# QUALITY ASSURANCE PROJECT PLAN
# & REMEDIATION SYSTEM DESIGN
# FORMER PEACOCK CLEANERS
# 4501 LAKE OTIS PARKWAY
# ANCHORAGE, ALASKA

**AUGUST 2011**

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ºC | degrees Celsius |
| ºF | degrees Fahrenheit |
| AAC | Alaska Administrative Code |
| ABCA | Analysis of Brownfields Cleanup Alternatives |
| ADEC | Alaska Department of Environmental Conservation |
| AK | Alaska Method |
| AOC | Area of Contamination |
| ARAR | applicable or relevant and appropriate requirements |
| bgs | below ground surface |
| BTEX | benzene, toluene, ethylbenzene, and xylenes |
| CoC | chain of custody |
| COC | constituents of concern |
| COPC | contaminants of potential concern |
| CSM | conceptual site model |
| cy | cubic yards |
| DCE | dichloroethene |
| DQO | data quality objectives |
| DRO | diesel range organics |
| E&E | Ecology & Environment, Inc. |
| EE/CA | Engineering Evaluation/Cost Analysis |
| EPA | U.S. Environmental Protection Agency |
| FTL | Field Team Leader |
| GRO | gasoline range organics |
| HAZWOPER | Hazardous waste operations and emergency response |
| IDW | investigation derived waste |
| LCS | laboratory control sample |
| LCSD | laboratory control sample duplicate |
| LDR | land disposal restriction |
| LOD | limit of detection |
| LOQ | limit of quantitation |
| MDL | method detection limit |
| µg/kg | micrograms per kilograms |
| mg/kg | milligrams per kilograms |
| µg/L | Micrograms per liter |
| mg/L | milligrams per liter |
| MOA | Municipality of Anchorage |
| MQO | measurement quality objective |
| NCP | National Contingency Plan |
| OVM | organic vapor monitor |
| PAH | polynuclear aromatic hydrocarbons |
| PCE | tetrachloroethene |
| PE | Project Engineer |
| PID | photoionization detector |
| PM | project manager |

| | |
|---|---|
| PPE | personal protective equipment |
| ppm | parts per million |
| QA/QC | quality assurance/quality control |
| QAPP | Quality Assurance Project Plan |
| RAO | remedial action objective |
| RCRA | Resource Conservation and Recovery Act |
| RPD | relative percent difference |
| RRO | residual range organics |
| SGS | SGS Environmental Services, Inc. |
| SOP | standard operating procedure |
| SSHSP | Site Specific Health and Safety Plan |
| SSO | Site Safety Officer |
| TCE | trichloroethene |
| UST | underground storage tank |
| UTS | universal treatment standards |
| VC | vinyl chloride |
| VES | vapor extraction system |
| VOC | volatile organic compound |

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## 1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) presents the remediation system design and implementation plan for the former Peacock Cleaners site in Anchorage, Alaska. The remedial action is being conducted by Shannon & Wilson, Inc. for the Municipality of Anchorage (MOA). This QAPP was written in general accordance with the U.S. Environmental Protection Agency (EPA) guidance documents for QAPPs (EPA, 2001), and to satisfy Alaska Department of Environmental Conservation (ADEC) Contaminated Sites regulatory requirement of 18 AAC 75.355 and 18 AAC 75.350. The technical scope is based on recommendations in Shannon & Wilson's May 2011 Analysis of Brownfields Cleanup Alternatives (ABCA) document (Shannon & Wilson, 2011) and June 8, 2011 proposal.

## 2.0 PROJECT OVERVIEW

### 2.1 Problem Definition

Potential contaminant sources identified on the property include dry cleaning solvent and Stoddard solvent. Stoddard solvent was apparently stored in a 1,000-gallon UST removed in December 2010. At that time, pipes connecting the tank to the former building were observed and removed. Other dry cleaning solvent(s), new or used, may have been stored in 55-gallon drums and a smaller 300-gallon UST removed in December 2010. Potential release mechanisms for the dry cleaning and Stoddard solvents include direct discharge to the ground surface; leaks from the drums, USTs and drainage piping; and spills during solvent transfer to and from the drums and USTs. Regulated petroleum hydrocarbon and chlorinated solvent compounds have been measured in the site's soil and groundwater at concentrations greater than regulated cleanup levels.

### 2.2 Project Summary

In 2008, the MOA was awarded an EPA Brownfields (BF) Cleanup Grant to address contamination issues at the former Peacock Cleaners site. The EPA Brownfields Cleanup Cooperative Agreement Number is BF-96085101.

An ABCA, dated May 2011, was prepared in general accordance with EPA guidance for cleanups with EPA grant funds and the Engineering Evaluation/Cost Analysis (EE/CA) Equivalent ABCA Checklist (EPA, 2004). The ABCA evaluated remedial alternatives to facilitate site reuse and redevelopment of the former Peacock Cleaners site. The ABCA document was reviewed by the EPA and ADEC and was posted for 30-day public review in late May 2011. The MOA submitted a Decision Document to the EPA and ADEC on July 1, 2011 (MOA, 2011).

Based on the alternatives analysis, the proposed treatment to be conducted using the Brownfields grant funding is in-situ passive vapor extraction, supplemented with a chemical oxidant application. This approach will focus on source-area soil treatment as a means of contaminant mass reduction and to facilitate limited reuse/redevelopment of the subject property. The primary elements of the remedial action program are soil excavation and on-site consolidation, baseline soil sampling, installation of the in-situ vapor extraction system (VES) and chemical oxidant, progress/confirmation sampling, and reporting.

The remedial action scope does not include long-term monitoring after the initial implementation in 2011, or other tasks outside the scope of the grant-funded work that may be required to achieve the overall project objectives. These other tasks may include additional site characterization to address data gaps, on-going groundwater monitoring, and final confirmation sampling.

## 2.3 Project Purpose and Objectives

The general purpose of the Brownfields program is to facilitate reuse/redevelopment of environmentally contaminated sites. Due to limited funding and the site's contamination characteristics, a "Cleanup Complete" determination is not anticipated as a result of this remedial action. The land use(s) that can be potentially achieved at the site, singularly through the grant-funded cleanup effort, will likely be limited and will need to be compatible with the site continuing to be regulated by ADEC as an active contaminated site, including institutional controls. In this context, the MOA's short-term cleanup objective is to obtain a beneficial reuse while making material progress toward eventual site closure and/or iteratively less-restrictive controls on allowable land uses.

The purpose of the current remedial action is to pursue MOA's short-term cleanup objective by implementing the recommendation presented in the May 2011 ABCA and documented in the July 2011 Decision Document. As described in the ABCA, the remedial strategy is based on prioritized mitigation of discrete human health exposure pathways. The site-specific complete or potentially complete exposure pathways identified in the conceptual site model (see Section 4 of the ABCA document) are prioritized for cleanup based on perceived immediacy of risk to human health or the environment, and on the level of land-use restriction resulting from each pathway.

Based on groundwater samples collected from off-Property monitoring wells, it appears that the impacted groundwater plume does not pose an imminent threat to human or ecological receptors. Therefore, the specific remedial action objective (RAO) for the work conducted under the Brownfields cleanup grant will be source area soil treatment. Complete source area remediation to the most stringent ADEC Method 2 cleanup levels is not practicable given the funding constraint. The RAO will instead incorporate concentration reduction thresholds to address specific exposure pathways for direct contact with soil (ingestion, dermal contact, and fugitive dust) and outdoor air inhalation. Other complete or potentially completed exposure pathways, such as groundwater ingestion/dermal contact, or indoor air vapor intrusion, are not directly targeted by the present cleanup effort, although effective source area concentration reduction will likely result in beneficial risk reduction for these exposure pathways as a secondary effect.

## 2.4 Regulatory Context

### 2.4.1 Constituents of Concern (COC)

For the purposes of this project, COCs are defined as compounds that have been measured at concentrations greater than the most stringent ADEC soil and groundwater cleanup levels listed in 18 AAC 75. Several additional regulated compounds are retained as contaminants of potential concern (COPC), as described below.

***Soil***

Diesel range organics (DRO), tetrachloroethene (PCE), trichloroethene (TCE) and cis-1,2-dichloroethene (DCE) were detected at concentrations above the most stringent ADEC Method 2 cleanup levels in site characterization soil samples collected in 2007 and 2008 (Shannon & Wilson 2008, Ecology and Environment 2009). DRO, PCE, TCE, gasoline range organics (GRO) and benzene were detected at concentrations above the most stringent ADEC Method 2 cleanup levels in soil samples collected during the 2010 Underground Storage Tank (UST) closure assessment (Shannon & Wilson, 2011). Other volatile organic compounds (VOCs) were either detected at concentrations less than their respective ADEC cleanup criteria or were not detected in the soil samples. Figure 1 shows the PCE concentrations measured in the field and analytical soil samples collected during the 2007 and 2008 field activities, and Figure 2 shows COC concentrations measured in samples collected during the 2010 UST closure assessment.

One other VOC compound (chloroethene/vinyl chloride [VC]) and polynuclear aromatic hydrocarbons (PAH) are retained as COPCs. Although VC was not detected in the 2010 soil samples, the reporting limits were greater than the most stringent Method 2 ADEC cleanup level. Moreover, VC is a degradation product of the reductive dechlorination process for PCE, TCE, and DCE, and may be produced as these compounds degrade.

The two 2010 soil samples tested for PAH contained trace concentrations of seven individual compounds, although at levels two to six orders-of-magnitude less than the most stringent Method 2 ADEC cleanup levels. These samples also contained up to 2,090 milligrams per kilogram (mg/kg) GRO and up to 2,030 mg/kg DRO. However, the highest DRO concentration (12,800 mg/kg) was measured in a soil sample that was not tested for PAH. Based on these data, we can conclude that PAH are eliminated as COPCs for only samples that contain up to 2,030 mg/kg DRO, and it is possible that higher levels are present in samples with greater DRO concentrations. Because the source-area soils treatment will presumably remove/treat the soils with the highest DRO concentrations, it is anticipated that DRO concentrations greater than 2,030 will not remain post-treatment and PAH can be removed as COPCs at that time.

***Groundwater***

GRO, DRO, residual range organics (RRO), PCE, TCE and cis-1,2-DCE were detected at concentrations above the ADEC Table C cleanup levels in the groundwater samples collected during the 2007, 2008, and/or 2010 sampling events. However, VC is retained as a groundwater COPC based on the same logic presented above for the soil COPCs.

Other VOCs, including benzene, toluene, ethylbenzene, and xylene (BTEX), were detected at concentrations less than their respective ADEC cleanup criteria in the groundwater samples from one or more on-Property monitoring wells. The closest groundwater sample to the on-Property source area that contained BTEX levels greater than ADEC Table C values was from temporary Well SP08, located south of the Property (the precise location relative to the property is uncertain due to discrepancies in the reported location). The 2008 sample from this monitoring point contained 7.1 micrograms per liter (µg/L) benzene and trace concentrations of toluene and xylene. Note that higher BTEX concentrations were measured in off-Property Monitoring Wells MW12 and MW13, located about 50 feet north of the Property. Groundwater samples collected from these two wells in 2008 contained BTEX concentrations up to 320 micrograms per liter (µg/L) benzene, 5,700 µg/L toluene, 3,300 µg/L ethylbenzene, and 14,600 µg/L total xylenes. A comparison of on-Property, source-area groundwater data to the Well MW12 and MW13 results suggests the source of BTEX contamination in Wells MW12 and MW13 is at least partly attributable to off-site source(s) north of the Property. Pending further evaluation, however, benzene is retained as a COPC for the site's groundwater.

### 2.4.2 Agency Oversight and Applicable Regulations

The governing agency for cleanup of contaminated sites in Alaska is the ADEC. ADEC will be the lead regulatory agency for this project, providing oversight, review and comment during work plan development and implementation and reporting. Due to the presence of chlorinated solvent-impacted media, the site is also subject to Resource Conservation and Recovery Act (RCRA) requirements. The EPA Region 10 RCRA Hazardous Waste Program will be responsible for RCRA regulatory determinations.

**State Regulations (ADEC)**

Site cleanup will be conducted under the State of Alaska Oil and Other Hazardous Substances Pollution Control regulations (18 Alaska Administrative Code [AAC] 75), which provides for protection of human health and the environment based on current and future land uses.

**Federal Regulations (EPA)**

The PCE and TCE measured in the site's soil and groundwater are presumed to be associated with the former dry cleaning operations, and are thus considered "spent halogenated solvents" that are classified as an F-listed waste (F002) under the RCRA designation for process wastes (40 CFR 261.31). In addition, environmental media (e.g., soil, groundwater) that contain these waste solvents also require management as an F002 listed hazardous waste under the "contained-in policy," if the media are moved or handled in such a way that constitutes waste generation. Generation occurs when the contaminated environmental media is excavated, graded, pumped, or otherwise disturbed. The site has been assigned EPA identification number AKR 00020 2747.

Once a hazardous waste is generated, the RCRA standards for transportation, treatment, storage, and disposal apply (40 CFR Parts 260-270). However, the EPA has developed regulation and policies to streamline remediation of certain wastes by allowing for movement and/or treatment of regulated media under specific circumstances that do not trigger land disposal restrictions (LDR), landfill permitting, and/or other RCRA requirements associated with conventional hazardous waste management units. Specifically, the Area of Contamination (AOC) policy will be applied to implement the remedial action plan.

The AOC policy provides for certain discrete areas of generally dispersed contamination to be considered as RCRA units. These units can be equated to RCRA landfills in the sense that "movement of hazardous wastes (e.g., PCE-impacted soil) within these areas would not be considered land disposal and would not trigger the RCRA land disposal restrictions" (EPA,1996). Because movement of soil within the AOC does not constitute "placement," landfill requirements for permitting, closure, post-closure monitoring, etc. do not apply. The allowable activities under the AOC policy are generally defined by the National Contingency Plan (NCP), which states that "placement does not occur when waste is consolidated within an AOC, when it is treated in-situ, or when it is left in place" (EPA, 1990). However, if the soils are removed from the AOC prior to sufficient treatment, such as by placement of soils in a tank, container, or Corrective Management Unit, or are moved from one AOC to another, the soils become subject RCRA management and permitting.

The AOC policy has already been applied to the site during the 2010 UST removal efforts. The AOC policy will also be used to consolidate soil as part of the *in-situ* remedial action. Specifically, soil excavated from the source area will be temporarily consolidated on liners to allow installation of subsurface technologies for in-situ soil treatment. The AOC does not permit long-term soil storage, ex-situ on-site treatment, or other actions that may be considered "soil placement" or active management of hazardous waste – such actions constitute creation of a hazardous waste management unit that is subject to appropriate permits.

#### 2.4.3 Applicable or Relevant and Appropriate Requirements (ARARs)

**ADEC Cleanup Levels**

State cleanup standards for contaminated soil and groundwater are presented in Title 18, Chapter 75 of the Alaska Administrative Code (18 AAC 75), *Oil and Other Hazardous Substances Pollution Control* (ADEC, 2008). The cleanup standards for individual chemicals in soil are based on the ADEC's Method 2 cleanup levels listed in Tables B1 and B2, 18 AAC 75.341, for the "under-40-inches precipitation zone." As listed below, distinct soil cleanup levels are provided for the "Direct Contact," "Outdoor Inhalation," and "Migration to Groundwater" exposure pathways. The direct contact and outdoor inhalation concentrations must be attained in the surface and subsurface soil to a depth of at least 15 feet, unless an institutional control or site conditions eliminate potential for exposure. In addition, cleanup to the most stringent Method 2 standard – typically the migration to groundwater standard - is normally required by ADEC for a cleanup complete (without institutional controls) determination. Cleanup standards for groundwater are the ADEC groundwater cleanup levels listed in Table C, 18 AAC 75.345.

**ADEC SOIL AND GROUNDWATER CLEANUP LEVELS**

| COC | SOIL* (ADEC Method 2) | | | GROUNDWATER (ADEC Table C) |
|---|---|---|---|---|
| | Direct Contact | Outdoor Inhalation | Migration to Groundwater | |
| GRO | 1,400 mg/kg | 1,400 mg/kg | 300 mg/kg | 2.2 mg/L |
| DRO | 10,250 mg/kg | 12,500 mg/kg | 250 mg/kg | 1.5 mg/L |
| Benzene | 150,000 µg/kg | 11,000 µg/kg | 25 µg/kg | 5 µg/L |
| PCE | 15,000 µg/kg | 10,000 µg/kg | 24 µg/kg | 5 µg/L |
| TCE | 21,000 µg/kg | 570 µg/kg | 20 µg/kg | 5 µg/L |
| DCE | $1x10^6$ µg/kg | 130,000 µg/kg | 240 µg/kg | 70 µg/L |
| VC | 5,500 µg/kg | 4,300 µg/kg | 8.5 µg/kg | 2 µg/L |
| PAH | For individual PAH compounds, see Table B1, 18 AAC 75.341 for soil cleanup levels and Table C, 18 AAC 75.345 for groundwater cleanup levels | | | |

* Interim concentration reduction thresholds are highlighted in blue

Reducing the contaminant concentrations to meet the ADEC cleanup criteria for unconditional closure is likely not attainable due to funding constraints, coupled with contaminant mass and distribution characteristics. To achieve the MOA objective of beneficial reuse/redevelopment of the property, the treatment will focus on achieving interim concentration reduction thresholds following the prioritized exposure pathway mitigation approach outlined in Section 2.3. The threshold levels selected to be protective of immediate threats to human health and the environment are equivalent to the ADEC direct contact or outdoor inhalation soil cleanup levels, whichever is most restrictive. The concentration reduction thresholds are not presented as cleanup levels for closure purposes, and may comprise the minimum level of cleanup acceptable to ADEC for property re-use.

**EPA/RCRA Contained-In Levels**

Soil and groundwater media designated as a hazardous waste, either by toxicity characteristic or through the contained-in policy, are subject to applicable RCRA hazardous waste requirements until the subject media are no longer classified as a hazardous waste and applicable LDR treatment standards have been satisfied. Unlike characteristics wastes, RCRA regulation does not provide specific cleanup levels for environmental media that contain listed waste. The EPA may establish - through a written contained-in decision - site-specific cleanup levels that are based on conservative health-based risk considerations. Based on conversations with the EPA, the contained-in concentrations for the PCE and TCE-impacted media at this site are the ADEC most stringent soil and groundwater cleanup levels cited above. These contained-in concentrations would also comprise the treatment standards for ex-situ soil remediation in a waste management unit.

In certain circumstances, the RCRA LDR will continue to apply to a contaminated soil that has been determined not to contain hazardous waste after treatment. This is the case when the contaminated soil contains hazardous waste when initially disturbed/removed, is treated to remove the hazardous characteristic, but still contains hazardous constituents at concentrations above LDR universal treatment standards (UTS). The UTS for PCE and its daughter products TCE and DCE is 6,000 micrograms per kilograms (µg/kg). For this site, the UTS is greater than the presumed “contained-in determination” concentrations; thus treatment to the contained-in level will also meet the LDR standard.

Note that the interim concentration reduction thresholds are greater than the presumed “contained-in determination” concentrations and the LDR UTS. Because soil will be consolidated within the AOC in a manner that does not constitute placement, soil that contains post-treatment COC concentrations less than the concentration reduction threshold but greater than the UTS will not violate LDR. However, impacted media containing residual concentrations greater than the most stringent ADEC cleanup criteria will remain subject to regulation and potentially further cleanup requirements.

# 3.0 BACKGROUND INFORMATION

## 3.1 Site Location and Description

The Property is located southeast of the Tudor Road and Lake Otis Parkway intersection in the mid-town Anchorage area at 4501 Lake Otis Parkway. The legal description of the approximately 1-acre parcel is Township 13 North, Range 3 West, Section 33, Lot 14. A commercial building and residential structure were present on the Property from the 1960s until demolition in July 2008. The locations of the former structures and other site features, including a Stoddard solvent UST, drinking water well, and septic leach pond, are shown on the site plan included as Figure 2. The Property is currently vacant and fenced.

The Property is partially vegetated with grass and trees. Vegetation is not present in the areas of the former Peacock Cleaner building and residence footprints, parking and access driveways. Cleared pads are present in the areas where the two structures were formally located. The overall site topography is generally flat with the exception of the southeast corner, where the former septic pond and adjacent soil mound create elevation differences of several feet or more from the prevailing grade. The surrounding topography generally slopes to the south to southeast, with an approximate 8-foot drop in elevation between the south side of the property and the adjacent parcel.

The term Property, as used herein, is defined by legal ownership boundaries. In comparison, the “site” refers to the area encompassing the known and potentially impacted media associated with the former dry cleaning operations and other on-Property sources. The site includes the Property and possibly portions of surrounding parcels.

The subsurface soil conditions generally consist of brown peat or brown, silty, sandy gravel from the ground surface to about 3 feet below ground surface (bgs). The surface soils are generally underlain by alternating layers of sand, silt, and gravel of varying thicknesses to the depth explored of 30 feet bgs.

Groundwater is encountered at depths ranging from about 5 feet bgs along the south Property boundary to about 15 feet bgs near the property center, primarily due to topographic differences in the ground surface. Based on surface topography, the regional groundwater gradient is assumed to be toward the south to southeast in the direction of South Fork Campbell Creek. However, the localized groundwater flow direction in the immediate site vicinity appears to vary, as flow directions to the northwest and southeast were inferred using groundwater data from discrete sampling events.

## 3.2 Land Use History

A dry cleaning business (Peacock Cleaners) operated on the property from its initial development in 1966 to 2008. The MOA foreclosed on the property in 1993 due to delinquent tax payments. Apparently Peacock Cleaners continued to operate on the property under a lease agreement with MOA following the foreclosure. The dry cleaning operations ceased at the site in February 2008 (E&E, 2009).

## 3.3 Previous Site Investigations

The following site assessments were conducted at the site between 2005 and 2010:

- Phase I Environmental Site Assessment (Hoefler Consulting Group, 2005)
- Site Characterization (Shannon & Wilson, 2007)
- Targeted Brownfields Assessment (Ecology and Environment Inc., 2008)
- UST Closure Assessment and Groundwater Monitoring (Shannon & Wilson, 2010)

Detailed summaries of the associated report documents are provided in the ABCA (Shannon & Wilson, 2011).

## 3.4 Extent of Contaminated Soil

Site soil is impacted with both petroleum hydrocarbon contaminants (GRO, DRO and benzene) and dry cleaning solvent contaminants (PCE, TCE, and DCE) at concentrations exceeding applicable ADEC cleanup criteria. As illustrated in Figure 1, the source areas of the petroleum hydrocarbon impacted soil and the dry cleaning solvent impacted soil both appear to be located near the southeast corner of the former dry cleaning facility and UST locations. However, the extent of petroleum hydrocarbon (Stoddard solvent)-impacted media appears to differ from that of the other solvent-impacted media, presumably due to different release events and contaminant fate and transport mechanisms.

### 3.4.1 Stoddard Solvent / Petroleum Hydrocarbons – Source Area

DRO concentrations exceeding the 250 mg/kg ADEC cleanup criterion were detected in samples collected from depths ranging between approximately 0.5 feet bgs to 13.5 feet bgs in the vicinity of the former USTs. The estimated area of soil with DRO concentrations exceeding the 250 mg/kg ADEC cleanup criteria, based on data collected from the 2007 and 2008 sampling events and the 2010 UST closure assessment, is shown on Figure 2.

Soil samples collected within the UST excavation area that contained GRO concentrations exceeding the 300 mg/kg ADEC cleanup criterion are shown on Figure 2. In addition, two excavation samples located near the southeast corner of the UST excavation, Samples S30 and S34, contained concentrations of benzene exceeding the 25 µg/kg ADEC cleanup criterion.

### 3.4.2 Chlorinated Solvents – Source Area

The highest PCE, TCE and DCE concentrations were measured in soil samples collected near the southeast corner of the former Peacock Cleaners building and in the vicinity of the former USTs and a drain pipe exiting the building. The actual discharge location(s) are not known but are likely associated with the former floor drain and discharge piping system. The elevated PCE concentrations extend from 0.5 to 20 feet bgs in this area, with the concentrations increasing from near the ground surface to 8 to 9 feet bgs, and then decreasing with depth. The concentrations and locations of PCE-impacted soil are shown on Figures 2 and 5.

During the 2007 and 2008 soil sampling events, TCE was not measured at concentrations greater than the most stringent ADEC cleanup level until 12 feet bgs, below which concentrations were observed to increase with depth to about 20 feet bgs. DCE was also detected at a concentration exceeding ADEC cleanup criteria in soil samples collected between 12 and 16 feet bgs. In comparison, each excavation soil sample collected between 2 and 9 feet bgs during the 2010 UST closure assessment contained a TCE concentration that exceeds the ADEC cleanup criterion. These samples did not contain levels of DCE exceeding the ADEC cleanup criterion.

### 3.4.3 Non-Source Area Soil Samples

The 2007 and 2008 sampling events focused on both the apparent source area and other potentially impacted areas of the Property. Field screening results of soil samples collected from the Stoddard solvent container storage area, the partially buried drum area, and the septic leach pond did not indicate the presence of COCs exceeding the reporting limit of 100 µg/kg. Two analytical soil samples, one from the surface soil in the Stoddard solvent container storage area and one from the near surface soil in the partially buried drum area, had concentrations of PCE (29 µg/kg and 40 µg/kg) exceeding the ADEC cleanup criterion. The field screening and analytical test results of soil samples in these three areas suggest PCE impacted soil is not widespread at concentrations exceeding the field screening reporting limit of 100 µg/kg. Containers of Stoddard solvent are no longer present within the former storage area. Likewise, the septic leach pond is no longer active as the former Peacock Cleaners building has been demolished. The number of drums present in the partially buried drum area is unknown.

### 3.5 Area of Contamination Determination (2010)

In October 2010 the MOA requested EPA approval to apply the AOC policy to the former Peacock Cleaners. The MOA sought to apply the AOC policy to PCE- and TCE-impacted soil that was to be excavated during proposed UST and drum removal activities and on-Property drinking water well decommissioning. The act of excavating or otherwise disturbing these materials is considered generation of an F-listed hazardous waste per the EPA's contained-in policy. The excavated soils would normally be subject to RCRA regulations pertaining to containerization, treatment time, and other permitting requirements for accumulated waste. Under the AOC policy, however, movement of soils within defined areas of generally dispersed contamination can be conducted without being considered "placement" that is subject to land disposal restrictions and other RCRA requirements.

In their November 9, 2010 letter, the EPA confirmed that the planned actions during the proposed UST and drum removal activities and well decommissioning were consistent with the AOC policy. The adopted AOC for the subject site is defined by the property boundaries of the former Peacock Cleaners parcel. The AOC policy was used to allow soil excavated during the UST removal to be temporarily consolidated on site, then replaced as backfill for in-situ treatment at a later date. Acceptance of the AOC policy was made with the understanding that the MOA was to continue progress toward overall site cleanup, and that the AOC policy could be applied to the soil consolidation and in-situ remediation activities described in this plan.

### 3.6 Summary of ABCA and Decision Document

The May 2011 ABCA presented an analysis of seven cleanup alternatives that vary in the extent of contaminated soil and groundwater treatment. The seven cleanup alternatives were selected based on a pre-screening for applicability to the site and general effectiveness for the site-specific COCs and impacted media, with a focus on source-area soil treatment, effectiveness in treating chlorinated solvents, sustainability, and limiting institutional controls. Each alternative was evaluated using effectiveness, implementability, and cost criteria. The cost criterion considered both the cost to install/implement the alternative (included cost)s, and long-term cost for system operation, monitoring, maintenance, groundwater monitoring, and other tasks that would not be funded using the Brownfields grant (excluded costs).

Based on the alternatives analysis, Alternative 5, In-Situ Passive Soil Vapor Extraction System (VES) and Chemical Oxidation, was recommended as the preferred alternative for the former Peacock Cleaners property. The combined technologies will serve both to chemically transform (oxidation) and physically remove (VES) contaminant mass, thereby reducing the potential for mobility and toxicity. An indirect benefit for groundwater cleanup will also be gained by reducing the capacity of the source-area soil to serve as a secondary source for continued groundwater contamination. Once the cleanup effects have been confirmed, the property may be useable for redevelopment with permanent structures, even though PCE-impacted soil with concentrations exceeding the migration to groundwater cleanup criterion will likely remain on site. Vapor intrusion from remaining VOC-impacted soil and groundwater may need to be addressed both in the design of on-Property structures, and to assess potential impact to current/future off-site structures. In addition, soil disturbed during future Property development will remain subject to RCRA regulation.

Of the seven alternatives considered, Alternative 5 was found to provide the best balance of short-term and long-term treatment potential, cost effectiveness for unit mass reduction, and ability to fully implement the alternative within the grant timeline and funding constraints. The in-situ passive VES is a sustainable remedial technology that has a lower carbon footprint than strategies that entail active treatment and/or waste transport to distant disposal facilities. This alternative also has the flexibility to be augmented with other alternatives, or upgraded to provide enhanced treatment capability. For example, combining asphalt paving (Alternative 2) with Alternative 5 is recommended to obtain the exposure pathway mitigation and land-use benefits of the paving, while still achieving meaningful concentration reduction through in-situ treatment. Similarly, the passive VES contained in Alternative 5 can be upgraded to an active system obtain a larger return on investment if additional funding becomes available. In fact, starting the system in a passive mode before upgrading to an active system may be advantageous from a health and safety perspective. The initial vapor concentrations anticipated to be generated by an active system would likely require emissions monitoring and treatment.

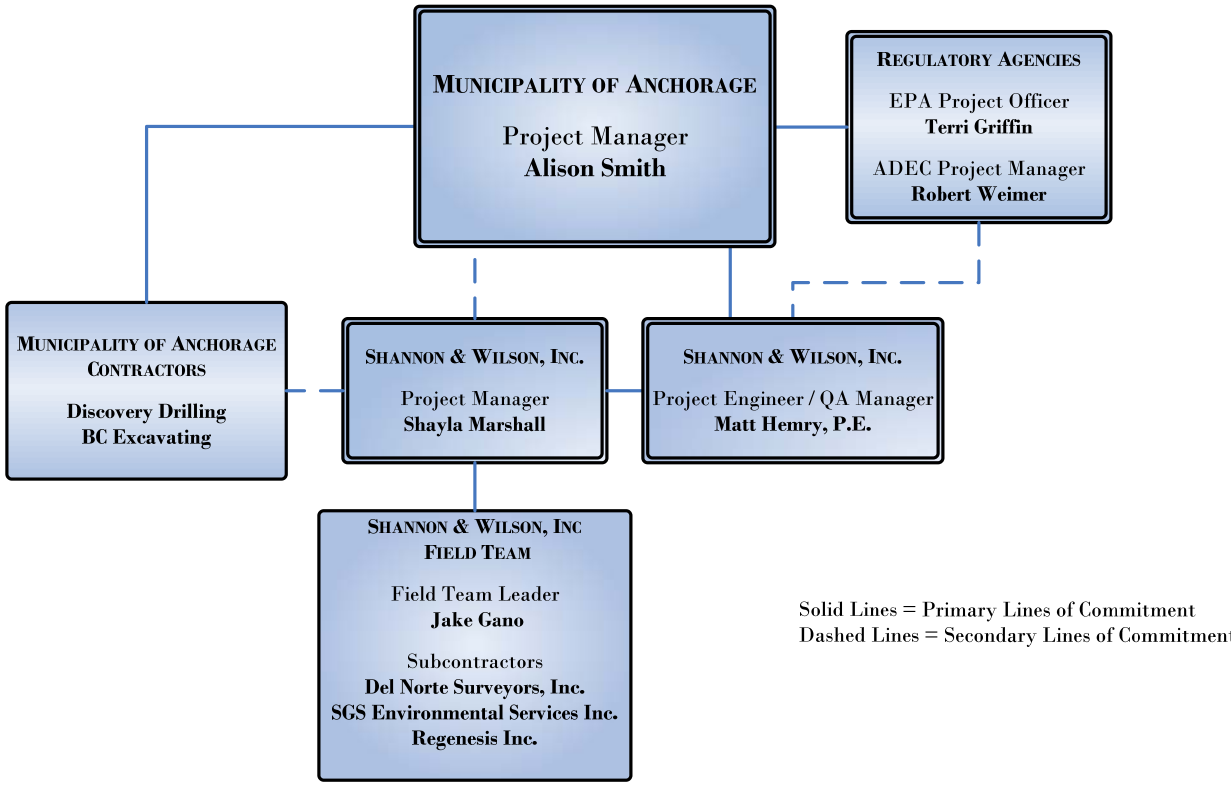
The ABCA document was posted for public review on May 27, 2011, with a comment deadline of June 30, 2011. No comments were received from the public or agencies during the public comment period. Following the 30-day public review comment, the recommendations in the ABCA were incorporated into the MOA's decision document, which was provided to the EPA and ADEC on July 1, 2011.

# 4.0 PROJECT MANAGEMENT AND COMMUNICATION PLAN

## 4.1 Project Team Organization and Responsibilities

The QAPP will be implemented by a project team consisting of the MOA and its contractors and subcontractors. General functions and responsibilities of the project team members are described below, and the lines of authority shown in the organization chart. Note that specific business entities are named as contractors/subcontractors, based on our understanding of MOA intentions. However, the duty of the named entities to perform these tasks is subject to establishment of contracts to perform the specific services. Terms and conditions of individual contracts will take precedence over scope descriptions in this QAPP. However, if such terms and conditions require a material variance from this scope, MOA will notify the agencies using the process described in Section 11.

**PROJECT ORGANIZATION AND LINES OF COMMUNICATION**




#### 4.1.1 MOA

MOA is the land owner and Brownfields grantee. MOA retains the ultimate authority and responsibility for implementing the QAPP. MOA personnel contacts, phone, fax, and e-mail are listed below.

Municipality of Anchorage
Real Estate Department
4700 Elmore Road
Anchorage, Alaska 99507

***Contract Manager*:**
Ms. Tammy Oswald
Email: OswaldTR@ci.anchorage.ak.us
Phone: 907-343-7986

***Project Manager:***
Ms. Alison Smith
Email: SmithAL@ci.anchorage.ak.us
Phone: 907-343-7531

### 4.1.2 Environmental Consultant

The Environmental Consultant will monitor the remediation system installation, conduct soil sampling, provide oversight of its subcontractors, and produce the summary report. If Shannon & Wilson Inc. is contracted for this function, the contact information and proposed key personnel are identified below. If the individuals listed below are not available, the MOA will be provided with names of replacement personnel.

Sampling activities for this project will be conducted by a "qualified person," or under the direct supervision of a qualified person. A qualified person is defined as defined in 18 AAC 75.990 as the following:

> a person who actively practices environmental science or engineering, geology, physical science, hydrology, or a related field and who has the following minimum education and experience:
>
> (A) a bachelor's degree or equivalent from a nationally or internationally accredited postsecondary institution in environmental science or engineering, geology, hydrology, physical science, or a related field; for purposes of this subparagraph, "equivalent" means at least 128 semester hours, 168 trimester hours, or 192 quarter hours at an accredited postsecondary institution, with at least 18 percent of those hours in a science major and at least 13 percent of those hours in upper division-level courses; and
>
> (B) at least one year of professional experience in environmental science or engineering, geology, physical science, hydrology, or a related field, obtained after the degree in (A) of this paragraph was obtained.

Each field representative will also have current 40-hour hazardous waste operations and emergency response (HAZWOPER) training and 8-hour refreshers; and will have current first aid and CPR certification.

**Shannon & Wilson Inc.**
5430 Fairbanks Street, Suite 3, Anchorage, Alaska 99518
(907) 561-2120 phone, (907) 561-4483 fax(Anchorage Office)

***Project Engineer and Quality Assurance Manager***

Mr. Matt Hemry, P.E. (email: msh@shanwil.com) will serve as Shannon & Wilson's Project Engineer (PE) and Quality Assurance (QA) Manager. The PE will provide the remediation system design and assist the Project Manager (PM) with technical oversight during remediation system installation. The QA Manager will assist the PM with corrective action to address non-conformances during QAPP implementation and communicating QAPP variances to the MOA; and will provide senior review of written submittals.

***Project Manager***

Ms. Shayla Marshall (email: sim@shanwil.com) will serve as Shannon & Wilson's Project Manager (PM). The PM will be responsible for scheduling and monitoring Shannon & Wilson's field activities, coordinating subcontractors, maintaining an updated project schedule, data assessment, and reviewing written deliverables. The PM will serve as the MOA's primary point of contact during field work, and will provide status updates to the MOA manager. The PM will notify the MOA immediately of any deviations from the work plan that will potentially impact schedule, data usability, or other performance criteria.

***Field Team Leader***

Mr. Jake Gano, E.I.T. (email: jag@shanwil.com) will serve as Shannon & Wilson's Field Team Leader (FTL). The FTL will be responsible for data acquisition in the field (e.g., soil sample collection, documenting remediation system installation, and conducting ambient air monitoring), oversight of Shannon & Wilson's subcontractors, assisting the PM with data assessment, and report preparation. The FTL will be responsible for maintaining field forms and logs on a daily basis.

The FTL will also serve as the Environmental Consultant's site safety officer (SSO). The SSO will be responsible for maintaining safe and healthy work practices for Shannon & Wilson employees, as outlined in the Site Specific Health and Safety Plan.

### 4.1.3 Subcontractors

Shannon & Wilson will subcontract selected project tasks and has contacted the following contractors to provide the specified services. The initial subcontractor coordination will be conducted by Shannon & Wilson's PM, who will negotiate the scope of work and compensation with the subcontractors. In the field, the FTL will have primary responsibility to coordinate and supervise subcontractor operations, but will not have the authority to change the QAPP scope without prior consultation with the Shannon & Wilson PM.

| Subcontractor | Assignments |
|---|---|
| SGS Environmental Services, Inc. (SGS) | Analytical testing laboratory (soil sample analysis) |
| Del Norte Surveying, Inc. | Survey excavation corners and riser pipe locations |
| Regenesis Inc. | Supply RegenOx™ material |

#### 4.1.4 Other MOA Contractors

Other services to be contracted directly by MOA include earthwork, remediation system installation, and soil boring drilling. MOA is presently in the process of contracting the business entities listed below. The MOA will retain ultimate authority and responsibility for directing entities contracted directly by MOA. The MOA may assign limited authority for on-site direction to the Environmental Consultant or other entity, as established by contract.

| Contractor | Assignments |
|---|---|
| BC Excavating (BCX) | Soil excavation/consolidation, remediation system installation, soil backfill and site restoration |
| Discovery Drilling, Inc. (Discovery) | Push-probe boreholes for progress sampling |

#### 4.1.5 Regulatory Agencies

We anticipate the State of Alaska will be the lead regulator for this project, and will be responsible for overall project oversight, and for making regulatory determinations under the ADEC Contaminated Sites program. Due to the presence of chlorinated solvent-impacted media, the site is also subject to RCRA requirements. The EPA Region 10 RCRA Hazardous Waste Program will be responsible for RCRA regulatory determinations.

##### 4.1.5.1 Alaska Department of Environmental Conservation

The primary ADEC contact will be Robert Weimer. John Carnahan may also be involved due to his knowledge of Brownfields grant implementation.

Robert Weimer
Contaminated Sites Program
Division of Spill Prevention and Response
555 Cordova Street
Anchorage, Alaska 99501

Email: Robert.Weimer@alaska.gov
Phone: (907) 269-7525

John Carnahan
Contaminated Sites Program
Division of Spill Prevention and Response
610 University Avenue
Fairbanks, Alaska 99709

Email: John.Carnahan@alaska.gov
Phone: (907) 451-2166

#### 4.1.5.2 U.S. Environmental Protection Agency

Terri Griffith
EPA Region 10
Office of Environmental Cleanup, Brownfields Program
Seattle, Washington

Email: Griffith.terri@epa.gov
Phone: (206) 553-8511

## 4.2 Project Coordination and Communications Plan

Project coordination and communication will occur throughout the planning, implementation, and reporting stages. Coordination during field activities will depend on the nature of the information to be communicated, as discussed below. Shannon & Wilson will not share technical information regarding scope, status, or screening and analytical results to persons other than the designated project team members, and in accordance with this communications plan. Members of the public will be asked to direct questions and concerns to the MOA PM.

Due to the unpredictable nature of subsurface conditions, variance(s) from the work plan for environmental remediation projects are not uncommon. The identification and communication of unexpected conditions will depend on the nature of the condition and the impact to schedule, scope, and/or cost. Minor scope modifications to facilitate data collection, that do not have material impact on schedule, cost, or data collection objectives will be made by the FTL in consultation with the Environmental Consultant's PM. These variances will be documented in the field notes, and communicated to the MOA PM on a timely basis, not to exceed 24 hours.

The MOA project manager will be notified immediately of the following conditions: conditions that pose an immediate safety hazard, damage to utilities, accidents/injuries (to field team or general public), or unexpected site conditions that have a material potential to impact the project scope, schedule, or budget. Examples of unexpected site conditions include:

- Unanticipated subsurface conditions;
- Inclement weather;
- Investigation-derived wastes requiring special handling or disposal; and
- Conditions that pose a safety hazard to site workers and/or the general public.

Scope changes and/or other mitigation measures associated with unexpected site conditions will be proposed by the Environmental Consultant, and authorized by the MOA PM. If the variances have a material potential to impact the treatment method, treatment effectiveness, quantity or quality of screening/sampling data, or regulatory compliance, the proposed modification will be communicated to the agencies for approval prior to implementation.

### 4.3 Schedule

A draft Project Schedule to complete the remedial action is provided in Figure 3. We understand the MOA desires the field work to be completed before the end of the 2011 summer field season. Installation of the in-situ remediation system is presently slated to commence in mid August 2011. Progress/confirmation sampling is anticipated to be completed in late October 2011, prior to the onset of frozen soil conditions. We will provide notice to the agencies at least 3 days prior to conducting any of the primary field tasks described herein.

We anticipate submitting the draft remedial action report 60 days after completion of the field activities, and the final remedial action report 15 business days following receipt of agency review comments.

## 5.0 REMEDIATION SYSTEM DESIGN AND INSTALLATION

This section presents our proposed technical approach to install the in-situ treatment system..

### 5.1 Project Logistics and Site Preparation

Project logistics will consist primarily of coordinating the field activities schedule with MOA representatives, our subcontractors, the MOA contractors, and the agencies. Mobilization activities will commence as soon as practicable following receipt of written QAPP approval from both the ADEC and EPA. An effort will be made to schedule the primary excavation and treatment cell construction tasks during an extended period of relatively dry weather, to reduce the potential for precipitation accumulation in the excavation base. The MOA will be responsible for publishing any public notices, informing adjacent property owners, or other stakeholder communications, as required.

The project area is generally accessible for the purposes of field work implementation. Chain-link fencing restricts access to the former Peacock Cleaners Property. The integrity of the chain-link-fencing will be maintained during the duration of the remedial action field efforts.

Prior to initiating excavation activities, the local utility locate service will be requested to identify buried utilities on the property. Based on former site assessment activities, buried utilities are not anticipated to be located within the designated excavation area.

Shannon & Wilson's field representative will mark the target treatment area boundaries (30 feet by 50 feet as shown on Figure 1) using surveyors flags/lathe and/or spray paint. Landmarks used to establish the treatment cell area include the 2010 UST excavation boundaries, the former building pad, existing monitoring wells, and GPS measurements of previous soil boring locations. Minor vegetation within the designated excavation area is anticipated and will be removed to facilitate excavation activities. After the excavation area is delineated, a walk through will be scheduled with MOA's excavation contractor to review the project requirements, identify areas for on-site soil consolidation, and discuss site access issues (e.g., fence maintenance, hours of allowable construction activity, etc.). At this time, nearby on-Property monitoring wells that are not within the treatment cell footprint (e.g., B1MW and B4MW) will be cleared marked to avoid damage during the construction activities. If necessary, additional protection or other mitigation measures will be implemented to protect the wells' structural integrity.

## 5.2 Soil Consolidation Area Preparation

Prior to soil excavation, MOA's construction contractor will identify the on-site area(s) within the AOC to temporarily consolidate soil removed to install the in-situ VES. To reduce the potential for inadvertent off-Property sediment transport through precipitation run-off, the contractor will also place silt fences along the portion of the slope comprising the Property's south boundary and adjacent to the anticipated treatment cell and soil consolidation areas

Although the remediation system is designed to treat approximately 550 to 600 cubic yards (cy), additional soil removal/consolidation is required due to excavation layback (est. 350 cy based on assumed slopes shown on Figure 4), potentially clean overburden (est. 55 cy for 1 foot), to account for subsurface VES materials (est. 40 cy), and to allow for limited focused deeper sampling in the excavation base (est. 50 cy). Based on the design dimensions shown on Figure 4, we estimate that sufficient room to consolidate 1,100 cy will be required. Note that it is important to allow for all excavated soil to be consolidated before backfilling, as the excavation will likely need to be completed before determining which portion of the consolidated soil will be targeted for in-situ treatment.

It is anticipated that the bulk of the consolidation will occur within the former Peacock Cleaners building footprint immediately north of the excavation area, and the former residence building footprint northeast of the excavation area. The ground surface in these areas appears to have been graded following the building demolition and is therefore generally flat and free of vegetation. To accommodate the total excavated soil volume, it may be necessary to identify other consolidation areas. If needed, these areas will be proposed to the agencies to ensure concurrence the area(s) are within the AOC, and will be cleared and/or graded as necessary to provide a sufficiently level surface.

Each consolidation area will be screened for oversize cobbles, branches, and other sharp objects that could puncture the base liner. A 10-mil petroleum resistant liner will be placed on the ground surface to prevent impact of the underlying surface soil. During site operations, a minimum 6-mil liner will be placed and secured over the excavated soil when soil is not being actively handled or sampled within the corresponding area, during hours of darkness, and at all other times when construction activity is not occurring at the site (e.g., temporary suspension due to ambient conditions).

### 5.3 Source Soil Excavation and Consolidation

The remediation system is designed to treat 550 to 600 cy of the most heavily-impacted source-area soil within the former Peacock Cleaners Property. This volume was calculated using previous site characterization data regarding the magnitude and extent of soil contamination, assuming a target threshold level of 10 ppm PCE. The designated area also encompasses the most heavily DRO-impacted source-area soils associated with the former Stoddard Solvent UST. The approximately 53 cy of contaminated soil excavated during the 2010 UST removal efforts will be re-excavated during this effort in addition to the geotextile liner that was used to mark the extent of the UST excavation prior to backfill.

The general boundaries of the excavation area are shown on Figure 1 and treatment system design dimensions are shown on Figure 4. The primary treatment unit will be excavated over a surface area of about 1,500 square feet (30 x 50 feet) to a depth of 12 feet bgs, with up to 50 cy of focused excavation to target potentially deeper contamination. In particular, focused soil removal may be conducted in the vicinity of former Boring SP12, where some of the highest PCE concentrations were measured, and where impacted soil appeared to extend below 12 feet bgs. Note that the total volume of the excavated unit within the 1,500 square foot treatment unit footprint is about 720 cy, but is reduced to 575 cy for the treatment unit after adjusting for the 1 foot of overburden, the volume occupied by the VES piping and bedding material, and the 50 cy of focused excavation beneath the primary excavation base.

The excavation will not extend laterally beyond the former Peacock Cleaners Property boundaries, which defines the site-specific AOC boundary. Excavation of impacted soil outside of the designated AOC may constitute generation of hazardous waste subject to LDR, permitting, and/or other RCRA requirements associated with solid waste management units. Particular care will be taken during excavation along the southern edge of the removal area where the property boundary is located within 10 feet of the designated excavation area.

During excavation, existing monitoring wells will be retained to the extent practicable. Monitoring Well B2MW is located in the northeast corner of the designated excavation area and will therefore be removed during the removal actions. Well removal will consist of using excavation equipment to fully remove the well casings. This well will be replaced concurrent with the first progress/confirmation sampling event, presently anticipated to occur in fall 2011.

Throughout the excavation, the excavated soil will be field screened on a 10-cy basis using an organic vapor monitor (OVM) and direct screening readings from the excavation base/sidewalls or backhoe bucket. The excavated impacted soil will be placed directly in the consolidation area(s) and segregated based on the following OVM readings: less than 5 ppm, less than 100 ppm, less than 1,000 ppm, and greater than 1,000 ppm.

## 5.4 Baseline Soil Sampling

After all target soils have been consolidated, Shannon & Wilson's PM will review the field notes and select the 600 cy that will be treated using the in-situ system. This determination will be based on the record of direct-reading field screening conducted during excavation. The consolidated soil with OVM readings of 1,000-plus ppm will be selected first, followed by iteratively lesser screening concentrations until the 600 cy cap is reached.

The approximately 600 cy of consolidated soil identified for treatment will be screened and sampled to establish baseline, pre-treatment COC concentrations. This sampling is not conducted for regulatory compliance or confirmation purposes. Instead, the sampling is intended to obtain data to assess the treatment efficiency over time. Specific data collection objectives are estimating total contaminant mass and range of contaminant concentrations within the treatment cell soil. The baseline data will be compared to progress sampling data to estimate the contaminant mass removed using the chemical oxidation and initial two months of passive vapor extraction. The data will also provide a field-verified basis for dosing future potential chemical oxidant applications, and establishes the basis for subsequent percent removal calculations.

The baseline screening and sampling will be conducted prior to replacing the consolidated soil in the treatment cell excavation. Because overall contaminant mass is the primary sampling objective, the soil sampling plan is directed at characterizing the bulk soil properties, and not only the highest concentrations. Note that the soil will have already been grossly segregated using the direct screening described in Section 5.3. Therefore, the soil will be considered in 100-cy lots corresponding to the discrete screening ranges. Each 100-cy lot will be characterized using one composite soil sample comprising five individual portions. The five portions will be collected from spatially-representative locations within the lot. Samples for headspace screening will also be collected from each discrete sampling location. A total of three grab samples will also be collected from the same sampling locations, based on the results of these screening results, to characterize the range of concentrations within the treatment cell soil. Additional information regarding the method of collecting composite soil samples is provided in Section 6.2, and the number and locations of individual soil portions is described in Section 7.1.1.

## 5.5 Passive In-Situ Vapor Extraction System Construction

A passive VES will consist of two arrays of slotted horizontal extraction pipe. The deeper array will be installed at a depth of 10 feet below the prevailing surface grade, and the shallow array will be installed 5.5 feet bgs. The individual VES lines will be constructed using sock-wrapped, 4-inch diameter, Schedule 40 PVC pipe with 0.020-inch slots. Each end of the extraction pipe will be attached to a vertical solid PVC riser pipe extending 4 feet above the ground surface. A passive ventilation fan will be place on the south riser pipe of each line, and a removable cap placed on the north-end riser. This configuration will allow flexibility to operate as a passive VES, be upgraded to an active/powered VES, or re-configured to a bioventing application.

At each of the two target array depths (10 feet and 5.5 feet bgs), the excavation base will be leveled and VES lines placed in a north-south orientation at 10-foot centers intervals. To protect the pipes, reduce potential for siltation, and promote soil gas flow to the pipes, each pipe will be placed in a pea-gravel bedding that extends at least 0.5 to 1 foot above, below, and on both sides of the slotted extraction lines. Note that the shallow array is off-set by 5 feet from the deeper array to enhance treatment efficiency and reduce the potential for treatment dead zones with the soil unit. Additional details of VES line installation are provided in Figures 4 and 5.

### 5.6 Excavation Backfill and Oxidant Application

The excavation will be backfilled with the consolidated source soil using an integrated effort with the VES system installation. The first task will be obtaining a level, uniform surface in the excavation base at 12 feet below the prevailing surface grade. Voids from the focused soil removal at the excavation base will be filled with excess soil from the removal/consolidation effort. If groundwater is present in the excavation base, excess soil that has screened less than 5 ppm will be used to backfill below the groundwater contact.

The remaining soil will be replaced in the excavation in 1 foot lifts, with the exception of the lifts directly above the VES arrays, which will be 1.5-foot lifts to avoid damage to the extraction pipes during oxidant application. Note that soil backfilling in the lifts must be coordinated such that the soil identified for treatment is placed within the boundaries of the treatment unit, with excess soil used to complete the backfill in the surrounding layback portion of the excavation. In addition, an attempt will be made to place the most heavily-impacted soil in the lifts directly above and below the two VES arrays.

Regenox™ oxidant will be applied to the base of the treatment unit at 12 feet bgs, and again at the top of each lift. Shannon & Wilson worked with the oxidant vendor, Regensis, Inc. to calculate a total oxidant loading of about 18,100 pounds to achieve concentration reduction threshold objectives for a target soil volume of 560 cy of PCE and DRO-impacted soil. This mass was increased by 10 percent to provide conservatism to the design, and to account for the higher treatment volume of 600 cy and a slightly larger application area. A total of 20,040 pounds of oxidant were purchased, comprising 13,950 pounds of Part A oxidant (465 thirty-pound buckets) and 6,090 pounds of Part B catalyst (203 thirty-pound buckets). Assuming an equal dosing at each of ten application depths, about 2,000 pounds of oxidant will be applied to each lift (1,390 pounds / 46.5 buckets of Part A compound and 609 pounds/20.3 buckets of Part B compound). For each lift, the appropriate portion of each part will be mixed separately in a water solution with 10 to 15 percent oxidant and applied with a spray gun evenly to the soil surface within the treatment unit. After both Part A and Part B mixtures are applied, a roto-tiller will be used to distribute the oxidant throughout the soil lift. The oxidant will be applied to the 10-foot bgs and 5.5-foot bgs and tilled into the lift before placing the VES extraction pipes at those depths.

The backfilled soil will not be compacted during placement in order to retain soil permeability and promote soil gas transport during the passive VES operation. A 10 to 15 percent bulking factor is therefore anticipated, and excess soils are anticipated. The excess soils will be used to level the ground surface near the south end of the treatment unit, but may also be mounded over the excavation area. Soils will not be left in the consolidation areas at the project's completion.

## 5.7 Ambient Air Monitoring

Ambient air monitoring will be conducted whenever soil handling is actively occurring. Monitoring will consist of OVM readings in the breathing zone within active working areas, and at the Property boundary. Action levels and responses are specified in the site-specific health and safety plan (SSHSP), which is provided under separate cover. It is emphasized that sustained periods of elevated readings will result in temporary suspension of site construction activities until readings subside.

## 5.8 Surveying

Prior to excavation, the proposed treatment unit boundaries will be documented by the environmental consultant using a hand-held geographic positioning system (GPS) unit. GPS readings will also be taken from the final excavation boundaries and VES riser pipes. In addition, the excavation boundaries and VES riser pipes will be surveyed by a professional land sruveyor to establish the final elevations and locations. The surveyors will mobilize to the site after the excavation is backfilled to conduct the surveying.

## 5.9 Progress/Confirmation Sampling

Progress/confirmation sampling will be conducted after the in-situ VES has been installed and operating for approximately two months. Due to the short time elapsed between treatment cell construction and the initial progress sampling, results from this effort will indicate the concentration reduction achieved largely through chemical oxidation, with relatively less short-term benefit from passive VES operation. If appropriate, the data will be used to support a beneficial re-use determination. Alternatively, the level of concentration reduction will be incorporated into the evaluation of future sampling/monitoring needs

The method of progress/confirmation soil sample collection has not been finalized, and may depend on actual in-place characteristics of the treatment cell, including cell geometry, access from all four sides, and level of soil consolidation. Considerations in selecting the sampling method include unnecessary mechanical soil consolidation that could reduce the VES effectiveness, retention of unconsolidated soil within sampling devices, and structural integrity of the treatment cell and in-situ VES piping during sampling. For planning purposes, the sampling method outlined in this document assumes a push-probe drill rig and macro-core samplers will be used. Potential alternatives include smaller drill rigs, hand borings, and test pits. Prior to initiation of progress/confirmation sampling, a QAPP addendum will be submitted to the agencies to specify the proposed sampling method.

Prior to initiating drilling, a sampling grid consisting of 10 boring locations will be established within the footprint of the 1,500 square-foot treatment unit. The boring locations will be selected to provide a spatial representation of the subsurface soil. The approximate boring locations are shown on Figure 5. The actual boring locations will be adjusted in the field based on the final excavation boundaries and subsurface VES piping locations.

Each boring location will be located using GPS measurements and drilled using a truck-mounted, direct push drill rig. Each push probe will be advanced to 14 feet bgs (2 feet below the treatment unit base) or groundwater contact, whichever is encountered first. Based on former groundwater depth measurements, groundwater in this area is expected at depths of 13 to 15 feet bgs. Note that the drilling depths may be adjusted based on soil mounding and/or other changes to the surface grade as a result of the soil consolidation and in-situ treatment activities.

Soil samples will be collected using continuous advancement of 5-foot macrocore sampler sleeves. Individual samples for field screening and/or laboratory analysis will be collected from up to seven intervals from each push probe (See Section 7.1). Assuming 600 cy of soil in the in-situ treatment unit, the resulting number of screening samples will equate to at least one per 10 cy of backfilled material. A total of thirteen (13) analytical samples will be selected for laboratory analysis – one sample from each boring and three additional samples to characterize vertical concentration distribution in the soil profile. The analytical samples selected will be based on headspace screening results and obtaining representative samples from each treatment lift.

## 5.10 Monitoring Well Installation

Monitoring Well B2MW, which will likely be removed during the soil excavation effort, will be replaced during the fall 2011 progress sampling event. The well will not be sampled as part of this effort, but instead will be included in the next groundwater sampling event to be conducted outside the scope of this focused remedial action.

The existing Well B2MW consists of three nested 1.25-inch diameter PVC well casings that were installed using a single borehole. Each casing contains a 2.5-foot screened section, with screen intervals extending from about 3.6 to 6 feet bgs, 13.2 to 15.7 feet bgs, and 22.3 to 24.8 feet bgs. Water was observed in the shallow well during the initial sampling in 2007, but has not been observed since and is assumed to have been perched, or an artifact of the surface discharges conducted by the former dry cleaning operation. Moreover, groundwater was not observed at this interval during the 2010 UST removal excavation. Groundwater depths in the 2007 and 2010 sampling events were measured at about 13.1 feet bgs in the "intermediate" well and 13.5 feet bgs in the "deep" well. Both intervals appear to be representative of the same unconfined aquifer, as boring logs indicate gravels and sands from 13 to 25 feet bgs.

We propose to replace the "intermediate" and "deep" well intervals, and add a third deeper interval. The third interval is added to further delineate the vertical concentration profile within the unconfined aquifer. The proposed screened intervals are one five-foot section between 11 and 16 feet bgs, and 2.5-foot sections between 22.5 to 25 feet bgs, and 35 feet to 37.5 feet bgs. These intervals, and the third one in particular, are subject to observations during drilling, and may be modified if a low-permeability unit is encountered that may comprise an aquitard.

The nested wells will be installed through a single borehole, using the same general method used to install the original B2MW well. A truck-mounted drill rig with 4.25-inch inside diameter hollow stem augers will be used to drill the borehole. Because subsurface conditions are already known, and the well will be installed through the treatment cell soil, sampling will be limited to the following intervals: continuous sampling between 10 and 16 feet (three 2-foot samples) to verify current groundwater contact, and sampling at 2.5-foot intervals between 25 and 37.5 feet bgs to characterize the previously un-logged materials at these depths. The soil samples will be recovered using 2-foot split spoon samplers driven through the hollow stem flights using a 340-pound hammer. Each recovered sample will be visually classified and screened using the headspace technique described in Section 6. Because the boring will extend through the treatment cell above groundwater, and saturated soil below groundwater contact, soil samples for analytical testing will not be collected.

The monitoring wells will be installed through the hollow-stem casing. To control costs associated with drilling footage, sealant materials, and investigation-derived waste, the wells will consist of 1.25-inch diameter casings installed in the common borehole. The casing material will be a schedule 40 PVC, and the screened sections will comprise pre-pack screens having 0.020-inch slots and a #10-#20 sand pack. After each successive well point is place, additional sand pack will be used to backfill around the well screen to about 0.5 to 1 foot above the screened section. Bentonite chips will be applied around the PVC piping and hydrated in place to a depth about1 foot below the bottom of the next-highest nested well casing. Bentonite will also be placed above the shallow well point to a depth about 1 or 2 feet bgs, and completed with soil from the treatment cell. Above-ground steel protective casings will be used around the nested monitoring well assembly.

The newly installed groundwater monitoring wells will not be developed at least 24 hours after installation using a submersible pump. Development will continue until at least 5 well volumes have been removed and water quality parameters have stabilized, 25 gallons of water are removed from each well point, or 3 hours of effort is expended. Water quality parameters will be considered stabilized when three consecutive measurements indicate that: pH is within 0.1 units, conductivity is within 3 percent, temperature is within 1 degree Celsius, and turbidity is within 10 percent or three consecutive readings of less than 10 Nephelometric Turbidity Units (NTUs). The development water will be contained in a 55-gallon drum.

### 5.11 Decontamination

Disposable sampling equipment will be used to the extent practicable, to reduce the chances for cross-contamination. Any reusable sampling equipment will be decontaminated after each use. The field decontamination procedure for sampling equipment will include, at a minimum, washing equipment in each of the following solutions:

- Solution #1 - Tap water rinse
- Solution #2 - Non-ionic detergent (i.e., Alconox) and tap water scrub
- Solution #3 - Tap water rinse

The decontamination procedure for push-probe and hollow-stem drilling rods will consist of a combination of wet and dry methods. After each use, the drilling rods will be brushed to remove loose soil. A propane torch will be used to conduct a dry decontamination of the rods. Temperature-sensitive elements, such as the expendable point holder and the lead rod, and the split-spoon samplers, will have an additional wet decontamination procedure. Decontamination water will be discharged to the ground surface.

### 5.12 IDW Management

Investigation-derived wastes (IDW) expected to be generated during the planned field activities are expected to include unregulated solid wastes, drill cuttings, and sampling wastes. We do not expect to generate other soil and/or water IDW during the planned field activities.

Solid Wastes. Solid wastes include used personal protective equipment (PPE), disposable sampling equipment, liners from the consolidation area, the geotextile liner marking the former UST removal excavation and remnants from Monitoring Well B2. These solid wastes will be disposed of as domestic waste at the local municipal landfill. Prior to disposal, soil residue will be removed to the extent possible using dry methods such as brushing.

Drill Cuttings: The replacement well for Monitoring Well B2MW will be located within the treatment cell. Therefore, drill cuttings from the associated installation borehole will be incorporated into the treatment cell.

_Sampling Wastes_. Soil contained in the headspace screening bags in unpreserved sample jars will be added directly to the treatment cell soil. Soil samples that have been field-extracted with methanol, but are not selected for laboratory analysis, will be consolidated into aluminum pans. After the methanol evaporates, the residual soil will be added to the treatment cell soil.

# 6.0 SOIL SAMPLING METHODS

This section describes the materials and methods that will be used to collect soil samples for field screening and fixed-laboratory analyses.

## 6.1 Sample Collection

Soil samples for field screening and/or laboratory analysis will be collected during the excavation/consolidation, baseline sampling, and progress sampling tasks. Soil samples will be collected using two methods: The first method entails sample collection directly from soil surfaces (e.g., the consolidation piles). A shovel or hand tools will be used to access freshly-exposed soil at depths 12 to 18 inches below the surface. A dedicated stainless-steel spoon or laboratory sampling spatula will be used to fill the appropriate field screening and/or analytical sample containers, as described below. The shovel or hand tool will be decontaminated between sample locations.

The second sampling method entails sample recovery during the push-probe drilling. Soil will be recovered from the boreholes using 5-foot macrocore sampling devices. Each 5-foot section of plastic sleeve will be removed from the sampling device and split down the long axis. The soil section will then be visually subdivided for screening purposes, without removing soil from the sleeve (See Section 7.1). Once the appropriate sample sections/intervals have been established for a given core sample, a stainless steel spoon will be used to collect representative soil from those intervals for both field screening and potential laboratory analysis.

## 6.2 Field Screening

A photoionization detector (PID) will be used to screen excavated soils for volatile organics. Two screening methods will be used for two discrete data collection objectives: direct screening during the excavation of the source soil for segregation purposes, and an ADEC-approved headspace screening method for baseline and progress/confirmation samples.

For direct screening, the soil in the excavator bucket will be screened with a PID by inserting the instrument probe tip in a shallow hole made in the soil with a spoon. Soils will be designated as potentially clean if they exhibit PID readings less than 5 ppm and have no visual or olfactory evidence of contamination. The remaining soil excavated from the source soil area will be considered impacted, and segregated as detailed in Section 5.3. If visual or olfactory observations indicate obvious contamination, screening can be performed less frequently.

Whereas direct screening readings will be used for segregation relative to an established action level, headspace screening samples will be used to determine relative level of impact, and to select a subset of screening samples for fixed-laboratory chemical testing. The headspace screening samples will be collected andtested using an ADEC-approved headspace technique. In accordance with this method, screening samples will be collected using stainless-steel spoons to transfer soil to resealable plastic bags. These samples will be warmed to a common temperature and tested within 1 hour of sample collection. The screening process will consist of agitating the sample bag, inserting the PID probe into the bag, and recording the maximum concentration reading. The PID will be calibrated on a daily basis, using 100 ppm isobutylene calibration gas. Each headspace screening sample will also be visually classified in the field.

### 6.3 Analytical Soil Sampling

Analytical samples will be collected using stainless-steel spoons (grab samples) or laboratory sample spoon/spatula (composite samples) to transfer soil to laboratory-supplied containers. The laboratory-provided sample containers will be filled in order of decreasing volatility; the jar(s) for volatile analytes (e.g., GRO, VOCs) will be collected first, headspace samples collected second, and jars for non-volatile analytes (e.g., DRO, PAH) last. Samples for VOC analysis will be collected and field-preserved in accordance with the method requirements, with methanol added to laboratory-supplied sample containers directly after soil collection. A minimum soil mass of 25 grams dry weight is desired for this analysis. To obtain lower laboratory reporting limits we will attempt to collect about 50 grams of soil, subject to the requirement that the methanol completely submerge the soil sample. One or more 25-ml vials of reagent-grade methanol will be added to the sample container, with sufficient volume to completely submerge the soil. To prevent leakage, the rim of each sample container will be quickly wiped free of soil particles with a piece of clean paper towel before capping.

Composite samples will be collected as part of the baseline sampling program. To collect composite samples for volatile analyses, a laboratory spatula will be used to place about 10 grams of soil from each of five sampling locations in the appropriate laboratory-supplied container. The spatula will be “calibrated” by the FTL to enable consistent collection of approximately 10 grams of soil. The samples will be collected in a manner to minimize time between aliquots, and the methanol added immediately after the last aliquot. If necessary, a second 25-ml vial of methanol will be used to submerge the combined soil volume. Composite samples for non-volatile analyses will be collected in a similar manner, except the spatula will be used to fill each container about 20 percent full, such that the container is full after the fifth portion is added. Based on conversations with the lab, the laboratory homogenizes non-volatile samples as a regular practice.

To minimize collection error, the following steps will be taken during sample collection:

- Samples will be collected with clean, stainless steel spoons/spatulas and sampling equipment that has been decontaminated.
- Disposable gloves will be worn by sampling personnel and changed between sample collections.
- The soil will be placed into a clean, laboratory-provided sample container(s), which will be quickly capped, sealed, and labeled.
- Containers will be properly sealed. Rims will be cleaned prior to tightening lids.

### 6.4 Sample Containers and Preservation

Environmental samples require various preservation methods to minimize analyte degradation during transport and storage. Table 1 lists the sample containers and preservation requirements for each analytical method and sample matrix. The method of adding the methanol preservative for volatile samples is described in Section 6.3.

Soil samples will be immediately cooled and maintained at 4ºC ± 2ºC through delivery to the analytical laboratories. The analytical samples will be placed in insulated coolers and protected from breakage using bubble-wrap or other inert material. Frozen gel packs will be placed in the cooler to maintain temperature objectives, which will be confirmed by the laboratory using a temperature blank placed in each cooler.

## 7.0 SAMPLE LOCATIONS, QUANTITIES, AND ANALYTICAL METHODS

The proposed number of analytical samples and the corresponding analyses are specified below and summarized in Table 2.

### 7.1 Project Samples

Project analytical samples will be collected from the consolidated soil prior to backfilling (baseline samples) and from the treatment unit after completion and operation of the in-situ treatment system.

#### 7.1.1 Baseline Soil Samples

Baseline sampling will comprise collection of analytical soil samples at a rate of one composite sample per 100 cy from the soil within the in-situ treatment unit. Assuming 600 cy of treatment zone soil, six (6) composite soil samples will be collected. Each composite sample will comprise five discrete sampling locations within the 100-cy lot (total of 30 locations for six 100-cy lots). The five locations will be selected to be spatially representative, noting both the overall objective of characterizing the average concentration within the lot, and that the lots will have already been segregated by gross concentration ranges during the excavation and screening process. In addition to the six composite samples, grab samples will be collected from three (3) of the thirty individual sample portion locations. The three samples will be selected based on headspace readings, to provide correlation between the screening and analytical data, and to verify the range of apparent concentrations within the soil to be treated. Therefore, two samples will be selected from the highest headspace readings, and one sample will be selected from the low end of the range of screening readings.

The composite and grab analytical samples will be analyzed by SGS for DRO by Alaska Method 102 (AK 102); GRO by Alaska Method 101 (AK 101); BTEX by EPA 8260B; and the short list of VOCs (PCE, TCE, cis-1,2-DCE and VC) by EPA 8260B. The one composite sample from the "hot" consolidation soil pile (> 1,000 ppm on the OVM) and the grab sample from the location with the highest headspace reading will also be tested for PAH by by EPA Method 8270C SIM. The samples will be analyzed on a regular turn around basis of two weeks.

### 7.1.2 Progress/Confirmation Soil Samples

Seven soil samples for field screening will be collected from each push-probe borehole. These samples will be obtained from the following intervals within the 5-foot macrocore samples: 1 to 2 feet bgs, 3 to 4 feet bgs, 5 to 6 feet bgs, 7 to 8 feet bgs, 9 to 10 feet bgs, 11 to 12 feet bgs, and the boring base. Note that these section locations and intervals within each 5-foot core may vary based on total sample recovery in the core, total borehole depth, and visual observations of soil conditions and potential contamination.

The number of analytical samples is based on total soil volume, in accordance with ADEC guidance for stockpile sampling. For the 600 cy of treated soil, thirteen (13) analytical soil samples will be collected. One analytical soil samples will be selected from each push probe boring based on field screening results. A total of three additional samples will be selected to obtain representative samples from each treatment lift, and further characterize vertical distribution through the soil profile. Twenty (20) progress/confirmation soil samples will be analyzed by SGS for DRO, GRO, BTEX, and the short list of VOCs (PCE, TCE, cis-1,2-DCE and VC). In addition, two samples will be analyzed for PAHs. The two samples will be selected in an attempt to reflect the highest headspace readings from each of the Stoddard Solvent and chlorinated solvent source areas; however, this will be complicated by the fact that the soils will have been mixed and segregated during excavation, and further mixed during replacement in the treatment cell. Absent distinguishing features between source areas, the two samples will be selected based on the two highest headspace screening readings. . The samples will be analyzed on a regular turn around basis of two weeks.

## 7.2 Field Quality Control Samples

### 7.2.1 Field Duplicate Samples

Duplicate samples will be used to assess both the sample matrix heterogeneity and the variability in sample collection procedures. One field duplicate/QC sample from the baseline soil samples and two field duplicates/QC samples from the progress/confirmation samples will be collected for laboratory analysis. At least one of the duplicate samples will be co-located with one of the project samples tested for PAH analysis. The QC samples will be numbered sequentially with the project samples and submitted to the project laboratory for the same analyses as the corresponding primary sample.

### 7.2.2 Trip Blanks

Trip (or travel) blank samples are used to determine if sample containers become contaminated during storage and shipment to and from the laboratory. One trip blank will be included with each sample cooler transported from the field that contains samples for volatile organic compounds, with a minimum of one trip blank per 20 samples. Trip blanks associated with soil samples will be comprised of a methanol matrix. Trip blanks will be prepared by the project laboratory and will be tested for GRO/BTEX and the short-list VOCs.

### 7.2.3 Temperature Blanks

Temperature blanks, although not analytical samples *per se*, are containers of water that travel with samples to allow the sample custodian to measure approximate sample temperatures. One temperature blank will be included with each sample cooler.

# 8.0 SAMPLE HANDLING AND CUSTODY

This section specifies the methods used to ensure sample integrity through the use of systematic sample identification, appropriate sample transport methods, and chain-of-custody (CoC) tracking procedures.

## 8.1 Sample Identification

### 8.1.1 Sample Numbering System

Each sample will be assigned a unique field sample designation that indicates the site location, sampling activity (e.g. baseline sample, progress/confirmation sample, etc.), sample matrix, and the numerical sequence. Samples selected for laboratory analysis will be assigned unique identification numbers. Field duplicate samples will be given the next sequential sample number so that the laboratory cannot distinguish them from other site samples. Trip blanks will also be numbered using this method.

### 8.1.2 Sample Labels

Each sample container will have a sample label affixed in a waterproof manner. Sample labels will be water resistant and contain the following information:

- Project name and number
- Sample identification number
- Preservative, where applicable
- Requested analyses
- Date and time of sample collection
- Sampler's initials.

## 8.2 Sample Holding Times

Holding times for each analytical method and sample matrix are listed on Table 1.

## 8.3 Chain-of-Custody Procedures

The collection, possession, and handling of individual samples must be traceable from the time of collection until the time the analytical laboratory reports the results of sample analyses. The field sample custodian (typically the sampler) is responsible for sample security and CoC record keeping in the field. Each analytical sample will also be documented on a CoC form, which will accompany the sample through the transport and analysis process. The CoC form will include:

- Project number
- Project/client name and location
- Sample identification (corresponding to the sample container labels)
- Date/time of sample collection
- Requested analyses
- Sample matrix
- Number and type of containers
- Sample preservatives
- Laboratory work order number
- Relinquishment record with signature, name, date, and time
- Receipt record with signature, name, date, and time.

The sample coolers will be hand-delivered to the SGS sample receiving facility in Anchorage. Upon receipt, the laboratory will sign and date the CoC form, document the condition of the samples, and record the cooler temperature. The laboratory will retain a copy of the CoC. The original COC form will be returned to Shannon & Wilson by the laboratory with the completed laboratory reports. An example CoC form is provided in Appendix A.

# 9.0 DATA MANAGEMENT AND REPORTING

Data management consists of the process and methods used to process, compile, analyze, and report the acquired data. Primary management tools for this project comprise will consist primarily of the field notes, laboratory deliverables packages, and summary written report.

## 9.1 Field Forms and Documentation

Field work will be documented in a field logbook, and will be supplemented with pre-printed field forms. Example forms are provided in Appendix A.

### 9.1.1 Field Logbook

Field notes will be used to document field activities and site data. Information recorded in the field notes will include the following:

- names of qualified personnel on site supervising or conducting field activities,
- date and time of sampling,
- weather conditions,
- names of sampler(s),
- photographs of site and field activities,
- field meter calibration documentation;
- detailed descriptions of treatment system installation activities, including daily summaries of work completed, volume of soil handled, excavation dimensions, VES piping placement, backfill lift intervals, and oxidant application volumes, etc.;
- a sampling log that identifies the following for each soil sample:
    - sample identification number
    - location
    - depth
    - time of collection
    - field screening result(s)
    - physical characteristics (e.g. soil classification, color, etc.)
    - selection for analytical testing;
- a site sketch that shows:
    - general site features (fencing, cleared areas, etc.)
    - delineation of soil excavation and consolidation areas
    - sample locations
    - property line locations
    - scale or approximate dimensions and north arrow;

- push-probe boring logs; and
- other information pertinent to the data collection objectives

#### 9.1.2 Sample Collection Log

Sample collection details will be documented in the field using the field logbook. At the end of each day, a sample collection log will be prepared to summarize that day's sampling activities. This form is intended to consolidate the data recorded in the various field sampling forms, and will serve as supporting documentation for preparation of the summary report. Separate forms will be used for each day.

#### 9.1.3 Photograph Log

Photographic documentation of significant visual field observations will be collected with electronic or film media. Photographs will depict excavation operations, the soil consolidation area, construction of the in-situ VES, sample locations and push probe boring operations. Sufficient photographs will be taken to record each element of the remedial action processes. For each photograph an attempt will be made to include suitable reference points, such as a sample marker.

Photographs will be recorded on a photograph log form. The Photo Log will include the time, date, and location of each photograph and may include direction, photo subject, and other relevant information.

### 9.2 Laboratory Data Package Format and Contents

The laboratory results will be provided in ADEC Level II Data Deliverables packages. The Level 2 report contains a Project Narrative, receiving records, sample results, surrogate results (as applicable), and sample preparation quality control (blanks, control spikes, and matrix spikes (as applicable)) summaries to include acceptance criteria.

### 9.3 Final Summary Report

The report task consists of preparing a final summary report. The report will be prepared in general accordance with the ADEC's applicable reporting requirements of 18 AAC 75. A single summary report will be prepared to document the site remedial actions and progress/confirmation soil sampling. At a minimum, the report will include the following:

- Discussion of site background;
- Detailed description of remedial action activities;
- Summarized field data, including tabulated field screening and analytical results, survey maps, and photographs;

- Scaled site plans and maps depicting excavation dimensions, sampling locations, and as-built remediation system elements;
- Discussion of analytical results in context of documenting treatment system effectiveness;
- A refinement of the conceptual site model using new physical and chemical data;
- An analytical data quality summary, including results of the data assessment and completed ADEC laboratory data review checklists;
- Conclusions regarding the treatment effectiveness, site status with respect to interim concentration reduction thresholds and/or other ARARs, land reuse supported by the level of treatment achieved at that time, and potential ICs that would accompany such land use(s);
- Evaluation of the need and schedule for additional soil progress sampling;
- Recommendations, as warranted, pursuant to MOA's short-term and long-term project objectives; and
- Appendices containing boring logs, site photographs, laboratory reports, and field notes.

Shannon & Wilson will provide the MOA with two paper copies and one electronic copy of the final summary report.

# 10.0 CHEMICAL DATA QUALITY CONTROL

## 10.1 Data Types

The data to be collected for this project will include the following:

- field observations;
- survey data;
- field screening results for soil samples, using hand-held meters; and,
- chemical testing data generated using fixed laboratory methods.

## 10.2 Data Users

Data generated during this work effort will be used both for real-time decisions in the field, and to support the overall RAO. The data will be provided to the project team to assess conformance with project objectives, and the agencies will develop a determination regarding the site's eligibility for reuse/redevelopment and the necessary institutional controls associated with such uses. Based on these findings, the MOA will incorporate the project data into their future property re-use/rehabilitation planning process.

## 10.3 Data Uses and Objectives

The project's intended data uses and objectives are identified in Sections 2.2 and 2.3 of this QAPP. The data used for these purposes include screening-level field data and chemical testing by a fixed laboratory using ADEC and EPA-approved methods.

Screening-level data will be used to support field decisions such as:

- selecting soil samples to submit to SGS for analysis; and
- segregating soil excavated during the source-area soil removal/consolidation.

Data quality objectives (DQOs) for the field-screening data will be based on proper calibration and function of the screening equipment. This equipment includes the OVM used to obtain semi-quantitative concentrations of VOCs in the soil samples. Calibration of the OVM will be conducted on a daily basis, in accordance with the manufacturer's recommendations. Documentation of the equipment calibration will be recorded in the field log book.

In comparison, data from samples collected for laboratory analysis will be used to assess conformance with the project's data collection objectives. These data will therefore need to be of a higher level of quality, and will be subjected to a more rigorous laboratory QA/QC effort.

## 10.4 Quality Control Samples

Quality control for analytical data will be assessed using field and laboratory QC samples.

### 10.4.1 Field QC Samples

Field QA/QC samples for this project will consist of field-duplicate samples, trip blanks, and temperature blanks.

We will collect and submit to SGS duplicate soil samples for analysis of GRO, DRO, BTEX, PCE, TCE, cis-1,2-DCE, VC and PAHs. One duplicate will be submitted from the consolidated soil baseline samples and two duplicates will be submitted from the in-situ VES progress/confirmation samples.

Trip (or travel) blank samples are used to determine if sample containers become contaminated during storage and transport to and from the laboratory. One trip blank will be included with each sample cooler transported from the field that contains samples for VOCs, with a minimum of one trip blank per 20 samples. Trip blanks associated with soil samples will consist of a methanol matrix and will be prepared by SGS.

Temperature blanks are containers of water that travel with samples to allow the sample custodian to measure approximate sample temperatures. One temperature blank will be included with each sample cooler transported from the field. Temperature measurements will be recorded by the laboratories immediately after opening the sample cooler, with results used to assess conformance with project requirements for sample packaging and delivery.

#### 10.4.2 Laboratory QC Samples

Laboratory QC requirements are defined by the laboratory's chemical quality program, and by the individual analytical protocols they use. A variety of internal laboratory QC samples is used to assess that the analyses are in control. These include method blanks, laboratory control samples (LCS), surrogate spikes, matrix spike samples, and spike duplicate samples.

Method blanks are clean, interference-free samples consisting of the same matrix as that of the corresponding project sample batch. They are used to monitor potential laboratory contamination, and will be included in each preparation batch of samples processed by SGS. The acceptance criterion for method blank samples is that all positive detections shall be less than one half the laboratory limit of quantitation (LOQ) for that sample. If concentrations in a method blank exceed this level, the corresponding project samples may be qualified as biased high during the analytical data review process.

LCS and LCS Duplicates (LCSD) are prepared by spiking method blank samples with project-specific target compounds. Data from these analyses provide a measure of the inherent accuracy and precision of the analytical method. LCS/LCSD analyses will be performed by SGS at a frequency of one per preparation batch of no more than 20 samples.

Known quantities of unique surrogate compounds are added to project samples subjected to organic analyses to measure recovery from the sample matrix. Surrogate recovery is used to assess instrument efficiency and matrix interference effects. Lists of surrogates that will be used for this project and their acceptable recovery ranges are provided in Table 3.

### 10.5 Measurement Quality Objectives for Chemical Data

Quality chemical data will be obtained through the use of standard operating procedures (SOPs) for sampling and analyses that minimize biases, the meticulous calibration of analytical equipment, and implementing corrective action when QA parameter measurements exceed pre-established tolerance limits.

Measurement Quality Objectives (MQOs) are quantitative criteria used to demonstrate that the sample collection and analysis procedures are reproducible, repeatable, and are appropriately measuring the target analyte concentrations without unacceptable bias. For this project, MQOs have been established for the following key data quality indicators:

- *Precision* – measures the relative percent difference between replicate samples;
- *Accuracy* – measures percent recovery of known spike concentrations;
- *Sensitivity* – the method detection limits and practical quantitation limits; and
- *Completeness* – the ratio of valid measurements to the total number of reported results.

Another data-quality indicator that will be used, but does not have a numerical MQO, is data representativeness. By working in general accordance with our proposed scope of work, the samples we collect are expected to be representative of site conditions at the locations and times they are obtained. In addition, the results of trip blank and method blank samples provide measures of representativeness by indicating potential sample bias due to sample contamination during the collection, transport, and analytical processes.

Precision is a measure of the degree of variability in measurements. It is typically calculated using repeated measurements of the same quantity by the same method. For the purposes of this plan, precision is indicated by the relative percent difference (RPD), defined as the difference between the sample and its duplicate concentrations divided by the mean of the two. RPDs will be calculated for project/duplicate sample sets, and LCS/LCSD samples. The laboratory limits on precision for the SGS QA procedures are provided in Table 3.

Accuracy is the closeness of a measurement with an accepted reference or true value. Bias can be caused by sample heterogeneity, or by consistent errors in the sample collection, handling, and/or analysis methods. Accuracy is calculated as the percent recovery of a known analyte spiked into project samples prior to analysis. The acceptable accuracy ranges for surrogates and LCS spikes are presented in Table 3.

Analytical sensitivity is evaluated using method detection limits (MDLs) and LOQ. The laboratory's target MDLs and LOQs are listed in Table 3. Analytes that are not detected will be reported as non-detect at a level equal to two times the MDL.

Completeness is the percentage of usable measurements, compared to the total number of measurements requested. Data are expected to meet acceptance criteria (precision, accuracy/bias, and sensitivity MQOs) for 85 percent of the laboratory analytical data requested.

### 10.6 Data Assessment

Data assessment is a process for determining the usability of data for stated project objectives, based on the compliance of laboratory-generated chemical data with MQOs and other data quality standards. For this project, Shannon & Wilson will conduct data verification and limited review. We will not conduct full data validation, including usability determinations for nonconforming data. Such usability determinations will be jointly developed using input from the regulatory agencies.

Chemical data will be provided by SGS in ADEC Level II Data Deliverables packages. Shannon & Wilson's data verification will consist of checking each data package to ensure that all analyses requested on the chain-of-custody forms were performed and reported, all relevant laboratory internal QC data have been provided, and that the specified analytical methods were used to test the samples.

The Environmental Consultant will conduct a limited data review to compare laboratory performance to numerical DQOs. Results of the review will be documented in completed ADEC Laboratory Data Review Checklist forms. A separate checklist form will be completed for each deliverables package.

### 10.7 Preventative Maintenance

Laboratory instruments will be maintained in accordance with procedures listed in SGS Quality Assurance Project Plan and Standard Operating Procedures. The PID field meter will be kept clean and its battery charged for daily use in the field.

### 10.8 Field Instrument Calibration

The PID field meter will be inspected and calibrated with the appropriate calibration gas on a daily basis. Calibration results will be documented in the field notebook.

### 10.9 Nonconformance/Corrective Actions

The initial responsibility to monitor analytical data quality and conformance with provisions of this QAPP lies with the analytical laboratories. Examples of nonconformance that may require corrective action include:

- problems with cooler receipt (e.g., elevated temperatures, improper or damaged sample jars, chain-of-custody discrepancies, incomplete sample labeling, etc.)
- exceeding analytical holding times;
- problems with instrument calibration;
- MQOs for precision, accuracy, or sensitivity are not met;
- unusual variations in LOQs; or
- deficiencies are detected during internal or external QA reviews and/or audits.

Laboratory corrective action procedures may be handled by the project laboratory's analyst, who will review preparation or extraction procedures for possible errors and check instrument calibration, spike and calibration mixes, instrument sensitivity, etc. If the problem persists or cannot be identified, the matter will be referred to the Laboratory Manager and/or Laboratory QA Officer for further investigation.

Corrective actions may include reanalysis, resampling, laboratory audits, or other appropriate measures. Nonconformance issues and resulting corrective action(s) will be documented, as appropriate, in our report following the project's completion.

Analytical data that do not satisfy MQOs or have other quality concerns may be qualified or rejected, based on the impact on data usability in context of project-specific objectives. Data qualifiers assigned by the laboratory or Environmental Consultant will be reflected in the summary report data tables and discussed in the data quality section of the summary report. Examples of common qualifier flags include:

U – the analyte is not detected above the MDL. Non-detects are reported at a limit of detection (LOD) equal to two times the MDL.

J – the analyte was positively identified, but the reported concentration is an estimate due to detection above MDL but less than the LOQ, or other quality control concerns (the applicability for a J flag qualifier for other quality concerns will be assessed on a sample-specific basis by the Environmental Consultant).

UJ – the analyte was not detected above the reported sample quantitation limit. However, the reported quantitiation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample (EPA, 1999).

B – Project samples that contain a detected analyte at a concentration within 5 times the magnitude of a positive detection in a blank sample (10 times for common laboratory contaminants) will be considered non-detect at the level measured in the project sample, and qualified with a B flag.

R – The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified (EPA, 1999).

Other flags may be appropriate, depending on the nature of the QC failure. For these circumstances, the nature of the failure will be considered in context of the data collection objectives, concentration magnitudes involved, and target cleanup levels to determine if data qualifications are needed. In general, the default position for qualifying data will be the EPA's National Functional Guidelines for Organic Data Review (EPA, 1999).

# 11.0 ASSESSMENT AND OVERSIGHT

The assessment and oversight tasks are used to evaluate the effectiveness of the project implementation and associated QA and QC activities. For this project, assessment and oversight tasks will include field audits, and a multi-tiered system of data quality assessment and document review.

## 11.1 Field Oversight

Shannon & Wilson's FTL and PM will jointly review field notes, CoC forms, and laboratory results on a daily basis. Non-conformances or QC issues identified in this review will be documented. The appropriate corrective action and notifications, as outlined in this QAPP, will be implemented directly, and documented in the field logbook.

In addition to the daily notes review, the Environmental Consultant's PE/QA manager will conduct periodic field audits to ensure system installation in conformance with the system design. At a minimum, field audits will be conducted before substantial earthwork commences, during placement of the deeper VES array, and at least once during application of the oxidant compound.

## 11.2 Chemical Data Quality Assessment

A multi-tiered, systematic process will be used to assess chemical data produced by the project laboratory. As described in Section10, the initial phase of review and potential corrective action will be conducted internally at the project laboratory. After submittal of final laboratory reports to the Environmental Consultant, the Environmental Consultant's FTL will review the reports, conduct data verification tasks, and complete the ADEC Laboratory Data Review checklists. At this stage, the FTL will make a preliminary determination of unresolved data quality issues that may impact the data usability. The FTL will review these issues with the project laboratory and Environmental Consultant's PM to develop an opinion regarding the data usability and the potential need for qualifiers. If issues are identified that have the potential to materially affect data completeness MQOs or the project's data collection objectives, the MOA PM and/or agencies, as appropriate, will be notified directly to identify potential corrective action. The process for identifying and implementing corrective action is described in Section 10.

The completed ADEC Laboratory Data Review checklists will be reviewed by the Environmental Consultant's PM and QA Manager prior to submittal to the agencies for final review.

### 11.3 Document Review

A multi-tiered, systematic process will be used to produce and review the summary report document. It is anticipated that the draft summary report will be written largely by the Environmental Consultant's FTL and staff specialists (e.g., drafting), with significant input from the PM. Upon completion, the PM will conduct a completeness review, and the QA Manager will conduct the internal senior management review. The draft report will be submitted to the MOA PM for internal review. Once MOA approves distribution, the report will be published for public access, including submittal to the EPA and ADEC.

## 12.0 REFERENCES

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## TABLE 1 - SOIL SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

| Analyte | Method | Soil Samples | | | |
|---|---|---|---|---|---|
| | | Container | Preservation | Temperature | Maximum Holding Times |
| Gasoline Range Organics (GRO) * | AK 101 | 4-oz. amber glass, TLS | 25 mL MeOH | 4ºC ± 2ºC | 14 days |
| Benzene, Toluene, Ethylbenzene, Xylenes (BTEX) * | EPA Method 8260B | | | | |
| Volatile Organic Compounds (VOC) * | | | | | |
| Diesel Range Organics (DRO) | AK 102 | 4-oz. amber glass, TLC | - | 4ºC ± 2ºC | 14 days until extraction, analyzed 40 days after extraction |
| Residual Range Organics (RRO) | AK 103 | | | | |
| Polynuclear Aromatic Hydrocarbons (PAH) | EPA Method 8270C SIM | | | | |

Note: Specifications in this table are based on EPA's published Solid Waste Test Methods, ADEC guidance documents, and laboratory SOPs

| KEY | DESCRIPTION |
|---|---|
| * | If volatile compounds are the only analyses to be conducted, an additional moisture content sample must also be submitted. |
| TLS | Teflon-lined septa, sonically bonded to screw caps |
| TLC | Teflon-lined screw caps |
| MeOH | Methanol (provided by laboratory) |

# TABLE 2 - SAMPLE LOCATIONS AND ANALYTICAL TESTING PROGRAM

**PROJECT SAMPLES**

| | | | FIELD SCREENING SAMPLES [a] | | FIXED-LAB SAMPLES | | NUMBER OF ANALYSES [b] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Field Activity Description** | **Quantity** | **Sample Media** | **Frequency** | **No. of Samples** | **Frequency** | **No. of Samples** | **GRO** | **DRO** | **BTEX** | **VOC** | **PAH** |
| Direct Screening of Excavated Soil | 1,100 cy [c] | Soil | 1/10 cy | 110 | - | - | - | - | - | - | - |
| Baseline Sampling of Excavated Soil | 600 cy [d] | Soil | 1/20 cy | 30 | 1 / 100 cy (composite) | 6 | 6 | 6 | 6 | 6 | 1 |
| | | | | | 1 / 200 cy (grab) | 3 | 3 | 3 | 3 | 3 | 1 |
| Progress/Confirmation Sampling with Push Probes | Ten 15-foot borings | Soil | 7 / borehole | 70 | 1 / boring plus 3 for vertical distribution | 13 | 13 | 13 | 13 | 13 | 2 |
| **Total Project Soil Samples** | | | | | | 22 | 22 | 22 | 22 | 22 | 4 |

**QUALITY CONTROL SAMPLES**

| | | | FIXED-LAB SAMPLES | | NUMBER OF ANALYSES [b] | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Sample Type** | **Sample Media** | | **Frequency** | **No. of Samples** | **GRO** | **DRO** | **BTEX** | **VOC** | **PAH** |
| Duplicate/QC Samples | Soil | | 1 / 10 project samples | 3 | 3 | 3 | 3 | 3 | 1 |
| Trip Blank | Soil | | 1 / cooler [e] | 4 | 4 | - | 4 | 4 | - |
| **Total QC Soil Samples** | | | - | 7 | 7 | 3 | 7 | 7 | 1 |

a Soil field screening samples will be tested using an organic vapor monitor (ThermoInstruments 580 PID, or equivalent)
b Target Compounds and Analytical Methods:
GRO Gasoline Range Organics by AK 101
DRO Diesel Range Organics by AK 102
RRO Residual Range Organics by AK 103
BTEX Benzene, Toluene, Ethylbenzene and Xylenes by EPA Method 8021B or 8260B
VOC Limited Volatile Oganic Compounds (PCE, TCE, DCE, VC) by EPA Method 8260B
PAH Polynuclear Aromatic Hydrocarbons by EPA Method 8270C SIM
c Excavated soil volume comprises in-situ treatment cell volume, focused soil removal from the excavation base, and excavation layback slopes
d Field screening and analytical sampling applies only to soil designated for replacement in the in-situ treatment unit
e Assumes two trip blanks for each of the baseline and progress/confirmation sampling efforts

# TABLE 3 - DATA QUALITY OBJECTIVES FOR SOIL ANALYSES

| | | Soil Sample Cleanup Levels and MQOs | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | ADEC Cleanup Levels [a] (mg/kg) | | Sensitivity [b] (mg/kg) | | Precision [c] (% RPD) | | Accuracy [d] (% recovery) |
| **ANALYSIS/ANALYTE** | **Method** | Most Stringent | Conc. Reduc Threshold | **MDL** | **LOQ** | **LCS** | **Field Dup** | **LCS** |
| Gasoline Range Organics (GRO) | AK 101 | 300 | 1,400 | 2 | 20 | 20 | 50 | 60 - 120 |
| Diesel Range Organics (DRO) | AK 102 | 250 | 10,250 | 2 | 20 | 20 | 50 | 75-125 |
| Residual Range Organics (RRO) | AK 103 | 10,000 | 10,000 | 2 | 20 | 20 | 50 | 60 - 120 |
| **Aromatic Volatile Organics (BTEX)** | | | | | | | | |
| Benzene | EPA 8260B | 0.025 | 11 | 0.0039 | 0.0125 | 20 | 50 | 75 - 125 |
| Toluene | EPA 8260B | 6.5 | 220 | 0.015 | 0.05 | 20 | 50 | 70 - 125 |
| Ethylbenzene | EPA 8260B | 6.9 | 110 | 0.0078 | 0.025 | 20 | 50 | 75 - 125 |
| o-Xylene | EPA 8260B | - | - | 0.015 | 0.05 | 20 | 50 | 75 - 125 |
| p- & m-Xylenes | EPA 8260B | - | - | 0.015 | 0.05 | 20 | 50 | 80 - 125 |
| Xylenes (total) | EPA 8260B | 63 | 63 | 0.031 | 0.1 | 20 | 50 | 85 - 125 |
| **Limited Volatile Organic Compounds (VOCs)** | | | | | | | | |
| Tetrachloroethene | EPA 8260B | 0.024 | 10 | 0.0039 | 0.0125 | 20 | 50 | 75 - 125 |
| Trichloroethene | EPA 8260B | 0.020 | 0.570 | 0.0039 | 0.0125 | 20 | 50 | 80 - 125 |
| cis-1,2-Dichloroethene | EPA 8260B | 0.24 | 130 | 0.0078 | 0.025 | 20 | 50 | 75 - 125 |
| Vinyl chloride | EPA 8260B | 0.0085 [A] | 4.3 | 0.0078 | 0.025 | 20 | 50 | 70 - 140 |
| **Polynuclear Aromatic Hydrocarbons (PAH)** | | | | | | | | |
| Acenaphthene | 8270C SIM | 180 | 2,800 | 0.0015 | 0.005 | 30 | 50 | 45 - 110 |
| Acenaphthylene | 8270C SIM | 1,800 | 2,800 | 0.0015 | 0.005 | 30 | 50 | 45 - 105 |
| Anthracene | 8270C SIM | 3,000 | 20,600 | 0.0015 | 0.005 | 30 | 50 | 55 - 105 |
| Benzo(a)Anthracene | 8270C SIM | 3.6 | 4.9 | 0.0015 | 0.005 | 30 | 50 | 50 - 110 |
| Benzo[a]Pyrene | 8270C SIM | 0.49 | 0.49 | 0.0015 | 0.005 | 30 | 50 | 50 - 110 |
| Benzo[b]Fluoranthene | 8270C SIM | 4.9 | 4.9 | 0.0015 | 0.005 | 30 | 50 | 45 - 115 |
| Benzo[g,h,i]Perylene | 8270C SIM | 1,400 | 1,400 | 0.0015 | 0.005 | 30 | 50 | 40 - 125 |
| Benzo[k]Fluoranthene | 8270C SIM | 49 | 49 | 0.0015 | 0.005 | 30 | 50 | 45 - 125 |
| Chrysene | 8270C SIM | 360 | 490 | 0.0015 | 0.005 | 30 | 50 | 55 - 110 |
| Dibenzo[a,h]anthracene | 8270C SIM | 0.49 | 0.49 | 0.0015 | 0.005 | 30 | 50 | 40 - 125 |
| Fluoranthene | 8270C SIM | 1,400 | 1,900 | 0.0015 | 0.005 | 30 | 50 | 55 - 115 |
| Fluorene | 8270C SIM | 220 | 2,300 | 0.0015 | 0.005 | 30 | 50 | 50 - 110 |
| Indeno(1,2,3-c,d)Pyrene | 8270C SIM | 4.9 | 4.9 | 0.0015 | 0.005 | 30 | 50 | 40 - 120 |
| 1-Methylnaphthalene | 8270C SIM | 6.2 | 280 | 0.0015 | 0.005 | 30 | 50 | 44 - 107 |
| 2-Methylnaphthalene | 8270C SIM | 6.1 | 280 | 0.0015 | 0.005 | 30 | 50 | 45 - 105 |
| Naphthalene | 8270C SIM | 20 | 28 | 0.0015 | 0.005 | 30 | 50 | 40 - 105 |
| Phenanthrene | 8270C SIM | 3,000 | 20,600 | 0.0015 | 0.005 | 30 | 50 | 50 - 110 |
| Pyrene | 8270C SIM | 1,000 | 1,400 | 0.0015 | 0.005 | 30 | 50 | 45 - 125 |

| **Surrogates** | **QC Limits [d] (% Recovery)** |
|---|---|
| GRO surrogate: 4-Bromofluorobenzene | 50 - 150 |
| DRO surrogate: 5a Androstane | 50 - 150 |
| RRO surrogate: n-Triacontane-d62 | 50 - 150 |
| BTEX/VOC surrogates: | |
| 1,2-Dichloroethane-D4 | 80 - 120 |
| 4-Bromofluorobenzene | 67 - 138 |
| Toluene-d8 | 85 - 125 |
| PAH surrogates: | |
| terphenyl-d14 | 85 - 125 |
| 2-Fluorobiphenyl | 45-105 |

**Notes:**

(a) Cleanup levels are taken from the ADEC Method 2 standards listed in Tables B1 and B2, 18 AAC 75,
zone (October 2008).
"Most Stringent" standard is the lowest of the migration to groundwater, direct contact, and outdoor inhalation levels
"Concentration Reduction Threshold" considers only direct contact and outdoor inhalation (see Section 2.4 of text)

(b) Sensitivity MQOs are based on historical laboratory capabilities.

(c) Precision MQOs are based on ADEC and method requirements for LCS and field duplicate samples.

(b) Acuracy MQOs are based on ADEC/method requirements for GRO, DRO, and RRO; and historical laboratory capabilities for VOC, PA

LOQ = Limit of Quantitation
MDL = Method Detection Limits
MQO = Measurement Quality Objectives
— No promulgated ADEC cleanup level for this compound.
A MDL < Cleanup level < LOQ, J-Flags (estimated values < PQL) will be requested from laboratory

**Tetrachloroethene (PCE) results in micrograms per kilogram (µg/kg)**

| Boring/ Sample ID | Sample depth interval (feet below the ground surface) | | | | | |
|---|---|---|---|---|---|---|
| | 0-0.5' | 0.5-4' | 4-8' | 8-12' | 12-16' | 16-20' |
| PS01 | - | <100 | <100 | <100 | **82.9 J** | <100 |
| PS02 | - | **1,500** | **28,000** | **53** | **73** | <100 |
| PS03 | - | **1,800** | **32,000** | **940** | **<930 *** | <100 |
| PS04 | - | **114.3** | **76.27** | <100 | <100 | <100 |
| PS05 | - | - | <100 | <100 | <100 | **153.6** |
| PS06 | - | <100 | <100 | <100 | <100 | <100* |
| PS07 | - | **51.38 J** | <100 | <100 | <100 | <100 |
| PS08 | - | - | <100 | <100 | <100 | <100 |
| PS09 | - | <14 | **51** | <100 | <100 | <100 |
| PS10 | - | **82.24J** | <100 | <100 | **30.97J** | - |
| PS11 | - | - | <100 | <100 | **183.2** | <100 |
| PS12 | - | **79** | **9,900** | <44 | **31.73J** | **62.05J** |
| SP01 | - | <14 | **<5,000 *** | **<270 *** | <100 | - |
| SP02 | - | - | <100 | <100 | <100 | - |
| SP03 | - | <18 * | **<2,700** | <11 | <23.0 * | - |
| SP04 | - | - | **186.4** | <100 | <100 | - |
| SP05 | - | **2,100** | **6,700** | **<980*** | <100 | <100 |
| SP06 | - | - | - | - | - | - |
| SP07 | - | - | - | <100 * | - | - |
| SP08 | - | <100 | <100 | - | - | - |
| SP09 | - | - | - | <100 | - | - |
| SP10 | - | <100 | <100 | <100 | <100 | <100 |
| SP11 | - | <37 | <100 | <100 | <100 | - |
| SP12 | - | **3,000,000 J** | **20,000,000 (6')** **34,000,000 (8')** | **2,324,875** | - | **300.6** |
| SP13 | - | **<6,700** | **<800** | <17 | - | - |
| SP14 | - | <100 | <100 | <100 | - | - |
| SP15 | - | - | **85.27J** | <100 | - | - |
| DA01 | <100 | - | - | - | - | - |
| DA02 | <56 | - | - | - | - | - |
| DA03 | <100 | - | - | - | - | - |
| DA04 | - | **29** | - | - | - | - |
| DA05 | - | <100 | - | - | - | - |
| DA06 | - | <100 | - | - | - | - |
| SA01 | - | <100 | <100 | <100 | - | - |
| SA02 | - | <100 | <100 | <100 | <100 | - |
| SA03 | - | <100 | <100 | <100 | <100 | - |
| SA04 | <14 | - | - | - | - | - |
| SA05 | <100 | - | - | - | - | - |
| SA06 | **40** | - | - | - | - | - |
| PL01 | - | - | - | - | - | - |
| LP01 | - | - | - | - | - | - |
| LP02 | <100 | - | - | - | - | - |
| LP03 | <100 | - | - | - | - | - |
| LP04 | <100 | - | - | - | - | - |
| B1 | - | **311 *** | - | - | **800 *** | - |
| B2 | - | **45,200(3-5') *** | - | - | **3,010 *** | - |
| B3 | - | - | <26.7 | - | - | - |
| B4 | - | - | - | - | **46.7** | - |
| B5 | - | - | <24.4 | - | - | - |

NOTE: Sample result shown in table and figure are laboratory analytical (where available) or GC/MS screening results.

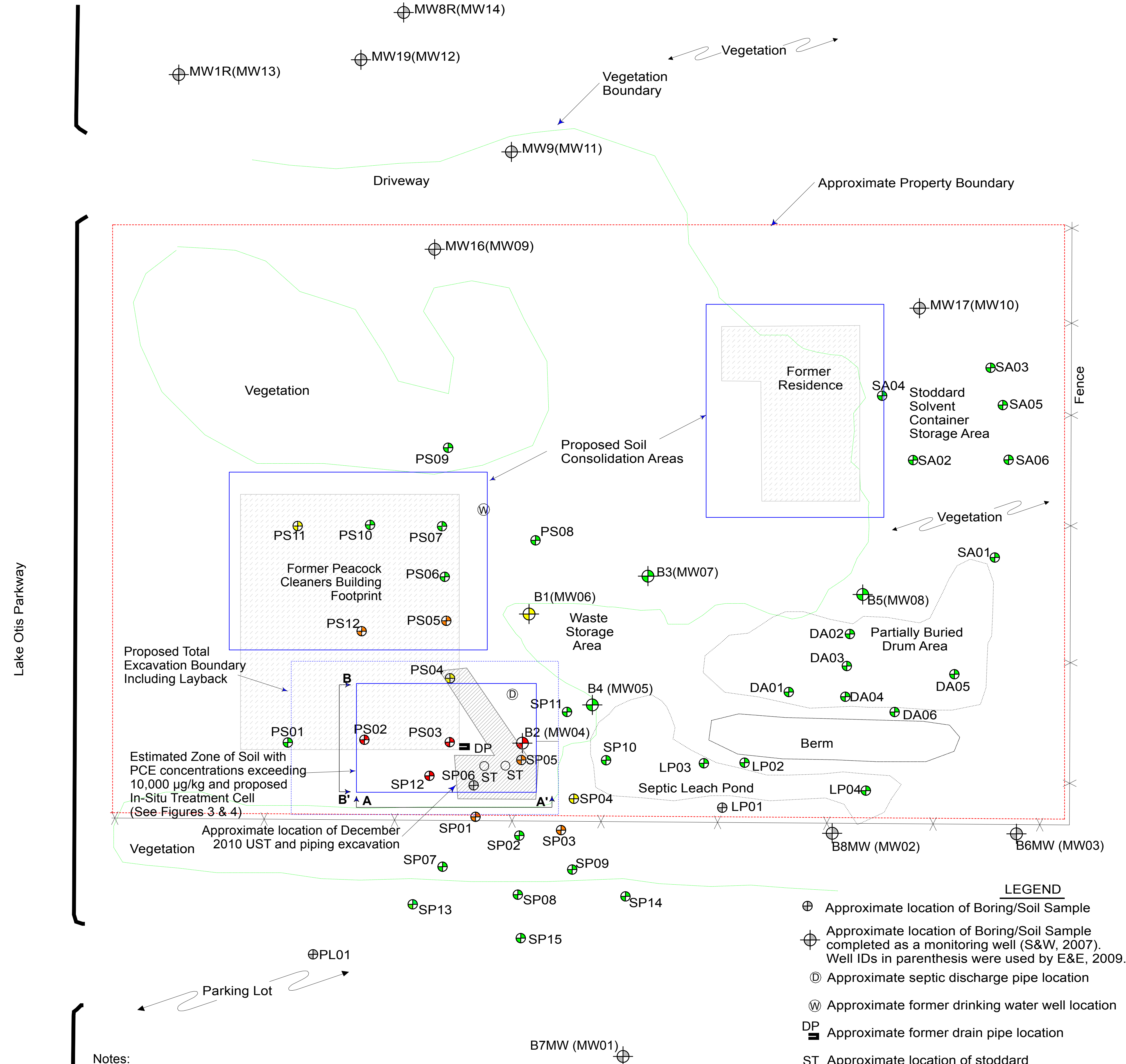
**9,900** Samples in bold indicate a detection at concentrations greater than the most stringent ADEC Method 2 cleanup level of 24 µg/kg

* Asterik indicates a detection of PCE daughter products or diesel range organics (DRO) in sample greater than most stringent ADEC Method 2 cleanup levels

J Concentration is an estimate

<100 PCE was not detected above the reporting limit of 100 µg/kg

\- Sample not collected or not analyzed




Notes:
Borings B1-B5 and B6MW - B8MW advanced by Shannon and Wilson, September and October 2007
All other borings advanced by E&E, September 2008
Base map adapted from Shannon and Wilson, 2008, and E&E, 2009

LEGEND

- Approximate location of Boring/Soil Sample
- Approximate location of Boring/Soil Sample completed as a monitoring well (S&W, 2007). Well IDs in parenthesis were used by E&E, 2009.
- D Approximate septic discharge pipe location
- W Approximate former drinking water well location
- DP Approximate former drain pipe location
- ST Approximate location of stoddard solvent tank stand pipe
- A_____A' B_____B' See Figures 3 and 4

PCE Soil Sample Results Color Key
- >10,000 µg/kg PCE
- >1,000 but <10,000 µg/kg PCE
- >100 but <1,000 µg/kg PCE
- <100 µg/kg PCE
- Soil samples not collected during boring or data unavailable

0 30 60
APPROXIMATE SCALE IN FEET

4501 Lake Otis Parkway
Anchorage, Alaska

**SITE PLAN AND 2007/2008 SOIL SAMPLE RESULTS**

August 2011 32-1-17172-008

**SHANNON & WILSON, INC.**
Geotechnical & Environmental Consultants

**Fig. 1**

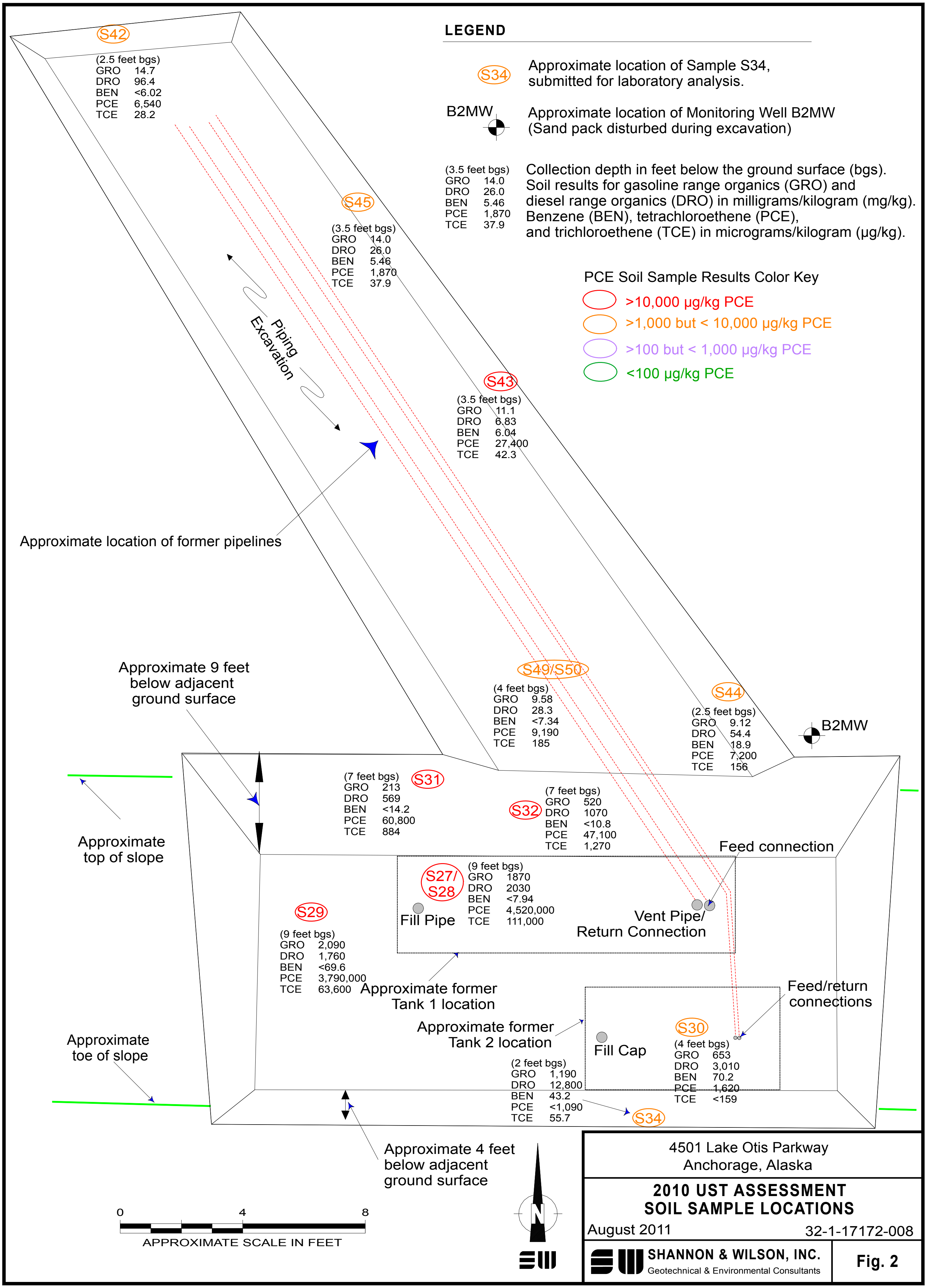
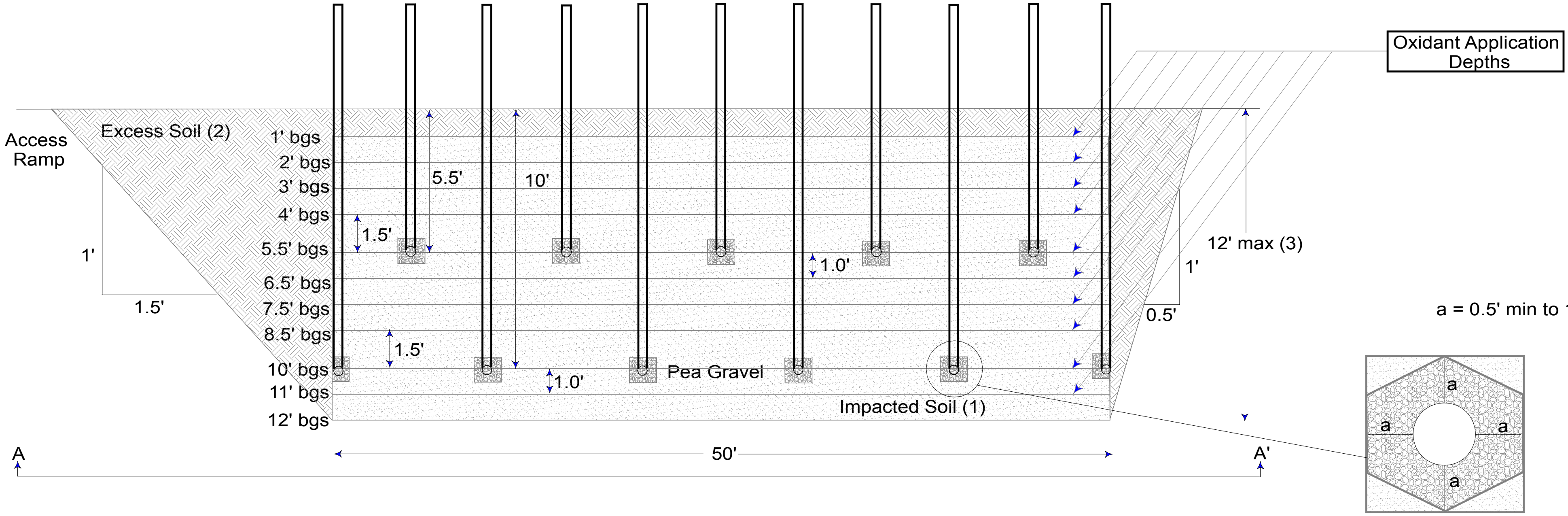

LEGEND
S34 Approximate location of Sample S34, submitted for laboratory analysis.
B2MW Approximate location of Monitoring Well B2MW (Sand pack disturbed during excavation)
(3.5 feet bgs) GRO 14.0 DRO 26.0 BEN 5.46 PCE 1,870 TCE 37.9
Collection depth in feet below the ground surface (bgs). Soil results for gasoline range organics (GRO) and diesel range organics (DRO) in milligrams/kilogram (mg/kg). Benzene (BEN), tetrachloroethene (PCE), and trichloroethene (TCE) in micrograms/kilogram (µg/kg).
PCE Soil Sample Results Color Key
>10,000 µg/kg PCE
>1,000 but < 10,000 µg/kg PCE
>100 but < 1,000 µg/kg PCE
<100 µg/kg PCE
S42 (2.5 feet bgs) GRO 14.7 DRO 96.4 BEN <6.02 PCE 6,540 TCE 28.2
S45 (3.5 feet bgs) GRO 14.0 DRO 26.0 BEN 5.46 PCE 1,870 TCE 37.9
Piping Excavation
S43 (3.5 feet bgs) GRO 11.1 DRO 6.83 BEN 6.04 PCE 27,400 TCE 42.3
Approximate location of former pipelines
S49/S50 (4 feet bgs) GRO 9.58 DRO 28.3 BEN <7.34 PCE 9,190 TCE 185
S44 (2.5 feet bgs) GRO 9.12 DRO 54.4 BEN 18.9 PCE 7,200 TCE 156
B2MW
Approximate 9 feet below adjacent ground surface
Approximate top of slope
S31 (7 feet bgs) GRO 213 DRO 569 BEN <14.2 PCE 60,800 TCE 884
S32 (7 feet bgs) GRO 520 DRO 1070 BEN <10.8 PCE 47,100 TCE 1,270
Feed connection
S27/S28 (9 feet bgs) GRO 1870 DRO 2030 BEN <7.94 PCE 4,520,000 TCE 111,000
Fill Pipe
Vent Pipe/ Return Connection
S29 (9 feet bgs) GRO 2,090 DRO 1,760 BEN <69.6 PCE 3,790,000 TCE 63,600
Approximate former Tank 1 location
Approximate former Tank 2 location
Feed/return connections
Fill Cap
S30 (4 feet bgs) GRO 653 DRO 3,010 BEN 70.2 PCE 1,620 TCE <159
Approximate toe of slope
(2 feet bgs) GRO 1,190 DRO 12,800 BEN 43.2 PCE <1,090 TCE 55.7
S34
Approximate 4 feet below adjacent ground surface
0 4 8
APPROXIMATE SCALE IN FEET
N
4501 Lake Otis Parkway Anchorage, Alaska
2010 UST ASSESSMENT SOIL SAMPLE LOCATIONS
August 2011
32-1-17172-008
SHANNON & WILSON, INC. Geotechnical & Environmental Consultants
Fig. 2

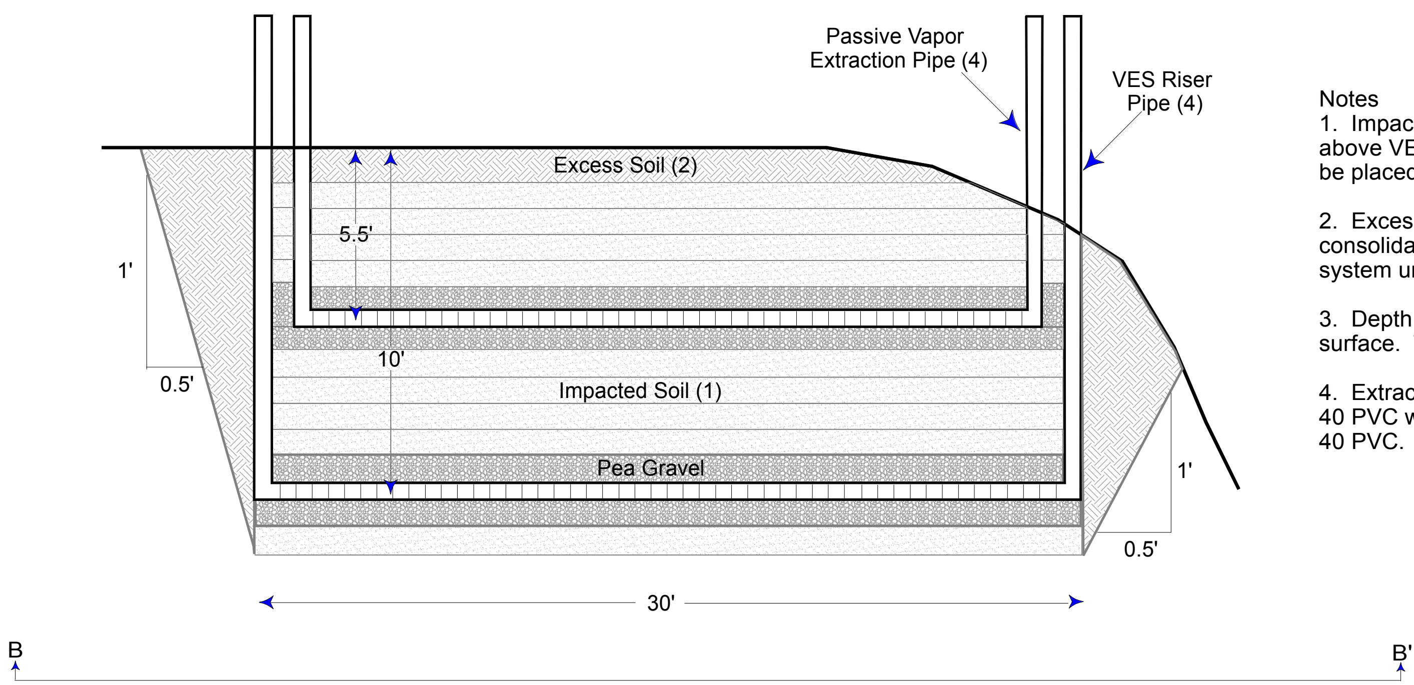
**FIGURE 3**
**PROJECT SCHEDULE**

| Task | Duration (calendar days) | Start Date | Completion Date | Week Beginning (2011) | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 6/20 | 6/27 | 7/4 | 7/11 | 7/18 | 7/25 | 8/1 | 8/8 | 8/15 | 8/22 | 8/29 | 9/5 | 9/12 | 9/19 | 9/26 | 10/3 | 10/10 | 10/17 | 10/24 | 10/31 | 11/7 | 11/14 | 11/21 | 11/28 | 12/5 | 12/12 | 12/19 |
| Draft QAPP | - | - | 11-Jul | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MOA Review | 2 days | 12-Jul | 13-Jul | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MOA, ADEC, EPA Review[1] | 24 days | 13-Jul | 5-Aug | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Final QAPP | 5 days | 8-Aug | 12-Aug | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Utility Locates | 1 days | 15-Aug | 15-Aug | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mobilization & Pre-Con Site Meet | 1 days | 16-Aug | 16-Aug | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Consolidation Area Preparation | 2 days | 16-Aug | 17-Aug | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Source Soil Excavation | 3 days | 18-Aug | 20-Aug | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| In-Situ VES Construction | 6 days | 22-Aug | 27-Aug | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Baseline Sampling | 6 days | 22-Aug | 27-Aug | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Site Restoration | 2 days | 29-Aug | 30-Aug | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Surveying | 1 days | 31-Aug | 31-Aug | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Passive In-Situ VES Operation | 56 days | 29-Aug | 23-Oct | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Progress/Confirmation Sampling | 2 days | 24-Oct | 25-Oct | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Laboratory Testing/Report | 14 days | 26-Oct | 8-Nov | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Summary Report | 30 days | 2-Nov | 1-Dec | | | | | | | | | | | | | | | | | | | | | | | | | | | |

1 We assume that the ADEC and EPA will issue a conditional approval, such that mobilization can commence while QAPP is finalized




Pea Gravel
Placement Detail




Notes

1. Impacted soil to be placed in 1-foot lifts, except 1.5 foot lifts above VES extraction pipes. The most highly-impacted soil to be placed in lifts directedly above and below extraction pipes.

2. Excess soil comprises the soil removed during excavation/ consolidation, but to be replaced in areas outside primary treatment system unit.

3. Depth of excavation base is referenced to prevailing ground surface. Total depth may be less at the south end.

4. Extraction pipe to be 4-inch diameter, sock-wrapped schedule 40 PVC with 0.020-inch slots. Riser pipe to be solid 4-inch schedule 40 PVC.

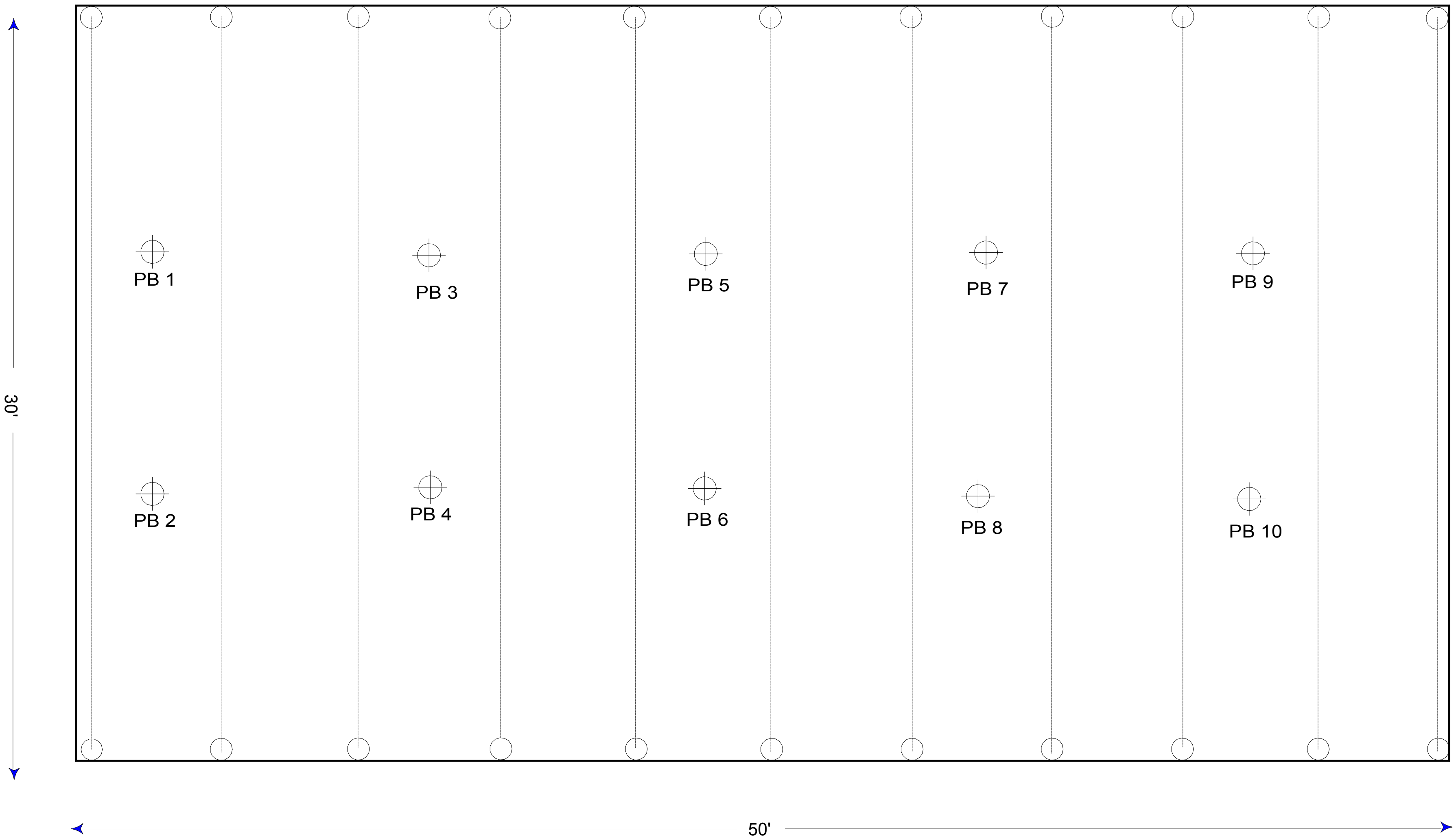
4501 Lake Otis Parkway
Anchorage, Alaska

**IN-SITU TREAMENT SYSTEM PROFILES**

August 2011 | 32-1-17172-008

**SHANNON & WILSON, INC.**
Geotechnical & Environmental Consultants

**Fig. 4**




Proposed Push-Probe Soil Boring for Progress/Confirmation Sample Collection

4501 Lake Otis Parkway
Anchorage, Alaska

**IN-SITU TREAMENT SYSTEM PLAN VIEW AND PROGRESS/CONFIRMATION SOIL SAMPLE LOCATIONS**

August 2011 32-1-17172-008

**SHANNON & WILSON, INC.**
Geotechnical & Environmental Consultants

**Fig. 5**

# APPENDIX A

## EXAMPLE CHAIN OF CUSTODY AND FIELD FORMS

**Sample Chain of Custody**

**Sample Collection Log**

**Photograph Log**

**Soil Boring Log**

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

# CHAIN-OF-CUSTODY RECORD

Page ______ of ______
Laboratory: ______________________
Attn: ______________________


400 N. 34th Street, Suite 100
Seattle, WA 98103
(206) 632-8020

2043 Westport Center Drive
St. Louis, MO 63146-3564
(314) 392-0050

303 Wellsian Way
Richland, WA 99352
(509) 946-6309

2055 Hill Road
Fairbanks, AK 99709
(907) 479-0600

5430 Fairbanks Street, Suite 3
Anchorage, AK 99518
(907) 561-2120

2255 S.W. Canyon Road
Portland, OR 97201-2498
(503) 223-6147

1200 17th Street, Suite 1024
Denver, CO 80202
(303) 825-3800


**Analysis Parameters/Sample Container Description**
(include preservative if used)

| Sample Identity | Lab No. | Time | Date Sampled | Comp | Grab | | | | | | | | Matrix | Total Number of Containers | LOCID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |

| Project Information | Sample Receipt | |
|---|---|---|
| Project Number: | Total Number of Containers | |
| Project Name: **Peacock Cleaners** | COC Seals/Intact? Y/N / NA | |
| Contact: **Shayla Marshall** | Received Good Cond./Cold | |
| Ongoing Project? Yes ☑ No ☐ | Delivery Method: | |
| Sampler: | (Attach shipping bill, if any) | |

| Instructions | |
|---|---|
| Requested Turnaround Time: **Normal** | EDD: **Level II Delieveables** |
| Special Instructions: | |

| Relinquished By: 1. | Relinquished By: 2. | Relinquished By: 3. |
|---|---|---|
| Signature: Time:_________ | Signature: Time:_________ | Signature: Time:_________ |
| Printed Name: Date:_________ | Printed Name: Date:_________ | Printed Name: Date:_________ |
| Company: **Shannon & Wilson** | Company: | Company: |

| Received By: 1. | Received By: 2. | Received By: 3. |
|---|---|---|
| Signature: Time:_________ | Signature: Time:_________ | Signature: Time:_________ |
| Printed Name: Date:_________ | Printed Name: Date:_________ | Printed Name: Date:_________ |
| Company: | Company: | Company: |

**Quote:** ______________________________

**NPDL WO#:** ______________________________

**Bill of Lading No:** ______________________________

**Custody Seal Nos:** ______________________________

**COC No:** ________________

# SAMPLE COLLECTION LOG

SHANNON & WILSON, INC

Project Nu Location: Location:

Date:

Sampler:

| Sample Number | Location | Sample Time | Depth Interval (ft) | | Matrix Type | Sampling Method | Sample Type | PID Reading | Soil Classification | Analyses |
|---|---|---|---|---|---|---|---|---|---|---|
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| Matrix Type | | Sampling Method | | Sample Type | |
|---|---|---|---|---|---|
| AR | Air | B | Bailer/Coliwasa | ES | Environmental sample |
| GW | Groundwater | D | Drill cuttings | ER | Equipment rinsate |
| PR | Product | G | Grab sampling | FB | Field blank |
| SB | Subsurf. soil | H | Hand auger | FD | Field duplicate |
| SE | Sediment | L | Tube liner | FM | Field measurement |
| SG | Sludge | P | Pump (liquid) | FR | Field replicate |
| SS | Surface soil | SS | Split spoon | MD | Matrix spike duplicate |
| SW | Surface water | T | Shelby tube | MS | Matrix spike duplicate |
| WR | Water | V | Vacuum (gas) | TB | Trip blank |
| | | W | Wipe sampling | | |

## PHOTO LOG

Project: Sheet No.
Personnel:
Camera:

| Date | Time | Photo Number | Direction | Subject |
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SHANNON & WILSON, INC.

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

# FIELD LOG OF BORING

DRILL COMPANY/DRILLER: Discovery
DRILL RIG EQUIPMENT:
DRILLING METHOD:
SAMPLE HAMMER: ROD TYPE/DIA.:
HAMMER WEIGHT: HAMMER DROP:
CASING SIZE/TYPE: SPOON DIA:
DOWN HOLE HAMMER: LUBRICANT:

JOB NO: BORING NO:
JOB NAME: **Peacock Cleaners Progress / Confirmation Sampling**
LOGGED BY:
LOCATION: ELEV.:
START DATE: END DATE:
WEATHER DURING DRILLING:

## *SAMPLE DATA*

| TIME / DATE | SAMP. NO. / TYPE | DEPTH FROM / TO | DRIVING RESISTANCE BLOWS / 6 INCH | L. RECOV. / # JARS | DRILL ACTION | CONTACTS / GROUNDWATER | PID | ENV. SAMPLE | FIELD CLASSIFICATION & SENSORY OBSERVATIONS [density/consistency; color; slightly, minor, MAJOR, then trace constituents; moisture; structure; other; USCS classification (geology)] |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

## *SUMMARY FIELD LOG OF BORING*

| DEPTH FROM | DEPTH TO | USCS CLASSIF. | GENERALIZED SOIL DESCRIPTION FOR DRAFTED GINT LOG |
|---|---|---|---|
| | | | |

COMMENTS (i.e. materials used, visitors, problems, etc.):
Boring location indicated in field notes.

## *GROUNDWATER DATA*

| WATER DEPTH | TIME | DATE |
|---|---|---|
| | | |
| | | |

## *SUMMARY OF TIME AND FOOTAGE*

FOOTAGE DRILLED:
SAMPLES: Attempted
Recovered
DATE/TIME DRILLING INITIATED:
DATE/TIME DRILLING COMPLETED:
OTHER:

BORING: SHEET OF