanical (i.e., augers, motors) (L M H)
h:
c:

☐ Environment (i.e., heat, cold) (L M H)
h:
c:

☐ Radiation (i.e., alpha, sun, laser) (L M H)
h:
c:

☐ Driving (i.e. car, ATV, boat) (L M H)
h:
c:

☐ Refer to the attached Hazard Analysis Sheet(s) or JSA

Comments:

Signature and Certification: I have read and understand the project specific HASP for this project.

Non-Life Threatening Injury or Illness
Call WorkCare 1-888-449-7787

SSE Employee*	Printed Name/Signature/Company	Sign In Time	Sign Out Time

***Short Service Employee (SSE) working for Arcadis <1 year.**

I will STOP the job any time anyone is concerned or uncertain about health & safety or if anyone identifies a hazard or additional mitigation not recorded in the site, project, job or task hazard assessment.

I will be alert to any changes in personnel, conditions at the work site or hazards not covered by the original hazard assessments.

If it is necessary to **STOP THE JOB,** I will perform **TRACK**; and then amend the hazard assessments or the HASP as needed.

I will not assist a subcontractor or other party with their work unless it is absolutely necessary and then only after I have done TRACK and I have thoroughly controlled the hazard.

All site staff should arrive fit for work. If not, they should report to the supervisor any restrictions or concerns.

In the event of an injury, employees will call **WorkCare at 1.888.449-7787** and then notify the field supervisor.

Utility strike, motor vehicle accident or 3rd party property damage - field supervisor will immediately notify the Project or Task Manager

Control Number: TSM- B0003010

TSM + project number plus date as follows: xxxxxxxx.xxxx.xxxxx - dd/mm/year

ARCADIS Design & Consultancy for natural and built assets

TAILGATE HEALTH & SAFETY MEETING FORM

Project Name:	**Burrows Island Light Station** **Anacortes, Washington**	**Project Location:**	
Date:	**Time:**	**Conducted by:**	**Signature/Title:**

Issues or concerns from previous day's activities:

Task anticipated to be performed today:

The following was used to communicate H&S information in this briefing (check all that apply):

☐ HASP (*including THA*)

☐ JSAs (*specify JSA #s*): ____________________

☐ Permits (*specify type or #*): ____________________

☐ Traffic Safety Plan

☐ FHSHB (*specify sections*): ____________________

☐ H&S Standard (*specify number*): ____________________

☐ H&S checklist (*specify type*): ____________________

☐ Activity specific hazard analysis:

Activity: ____________________

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	☐	Chemical	☐	Driving	☐	Electrical	☐
Environmental	☐	Gravity	☐	Mechanical	☐	Motion	☐
Personal Safety	☐	Pressure	☐	Radiation	☐	Sound	☐

Controls required to be used:

PPE Required (If not using JSA or Permit with PPE requirements):

☐ Hard hat

☐ Safety glasses

☐ Face shield

☐ Safety goggles

☐ Steel/composite toe boots

☐ Traffic vest (*specify II or III*): ____________

☐ Life Vest (*specify type*): ____________

☐ Protective Suit (*specify type*):

☐ Protective gloves (*specify type*):

☐ Other (*specify*):

Signature and Certification: I have read and understand the project specific HASP for this project.

Non-Life Threatening Injury or Illness Call WorkCare 1-888-449-7787

SSE Employee*	**Printed Name/Signature/Company**	**Sign In Time**	**Sign Out Time**

I will STOP the job any time anyone is concerned or uncertain about health & safety or if anyone identifies a hazard or additional mitigation not recorded in the site, project, job or task hazard assessment.

I will be alert to any changes in personnel, conditions at the work site or hazards not covered by the original hazard assessments.

If it is necessary to **STOP THE JOB,** I will perform **TRACK**; and then amend the hazard assessments or the HASP as needed.

I will not assist a subcontractor or other party with their work unless it is absolutely necessary and then only after I have done TRACK and I have thoroughly controlled the hazard.

All site staff should arrive fit for work. If not, they should report to the supervisor any restrictions or concerns.

In the event of an injury, employees will call **WorkCare at 1.888.449-7787** and then notify the field supervisor.

Utility strike, motor vehicle accident or 3rd party property damage - field supervisor will immediately notify the Project or Task Manager

***Short Service Employee (SSE) working for Arcadis <1 year.**

What You Need to Know

Emergency Phone: 911 *WorkCare Phone:* 1-888-449-7787
Your nearest hospital: Island Hospital, 1211 24th Street, Anacortes, WA 98221, , , 360-299-1300

H&S Specialist for this project: Alec MacAdam *Cell Phone:* 720-454-0948
Project Site Safety Officer: Mark Ullery
Nearest assembly area(s): Adjacent to and south of the Boat House
Nearest storm shelter(s): Boat House

Confirm the following PPE is on site: hard hat, safety glasses, boots with protective toe and shank, traffic vest Class II. Applicability of PPE to a particular work task is specified in the JSA or permit.

Confirm the following supplies and equipment are on site: first aid kit, fire extinguisher, eyewash (bottle), drinking water, insect repellent, sunscreen. Applicability of supplies and equipment to a specific task is specified in the JSA or permit and must be reviewed in the safety briefing.

Review applicable JSA or permit for the task being performed in the safety briefing.

Due to the remote nature of your project site, you must discuss the communication plan with TM, APM or PM prior to starting work for the day.

One or more shipping determinations apply this project. Review of the shipping determination(s) is required during initial safety briefing for project.

This project utilizes a Heat Illness Prevention Plan consistent with Washington DOSH requirements. This plan must be reviewed in the safety briefing.

Prior to intrusive work on this project, review of the Utilities and Structures Checklist and site walkover for utility identification is required.

During the initial safety briefing on this project, review Journey Management Plan for effectiveness and accuracy.

Due to the tick hazards associated with this project, The JSA or permit for the planned work activity must address specific controls to prevent tick hazards. These controls must be discussed in the safety briefing.

Due to the poisonous plant hazards associated with this project, The JSA or permit for the planned work activity must address specific controls to prevent poisonous plant hazards. These controls and an overview of how to identify poisonous plants expected to be present must be discussed in the safety briefing. See FHSHB for description information.

SDSs for this project will be available in printed form in the company vehicle. All project workers will be notified of the SDS location in their initial safety briefing.

Air Monitoring Documentation Form

ARCADIS Design & Consultancy for natural and built assets

PID Model:

LEL/O_2 Model:

CIT Model:

Dust Mon. Model:

Monitor Frequency:

Air Monitoring Results

Date	Time	PID (units)	O_2 (%)	LEL (% LEL)	CIT (ppm)	Dusts (mg/m^3)	Location

CIT = Colorimetric Indicator Tube
LEL = Lower Explosive Limit
mg/m3 = Milligram per cubic meter
O2 = Oxygen

ppm = Part per million
% = Percent
PID = Photoionization Detector

PID Calibration Log

ARCADIS Design & Consultancy for natural and built assets

Zero Gas Source: ____________ Instrument Type: ____________ PAGE ____ of ____

Lot Number/Expiration Date: ____________ Serial Number: ____________

Calibration Gas Source: ____________ Instrument Type: ____________

Lot Number/Expiration Date: ____________ Serial Number: ____________

Concentration: ____________ ____________

Instrument Number	Date	Time	Zero Cal. OK (Y/N)	Calibration Gas Reading	Comments	Calibration w/in 2% (Y/N)?	Alarms Set (Yes/No)?	User Initials

APPENDIX E

Supplemental Plans

Arcadis Lone Worker or Remote Location Communication Plan

(For international travel/work, use the Travel Security Plan template in lieu of this template)

Project Name: Burrows Island Light Station Anacortes, Washington

Project Number: B0003010

Date: 10/3/2018

Revision:

General Information (select all that apply):

☐ Worker will be alone
☒ Buddy system will be used
☒ Area is within cell phone service range
☐ Cell phone service is limited or out of range
☐ Worker will be performing high risk activity (Lone Worker is not permitted)
☐ Work will be performed outside normal operating hours (nights or weekends)
☐ Wilderness work
☒ Site is not accessible to standard emergency services
☐ Other unique site conditions that may hinder employee's ability to get help, if required.
Explain:

Communication Plan

Frequency of Communication: 4 HOURS

Planned Start Time: 8:00:00 AM Planned End Time: 8:00:00 PM

Contact Information: Paul McCullough (Cell: 206.214.7161)
Field Worker Name: Mark Ullery
Field Worker Phone Number: 360.292.8990
Vehicle Make/Model/ Plate: N/A
Office Contact Name: Paul McCullough
Office Contact Phone Number: 206.726.4728

Method of Communication:

☒ Cell Phone (including text notification)
☐ Landline
☐ 2-way Radio
☐ Satellite Phone

☐ GPS
☐ Transponder
☐ Other:

Contingency Plan (if the Field Worker cannot be reached, describe actions the Office Contact will take)

If the field worker cannot be reached within an hour of multiple call attempts, emergency evacuation personnel will be contacted by calling 911 and/or the USCG.

Notification Log

Time	Field Worker Notification	Office Receipt of Notification
8:00:00 AM		
12:00:00 PM		
4:00:00 PM		
8:00:00 PM		

Arcadis Journey Management Plan

Project Name: Burrows Island Light Station Anacortes, Washington
Project Number: B0003010
Date: 10/3/2018
Revision:

Route Identification

Planning and evaluation of route(s) on this project will utilize (*select all that apply*):

☒ On-line mapping software with traffic reporting
☐ On-line mapping software without traffic reporting
☐ GPS navigation with traffic reporting (portable unit or integrated into the vehicle)
☐ Standard GPS navigation device (portable unit or integrated into the vehicle)
☒ App with mapping and traffic reporting
☐ App without traffic reporting
☐ Government website with traffic and construction zone reporting
☐ Standard maps or atlases
☐ Other -Specify:

Identified Hazards

List any identified hazards or route concerns identified in the route identification above:

Travel to and from the site requires transit by ferry.
Ferry schedule located here: https://www.wsdot.com/Ferries/Schedule/default.aspx
Heavy traffic is expected along Interstate 90 during normal business rush hours (7-9am and 4-6pm). Avoid travel during these times if possible.

List any portions of this route that have recommended driving restrictions due to time of day, weather, or security

Heavy traffic is expected along Interstate 90 during normal business rush hours (7-9am and 4-6pm). Avoid travel during these times if possible.

☒ Driving JSA attached or provided in the project specific HASP
☐ Vehicle Pre-Trip Inspections required: ☐ Daily ☒ Weekly
☐ Commercial Motor Vehicle (CMV) requirements apply to this project.

Tolls

☐ All or portions of this route includes toll roads.
Specify how the tolls are paid (select all that apply):

☐ Transponder
☐ License Plate
☐ Cash only
☐ Other:

☐ Request transponder for vehicle when renting
☐ Review rental agreement concerning rental agency participation in license plate toll payment systems.

Documentation

When using on-line mapping software to prepare routes, it is recommended to print an overview map with route, and turn by turn maps of route when available. When using GPS navigation devices, it is also recommended that on-line mapping software routes and maps be printed to augment the GPS navigation device routing. Standard maps or atlases should only be considered if navigation assistance from a passenger in the vehicle.

Printing of maps from on-line mapping software should be considered, especially if little is known about potential traffic or construction hazards from primary route planning.

All hard copy maps and driving directions are attached.

Signatures

JMP Prepared by: Eric Epple Date: 10/3/2018

Driver Review: Date:

Date:

Date:

Date:

Purpose and Scope

Date Completed 10/3/2018 **Revised 5/23/2018**

The purpose of this document is to serve as a planning tool and implementation guide to help the Project Team Site, Site Safety Officer (SSO) or other designated responsible party to comply with the requirements set forth by Cal/OSHA Title 8 CCR 3395 Heat Illness Prevention Standard and the Washington State Outdoor Heat Exposure Regulations 296-62-09510 thru 09560.

Note: This HASP Supplement is required to be used in California and Washington states. The Arcadis Health and Safety Standards ARC HSIH013 Heat Stress Prevention, and ARC HSGE008 Injury and Illness Prevention Program (IIPP) must accompany this HASP Supplement. To completely address the regulatory requirements for work in CA and WA states these standards are required to be used in association with the project-specific HASP and this supplement.

Project sites in other states and provinces can use this HASP Supplement as a Best Management Practice to prevent heat illness related injury.

The scope of this HIPP applies to Arcadis projects which include, but are not limited to: outdoor operations conducted in hot weather such as construction, refining, oil and gas extraction, asbestos removal, and hazardous waste site activities, especially those that require employees to wear semi-permeable or impermeable protective clothing that are more likely to cause heat stress for the user. This HIPP provides guidance to prevent or reduce the risk of work-related heat illness. This HASP Supplement provides site specific instructions for actions to be completed at the project site.

Project Site Name	Burrows Island Light StationAnacortes, Washington	**Project Manager**	Josh Gravenmier

Authority and Implementation

The following designated individuals have authority and responsibility for implementing the provisions of this program at the project work site indicated above.

Site Safety Officer (SSO)	Mark Ullery	**Designated Alternate**	TBD

Procedures for Provision of Water

The SSO or designee will be responsible for implementing the following when conditions at the site are anticipated to exceed 80 degrees Fahrenheit (F) (26.6 Celsius [C]):

1. Proper hydration is critical to preventing heat related illness and injury.

Project sites need to maintain an adequate supply of suitably cool, fresh and pure potable water on site at all times to allow each employee to consume **1 quart (1 L) of water per hour**, ideally at a rate of four 8-oz (250 mL) cups per hour. Fresh and pure is defined as "odor free" and "suitably cool" is defined as water being cooler than the ambient temperature but not so cold as to cause discomfort or prevent drinking.

Note: Electrolyte replacement drinks or “Sports Drinks” should be used to replace essential minerals lost during sweating. Sports drinks should supplement water intake e.g. one “sport drink” to every three bottles of water (3 waters : 1 sport drink).

Also, a teaspoon of salt added to every gallon of water could also be used. Entering the requested information into the formula provided below calculates the number of quarts of water required per employee, per hours worked per day.

2. During the Tailgate Safety Meeting and site briefings identify and communicate the type and location of the water source. The water source must provide suitably cool, fresh and pure water in sufficient quantity for all employees at the site. Water shall be provided free of charge or expenses will be reimbursed for employees. Note in the line below what type of water source will be provided (e.g. onsite potable plumbed system, chilled coolers containing bottled water, or drinking water coolers and disposable cups in sufficient quantity to support all field staff present). If the source is potable plumbed water do not complete Item 6 of this Section.

	Potable plumbed source	X	Bottled water in chilled cooler.		Drinking water dispensers & cups

3. Communicate to staff whether all water for the day will be provided at the start of the shift (e.g., 2 gallons (8 L) per employee for an 8-hour shift), or how and when water will be replenished.

Note: A sufficient quantity of water must always be present and readily accessible to allow every employee to consume at least 1 quart (1L) of water per hour. It is suggested to have a minimum of three hours supply of water per employee on hand.

4. Water supplies must be positioned as close as reasonable possible to site workers. Placing water only in shaded areas or by toilet facilities is not sufficient, particularly at large work sites or at multi-story construction sites. Drinking water sources need to be close enough to workers to allow for routine consumption.

5. Inspect the coolers / water dispensers for cleanliness and replenishment of water and cooling ice routinely based on temperatures and staff size. Cooling ice will be stored in clean coolers if added directly to water dispensers.

Note: If the site temperature exceeds 90 deg. F (32 C) the frequency of the cooler inspection will increase to verify water remains cool and the water supply is maintained.

6. Oversee the daily inspection and maintenance of coolers to ensure they are kept clean and in good condition.

Number of Employees	2	**Number of Work Hours Per Day**	8	**Quarts of Water Needed**	16

Below are calculations for using either water dispensers, or coolers stocked with bottles of water.

Gallons of Water Needed	4	**Number of Coolers Needed**	1	**Amount of 16-oz Bottles Required**	32

NOTE - Cooler/bottle calculation accounts for one cooler stocked with 16-ounce (500 mL) bottles to be provided for every four workers. Water dispensers come in variety of sizes (e.g. 3, 5, 7 & 10 gallon. The gallons calculation is provided to clarify what size is sufficient for the onsite staff.

Form Color Key	🟨	*Enter requested Information*
	🟩	*Calculation Completed*

Check which situation applies. Must check at least one box, or provide additional detail.

X	Ice will be purchased at the start of each day by the site SSO or designee.
	Ice will be distributed from on-site machine or service meeting applicable potable water standards.
	Additional details:

Checklist of materials to order and keep on hand.

	Anti-microbial hand cleaner.		Food Safe cleaning product for water cooler.
X	Paper towels.		Sufficient amount of drinking cups for each employee and water dispenser.
	Potable water to clean coolers.		Other Items -

Access to Shade

1. The SSO or designee is responsible for directing how shade will be coordinated and placed when temperatures exceed **80 deg. F (26 C)**.

2. Before the start of work, the location of the shade areas, the importance of taking shade breaks, recognizing the signs and symptoms of heat illness, the schedule of shade breaks, and the location of shade break locations (if not portable) will be addressed during each Tailgate Safety Meeting and site briefing. Access to shade must be allowed at all times.

Note: Where required by regulation, shade breaks will be taken at a minimum rate of 10 minutes of shade for every two hour work period. As temperature increases shade breaks will increase in frequency. See the Heat Index table below for Heat Index specific Action Levels defining shade break frequency and duration.

3. The amount of shaded areas must be able to accommodate all employees taking a recovery or rest break including those employees who are on meal breaks. This doesn't mean that the shaded area(s) must provide shade to accommodate all employees on a site or working a shift at the same time. An example includes rotating routine breaks among employees. Also, additional portable shade structures can be erected on an "as-needed" basis. Employees must have enough shaded space so they can sit in a normal posture fully in the shade with enough space to allow for sitting without being in physical contact with each other. **Employees who desire access to shade must not be deprived of it due to lack of space.**

4. Employees who take a preventative cool-down rest; (1) shall be monitored and asked if they are experiencing symptoms of heat related illness (2) shall be encouraged to remain in the shade; (3) shall not be ordered back to work until signs or symptoms of heat illness have abated, but in no event less than 5 minutes in addition to the time needed to access the shade.

If an employee exhibits signs or symptoms of heat illness while taking a preventative cool-down rest the SSO will provide appropriate support (e.g. additional hydration and/or call to WorkCare) or emergency response support as needed based on symptoms.

5. Shade structures will be relocated to follow along with the crew for moving tasks. Shade structures will be placed within 50 feet of the work area, if practical. Shade structures must be no further than a short walk away (e.g. 2-3 minutes) from the work area. This consideration becomes critical as the temperature rises above **80 deg. F (26 C)**.

6. In situations where it is not safe or feasible to provide shade, the SSO will document in the HASP Supplement the unsafe or unfeasible conditions, and include the steps taken to provide alternative cooling measures equivalent to shade.

Check Available Option

☐	Provide vehicle(s) with working air conditioner to all employees on recovery or rest breaks as well as employees taking onsite meal breaks on the shift at any time.)
☐	Provide temporary or mobile shade structure(s) that are either ventilated or open to air movement (Secure against wind.)
X	Building or permanent structure(s) in close proximity to the work area that provide a cooling environment either through mechanical ventilation or are open to air movement will be used for shade. (Job trailer, pavilion, manufacturing building, etc.)

Monitoring of Weather

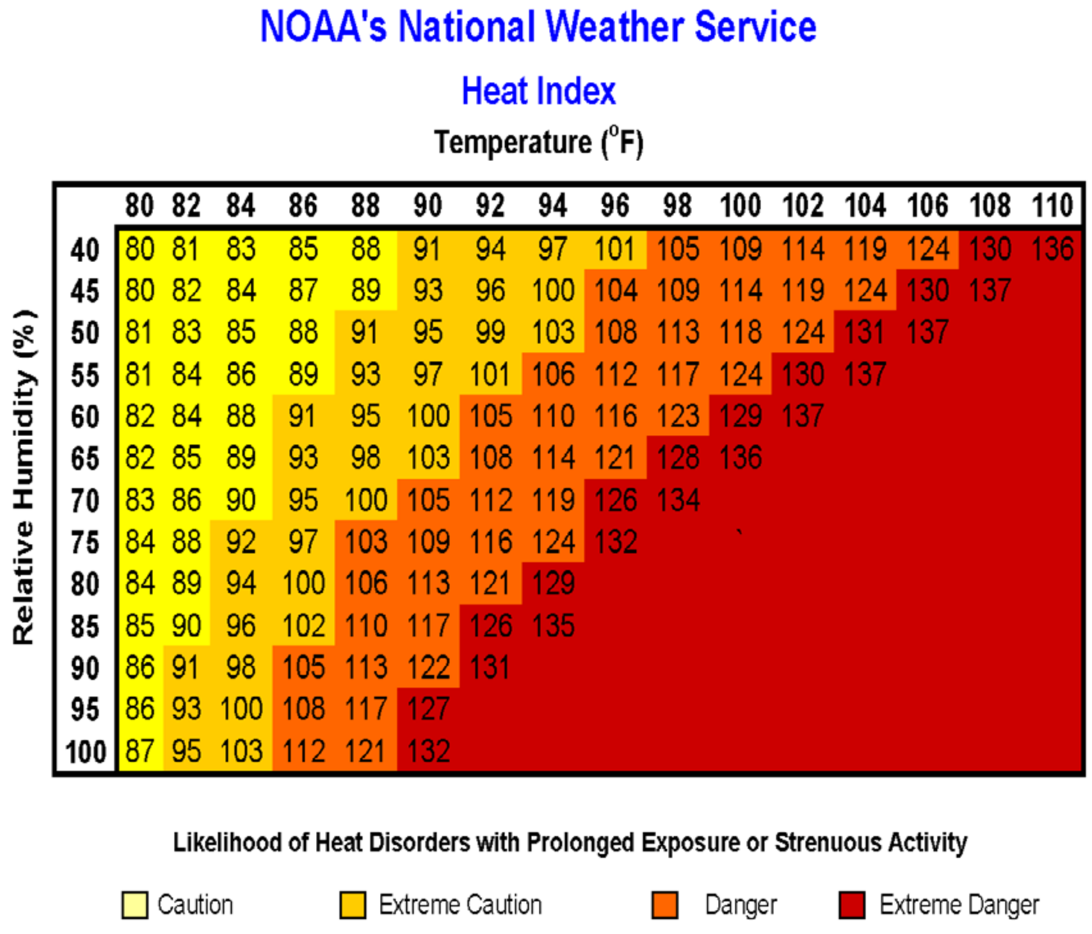
1. The SSO or designee must check the extended weather forecast in advance of the upcoming work on a weekly basis. Work schedules will be adjusted in advance, taking into consideration whether high temperatures or a heat wave is expected.
Accepted weather forecasting resources include webpages such as: http://www.noaa.gov/ or http://www.weather.com/ or the OSHA Heat Safety Tool app.

2. Before work starts for the day or for the shift, the SSO will review the forecasted temperature and humidity for the work site and compare conditions against the National Weather Service Heat Index (below) to evaluate the risk level for heat illness. Determination will be made of whether or not workers will be exposed to a combination of temperature and humidity characterized as "Extreme Caution", "Danger" or "Extreme Danger" for heat illnesses. It is important to note that the temperature at which these warnings occur must be adjusted if site workers are working in full sunlight with no breeze.

3. Where state regulations apply a thermometer or similar on-site monitoring device will be used at the job site to monitor for sudden increases in temperature. The SSO will be responsible for obtaining a thermometer prior to the start of the project and making it readily accessible or mounting it in an area where it can easily be monitored throughout the course of the day.

3a. If the temperature exceeds **80 deg. F (26 C)** shade structures will be opened and made available to workers.

3b. If the temperature equals or exceeds **95 deg F (35 C)** additional preventive measures (such as those outlined in the High Heat Procedures) will be implemented.



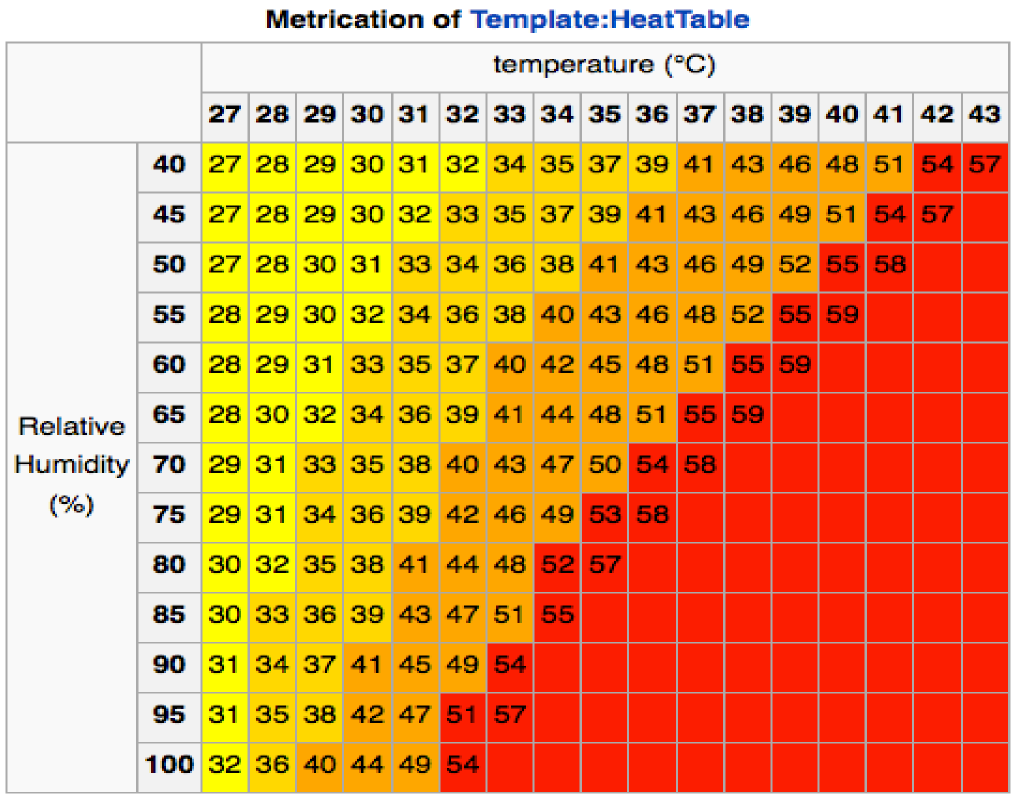
NOAA's National Weather Service

Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity



Metrication of Template:HeatTable

Relative Humidity (%)	temperature (°C)																
	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
40	27	28	29	30	31	32	34	35	37	39	41	43	46	48	51	54	57
45	27	28	29	30	32	33	35	37	39	41	43	46	49	51	54	57	
50	27	28	30	31	33	34	36	38	41	43	46	49	52	55	58		
55	28	29	30	32	34	36	38	40	43	46	48	52	55	59			
60	28	29	31	33	35	37	40	42	45	48	51	55	59				
65	28	30	32	34	36	39	41	44	48	51	55	59					
70	29	31	33	35	38	40	43	47	50	54	58						
75	29	31	34	36	39	42	46	49	53	58							
80	30	32	35	38	41	44	48	52	57								
85	30	33	36	39	43	47	51	55									
90	31	34	37	41	45	49	54										
95	31	35	38	42	47	51	57										
100	32	36	40	44	49	54											

Note: The NOAA Index was devised for sites with partial shade & light wind conditions. Work conducted in direct/full sunlight (e.g. no breeze or partial shade) adds up to 15 deg. F (8 C) to the Heat Index evaluation

Heat Index Action Levels (Contact Project Manager & Notify that Actions Levels have been triggered.

Below are recommended additional controls. Each level is additive.

If Heat Index indicates **"CAUTION" 80 - 89 F.(26 - 32 C).** Implement one or more of the following:

Provide hydration, schedule breaks, wear lightweight clothing, shaded break areas

If Heat Index indicates **"EXTREME CAUTION" 90 - 97 F (32 - 39 C)**. Implement all the above and add one or more of the following:

Provide light duty PPE, cooled break areas, shaded work areas.

NOTE: "Light Duty PPE" includes items such as hard hat sun shades, sun hats, and dry or wet evaporative cooling vests, microfiber towels, scarves, headbands, hard hat neck shades, hard hat suspension inserts and sweatbands.

If Heat Index indicates **"DANGER" 98 - 107 F (39 - 43 C)**. Add one or more of the following:

Provide cooled work areas, modify work schedule, provide heavy duty PPE, vital sign monitoring & Stop Work

NOTE: "Heavy Duty PPE" includes phase-change cooling vests, gel pack and ice pack equipped cooling vests. Ice pack vests are generally offer the coldest option and should not be worn directly against the skin.

If Heat index indicates **"EXTREME DANGER" >108 F (44 + C).** or greater Stop Work until conditions change or hazards are effectively controled.

Procedures for High Heat Conditions and Heat Waves

These procedures are additional preventative measures to be implemented when the temperature is $\geq$ 95 deg F (35 C).

The SSO or designee is responsible for ensuring effective observation and monitoring of employees during periods of high heat by implementing one or more of the following procedures:

1. SSO or designee will supervise 20 or fewer employees.
2. The "Buddy System" is mandatory. Conduct routine checks for early signs of Heat Illness. Set and verify routine consumption of water & sports drinks in a 3:1 ratio.
3. Maintain regular communication between Project Manager or SSO / designee and field staff (e.g. via mobile phone, radio or another effective means) for observation of early signs of heat illness.
4. Designate one or more employees as authorized to contact emergency medical services and communicating that if no designate is identified and the SSO is unavailable that any employee can call for emergency medical assistance.
5. Modify work schedule to avoid hottest parts of the day **(DEFINE THIS TIME PERIOD AND IF ABLE TO, START EARLIER OR WORK LATER)**.

Tailgate Safety Meetings will include a review the high heat procedures, encourage employees to drink plenty of water, and remind employees of the importance to take a preventative or recovery cool-down rest when necessary.

The "Buddy System" must be implemented. Particular attention needs to be paid to new employees or employees who have yet to acclimate to high heat conditions. Additionally, frequent communication will be maintained with employees working by themselves (via cell phone or two-way radio), to be on the lookout for possible symptoms of heat illness.

Employees will be observed for alertness and signs and symptoms of heat illness at regular intervals to be documented in the field book or field log.

When the SSO is not available, an alternate responsible person must be assigned to look for signs and symptoms of heat illness. Such a designated observer will be trained and know what steps to take if heat illness occurs.

"Heat Wave" Procedures

A "heat wave" as defined by the National Oceanic and Atmospheric Administration (NOAA), is a period of abnormally and uncomfortably hot and unusually humid weather." Typically, a heat wave lasts 2 or more days. A "Heat Wave" as defined for the purposes of this Standard is when temperatures are sustained above 80 deg F (26 C).
During a heat wave or if site conditions indicate the potential for "Extreme Caution", "Danger" or "Extreme Danger" per the NOAA Heat Index Table the following steps will be taken:

Work schedules will be modified to protect workers from heat illnesses. The SSO or designee in coordination with the project team, will use their Stop Work Authority and evaluate the following actions and document the action in the daily field log

1. Modify work hours.
2. Reschedule or suspend work or specific tasks that are strenuous.
3. Cease work for the day.

If schedule modifications are not possible, the Heat Illness Prevention Plan will be reviewed before work resumes. At a minimum, procedures for heat illness prevention, the provisions of the high heat procedures, the weather forecast and emergency response protocols will be reviewed.

Employees will be provided with additional water and rest breaks and will be observed more frequently. During work activities and rest breaks, employees will be observed for signs and symptoms of heat illness.

All employees will maintain frequent communication with the SSO or designee, who will be monitoring workers for possible symptoms of heat illness. In the event of large project sites where the SSO may be unable to be near the workers (to directly observe or communicate with them), then communication via a cell phone or radio may be used for this purpose provided reception in the area is reliable.

Procedure for Emergency Response

Emergency procedures include recognizing the symptoms of heat related illness. A critical step also involves ensuring that effective communication is established either through voice, direct observation or electronic means such as via mobile phones or 2-way radios. In an emergency situation it is critical that employees understand the process and contact information for requesting emergency medical support. The reception coverage for the site must be evaluated and understood to ensure adequate communication is in place across the project site

1. The SSO or designee is responsible for implementing the following procedures for emergency response. These procedures include, but are not limited to, the following:

2. Prior to assigning staff to a particular work site, during the Tailgate H&S Tailgate Safety Meeting all site workers will review a map of the Site along with clear and precise directions (such as streets or road names, distinguishing features, and distances to major roads), to avoid a delay of emergency medical services.

3. Prior to assigning staff to a particular work site, efforts will be made to ensure that a qualified and appropriately trained and equipped person is available at the site to render first aid, if necessary.

4. Prior to the start of the morning Tailgate Safety Meeting, a determination will be made of whether or not a language barrier is present at the site, and steps will be taken (such as assigning the responsibility to call emergency medical services to the SSO or an English speaking worker) to ensure that emergency medical services can be immediately called in the event of an emergency in accordance with the HASP.

5. All SSOs and supervisors will carry cell phones or other means of communication to ensure that emergency medical services can be called. Checks will be made to ensure that these electronic devices are allowed on site, have adequate reception across the site, and are functional prior to each shift.

6. When an employee reports symptoms, or is observed displaying symptoms of possible heat illness, steps will be taken immediately to keep the affected employee cool and comfortable until emergency service responders have been called and treatment guidance is provided, or until they arrive at the Site (to reduce the progression to more serious illness).

7. During a heat wave or hot temperatures, workers will be reminded and encouraged to immediately report to the SSO any signs or symptoms they are experiencing.

Procedure for Handling a Sick Employee

1. The SSO or designee is responsible for implementing the following procedures for handling a sick employee.
These procedures include the following:

2. When an employee displays possible signs or symptoms of heat illness, the SSO or designee will check the sick employee and determine whether resting in the shade and drinking cool water will suffice or if emergency service providers will need to be called. In the event of a non-emergency incident the SSO will contact the employees supervisor or the project manager as well as calling **WorkCare Incident Intervention Hotline 1-888-449-7787** for non-emergency medical assistance.
A sick worker will not be left alone, and will be monitored closely for the remainder of the day or until emergency support arrives.

3. Signs of the onset of Heat Illness are: excessive fatigue, heavy sweating, headaches, cramps, dizziness, elevated pulse.
Signs of Heat Exhaustion are: Cool, moist, pale or flushed skin, nausea or vomiting, disorientation or confusion.
Signs of Heat Stroke are: hot, red skin which can feel dry to the touch, or moist from overexertion, changes in consciousness, rapid or weak pulse, shallow rapid breathing.

4. When an employee displays possible signs or symptoms of heat illness and no trained first aid worker or supervisor is available at the site, emergency service providers will be called.

5. Emergency service providers will be called immediately if an employee displays signs or symptoms of heat illness (loss of consciousness, incoherent speech, convulsions, red and hot face) or does not get better after drinking cool water in intervals of 8 ounces every 15 minutes and resting in the shade. While the ambulance is in route, first aid will be administered (**cool the worker: place the worker in the shade, remove excess layers of clothing, place ice pack in the armpits and groin area and fan the victim**). A worker determined to be suffering heat illness will not be allowed to leave the site except under medical care.

6. If an employee displays signs or symptoms of severe heat illness (loss of consciousness, incoherent speech, convulsions, red and hot face), and the work site is located more than 20 minutes away from a hospital, call emergency service providers, communicate the signs and symptoms of the victim, and request an Air Ambulance if necessary.

Revisions, notes, amendments, and clarifications specific to this plan will be detailed in the space below:

SHIPPING/TRANSPORTATION DETERMINATION FORM

Revision 10

Regulated Material Shipping Determination

Date: 10/3/2018
Project Name: Burrows Island Light Station
Project Number: B0003010
Supplemental Information: Analytical data (attached)

1) Description of the Material to be Transported or Shipped

1a Select a description category ===> Samples

1b *Soil/sludge/sediment with ppb or low ppm concentrations of metals*

1c Lead

☑ This material is mixed with water, soil or other inert material
☑ This material will be shipped on wet or blue ice
☐ Consignment contains dry ice
☐ Consignment contains containers with acid/base preservatives prepared by an analytical laboratory.
☐ Leave this box unchecked

2) Classification and Identification

2a This material is: Not Restricted/Not Regulated

Do not complete sections 2b or 2c below

Complete for Hazardous Materials ONLY:

2b UN/NA/ID# : NA 2c PG: NA Primary Hazard Class: NA
Subsidiary Hazard Class: NA NA

PSN: NA

Add the word "mixture" or "solution" in cell G30 above if not already included in the PSN.

☐ See Section 7a

2d This material is a: No additional criteria applies to this material

3) Packaging, Exceptions and Shipping Information

3a Packaging Type: Combination Package - Non-Bulk
3b Inner Container Category: Glass receptacles
3c Number and Quantity:

	Number		Container type			**Net Qty. Each Container**	
Container type #1	20		4 oz	None		4	oz
Container type #2	0		None	None			None
Container type #3	0		None	None			None
Container type #4	0		None	None			None
Container type #5	0		None	None			None
Container type #6	0		None	None			None

<= Select units here
TIP: Do not place units in the white column. Place the largest container in bottle set in row #1.

3d Intermediate Packaging: Plastic bag/liner
3e Outer Packaging: Non-specification box- plastic (sample cooler)
3f Other: None Type: None

☐ Overnight AIR shipping for next day delivery is required

Your suggested shipping configuration (excluding MOT option): Not available for this shipping configuration.

This material will be shipped (mode of transport and type of shipment):

3g Road as a non-regulated/restricted consignment

If using an exception/exemption, list the exception/exemption below

3h None

Carrier/Transporter information:

3i Arcadis or Lab Courier Transport

Auth. Air Limits for EQ, LQ and Fully Reg. Shipments and Selected Ground LQ and SQE:

Inner Container Limit (NA- Not Applicable; F- Forbidden; mg, g, or kg for solids; ml or L for liquids):

Glass	NA	NA
Metal	NA	NA
Plastic	NA	NA

Plastic Bag	NA	NA
Paper Bag	NA	NA
Fibre	NA	NA

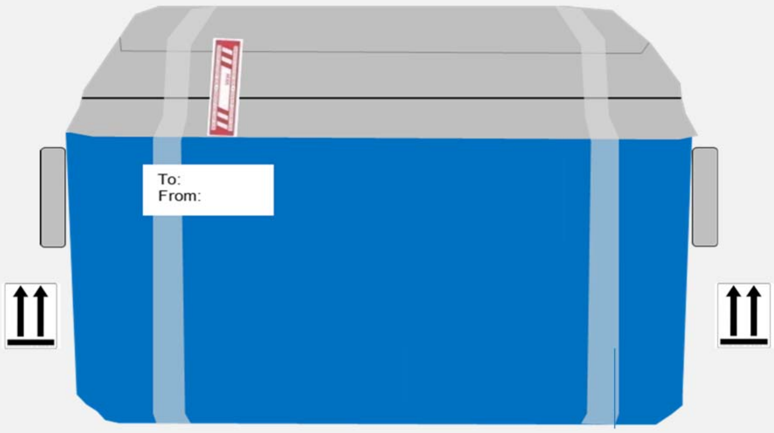
Outer Package Limit

	NA	NA
Total net volume/mass:	0	L/Kg

☑ Arcadis Shipping Guide US-001 attached
☐ Specific package closure instructions are attached
☐ Arcadis Shipping Guide or HSSP is available for this shipment: NA

4) Marks and Labels for Non-Bulk Packages

Orientation arrows, if shown, may be red or black in color.



Place all marks and labels checked in this section on same side of package (excludes orientation arrows, if shown).

5) Documentation

☑ No special documentation required
☐ Requires a Shipper's Declaration (air) prepared using : None
☐ Requires HazMat ground shipping papers prepared using: None
☐ Requires a Bill of Lading or Manifest (>MOT, Freight,Trucking Co., Waste Hauler, etc.)
☐ Requires Special Permit DOT-Special Permit #:
☐ Other:

6) Emergency Response

☐ Use ChemTel 24/7 Emergency Phone and Contract Number
or approved equivalent (authorized client or vendor) for this shipment:
1-800-255-3924 (ChemTel #MIS0007883) Register this shipment with ChemTel:
Have carrier tracking number available. http://Arcadis.chemtel.net/
☐ Ensure current edition of Emergency Response Guidebook in vehicle (this applies to Arcadis Transport requiring a shipping paper)

7) Special Instructions (Specify any "See Section 7" details in 7a)

7a

8) References and Rationale for the Determination (add additional sheets, if required).

NA

DOT Special Provisions: NA

8a Due to the low levels of hazardous constituents, non-hazardous sample medium, and small amount of material being transported, it has been determined that this material does not require regulation under DOT-IATA.

211	Rationale must be at least 200 characters (including spaces)

QUICK VIEW SHIPPING DETERMINATION FORM

Revision 10

For Use by Field Staff

Date:	10/3/2018
Project Name:	Burrows Island Light Station
Project Number:	B0003010

This Determination applies to

The material you will be shipping includes the following:
Soil/sludge/sediment with ppb or low ppm concentrations of metals: Lead

If this is not what you are shipping or if you need help, contact Eric Epple
at 206-794-6904 for assistance and guidance.

The material in your shipment has been classified as a: Not Restricted/Not Regulated

This material has been identified as:

PROPER SHIPPING NAME (including applicable modifiers and technical names):

An ID Number, Proper Shipping Name, Hazard Class, and Packing Group are not required for this shipment.

ID NUMBER: **NA** Hazard Class NA (NA) Packing Group NA

☐ The above information in RED is required on the outer package of your shipment as illustrated in the picture

☒ Follow Shipping Guide US-001 to prepare this shipment ☐ Follow Shipping Guide US-015 for dry ice

☐ Refer to the referenced HSSP to right for more information: NA

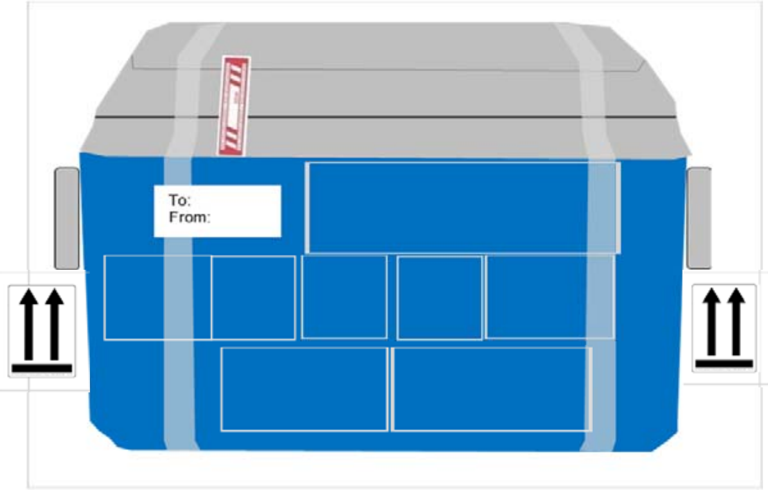
Package preparation configuration per package shipped (not to exceed):

Inner container sizes and quantity:

# of containers	Size	Type	Net Qty Each
20	4 oz	None	4 oz
0	None	None	0 None
0	None	None	0 None
0	None	None	0 None
0	None	None	0 None
0	None	None	0 None

Intermediate packaging:	Plastic bag/liner
Outer packaging:	Non-specification box- plastic (sample cooler)

Place marks and labels on same side of package, except orientation arrows should be placed on each end of package.



If you do not have all of the marks or labels shown above. DO NOT GIVE THE PACKAGE TO FEDEX or UPS. Orientation arrows may be red colored. If required, contact the individual listed above for assistance.

☐ Your supervisor (PM, TM, or Field supervisor) must register this shipment with ChemTel (the Arcadis 24 hour emergency phone number provider).

You must offer this shipment to: Arcadis or Lab Courier Transport

ARCADIS SHIPPING GUIDE NO. US-001

Environmental Sample Cooler Preparation for Hazardous Materials Shipping
Do Not Use After 12/31/2018

1) Fill bottles <90% Full

2) Tape lids secure

3) Place bottles in protective bubble wrap bags or wrap in cushioning material

4) Place protected bottles inside of a self-sealing bag (Ziploc® bag)

5) Select a clean, like new ice chest ≤52 quart capacity. Avoid ice chests with drain plugs

6) Line ice chest with plastic bag (heavy duty trash bag)

7) Place absorbent pads, vermiculite, or other compatible absorbent in ice chest (enough to absorb contents of ice chest) and additional cushioning material (like bubble wrap)

8) Place all bottles in ice chest in upright position (including temperature blank if required by your work plan)

9) Fill remaining void with compatible absorbent, cushioning materials or ice in self-sealing plastic bags (if using cooling preservation). Don't overfill the bag liner.

10) Twist and tie off top of plastic bag

11) Place chain-of-custody in self-sealing plastic bag and tape to inside lid of ice chest

12) Close lid and secure with strapping/packing tape all the way around the ice chest. Apply chain-of-custody seals (one on each side or as directed in your work plan)

HAZARDOUS MATERIALS SHIPPING/TRANSPORTATION DETERMINATION FORM

Materials of Trade Template for use with the Standard Excel HASP 12/7/2016

Date:	10/3/2018
Project Name:	Burrows Island Light Station
Project Number:	B0003010
Supplemental Information:	MSDS/SDS

Description of the Material to be Transported or Shipped:

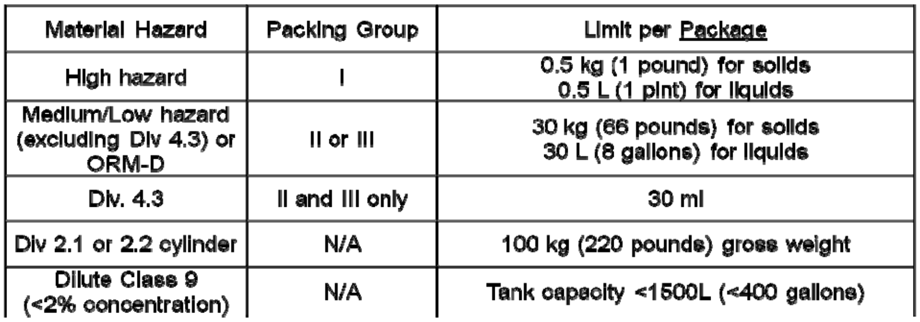
Checked materials in the HAZCOM/GHS worksheet, Monitoring worksheet, Safety Supplies and Equipment section and Level C Supplement (if applicable) of the Standard Excel HASP Template for this project and samples will be transported under the Materials of Trade Exception (49 CFR 143.6) in Arcadis owned, leased or rented vehicles and/or lab courier (employee of the lab), and/or requipment rental vendor (employee of the vendor). Eligible samples must meet qualifying criteria in the Limitations section below.

Special Instructions:

1) All containers will be maintained in an upright condition with lids or other openings secure. Containers will be protected against movement during transport and have adequate cushioning for protection
2) Cylinders will have regulators removed and protective caps in place during transport. Cylinders will be secure in the vehicle.
3) Batteries regardless of type or size, will have terminal protected and each battery will be protected from crushing, pressure or other condition that may affect the integrity of the battery.
4) ChemTel 24 hr. phone number and registration is not required.
5) Fire extinguishers will be mounted and secure in company owned or leased vehicles.
6) Fuels will be transported in DOT or OSHA approved metal or plastic containers (ie. safety cans).

Limitations

1) No more than 440 pounds (combined gross weight) of materials subject to this shipping determination are permitted on a transport vehicle and individual container limits are specified in the chart below.
2) Materials that are radioactive or explosive are not eligible for MOT Exception and separate shipping determinations will be required for those materials.
3) Flammable gases not transported in a specification cylinder are not eligible for the MOT Exception and separate shipping determination will be required.
4) Gasoline transported in glass containers (samples) are not eliglible for MOT Exception. Follow HSSP-019 for transport of gasoline in glass containers.
5) Div. 6.2 materials are not covered by this generic determination.
6) Self-reactive materials, poisonous by inhalation materials, and hazardous wastes are not permitted under MOT Exception.



Material Hazard	Packing Group	Limit per Package
High hazard	I	0.5 kg (1 pound) for solids 0.5 L (1 pint) for liquids
Medium/Low hazard (excluding Div 4.3) or ORM-D	II or III	30 kg (66 pounds) for solids 30 L (8 gallons) for liquids
Div. 4.3	II and III only	30 ml
Div 2.1 or 2.2 cylinder	N/A	100 kg (220 pounds) gross weight
Dilute Class 9 (<2% concentration)	N/A	Tank capacity <1500L (<400 gallons)

References and Rationale for the Determination:

49 CFR 173.6
These materials are used in support of Arcadis work.

Determination performed by: Eric Epple

HAZARDOUS MATERIALS SHIPPING/TRANSPORTATION DETERMINATION FORM

Field Equipment GROUND/AIR Template 12/7/2016

Project/Office Name:	Burrows Island Light Station
Project Number:	B0003010
Supplemental Information:	MSDS/SDS

Description of the Material to be Transported or Shipped:

Rental equipment to be return shipped by the ground or air mode of transportation subject to this determination include: air monitoring/sampling equipment, water quality instruments, survey and measurement equipment, GPS devices, computer tablets, cameras, communication devices, weather monitoring equipment, heat/cold stress monitors and noise monitoring equipment subject to the following conditions:

1) Dry cell batteries (including alkaline, NiMH, and NiCad batteries) and/or nonspillable batteries shipped alone, contained in or packed with equipment.

2) Equipment containing lithium-ion batteries will be ≤100 watt hour (Wh)/battery and ≤20 Wh/cell with ≤4 cells/2 batteries in package with no spare Li-ion batteries packed with equipment.

3) Equipment may be packed with DOT 39 calibration gas cylinders (Division 2.2) and will not require a Cargo Aircraft Only Label on return shipment.

4) Equipment may contain small flammable gas cylinders to power equipment or perform analyses which will be empty upon return shipment.

5) Equipment may be packed with/contain cleaning or calibration solutions meeting the criteria of Hazard Classes 3, 4.1, 4.2 , 5.1, 5.2 , 6.1, 8 or 9 in PG II or III, and solutions are in plastic, glass or metal containers ≤30 ml per container and ≤500 ml (PGII) and ≤1L (PG III) per completed package (air shipment) or ≤30 ml per container ≤ 29 kg (64 pounds) (ground shipment).

6) Equipment may be shipped with calibration solutions or powders which are limited to pH buffer, conductivity, and turbidity standards or standards made specifically for water quality meters calibration. Standards referenced will not meet the criteria of a DOT or ICAO/IATA hazard class.

7) Equipment does not contain components that are magnetic, radioactive, or contain materials under pressure (>15.22 psi absolute) which are not in DOT 39 cylinders.

8) Equipment is clean and free of site contaminants.

9) The shipment will not contain chemical kits (Hach kits, DTECH kits or similar kits), colorimetric indicator tubes (Drager tubes, etc.), first aid kits or fire extinguishers and equipment containing mercury.

Special Instructions and Limitations:

1) This determination is void if the above conditions are not met or the shipment contains devices or substances not list above. This determination is void if lithium metal batteries are contained in the shipment (excludes button cells attached to circuit boards of equipment).

2) All batteries should remain installed in equipment and spare batteries, regardless of type and charge, will have terminals protection; and each battery will be protected from metal objects, crushing, or puncturing by other components in the package.

3) Air and ground shipment of equipment with nonspillable batteries will be marked on the outer package "Nonspillable Battery". Also, for air shipments, the air waybill (if used) will be marked "Not Restricted, A67".

4) Air shipment of equipment with dry cell batteries will have "Not Restricted, A123" written on the air waybill or shipping label (refer to Shipping Guide US-050 for battery mark and notation information).

5) Shipments containing pressurized DOT 39 cylinders (look for mark or stamp indicating cylinder type) will be shipped in accordance with HSSP-020 (designed for air shipment but same rules apply for ground shipment). For air shipments, the Shipper's Declaration will be prepared using approved software. For ground shipments, FedEx Ground pre-registration required and cylinder offered under FedEX Ground HazMt shipping papers (form OP-900 and OP-950).

6) Shipments with small quantities of HazMat liquids (see above) will be shipped in accordance with HSSP-016 (air shipment) or HSSP-028 (ground shipment) requirements. Container closures will be secured by secondary securement method (taping, etc.).

7) FIDs will be return shipped with hydrogen tanks empty and valves open.

8) Equipment will be packed in a manner which provides protection to the device and its ancillary components, with the device in the off position and protected against accidental activation.

9) Non-hazardous liquids and powders that may be packed with the rental equipment will be packed with lids or other closure method secure and protected with secondary securement method (taping, wiring, clipping, etc.).

10) If shipping in packaging provided by the vendor, check exterior of the package and remove obsolete marks or labels. Also check package to ensure it is not damaged or has other condition that might impair package integrity.

Emergency Phone Number:
Arcadis requires 24 emergency phone number on package (if requiring a mark or label) and/or on any shipment requiring a shipping paper.

"1-800-255-3924 CHEMTEL #MIS0007883"

Register this shipment at: http://arcadis.chemtel.net/

Certification:

I certify field equipment and supply shipments that will be prepared for air transport for this project or office, will be prepared and checked to ensure the package conforms to the requirements and limitations of this shipping determination. I will utilize referenced Arcadis guidance, when applicable, in preparing these shipment(s). I will not rely solely on vendor instructions for return shipment package preparation. I am current on HazMat #1 or HazMat #12 training or approved equivalent.

Offeror(s) Signature/Date:

____________________/__________ ____________________/__________

____________________/__________ ____________________/__________

____________________/__________ ____________________/__________

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APPENDIX F

Near Miss Reports from Similar USCG/Arcadis Poverty Island Project

Near Misses and TIPS from Mobilization 1

Task Improvement Process: H&S - Field Multi-task (General)

General

TIP ID	62544	**Status**	(5) Completed
Observation Type	Peer to Peer	**Observation Date**	11/15/2018 12:00:00 AM
TIP Form	H&S - Field Multi-task (General)		
Task Observed	Soil analysis using XRF analyzer		
Equipment On Site	XRF analyzer and stand, general soil sampling equipment, table and tent		
Pertinent Information	Soil samples were collected and handled in plastic bags, XRFs were set up with stands to limit repetitive motion from handling and shooting bags.		

Client / Project

Client	US Coast Guard
Project Number	B00030100006
Project Name	BURROWS REMEDIAL INVESTIGATION
PIC	SCLAFANI, TROY
Project Manager	GRAVENMIER, JOSH

User Roles

Role Name	Employee Name	Due Date	Completed Date	Supervisor Name	Active
Created By	Ullery, Mark	12/06/2018	11/20/2018	Orchard Aragon, Barbara C	☑
Feedback By	Ullery, Mark	11/20/2018	11/20/2018	Orchard Aragon, Barbara C	☑
Observee	Haslam, Kyle D	11/15/2018	11/15/2018	Orchard Aragon, Barbara C	☑
Observee Supervisor	Orchard Aragon, Barbara C	12/06/2018	11/20/2018	Annis, Matthew Robert	☑
Observer	Ullery, Mark	12/06/2018	11/20/2018	Orchard Aragon, Barbara C	☑
Quality Reviewer	Hagarty, Edward Patrick	12/19/2018	12/19/2018	Fernandez, Edward J	☑
Reviewer	Gravenmier, Josh J	01/03/2019	11/21/2018	Demetrios, Ginna E	☑
Reviewer	McCullough, Paul T	01/03/2019	12/03/2018	Annis, Matthew Robert	☑

Observations

Task Type / Observation	Correct	Questionable	Comments
General			
PPE worn according to HASP/JLA specifications and inspected before use	☑	☐	Variation for hard hats discussed with project team, gloves and dosimeter warn as recommended in the HASP.
STOP work authority used where appropriate	☑	☐	Stop Work used when sampling procedures were not clear.
Body Use/Positioning			
Proper lifting/pushing / pulling techniques used (no awkward positions/posture; no twisting or excessive reaching; no straining; no excessive weight; load under control/stable; etc.)	☑	☐	Good set up of working station to limit bending.
Body parts away from pinch points (clear or protected from being caught between objects/equipment or from contacting sharp objects/edges, etc.)	☑	☐	Good awareness of pinch points.
Body parts not in the Line of Fire (protected from being struck by traffic, equipment, falling/flying objects, etc.)	☑	☐	XRF stands shielded and body distance maintained while analyzing.
Work Procedures/Environment			
Correct type and number of barricades/warning devices/cones	☐	☐	
Communication with others when necessary (hand signals, flags, etc.)	☑	☐	Good team communication while working in close proximity
Right tools and equipment selected for the job and inspected before use	☑	☑	XRF unit failed during regular use. Team planned ahead and had a backup.
Tools and equipment used properly	☑	☐	XRFs set up and used properly
Housekeeping performed (work areas and pathways clear of hazards, uneven surfaces addressed, etc.)	☑	☐	
Slip/trip/fall hazards addressed (path selected and cleared, eyes on path, speed, footing, etc.)	☐	☑	Wet surfaces surrounding work area.
Proper energy control (electrical systems grounded, lock out / tag out performed, isolated, cords / fixtures in good condition, GFCI inspected and utilized when appropriate and used properly, etc.)	☐	☐	

Protected from overhead/underground utilities (proper clearance, properly marked, spotters as necessary, etc.)	☑	☐	Utility checklist and lines of evidence completed. Soft dig methods
Safe work on/near water (appropriate flotation device, appropriate boat for body of water and operation of boat, etc.)	☑	☐	PFDs worn while loaded and unloading boat.
Chemical/Radiation protection (decontamination ones set up properly, air monitoring completed and logged, etc.)	☑	☐	Dosimeter badges worn, no additional public so exclusion zone adequate.
Fall from elevated height prevention (maintains 3-points of contact, appropriate ladder, mounting/dismounting vehicle/equipment, fall arrest system, etc.)	☑	☐	
Any additional safety issues identified?	☐	☐	

TIP Summary

TIP Summary	
Discussion following the TIP lead by	Ullery, Mark
Date of follow-up discussion	11/20/2018 12:00:00 AM
Positive Comments	Good set up of work area and communication with team. Good focus on safety.
Discussion Summary Completed	Peer to Peer
Summary of Questionable Items	Slips/trips/falls on slick surfaces near work area. Not really a better option to set up at, but still goof to consider for future.

Action Items (Optional): None

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Gravenmier, Josh J Reviewer Approve 11/21/2018	Thanks for performing the TIP. Pre-planning is key to identifying potential issues both with equipment (XRF backup) and slip/trip/fall hazards (wet surfaces identification) so that we were prepared.
Employee: **Role** **Review Type** **Completed Date**	McCullough, Paul T Reviewer Approve 12/3/2018	Thanks for completing this TIP. The team did a good job in following procedures while using the XRF. It was nice to see that XRF samplers were using dosimeters and kept exposures ALARA by using dedicated XRF sample station that placed the operators hands away from the X-ray source. Slips, trips and falls were identified as a hazard, which was addressed by having a dedicated sample station (under a tent cover to protect from rain).
Employee: **Role** **Review Type** **Completed Date**	Hagarty, Edward Patrick Quality Reviewer NA 12/19/2018	Good TIP, it appears that there was good planning and execution. Glad to see that PFDs were being utilized near water as performing simple tasks are often compromised with the additional complication of working near or over water.

Task Improvement Process: H&S - Field Multi-task (General)

General

TIP ID	62524	**Status**	(5) Completed
Observation Type	Peer to Peer	**Observation Date**	11/14/2018 1:00:00 PM
TIP Form	H&S - Field Multi-task (General)		
Task Observed	The observee was collecting shallow (0-6" below ground surface) soil samples using a hand trowel during this TIP observation.		
Equipment On Site	Hand trowel, bucket with decon supplies, and Ziploc bags. Other equipment onsite included hand auger, XRFs, and a PID, but these were not used during the observation.		
Pertinent Information	Site is on a relatively remote island that is accessed via infrequent ferry boat. Weather was calm and overcast, temperature was in the mid 50s. Site is undulating with exposed bedrock in areas and some piles of discarded building materials.		

Client / Project

Client	US Coast Guard
Project Number	B00030100006
Project Name	BURROWS REMEDIAL INVESTIGATION
PIC	SCLAFANI, TROY
Project Manager	GRAVENMIER, JOSH

User Roles

Role Name	Employee Name	Due Date	Completed Date	Supervisor Name	Active
Created By	Haslam, Kyle D	12/05/2018	11/20/2018	Orchard Aragon, Barbara C	☑
Feedback By	Haslam, Kyle D	11/14/2018	11/14/2018	Orchard Aragon, Barbara C	☑
Observee	Ullery, Mark	11/14/2018	11/14/2018	Orchard Aragon, Barbara C	☑
Observee Supervisor	Orchard Aragon, Barbara C	12/05/2018	11/20/2018	Annis, Matthew Robert	☑
Observer	Haslam, Kyle D	12/05/2018	11/20/2018	Orchard Aragon, Barbara C	☑
Quality Reviewer	Bierei, Mark A	12/17/2018	12/17/2018	Limbers, Timothy	☑
Reviewer	Gravenmier, Josh J	01/03/2019	11/21/2018	Demetrios, Ginna E	☑
Reviewer	McCullough, Paul T	01/03/2019	12/02/2018	Annis, Matthew Robert	☑

Observations

Task Type / Observation	Correct	Questionable	Comments
General			
PPE worn according to HASP/JLA specifications and inspected before use	☑	☑	Observee did not have cut-resistant gloves on while using hand trowel. All other PPE worn in accordance with JSA and HASP.
STOP work authority used where appropriate	☑	☐	Observee performed a quality stop work and measured hole depth to confirm entire 6" interval was being captured in soil samples.
Body Use/Positioning			
Proper lifting/pushing / pulling techniques used (no awkward positions/posture; no twisting or excessive reaching; no straining; no excessive weight; load under control/stable; etc.)	☑	☐	Used knee pads to collect samples. Good ergonomics.
Body parts away from pinch points (clear or protected from being caught between objects/equipment or from contacting sharp objects/edges, etc.)	☑	☐	
Body parts not in the Line of Fire (protected from being struck by traffic, equipment, falling/flying objects, etc.)	☑	☐	
Work Procedures/Environment			
Correct type and number of barricades/warning devices/cones	☐	☐	Not Applicable
Communication with others when necessary (hand signals, flags, etc.)	☑	☐	Good verbal communication with team members.
Right tools and equipment selected for the job and inspected before use	☑	☐	
Tools and equipment used properly	☑	☐	Hand trowel used properly and decontaminated between each sample location.
Housekeeping performed (work areas and pathways clear of hazards, uneven surfaces addressed, etc.)	☑	☐	Tools and equipment stored in bucket when not in use.

Slip/trip/fall hazards addressed (path selected and cleared, eyes on path, speed, footing, etc.)	☑	☐	Observee took the clearest path between sample points, even if that was longer.
Proper energy control (electrical systems grounded, lock out / tag out performed, isolated, cords / fixtures in good condition, GFCI inspected and utilized when appropriate and used properly, etc.)	☐	☐	Not Applicable
Protected from overhead/underground utilities (proper clearance, properly marked, spotters as necessary, etc.)	☑	☐	Subsurface utility structures checklist completed prior to starting intrusive work.
Safe work on/near water (appropriate flotation device, appropriate boat for body of water and operation of boat, etc.)	☐	☐	Not Applicable - Work was not near water.
Chemical/Radiation protection (decontamination ones set up properly, air monitoring completed and logged, etc.)	☑	☐	Observee wore nitrile gloves and exhibited good hygiene practices.
Fall from elevated height prevention (maintains 3-points of contact, appropriate ladder, mounting/dismounting vehicle/equipment, fall arrest system, etc.)	☐	☐	Not Applicable - Work was not near cliff/at height.
Any additional safety issues identified?	☐	☐	None

TIP Summary

TIP Summary	
Discussion following the TIP lead by	Haslam, Kyle D
Date of follow-up discussion	11/14/2018 12:00:00 AM
Positive Comments	Observee demonstrated good housekeeping and hygiene practices. Body positioning was ergonomically correct due to the use of a kneeling pad. Observee communicated well with project team.
Discussion Summary Completed	Peer to Peer
Summary of Questionable Items	Employee was not wearing cut-resistant gloves while using hand trowel.

Action Items (Optional): None

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Gravenmier, Josh J Reviewer Approve 11/21/2018	Thanks for performing the TIP. Good observations and good discussion on it during the call today. I am glad that once the questionable item of observing the lack of cut-resistant gloves occurred that we Stopped Work and immediately added the required PPE. Well done.
Employee: **Role** **Review Type** **Completed Date**	McCullough, Paul T Reviewer Approve 12/2/2018	Reviewed and approved. This is a particularly useful tip for new field projects and provided an opportunity to engage with the field team to ensure that safety expectations were achieved.
Employee: **Role** **Review Type** **Completed Date**	Bierei, Mark A Quality Reviewer NA 12/17/2018	Good TIP and follow-up. Not familiar with particular project but description identifies as remote island with infrequent ferry runs. Curious if the site had cell phone coverage and what would be the emergency response if something serious did happen. If occupied by USCG TeamsI guess that would answer the question but that was the one thing that came to mind during my review.

Task Improvement Process: Chevron - Senior Management Field H&S Checklist

General

TIP ID	62331	**Status**	(5) Completed
Observation Type	Supervisor(includes PM, TM, or other senior mgr) to Employee	**Observation Date**	11/13/2018 12:00:00 AM
TIP Form	Chevron - Senior Management Field H&S Checklist		
Task Observed	Mobilization and first day of field work at Burrows Island Lighthouse. Tasks observed included: boat transportation to island, loading and unloading supplies to/from boat; setup of field camp on island (tent); safety tailgate meeting by SSO prior to boat launch; safety tailgate meeting by boat captain; safety meeting at Burrows Island (including review of JSAs, task hazards, XRF safety/dosimetry, PPE, short service employee management; buddy system, etc); field survey of sampling area with GPS; inspection of sampling areas by field team to locate site features/sampling areas; setup and operation of XRF unit; layout of sampling areaswith flags; collection of soil samples for XRF analysis; demobilization; and boat transportation back to Anacortes. Field Staff included: Mark Ullery (SSO, Field Lead); Kyle Haslam; Kelsey Franco; Julia Vidonish (short service employee).		
Equipment On Site	XRF units Trimble GPS PID Hand tools (shovels, trowel, hand auger, post hole digger) Satellite Phone Fire extinguishers First aid kits Water PPE (Level D) Rainware Buckets Tent/Table		
Pertinent Information	Burrows Island is a United States Coast Guard Light Station location on a remote island near Anacortes, WA. The site may be accessed by boat or helicopter (site access was provided by Island Express Charters, a licensed water taxi). Scope of work is to perform a remedial investigation, focused feasibility study and remedial design to address lead based paint impacts to shallow soil. Additionally, site will be evaluated for potential petroleum hydrocarbons and PCBs from historic operations (including documented transformer oil spill in 1980). This was first day of first mobilization. Goal was to identify site features to develop future RI plans (SAP/QAPP); photo document area; and collect preliminary XRF data for lead in shallow soil at locations of historic and existing infrastructure.		

Client / Project

Client	US Coast Guard
Project Number	B00030100006
Project Name	BURROWS REMEDIAL INVESTIGATION
PIC	SCLAFANI, TROY
Project Manager	GRAVENMIER, JOSH

User Roles

Role Name	Employee Name	Due Date	Completed Date	Supervisor Name	Active
Created By	McCullough, Paul T	12/04/2018	11/14/2018	Annis, Matthew Robert	☑
Feedback By	Annis, Matthew Robert	11/13/2018	11/13/2018	Bonkoski, Brooke R	☑
Observee	Ullery, Mark	11/13/2018	11/13/2018	Orchard Aragon, Barbara C	☑
Observee Supervisor	Orchard Aragon, Barbara C	12/04/2018	11/14/2018	Annis, Matthew Robert	☑
Observer	McCullough, Paul T	12/04/2018	11/14/2018	Annis, Matthew Robert	☑
Quality Reviewer	Gravenmier, Josh J	12/03/2018	12/03/2018	Demetrios, Ginna E	☑
Responsible Person	McCullough, Paul T	01/03/2019	11/30/2018	Annis, Matthew Robert	☑
Reviewer	Haslam, Kyle D	12/28/2018	11/20/2018	Orchard Aragon, Barbara C	☑

Observations

Task Type / Observation	Correct	Questionable	Comments
Roles & Responsibilities			
H&S responsibilities/requirements for the project are clearly defined and understood by project staff.	☑	☐	I interviewed each field staff for understanding of requirements and everyone had good understanding
Roles and responsibilities for each project team member (onsite & offsite) are defined and understood by project staff.	☑	☐	Roles were well understood. Mark Ullery is SSO and field team leader. All staff were aware that Julia Vidonish was short service employee.
Field staff understand applicable client and/or site/owner requirements.	☑	☐	Staff reviewed field sampling memorandum and participated in kick off call with PM and technical lead prior to mobilization

Site Health and Safety Officer (SHSO) has been designated.	☑	☐	Site safety officer is Mark Ullery.
Selected subcontractors have been reviewed for H&S qualifications and performance.	☐	☐	Not applicable. No subcontractors were used for this phase of work
Short Service Employees are appropriately identified and assigned a field mentor.	☑	☐	Julia Vidonish was identified as Short Service Employee.
HASP/Documentation			
Site specific Health and Safety Plan (HASP) is onsite and field staff can confirm the location.	☑	☐	HASP was on-site and field staff were aware of its location at field tent.
HASP has been reviewed within in the last year.	☑	☐	HASP is dated October 22, 2018 and was signed by Eric Epple (preparer), Grey Coppi (HASP Reviewer, Federal Projects), and Josh Gravenmier (project manager). No addenda were identified.
Field staff understand and have signed the HASP.	☑	☐	Field Staff signed HASP. Additionally Culture of Caring Form was signed by Paul McCullough, after discussing
HASP writers and job experts were identified to develop the HASP and associated JSAs.	☑	☐	JSAs were reviewed by SSO and HASP reviewer during HASP development. Also, included previous TIPs and near miss report from similar USCG lighthouse characterization project (Poverty Island). These were discussed.
Sign-in log for site visitors (persons observing work intermittently and not in a manner exposing them to site chemicals of concern) that are not working is being utilized.	☐	☐	No site visitors. One person visited the site who owned property on a different portion of Burrows Island. This person did not stay or observe field work and did not sign the HASP.
HASP lists required exposure monitoring. Air monitoring and equipment calibration are documented by trained Portable Gas Detection personnel.	☑	☐	Dosimeters (whole body) were provided to field staff who operate XRF. Paul McCullough was provided a visitor dosimeter
Utilities have been cleared using the ARCADIS Utility Clearance Standard and the Utility Clearance Checklist and the Chevron Ground Disturbance Review or Well Abandonment Checklist(s)?	☑	☐	three lines includes: previous underground utility survey; information from USCG and question of NWSS; and soft digging methods (hand tools).
JSAs are available, are being reviewed, and field staff are applying the "dirty" JSA concept.	☑	☐	JSAs were reviewed during tailgate meeting.
JSAs are being completed properly, including assigning Responsible Persons, documenting Verification & Validation of mitigating steps and are being signed by all affected workers every day or shift.	☑	☐	JSAs were available and reviewed.
JSA lookbacks are being completed.	☐	☐	
TIPs are being performed for site specific tasks and if not TIPs are planned for site specific tasks.	☑	☐	3 tips should be prepared for this phase of project per PM.
Tailgate meetings are conducted before work begins and after the mid-day break.	☑	☐	Tailgate meetings were conducted before boat mobilization, after arrivals to Island, and after equipment setup and sampling activities were performed.
Tailgate meetings cover appropriate topics, including review of JSAs, previous near misses, and completion of permit to work.	☑	☐	Tailgate emphasized hazards including wearing PFDs when working within 6 feet of water; slips trips falls in uneven terrain, safety around slopes and cliff.
Tailgate meetings include subcontractors and/or clients.	☑	☐	Not applicable. Client was not at site, but reviewed HASP prior to mobilization. No subcontractors are used for this phase of work.
Buddy System is being used and is part of the HASP requirements.	☑	☐	Team is using buddy system.
Are critical pieces of equipment (heavy equipment, drill rigs, air compressors, ect.) being inspected using a checklist ON SITE and DAILY by subconractor or Arcadis personnel?	☑	☐	No heavy equipment is used, only hand tools. The manufactures instruction for XRF use was on-site and consulted during setup of equipment.
A Work Packet Request and Project Planning Checklist was used to prepare for this field event.	☑	☐	Not applicable - no work permits
Training			
Project Manager/Supervisor has completed OSHA Site Supervisor Training.	☐	☑	There was initial confusion on whether OSHA 8 hour supervisor training was required for SSO. This was identified during pre-mobilization call. SSO was required to obtain training the weekend prior to mobilization. Future efforts to communicate safety training requirements for on-site supervisors could minimize confusion.
Employees can explain what training is required for assigned tasks.	☑	☐	Training requirements were known to staff as communicated in Section 3.4 of HASP. Several employees had to receive lead awareness training, and XRF safety training. There was confusion on what radiation awareness training was required by some staff. Training certificates for field staff were included in the HASP.

Arcadis and subcontractor personnel have relevant training records and/or certifications and medical surveillance clearance records onsite.	☐	☑	Training records were included in the field book. However, medical surveillance records were not included.
Hazard Recognition			
Employees are using TRACK and they can describe how they are applying TRACK for assigned tasks.	☑	☐	There were discussions on TRACK during tail gate meetings and during site inspections in remote portions of the island
Employees can define Stop Work Authority and how it is applied.	☑	☐	Observed Pause (Stop Work) to remind employee to not walk backwards when setting temporary flag to identify sample location
Solutions implemented as the result of incident, injury or near miss can be verified and validated.	☑	☐	Discussed safety observations, TIPS and near miss reporting. Staff were familiar with process.
Employees can explain how they are combatting fatigue.	☑	☐	SSO discussed fatigue with field team. Area was designated to take water and rest breaks.
Housekeeping efforts are being conducted onsite and staff understand the purpose.	☑	☐	Area was designated where trash would be stored. General trash (lunch containers, water bottles, etc) was separated from IDW.
Work zones/exclusion zones are clearly identified.	☑	☐	Site is remote with no access to visitors. Area was designated to process XRF samples. No other delineators/work zone demarcation was considered necessary.
Is the exclusion zone appropriately sized for the work being conducted/surroundings?	☑	☐	Remote island. No access to public/visitors.
Appropriate measures have been taken to ensure the personal security of project employees.	☑	☐	Remote island; buddy system; equipment can be secured in locked building.
Staff can identify major hazards associated with the project and as well as appropriate controls.	☑	☐	Additional training should be provided for recognition of poison oak. Staff could recognize other hazards.
PPE			
A PPE Hazard Assessment has been completed by a qualified person during the planning phase hazard analysis.	☑	☐	Performed during HASP development. SSO did not require use of hard hats in open areas and discussed with PM.
Employees are wearing PPE in accordance with the JSA and appropriate for associated hazards.	☑	☐	Observed good use of gloves and other PPE.
Employees are trained on PPE hazard assessments, PPE selection, how to properly don PPE, PPE maintenance, and PPE disposal.	☑	☐	standard level D PPE.
Emergency Response			
Employees know what to do in the even of an emergency.	☑	☐	Emergency procedures and meet up location was communicated during tailgate.
Emergency drills are being conducted at the site at least annually and documented?	☐	☑	No applicable. No emergency drills have been scheduled as part of this phase of work.
Employees are provided with means to communicate in the event of an emergency.	☑	☐	Cell phones were operational. Additionally, due to remote location on island a satellite phone was available in the event that cell phone coverage was not available due to unforeseeable condition.
Emergency information is posted in appropriate locations.	☑	☐	Emergency information is available in HASP.
WorkCare phone number is available and staff are informed of what WorkCare is and how it should be used.	☑	☐	Work care phone number was available.
Emergency Equipment is available, including first aid kits, fire extinguishers, eye wash, etc.	☑	☐	emergency equipment was available at field station (at Tent)
If required by the HASP, a designated onsite employee is First Aid/CPR/BBP trained and current.	☑	☐	All field team members have first aid/CPR training. Certificates were kept in field book.
Vehicle/Driving Safety			
Smith System Driving techniques are being used by project employees.	☑	☐	Discussed driving safety including use of Smith System. JSA for driving was reviewed.
Appropriate vehicle size for the task being performed. (i.e., do not accept "upgrades" from rental agencies)	☑	☐	All four field staff drove in rental van. This van was selected in consideration of number of passengers and ability to store equipment while maintaining visibility out of the back window. In talking with SSO, this was a lesson learned from previous project where visibility was poor due to selection of inappropriate rental vehicle.
Staff understand the "Three Feet for Safety" rule (3 ft. safety cushion when operating vehicles).	☑	☐	Discussed with SSO
360-degree walk arounds (GOAL) being conducted prior to driving?	☑	☐	Discussed with SSO

Spotters are used when backing or when operating vehicles/equipment within 3 ft. of stationary objects (even at low speeds).	☑	☐	Discussed with SSO
Overnight accommodations are within a reasonable distance to and from the site.	☑	☐	Field team is staying locally in Anacortes tom minimize travel time to marina. Staff will be transported to and from island each day. Discussed need for lighting in the event that water taxi arrives late. Multiple flashlights are available if needed.
Cargo is properly secured in passenger compartments as well as open beds of trucks or trailers.	☑	☐	To minimize transportation of gear (and additional lifting/handling), equipment will be left in secure (locked) area at site if possible. All equipment will be removed at time of final demobilization.
HazMat			
SDS are available for chemicals onsite. Employees understand the purpose of SDS and how to utilize them.	☑	☐	SDS information is in HASP
There is a plan in place for the appropriate transportation and/or shipping of hazardous materials per US DOT.	☑	☐	Shipping paperwork was available. Team will keep IDW on-site following appropriate analytical testing and/or waste determination.
Employees handling or shipping HAZMAT have the required training.	☑	☐	Field staff have received training.
Employees are completing shipping determinations for all environmental shipments.	☑	☐	Yes.
Hazardous materials onsite are stored appropriately in a designated area.	☑	☐	IDW will be stored at designated area (discussed with NWSS beforehand)pending waste determination.
Hazardous materials stored onsite are labeled appropriately.	☑	☐	SSO indicated that IDW will be labelled as appropriate.
Drums containing petroleum are fitted with a drum vent to release pressure.	☐	☐	No drums of IDW will be generated as part of this work.
Preventing Serious Injuries and Fatalities			
Field crew incorporated the Preventing Serious Injuries and Fatalities (SIF) field guide during tailgate meeting or other time during day.	☐	☐	Chevron specific - not applicable. However, hazards were discussed during tailgate.
Field crew is able to identify tasks that could lead to SIF and associated hazards/mitigations.	☑	☐	Discussed hazard mitigation
Staff can identify human performance factors that affect their work, and explain the preventive actions they are taking to reduce those risks and achieve incident-free operations.	☑	☐	Discussed with field staff.
Work Zone Safety			
Does the team have a Traffic Control Plan?	☐	☐	No TCP is necessary. Remote island, no roads or vehicle access.
Is the team assessing and addressing changes to the TCP and JSAs based on existing traffic conditions?	☐	☐	No traffic at site
Is the team establishing work zones based upon Chevron’s Traffic Control Risk Matrix that defines the level of traffic control required?	☐	☐	Not applicable. No traffic.
Is emergency equipment located in close proximity to the work zone? All equipment easily accessible?	☐	☐	Emergency equipment is located at staging area (at tent)
Is the established traffic control appropriate for the conditions?	☐	☐	Not applicable. No traffic.
Additional Comments			
Comments:	☑	☐	Overall, the team was very engaged and taking safety very seriously. There was good communication and the team was using the buddy system effectively. The site has unique challenges and team needs to continue to make safety the top priority .
Comments:	☐	☐	
Comments:	☐	☐	

TIP Summary

TIP Summary	
Discussion following the TIP lead by	Annis, Matthew Robert
Date of follow-up discussion	11/13/2018 12:00:00 AM

Positive Comments	Burrows Island is a unique location on a remote island accessible only by boat or helicopter. The team spent considerable effort in planning for this visit and this planning paid off with a successful mobilization. Team was diligent in ensuring they had proper training despite some initial confusion on requirements for OSHA 8 hour supervisors training. Good use of stop work authority and buddy system when employee was reminded to not walk backwards while marking out sampling locations. XRF sampling chamber was excellent example of ALARA principal to keep exposure to ionizing radiation as low as reasonably achievable.
Discussion Summary Completed	Supervisor Led
Summary of Questionable Items	Training records - initial confusion on training requirements for OSHA 8 hour training and how to obtain Arcadis Radiation Safety Training. Records of medical surveillance were not available (although other training records were available).

Action Items

Responsible Person		Action Item
Employee: **Due Date:** **Completed Date:**	022656 (McCullough, Paul T) 01/03/2019 11/30/2018	Communicate OSHA 8-hour supervisor training requirements to other Seattle field staff to avoid potential future misunderstandings on requirements.

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Haslam, Kyle D Reviewer Approve 11/20/2018	Thorough TIP that truly captured the level of effort that the office and field teams contributed to see this project completed safely. I agree that all of us could do a better job of ensuring we understand all client, Arcadis, and government requirements (training in this instance) well before mobilizing to the job site. Luckily we were able to respond in time to keep project schedule on track. Suggest a revision to the TIP that shows both boxes as unchecked on the line item regarding emergency drills, as this is not applicable, not questionable.
Employee: **Role** **Review Type** **Completed Date**	Gravenmier, Josh J Quality Reviewer NA 12/3/2018	Thanks for performing the stewardship TIP! In the future, the TIP discussion and review should include the PM. I am glad that the OSHA 8 hour supervisor training requirement is a lesson learned bigger than this project. However, the OSHA 8 hour supervisor training was identified as required during development of project HASP (finalized 10/22) and then reiterated during the project kickoff meeting (11/8) so there was ample time to ask questions and obtain the training prior to the kickoff call, where the confusion was identified.

Task Improvement Process: H&S - Project Assessment Checklist

General

TIP ID	62239	**Status**	(5) Completed
Observation Type	Supervisor(includes PM, TM, or other senior mgr) to Employee	**Observation Date**	11/8/2018 12:00:00 AM
TIP Form	H&S - Project Assessment Checklist		
Task Observed	Burrows Island Mobilization #1 Field Kickoff meeting. XRF Screening and Site Reconnaissance		
Equipment On Site	Discussing field event that will include: XRF, GPS, PID, cameras, tablet, and hand trowels.		
Pertinent Information	objectives of mobilization #1 include: - ID locations of all existing and historic site features to the extent that these locations can be visually identified in the field. - photo document study area - ID areas of visual contamination - ID approximate depth to bedrock - visually assess conditions of painted structures (chipping, flaking, etc.) - ID areas where soil sampling is not practicable or is unsafe - perform XRF screening (surface and subsurface if elevated at surface) - collect soils samples for lead with a range of XRF concentrations to calibrate readings		

Client / Project

Client	US Coast Guard
Project Number	B00030100006
Project Name	BURROWS REMEDIAL INVESTIGATION
PIC	SCLAFANI, TROY
Project Manager	GRAVENMIER, JOSH

User Roles

Role Name	Employee Name	Due Date	Completed Date	Supervisor Name	Active
Created By	Gravenmier, Josh J	11/29/2018	11/12/2018	Demetrios, Ginna E	☑
Feedback By	Gravenmier, Josh J	11/08/2018	11/08/2018	Demetrios, Ginna E	☑
Observee	Gravenmier, Josh J	11/08/2018	11/08/2018	Demetrios, Ginna E	☑
Observee Supervisor	Gravenmier, Josh J	11/29/2018	11/12/2018	Demetrios, Ginna E	☑
Observer	Ullery, Mark	11/29/2018	11/12/2018	Orchard Aragon, Barbara C	☑
Quality Reviewer	Gravenmier, Josh J	12/03/2018	12/03/2018	Demetrios, Ginna E	☑
Responsible Person	Ullery, Mark	11/12/2018	11/12/2018	Orchard Aragon, Barbara C	☑
Reviewer	Sclafani, Troy S.	12/26/2018	11/15/2018	Rubis, Terri L.	☑

Observations

Task Type / Observation	Correct	Questionable	Comments
General questions			
1. Does the project have a Health and Safety Plan (HASP)?	☑	☐	Dated 10/22/2018
2. Did the PM participate in the hazard analysis process, and can PM identify the major hazards and how they are controlled?	☑	☐	Yes I did.
3. Does the project have a Health and Safety Plan (HASP) that has been reviewed annually? Is a current copy located at the project site?	☑	☐	Yes.
4. Does the HASP have relevant and detailed JSAs?	☑	☐	Reviewed during meeting.
5. Has the PM or H&S Department conducted any H&S assessments on the project? If so, were solutions addressed and corrective actions implemented?	☑	☐	Stewardship TIP performed during previous field event at site in 2015. The TIP was reviewed.
6. Have TIPs been done, or have any been planned for upcoming work?	☑	☐	3 TIPs and 1 near miss planned.
Projects Involving Active Field Work			
7. Has staff been provided appropriate PPE for the job?	☑	☐	Yes.
8. Has the PM verified that tailgate safety meetings are conducted, and periodically reviewed completed copies of the forms?	☑	☐	Paul McCullough will perform a site stewardship visit on day 1 of the field event.
9. Is work intrusive requiring utility clearance? If so, what activities have been completed to ensure proper utility clearance according to ARCADIS policy?	☑	☐	Utility clearance checklist completed. Utilities to be added to sampling maps.

10. Will work be close to traffic such that a traffic control plan is required, and if so has one been completed?	☐	☐	NA.
Projects with ARCADIS-contracted subcontractors			
11. Are ARCADIS subcontractors included in the H&S process (participating in tailgate meetings, have input on hazard recognition, etc.)?	☐	☐	NA.
12. Have ARCADIS subcontractors been provided a copy of our HASP so they are aware of the minimum H&S requirements?	☐	☐	NA.
Misc items identified during assessment			
13. Other	☐	☑	During review of the training it was identified that the SSO did not have the required Hazwoper 8-hour supervisor training.
14. Other	☐	☐	
15. Other	☐	☐	

TIP Summary

TIP Summary	
Discussion following the TIP lead by	Gravenmier, Josh J
Date of follow-up discussion	11/8/2018 12:00:00 AM
Positive Comments	Team is experienced and well prepared for the task. The mobilization field memo was used to provide high level review of the H&S requirements and the tasks to be performed. Kickoff call included all field staff.
Discussion Summary Completed	Supervisor Led
Summary of Questionable Items	During review of the training requirements we discovered that the SSO did not have the required Hazwoper supervisor training.

Action Items

Responsible Person		**Action Item**
Employee: **Due Date:** **Completed Date:**	020772 (Ullery, Mark) 11/12/2018 11/12/2018	Complete the Hazwoper supervisor training prior to the field event.

Review Comments

Reviewer		**Comments**
Employee: **Role** **Review Type** **Completed Date**	Sclafani, Troy S. Reviewer Approve 11/15/2018	Great TIP. Good details and comments in each observation - precisely how it should be done. Good catch on the SSO needing Supervisor training - very important. Presumably it has also been verified and documented that all site staff are current on Hazwoper refresher and medical surveillance since there is high lead concentrations on the island. Well done.
Employee: **Role** **Review Type** **Completed Date**	Gravenmier, Josh J Quality Reviewer NA 12/3/2018	Thanks for performing the stewardship TIP! In the future, the TIP discussion and review should include the PM. I am glad that the OSHA 8 hour supervisor training requirement is a lesson learned bigger than this project. However, the OSHA 8 hour supervisor training was identified as required during development of project HASP (finalized 10/22) and then reiterated during the project kickoff meeting (11/8) so there was ample time to ask questions and obtain the training prior to the kickoff call, where the confusion was identified.

Near Miss

General

INV ID	19745	**Status**	(5) Completed
Loss Type	Near Miss	**Completed Date**	01/15/2019
Reported By	020772 (Ullery, Mark)		
Incident Date & Time	11/15/2018 2:00:00 PM		
Incident Address	Burrows Island Light Station Anacortes, WA 98222 US		
Location Name	CONCORD, CA		
Work Type Name	Surveying-land		
Hazard Type	Gravity		
Incident Description	While surveying the boundary of one of the former buildings at the Burrows Island site, Kyle stepped into an unmarked hole that was covered with vegetation. Although he was not injured as a result, there is a high likelihood that he or someone else could have been hurt by stepping into the hole, which was not readily visible. In addition, Kyle was operating a tablet and GPS device which likely distracted his focus from looking where he was walking.		

Client / Project

Client	US Coast Guard
Project Number	B00030100006
Project Name	BURROWS REMEDIAL INVESTIGATION
PIC	SCLAFANI, TROY
Project Manager	GRAVENMIER, JOSH

Involved /Witness

Employees Involved / Witness

Role	Employee	Involved	Witness	Due Date	Completed Date	Active Employee
Involved / Witness	Haslam, Kyle D	☑	☑	11/22/2018	11/20/2018	☑
Reported By	Ullery, Mark	☐	☑	11/27/2018	11/20/2018	☑

Investigation Team

Role	Employee	Investigation Team	Due Date	Completed Date	Active Employee
Investigation Team	Franz, Kelsey Lee	☑	12/15/2018	11/20/2018	☑
Investigation Team	Gravenmier, Josh J	☑	12/15/2018	11/20/2018	☑
Investigation Team	McCullough, Paul T	☑	12/15/2018	11/20/2018	☑
Investigation Team	Vidonish, Julia Elizabeth	☑	12/15/2018	11/20/2018	☑
Involved / Witness	Haslam, Kyle D	☑	11/22/2018	11/20/2018	☑
Reported By	Ullery, Mark	☑	11/27/2018	11/20/2018	☑

Reviewers

Role	Employee	Due Date	Completed Date	Active Employee
Reviewer	Gravenmier, Josh J	12/11/2018	11/21/2018	☑
Reviewer	McCullough, Paul T	12/11/2018	12/03/2018	☑

Root Cause

Root Cause(s) of the Near Miss

The root cause was likely not understanding the risk of encountering holes or other voids in the work area. In addition, TRACK was not properly used and the tablet and GPS likely provided additional distractions that kept focus away from the walking path.

Categorize Root Causes

Applies	Primary	Root Cause Factor
		Training / Competency
☑	☑	Did not recognize the risk
☐	☐	Did not have skill, competence, experience, or knowledge
☐	☐	Has not completed required training
☐	☐	Training inadequate or ineffective
		Adherence to Standards, Practices, Expectations
☑	☐	Did not use TRACK, PM or quality tools
☐	☐	Did not use Stop Work Authority

☐	☐	Not familiar with or did not follow standards, procedures (HASP, QA plan, JSA, etc)
☐	☐	Inadequate project planning, including budgeting and scheduling, and/or follow-up review
☐	☐	Behavior encouraged or tolerated with no consequence by supervisor, co-workers, or other parties
☐	☐	Employee or supervisor does not support H&S
☐	☐	Improper use of tools or equipment
		Availability of Standards, Practices, Procedures
☐	☐	No standard, procedure or practice (QA Plan, HASP, JSA, standard)
☐	☐	Inadequate standard, procedure or practice (QA Plan, HASP, JSA, standard)
		Communications
☐	☐	Inadequate management establishment and communication of expectations / culture
☐	☐	Inadequate team communication (i.e., tailgate, kickoff meeting, management of change)
☐	☐	Inadequate communication with client
		Tools/Equipment
☐	☐	Proper tools or equipment unavailable (including software)
☐	☐	Tools or equipment damaged
☐	☐	Tools improperly maintained/calibrated equipment
		Factors out of our Control
☐	☐	Natural Forces - Events outside of human control
☐	☐	Third party out of our control

Resolution

Summary of Actions Taken to Resolve or Correct the Near Miss

Discussed distracted walking and equipment use while walking. Also risks associated with using two pieces of equipment (tablet and beacon). Next time, may select a GPS beacon that could be worn instead of one that required a survey rod.

Action Items

Responsible Person		Action Item
Employee: **Due Date:** **Completed Date:**	017561 (Haslam, Kyle D) 12/31/2018 01/07/2019	Update JSA to include distracted walking or multitasking as a hazard with mitigation.

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Gravenmier, Josh J Reviewer Approve 11/21/2018	Thanks for identifying the near miss and glad the Kyle was not injured! Good discussion on it during the post field event call today and for adding the action item of updating the JSA to address distracted walking so we can learn from this for the next field event.
Employee: **Role** **Review Type** **Completed Date**	McCullough, Paul T Reviewer Approve 12/3/2018	Thanks for reporting the near miss. Root cause was failure to recognize the STF hazard, and could potentially have been mitigated by performing a through inspection of the walking area to establish safe path to travel. Action item to update JSA is appropriate.

Near Miss

General

INV ID	19725	**Status**	(5) Completed
Loss Type	Near Miss	**Completed Date**	12/03/2018
Reported By	024239 (Franz, Kelsey Lee)		
Incident Date & Time	11/15/2018 1:00:00 PM		
Incident Address	Burrows Island Anacortes, WA 98221 US		
Location Name	CONCORD, CA		
Work Type Name	Soil sampling/well installation-manual		
Hazard Type	Gravity		
Incident Description	There was a piece of painted plywood lying on the ground next to the duplex which Julia and Kelsey both slipped on. The plywood was clearly visible and slightly wet due to earlier rain. Julia slipped on the wood earlier and mentioned it to Kelsey, Kyle, and Mark. Neither Julia nor Kelsey suffered any injury from slipping on the plywood. Mark and Kelsey flipped the plywood on its side and leaned it against a tree to remove the slipping hazard.		

Client / Project

Client	US Coast Guard
Project Number	B00030100006
Project Name	BURROWS REMEDIAL INVESTIGATION
PIC	SCLAFANI, TROY
Project Manager	GRAVENMIER, JOSH

Involved /Witness

Employees Involved / Witness

Role	Employee	Involved	Witness	Due Date	Completed Date	Active Employee
Involved / Witness	Ullery, Mark	☐	☑	11/22/2018	11/20/2018	☑
Involved / Witness	Vidonish, Julia Elizabeth	☑	☐	11/22/2018	11/20/2018	☑
Reported By	Franz, Kelsey Lee	☑	☐	11/26/2018	11/20/2018	☑

Investigation Team

Role	Employee	Investigation Team	Due Date	Completed Date	Active Employee
Investigation Team	Haslam, Kyle D	☑	12/15/2018	11/20/2018	☑
Involved / Witness	Ullery, Mark	☑	11/22/2018	11/20/2018	☑
Involved / Witness	Vidonish, Julia Elizabeth	☑	11/22/2018	11/20/2018	☑
Reported By	Franz, Kelsey Lee	☑	11/26/2018	11/20/2018	☑

Reviewers

Role	Employee	Due Date	Completed Date	Active Employee
Reviewer	Gravenmier, Josh J	12/11/2018	11/21/2018	☑
Reviewer	McCullough, Paul T	12/11/2018	12/03/2018	☑

Root Cause

Root Cause(s) of the Near Miss

The hazard was not properly dealt with when initially encountered nor after it caused the first near miss associated with it. Communication was made to the team, but the hazard was not properly mitigated.

Categorize Root Causes

Applies	Primary	Root Cause Factor
		Training / Competency
☐	☐	Did not recognize the risk
☐	☐	Did not have skill, competence, experience, or knowledge
☐	☐	Has not completed required training
☐	☐	Training inadequate or ineffective
		Adherence to Standards, Practices, Expectations
☑	☑	Did not use TRACK, PM or quality tools
☐	☐	Did not use Stop Work Authority
☐	☐	Not familiar with or did not follow standards, procedures (HASP, QA plan, JSA, etc)

☐	☐	Inadequate project planning, including budgeting and scheduling, and/or follow-up review
☐	☐	Behavior encouraged or tolerated with no consequence by supervisor, co-workers, or other parties
☐	☐	Employee or supervisor does not support H&S
☐	☐	Improper use of tools or equipment
		Availability of Standards, Practices, Procedures
☐	☐	No standard, procedure or practice (QA Plan, HASP, JSA, standard)
☐	☐	Inadequate standard, procedure or practice (QA Plan, HASP, JSA, standard)
		Communications
☐	☐	Inadequate management establishment and communication of expectations / culture
☑	☐	Inadequate team communication (i.e., tailgate, kickoff meeting, management of change)
☐	☐	Inadequate communication with client
		Tools/Equipment
☐	☐	Proper tools or equipment unavailable (including software)
☐	☐	Tools or equipment damaged
☐	☐	Tools improperly maintained/calibrated equipment
		Factors out of our Control
☐	☐	Natural Forces - Events outside of human control
☐	☐	Third party out of our control

Resolution

Summary of Actions Taken to Resolve or Correct the Near Miss

Steps to avoid the near-miss in the future include:

- Exercise TRACK
- think "if not me, then who"
- During a site walk, fix hazards that can be remedied
- Take every hazard seriously
- Plan best route

Action Items (Optional): None

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Gravenmier, Josh J Reviewer Approve 11/21/2018	Thanks for identifying the near miss and mitigating the hazard to prevent another slip and potential injury. Going over the near miss during the post field event debrief call yesterday helped in understanding the circumstances better. Not recognizing the risk after the first slip would be the primary factor - see it, own it!
Employee: **Role** **Review Type** **Completed Date**	McCullough, Paul T Reviewer Approve 12/3/2018	Thanks for reporting the near miss and for discussing it with project team. This near miss provides a valuable lesson - if you see something, say something. The root cause was not fully appreciating the potential STF hazard and communicating it with the team. Stop work authority could also have been used in this situation to address the slip hazard when it was initially identified.
Employee: **Role** **Review Type** **Completed Date**	Evanko, Hillary M Quality Reviewer NA 12/31/2018	This kind of simple hazard (housekeeping) is the factor of so many injuries. This is definitely something all employees can take home - take the extra few minutes (and engage another person to help, if needed) to address a housekeeping hazard so that it is no longer a hazard.

Near Miss

General

INV ID	19651	**Status**	(5) Completed
Loss Type	Near Miss	**Completed Date**	01/07/2019
Reported By	022656 (McCullough, Paul T)		
Incident Date & Time	11/13/2018 2:00:00 PM		
Incident Address	Burrows Island Lighthouse Skaggit County (near Anacortes), WA 98221 US		
Location Name	CONCORD, CA		
Work Type Name	Surveying-land		
Hazard Type	Motion		
Incident Description	Employee was marking out soil sampling locations with temporary flags in grid pattern and lost situational awareness while walking backwards with tape measurer to identify next sampling location. Sample area was approximately 30 feet away from steep slope. Employee could have tripped, or if situational awareness was lost closer to slope, employee could have fell and sustained potential injury. Buddy system was being used at the time and coworker stopped employee and discussed safer way to conduct the work. Employee was thankful of the intervention and made appropriate adjustment to safely complete the task.		

Client / Project

Client	US Coast Guard
Project Number	B00030100006
Project Name	BURROWS REMEDIAL INVESTIGATION
PIC	SCLAFANI, TROY
Project Manager	GRAVENMIER, JOSH

Involved /Witness

Employees Involved / Witness

Role	Employee	Involved	Witness	Due Date	Completed Date	Active Employee
Reported By	McCullough, Paul T	☐	☑	11/20/2018	11/14/2018	☑

Investigation Team

Role	Employee	Investigation Team	Due Date	Completed Date	Active Employee
Investigation Team	Haslam, Kyle D	☑	12/13/2018	11/14/2018	☑
Reported By	McCullough, Paul T	☐	11/20/2018	11/14/2018	☑

Reviewers

Role	Employee	Due Date	Completed Date	Active Employee
Reviewer	Ullery, Mark	12/05/2018	01/03/2019	☑

Root Cause

Root Cause(s) of the Near Miss
Root Cause: Employee did not recognize hazard of tripping while focusing on using the tape measurer to set the next flag.

Categorize Root Causes

Applies	Primary	Root Cause Factor
		Training / Competency
☑	☑	Did not recognize the risk
☐	☐	Did not have skill, competence, experience, or knowledge
☐	☐	Has not completed required training
☐	☐	Training inadequate or ineffective
		Adherence to Standards, Practices, Expectations
☑	☐	Did not use TRACK, PM or quality tools
☐	☐	Did not use Stop Work Authority
☐	☐	Not familiar with or did not follow standards, procedures (HASP, QA plan, JSA, etc)
☐	☐	Inadequate project planning, including budgeting and scheduling, and/or follow-up review
☐	☐	Behavior encouraged or tolerated with no consequence by supervisor, co-workers, or other parties
☐	☐	Employee or supervisor does not support H&S
☐	☐	Improper use of tools or equipment

		Availability of Standards, Practices, Procedures
☐	☐	No standard, procedure or practice (QA Plan, HASP, JSA, standard)
☐	☐	Inadequate standard, procedure or practice (QA Plan, HASP, JSA, standard)
		Communications
☐	☐	Inadequate management establishment and communication of expectations / culture
☐	☐	Inadequate team communication (i.e., tailgate, kickoff meeting, management of change)
☐	☐	Inadequate communication with client
		Tools/Equipment
☐	☐	Proper tools or equipment unavailable (including software)
☐	☐	Tools or equipment damaged
☐	☐	Tools improperly maintained/calibrated equipment
		Factors out of our Control
☐	☐	Natural Forces - Events outside of human control
☐	☐	Third party out of our control

Resolution

Summary of Actions Taken to Resolve or Correct the Near Miss

Discuss near miss with project team and during safety moments with others. Use this near miss to reinforce use of Track, buddy system, and importance of maintaining situational awareness at all times (keep safety and health first in all things).

Action Items

Responsible Person		Action Item
Employee: **Due Date:** **Completed Date:**	023933 (Vidonish, Julia Elizabeth) 01/10/2019 01/07/2019	Provide lessons learned from this near miss in a safety moment with Burrows Team.

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Ullery, Mark Reviewer Approve 1/3/2019	Good capture of a minor incident that certainly could have become a much larger issue given the remoteness of the site.

Near Miss

General

INV ID	17974	**Status**	(5) Completed
Loss Type	Near Miss	**Completed Date**	07/02/2018
Reported By	020111 (Olechiw, Theresa Z)		
Incident Date & Time	6/3/2018 1:00:00 PM		
Incident Address	Poverty Island Fairbanks Township, MI 49835 US		
Location Name	NOVI, MI		
Work Type Name	Water work and boating		
Hazard Type	Personal Safety		
Incident Description	The USCG Poverty Island project required the Team to mobilize by Charter Boat to the site which is an island in Lake Michigan which no longer contains a dock. The charter boat captain proposed to use his dinghy to transport the staff and equipment from his 33 foot former Navy vessel to the rocky shore of the island. After an initial kick off meeting the Team reviewed the process for transporting people and equipment from the charter boat onto the island and determined that the proposed dingy was too small, unstable and would require an excessive amount of trips to unload. This task was determined to be one of the highest risk of the project. The boat captain was contacted and was asked to provide an alternative means of access. An aluminum boat with motor was rented for this task. The Team was able to unload staff and all the equipment in three trips in a safe manner. It was confirmed after the project was completed that the dingy would not have functioned as needed.		

Client / Project

Client	US Coast Guard
Project Number	MI0010210001
Project Name	USCG Poverty Island Site Inves
PIC	SCLAFANI, TROY
Project Manager	ZELLMER, GREGORY

Involved /Witness

Employees Involved / Witness

Role	Employee	Involved	Witness	Due Date	Completed Date	Active Employee
Involved / Witness	Alessi, Timothy G	☐	☑	06/10/2018	06/08/2018	☑
Involved / Witness	Barton, Colleen O'Shea	☐	☑	06/10/2018	06/08/2018	☑
Involved / Witness	VanDenBerge, Kristen Hope	☐	☑	06/10/2018	06/08/2018	☑
Involved / Witness	Westhuis, Austin W.	☐	☑	06/10/2018	06/08/2018	☑
Reported By	Olechiw, Theresa Z	☑	☐	06/10/2018	06/08/2018	☑

Investigation Team

Role	Employee	Investigation Team	Due Date	Completed Date	Active Employee
Investigation Supervisor	Zellmer, Gregory E	☑	06/10/2018	06/08/2018	☑
Involved / Witness	Alessi, Timothy G	☐	06/10/2018	06/08/2018	☑
Involved / Witness	Barton, Colleen O'Shea	☑	06/10/2018	06/08/2018	☑
Involved / Witness	VanDenBerge, Kristen Hope	☐	06/10/2018	06/08/2018	☑
Involved / Witness	Westhuis, Austin W.	☐	06/10/2018	06/08/2018	☑
Reported By	Olechiw, Theresa Z	☐	06/10/2018	06/08/2018	☑

Reviewers

Role	Employee	Due Date	Completed Date	Active Employee
Reviewer	Zellmer, Gregory E	06/29/2018	07/02/2018	☑

Root Cause

Root Cause(s) of the Near Miss
Unfamiliarity with the size and type of dingy to be used.

Categorize Root Causes

Applies	Primary	Root Cause Factor
		Training / Competency
☐	☐	Did not recognize the risk
☑	☐	Did not have skill, competence, experience, or knowledge

☐	☐	Has not completed required training
☐	☐	Training inadequate or ineffective
		Adherence to Standards, Practices, Expectations
☐	☐	Did not use TRACK, PM or quality tools
☐	☐	Did not use Stop Work Authority
☐	☐	Not familiar with or did not follow standards, procedures (HASP, QA plan, JSA, etc)
☐	☐	Inadequate project planning, including budgeting and scheduling, and/or follow-up review
☐	☐	Behavior encouraged or tolerated with no consequence by supervisor, co-workers, or other parties
☐	☐	Employee or supervisor does not support H&S
☐	☐	Improper use of tools or equipment
		Availability of Standards, Practices, Procedures
☑	☑	No standard, procedure or practice (QA Plan, HASP, JSA, standard)
☐	☐	Inadequate standard, procedure or practice (QA Plan, HASP, JSA, standard)
		Communications
☐	☐	Inadequate management establishment and communication of expectations / culture
☐	☐	Inadequate team communication (i.e., tailgate, kickoff meeting, management of change)
☐	☐	Inadequate communication with client
		Tools/Equipment
☐	☐	Proper tools or equipment unavailable (including software)
☐	☐	Tools or equipment damaged
☐	☐	Tools improperly maintained/calibrated equipment
		Factors out of our Control
☐	☐	Natural Forces - Events outside of human control
☐	☐	Third party out of our control

Resolution

Summary of Actions Taken to Resolve or Correct the Near Miss

The aluminum boat was substituted for the dinghy providing a save means of landing on the island.

Action Items (Optional): None

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Zellmer, Gregory E Reviewer Approve 7/2/2018	This was an excellent example of the team working together asking the appropriate questions and coming up with a safe solution.

Near Miss

General

INV ID	17974	**Status**	(5) Completed
Loss Type	Near Miss	**Completed Date**	07/02/2018
Reported By	020111 (Olechiw, Theresa Z)		
Incident Date & Time	6/3/2018 1:00:00 PM		
Incident Address	Poverty Island Fairbanks Township, MI 49835 US		
Location Name	NOVI, MI		
Work Type Name	Water work and boating		
Hazard Type	Personal Safety		
Incident Description	The USCG Poverty Island project required the Team to mobilize by Charter Boat to the site which is an island in Lake Michigan which no longer contains a dock. The charter boat captain proposed to use his dinghy to transport the staff and equipment from his 33 foot former Navy vessel to the rocky shore of the island. After an initial kick off meeting the Team reviewed the process for transporting people and equipment from the charter boat onto the island and determined that the proposed dingy was too small, unstable and would require an excessive amount of trips to unload. This task was determined to be one of the highest risk of the project. The boat captain was contacted and was asked to provide an alternative means of access. An aluminum boat with motor was rented for this task. The Team was able to unload staff and all the equipment in three trips in a safe manner. It was confirmed after the project was completed that the dingy would not have functioned as needed.		

Client / Project

Client	US Coast Guard
Project Number	MI0010210001
Project Name	USCG Poverty Island Site Inves
PIC	SCLAFANI, TROY
Project Manager	ZELLMER, GREGORY

Involved /Witness

Employees Involved / Witness

Role	Employee	Involved	Witness	Due Date	Completed Date	Active Employee
Involved / Witness	Alessi, Timothy G	☐	☑	06/10/2018	06/08/2018	☑
Involved / Witness	Barton, Colleen O'Shea	☐	☑	06/10/2018	06/08/2018	☑
Involved / Witness	VanDenBerge, Kristen Hope	☐	☑	06/10/2018	06/08/2018	☑
Involved / Witness	Westhuis, Austin W.	☐	☑	06/10/2018	06/08/2018	☑
Reported By	Olechiw, Theresa Z	☑	☐	06/10/2018	06/08/2018	☑

Investigation Team

Role	Employee	Investigation Team	Due Date	Completed Date	Active Employee
Investigation Supervisor	Zellmer, Gregory E	☑	06/10/2018	06/08/2018	☑
Involved / Witness	Alessi, Timothy G	☐	06/10/2018	06/08/2018	☑
Involved / Witness	Barton, Colleen O'Shea	☑	06/10/2018	06/08/2018	☑
Involved / Witness	VanDenBerge, Kristen Hope	☐	06/10/2018	06/08/2018	☑
Involved / Witness	Westhuis, Austin W.	☐	06/10/2018	06/08/2018	☑
Reported By	Olechiw, Theresa Z	☐	06/10/2018	06/08/2018	☑

Reviewers

Role	Employee	Due Date	Completed Date	Active Employee
Reviewer	Zellmer, Gregory E	06/29/2018	07/02/2018	☑

Root Cause

Root Cause(s) of the Near Miss
Unfamiliarity with the size and type of dingy to be used.

Categorize Root Causes

Applies	Primary	Root Cause Factor
		Training / Competency
☐	☐	Did not recognize the risk
☑	☐	Did not have skill, competence, experience, or knowledge

☐	☐	Has not completed required training
☐	☐	Training inadequate or ineffective
		Adherence to Standards, Practices, Expectations
☐	☐	Did not use TRACK, PM or quality tools
☐	☐	Did not use Stop Work Authority
☐	☐	Not familiar with or did not follow standards, procedures (HASP, QA plan, JSA, etc)
☐	☐	Inadequate project planning, including budgeting and scheduling, and/or follow-up review
☐	☐	Behavior encouraged or tolerated with no consequence by supervisor, co-workers, or other parties
☐	☐	Employee or supervisor does not support H&S
☐	☐	Improper use of tools or equipment
		Availability of Standards, Practices, Procedures
☑	☑	No standard, procedure or practice (QA Plan, HASP, JSA, standard)
☐	☐	Inadequate standard, procedure or practice (QA Plan, HASP, JSA, standard)
		Communications
☐	☐	Inadequate management establishment and communication of expectations / culture
☐	☐	Inadequate team communication (i.e., tailgate, kickoff meeting, management of change)
☐	☐	Inadequate communication with client
		Tools/Equipment
☐	☐	Proper tools or equipment unavailable (including software)
☐	☐	Tools or equipment damaged
☐	☐	Tools improperly maintained/calibrated equipment
		Factors out of our Control
☐	☐	Natural Forces - Events outside of human control
☐	☐	Third party out of our control

Resolution

Summary of Actions Taken to Resolve or Correct the Near Miss

The aluminum boat was substituted for the dinghy providing a save means of landing on the island.

Action Items (Optional): None

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Zellmer, Gregory E Reviewer Approve 7/2/2018	This was an excellent example of the team working together asking the appropriate questions and coming up with a safe solution.

Near Miss

General

INV ID	17975	**Status**	(5) Completed
Loss Type	Near Miss	**Completed Date**	06/13/2018
Reported By	020111 (Olechiw, Theresa Z)		
Incident Date & Time	6/3/2018 5:00:00 PM		
Incident Address	Poverty Island Banks TOwnship , MI 49835 US		
Location Name	NOVI, MI		
Work Type Name	Other		
Hazard Type	Personal Safety		
Incident Description	The USCG Poverty Island Team had planned to camp on the island in case of high winds which made transportation from the island to dangerous. The Team had planned for several methods of communication with the associate project manager (APM). Once the APM realized that the Team was staying on the island, she realized she did not have a means of contacting the Team members families. Fortunately the Team was able to reach out to they families by Satellite phone.		

Client / Project

Client	US Coast Guard
Project Number	MI0010210001
Project Name	USCG Poverty Island Site Inves
PIC	SCLAFANI, TROY
Project Manager	ZELLMER, GREGORY

Involved /Witness

Employees Involved / Witness

Role	Employee	Involved	Witness	Due Date	Completed Date	Active Employee
Involved / Witness	Alessi, Timothy G	☑	☑	06/18/2018	06/12/2018	☑
Involved / Witness	Barton, Colleen O'Shea	☑	☑	06/18/2018	06/12/2018	☑
Involved / Witness	VanDenBerge, Kristen Hope	☑	☑	06/18/2018	06/12/2018	☑
Involved / Witness	Westhuis, Austin W.	☑	☑	06/18/2018	06/12/2018	☑
Reported By	Olechiw, Theresa Z	☑	☐	06/18/2018	06/12/2018	☑

Investigation Team

Role	Employee	Investigation Team	Due Date	Completed Date	Active Employee
Involved / Witness	Alessi, Timothy G	☐	06/18/2018	06/12/2018	☑
Involved / Witness	Barton, Colleen O'Shea	☑	06/18/2018	06/12/2018	☑
Involved / Witness	VanDenBerge, Kristen Hope	☐	06/18/2018	06/12/2018	☑
Involved / Witness	Westhuis, Austin W.	☐	06/18/2018	06/12/2018	☑
Reported By	Olechiw, Theresa Z	☑	06/18/2018	06/12/2018	☑

Reviewers

Role	Employee	Due Date	Completed Date	Active Employee
Reviewer	Zellmer, Gregory E	07/03/2018	06/13/2018	☑

Root Cause

Root Cause(s) of the Near Miss

The Team had no experience with an remote overnight. While prepared with adequate equipment and supplies and a communication plan within the company, consideration to expand that communication to their families was not discussed as a Team.

Categorize Root Causes

Applies	Primary	Root Cause Factor
		Training / Competency
☑	☑	Did not recognize the risk
☐	☐	Did not have skill, competence, experience, or knowledge
☐	☐	Has not completed required training
☐	☐	Training inadequate or ineffective
		Adherence to Standards, Practices, Expectations
☐	☐	Did not use TRACK, PM or quality tools

☐	☐	Did not use Stop Work Authority
☐	☐	Not familiar with or did not follow standards, procedures (HASP, QA plan, JSA, etc)
☐	☐	Inadequate project planning, including budgeting and scheduling, and/or follow-up review
☐	☐	Behavior encouraged or tolerated with no consequence by supervisor, co-workers, or other parties
☐	☐	Employee or supervisor does not support H&S
☐	☐	Improper use of tools or equipment
		Availability of Standards, Practices, Procedures
☐	☐	No standard, procedure or practice (QA Plan, HASP, JSA, standard)
☑	☐	Inadequate standard, procedure or practice (QA Plan, HASP, JSA, standard)
		Communications
☑	☐	Inadequate management establishment and communication of expectations / culture
☐	☐	Inadequate team communication (i.e., tailgate, kickoff meeting, management of change)
☐	☐	Inadequate communication with client
		Tools/Equipment
☐	☐	Proper tools or equipment unavailable (including software)
☐	☐	Tools or equipment damaged
☐	☐	Tools improperly maintained/calibrated equipment
		Factors out of our Control
☑	☐	Natural Forces - Events outside of human control
☐	☐	Third party out of our control

Resolution

Summary of Actions Taken to Resolve or Correct the Near Miss

The Team should have left an emergency contact list with the APM and their families so that updates could have been provided by the APM to the families and then the families had someone to reach out to with questions.

Action Items (Optional): None

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Zellmer, Gregory E Reviewer Revise 6/11/2018	Recommended changes: change "No standard, procedure or practice (QA Plan, HASP, JSA, standard)" to "Inadequate standard, procedure or practice..." - we had a standard in place, just did not include family; remove "Inadequate management establishment and communication of expectations / culture" as primary - you can keep it as applies; add did not recognize the risk - that should be the primary as we had a good plan in place just didn't recognize the family communications aspect until it came up.
Employee: **Role** **Review Type** **Completed Date**	Zellmer, Gregory E Reviewer Approve 6/13/2018	
Employee: **Role** **Review Type** **Completed Date**	Bean, Scott Quality Reviewer NA 6/26/2018	Contingency planning is key especially in situations where resources and communications are limited. Good job identifying the risk and learning from the experience.

Near Miss

General

INV ID	17975	**Status**	(5) Completed
Loss Type	Near Miss	**Completed Date**	06/13/2018
Reported By	020111 (Olechiw, Theresa Z)		
Incident Date & Time	6/3/2018 5:00:00 PM		
Incident Address	Poverty Island Banks TOwnship , MI 49835 US		
Location Name	NOVI, MI		
Work Type Name	Other		
Hazard Type	Personal Safety		
Incident Description	The USCG Poverty Island Team had planned to camp on the island in case of high winds which made transportation from the island to dangerous. The Team had planned for several methods of communication with the associate project manager (APM). Once the APM realized that the Team was staying on the island, she realized she did not have a means of contacting the Team members families. Fortunately the Team was able to reach out to they families by Satellite phone.		

Client / Project

Client	US Coast Guard
Project Number	MI0010210001
Project Name	USCG Poverty Island Site Inves
PIC	SCLAFANI, TROY
Project Manager	ZELLMER, GREGORY

Involved /Witness

Employees Involved / Witness

Role	Employee	Involved	Witness	Due Date	Completed Date	Active Employee
Involved / Witness	Alessi, Timothy G	☑	☑	06/18/2018	06/12/2018	☑
Involved / Witness	Barton, Colleen O'Shea	☑	☑	06/18/2018	06/12/2018	☑
Involved / Witness	VanDenBerge, Kristen Hope	☑	☑	06/18/2018	06/12/2018	☑
Involved / Witness	Westhuis, Austin W.	☑	☑	06/18/2018	06/12/2018	☑
Reported By	Olechiw, Theresa Z	☑	☐	06/18/2018	06/12/2018	☑

Investigation Team

Role	Employee	Investigation Team	Due Date	Completed Date	Active Employee
Involved / Witness	Alessi, Timothy G	☐	06/18/2018	06/12/2018	☑
Involved / Witness	Barton, Colleen O'Shea	☑	06/18/2018	06/12/2018	☑
Involved / Witness	VanDenBerge, Kristen Hope	☐	06/18/2018	06/12/2018	☑
Involved / Witness	Westhuis, Austin W.	☐	06/18/2018	06/12/2018	☑
Reported By	Olechiw, Theresa Z	☑	06/18/2018	06/12/2018	☑

Reviewers

Role	Employee	Due Date	Completed Date	Active Employee
Reviewer	Zellmer, Gregory E	07/03/2018	06/13/2018	☑

Root Cause

Root Cause(s) of the Near Miss

The Team had no experience with an remote overnight. While prepared with adequate equipment and supplies and a communication plan within the company, consideration to expand that communication to their families was not discussed as a Team.

Categorize Root Causes

Applies	Primary	Root Cause Factor
		Training / Competency
☑	☑	Did not recognize the risk
☐	☐	Did not have skill, competence, experience, or knowledge
☐	☐	Has not completed required training
☐	☐	Training inadequate or ineffective
		Adherence to Standards, Practices, Expectations
☐	☐	Did not use TRACK, PM or quality tools

☐	☐	Did not use Stop Work Authority
☐	☐	Not familiar with or did not follow standards, procedures (HASP, QA plan, JSA, etc)
☐	☐	Inadequate project planning, including budgeting and scheduling, and/or follow-up review
☐	☐	Behavior encouraged or tolerated with no consequence by supervisor, co-workers, or other parties
☐	☐	Employee or supervisor does not support H&S
☐	☐	Improper use of tools or equipment
		Availability of Standards, Practices, Procedures
☐	☐	No standard, procedure or practice (QA Plan, HASP, JSA, standard)
☑	☐	Inadequate standard, procedure or practice (QA Plan, HASP, JSA, standard)
		Communications
☑	☐	Inadequate management establishment and communication of expectations / culture
☐	☐	Inadequate team communication (i.e., tailgate, kickoff meeting, management of change)
☐	☐	Inadequate communication with client
		Tools/Equipment
☐	☐	Proper tools or equipment unavailable (including software)
☐	☐	Tools or equipment damaged
☐	☐	Tools improperly maintained/calibrated equipment
		Factors out of our Control
☑	☐	Natural Forces - Events outside of human control
☐	☐	Third party out of our control

Resolution

Summary of Actions Taken to Resolve or Correct the Near Miss

The Team should have left an emergency contact list with the APM and their families so that updates could have been provided by the APM to the families and then the families had someone to reach out to with questions.

Action Items (Optional): None

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Zellmer, Gregory E Reviewer Revise 6/11/2018	Recommended changes: change "No standard, procedure or practice (QA Plan, HASP, JSA, standard)" to "Inadequate standard, procedure or practice..." - we had a standard in place, just did not include family; remove "Inadequate management establishment and communication of expectations / culture" as primary - you can keep it as applies; add did not recognize the risk - that should be the primary as we had a good plan in place just didn't recognize the family communications aspect until it came up.
Employee: **Role** **Review Type** **Completed Date**	Zellmer, Gregory E Reviewer Approve 6/13/2018	
Employee: **Role** **Review Type** **Completed Date**	Bean, Scott Quality Reviewer NA 6/26/2018	Contingency planning is key especially in situations where resources and communications are limited. Good job identifying the risk and learning from the experience.

Near Miss

General

INV ID	18038	**Status**	(5) Completed
Loss Type	Near Miss	**Completed Date**	07/02/2018
Reported By	010700 (Alessi, Timothy G)		
Incident Date & Time	6/3/2018 9:00:00 PM		
Incident Address	Poverty Island NA, MI NA US		
Location Name	NOVI, MI		
Work Type Name	Soil sampling/well installation-manual		
Hazard Type	Environment		
Incident Description	Staff were mobilized to the Poverty Island Site on Sunday. The decision was made early in the day to stay on the island overnight as opposed to transferring equipment back to the charter boat which had many health and safety risks. The team used dehydrated meals for their ease of use. The use these water needed o be boiled using a small backpacking stove. Storms had moved into the area on Sunday evening and the hard rain made it impossible to use the stove outside. The team set up the stove inside the field tent on a safe stable pad to boil water. A team member recommended opening the front and rear screen to allow the tent to vent while using the stove. This was done in addition to having ventilation overhead under the rain fly to alleviate any carbon monoxide issues.		

Client / Project

Client	US Coast Guard
Project Number	MI0010210001
Project Name	USCG Poverty Island Site Inves
PIC	SCLAFANI, TROY
Project Manager	ZELLMER, GREGORY

Involved /Witness

Employees Involved / Witness

Role	Employee	Involved	Witness	Due Date	Completed Date	Active Employee
Involved / Witness	Barton, Colleen O'Shea	☑	☑	06/10/2018	06/18/2018	☑
Involved / Witness	VanDenBerge, Kristen Hope	☑	☑	06/10/2018	06/18/2018	☑
Involved / Witness	Westhuis, Austin W.	☑	☑	06/10/2018	06/18/2018	☑
Reported By	Alessi, Timothy G	☑	☑	06/10/2018	06/18/2018	☑

Investigation Team

Role	Employee	Investigation Team	Due Date	Completed Date	Active Employee
Investigation Supervisor	Olechiw, Theresa Z	☑	06/10/2018	06/18/2018	☑
Involved / Witness	Barton, Colleen O'Shea	☐	06/10/2018	06/18/2018	☑
Involved / Witness	VanDenBerge, Kristen Hope	☐	06/10/2018	06/18/2018	☑
Involved / Witness	Westhuis, Austin W.	☐	06/10/2018	06/18/2018	☑
Reported By	Alessi, Timothy G	☑	06/10/2018	06/18/2018	☑

Reviewers

Role	Employee	Due Date	Completed Date	Active Employee
Reviewer	Zellmer, Gregory E	07/09/2018	07/02/2018	☑

Root Cause

Root Cause(s) of the Near Miss

The team was hungry and tired at the end of a 15 hour day. The stove was set up safely on a stable fire-proof surface. Field team members did not utilize TRACK to recognize the carbon monoxide potential. Another field team member did immediately recognize the hazard and it was remedied.

Categorize Root Causes

Applies	Primary	Root Cause Factor
		Training / Competency
☑	☐	Did not recognize the risk
☐	☐	Did not have skill, competence, experience, or knowledge
☐	☐	Has not completed required training
☐	☐	Training inadequate or ineffective
		Adherence to Standards, Practices, Expectations

☑	☑	Did not use TRACK, PM or quality tools
☐	☐	Did not use Stop Work Authority
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☐	☐	Tools improperly maintained/calibrated equipment
		Factors out of our Control
☐	☐	Natural Forces - Events outside of human control
☐	☐	Third party out of our control

Resolution

Summary of Actions Taken to Resolve or Correct the Near Miss

The potential for carbon monoxide was recognized by a member of the field team and the tent was adequately vented within a minute of the stove being ignited.

Action Items (Optional): None

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Zellmer, Gregory E Reviewer Approve 7/2/2018	Good hazard recognition by field crew and communication to come up with a solution to reduce the potential hazard.

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