REMEDIAL ACTION WORK PLAN

Former Service Station Property
5216 SE 28th Avenue
Portland, Oregon

January 8, 2015

Prepared for:

Odyssey Property Holdings, Inc.
Portland, Oregon

Prepared by:

Hahn and Associates, Inc.
Portland, Oregon

HAI Project No. 7586
DEQ ECSI No. 4803

TABLE OF CONTENTS

TABLE OF CONTENTS (cont.)

TABLE OF CONTENTS (cont.)

TABLES (Embedded in Text) Page

TABLES (At End of Text)

FIGURES

APPENDICES

1.0 INTRODUCTION

Odyssey Property Holdings, Inc. retained Hahn and Associates, Inc. (HAI) to prepare this Remedial Action Work Plan (the Work Plan) for a former vehicle fuel/service station property located at 5216 SE 28th Avenue, Portland, Oregon (the "Site") (Figures 1 and 2). The property is listed by the Oregon Department of Environmental Quality (DEQ) as Environmental Cleanup Site Information (ECSI) File No. 5694. This Work Plan outlines the remedial measures proposed to address residual contamination of soils that have been shown to potentially pose an unacceptable risk to future users of the property.

The work activities will be conducted as a Removal Action [Oregon Administrative Rules (OAR) 340-122-0070] with oversight by the DEQ. The proposed soil removal action will be performed during future site redevelopment activities. No specific plans or dates for Site redevelopment exist at this time. Accordingly, no specific date for implementation of this plan has been established.

Previous Remedial Investigation (RI) activities were completed at the Site as stipulated in an October 29, 2008 *Voluntary Letter Agreement for Site Investigation* between Odyssey Property Holdings, Inc. and the DEQ Voluntary Cleanup Program. The results of the RI activities were presented in a July 2012 *Remedial Investigation Report* [1]. In addition, a Feasibility Study (FS)[2] was completed to evaluate potential remedial alternatives to address areas of contamination that exceed established risk limits.

To assist in the management of any contaminated soil or groundwater that may be encountered during future site redevelopment activities outside of the areas addressed by this Work Plan, a Contaminated Media Management Plan (CMMP)[3] has also been prepared for the Site.

In the near term, the purpose of this Work Plan, is to put in-place the necessary institution controls that will allow for conditional No Further Action

---

[1] Hahn and Associates, Inc. (2012). *Remedial Investigation Report, Former Service Station Property, 5216 SE 28th Avenue, Portland, Oregon* (HAI Project No. 7586). July 13, 2012.

[2] Hahn and Associates, Inc. (2013a). *Focused Feasibility Study, Former Service Station Property, 5216 SE 28th Avenue, Portland, Oregon* (HAI Project No. 7586). September 27, 2013.

[3] Hahn and Associates, Inc. (2013b). *Contaminated Media Management Plan, Former Service Station Property, 5216 SE 28th Avenue, Portland, Oregon* (HAI Project No. 7586). September 27, 2013.

(NFA) designation for the property. Ultimately, the purpose of the Work Plan is to provide a plan for an appropriate soil removal action at the point in time in which redevelopment of this property is pursued.

Specifically, the Work Plan addresses the removal of residual soil contamination that was previously identified at two areas of the site, including gasoline-related chemicals in a former pump island area, and chlorinated solvents in a former oil-water separator area. Also included in this Work Plan are sections addressing confirmation sampling, groundwater management, and decommissioning of a suspect abandoned heating oil tank, as well as a Sampling and Analysis Plan (SAP) and a site-specific Health and Safety Plan (HASP).

2.0 BACKGROUND

This section presents a brief summary of the characteristics of the Site, as pertinent to the proposed removal action. More detailed information on the Site characteristics is presented in the RI Report (HAI 2012).

2.1 Site Location and Description

The subject property, located at 5216 SE 28th Avenue, comprises 0.69 acres at the northeast corner of SE 28th Avenue and SE Steele Street in Portland, Multnomah County, Oregon (Figure 2). The property is owned by Odyssey Property Holdings, Inc., and is located in the southwest 1/4 of the northwest 1/4 of Section 13, Township 1 South, Range 1 East of the Willamette Meridian (W.M.), Tax Lot Number 500.

The subject property is the former location of an automotive service/fuel station in the 1970s (see Section 2.2), which is believed to be the source of the contamination that is present in soil and groundwater. As discussed in the RI Report (HAI 2012), although contamination is present within groundwater on and off the property, the only media for which a potential unacceptable risk was identified by the Risk Assessment was on-site soil and soil gas.

The subject property is currently vacant and primarily covered with weathered asphalt pavement. Three small landscape areas are present along the sidewalks of SE 28th Avenue and SE Steele Street. Accordingly, access to contaminated soils by excavation equipment should be unencumbered.

2.2 Site Use History

In 1970, Humble Oil & Refining Company (later Exxon) constructed a fuel/service station on the property, which operated at the property until 1978. All but one of the underground storage tanks (USTs) were removed in 1978, and the service station building was demolished in 1980. A small abandoned heating oil UST appears to remain at the property.

2.3 Physical Site Setting

The physical characteristics of the Site and surrounding area are discussed in detail in the RI Report (HAI 2012), with those pertinent to the removal action summarized below.

The areas and depths of the proposed removal action will encounter a single Pleistocene-age geologic unit referred to as the Fine Grain Facies of the Missoula Flood Deposits (Qff), which are unconsolidated fluvial deposits resulting from multiple outburst floods of glacial Lake Missoula. The Qff unit is composed of silts and fine sands, which are easily excavated with standard excavating equipment.

Groundwater beneath the property generally occurs at depths between 12 and 15 feet below ground surface (bgs), but may seasonally be as high as 10 feet bgs. Shallow groundwater beneath the site flows to the west-southwest.

2.4 Nature and Extent of Contamination

The RI identified hazardous substance releases from three different sources at the subject property: 1) a minor release of heating oil at an abandoned heating oil tank location; 2) gasoline releases at the former fueling island area; and 3) petroleum hydrocarbon and chlorinated solvent releases at the former oil-water separator area. These areas of impact are shown on Figure 2 and discussed below.

Heating Oil Tank Area

An abandoned approximate 300-gallon heating oil tank is believed to remain in-place off the southeast corner of the former service station building at the subject property. Testing in this area suggests that only a minor release of heating oil is present at the tank location, affecting less than 5 cubic yards of soil. Petroleum-impacted soil (diesel-range) is present in the vicinity of the abandoned UST between depths of approximately 6.5 and 7 feet bgs. The maximum diesel-range (i.e. heating oil) petroleum hydrocarbon

concentration detected in this area was 1,760 milligrams/kilogram (mg/kg). The detected concentrations of heating oil are below all risk screening levels applicable to this Site.

Gasoline Releases at Fueling Island Area (Area 1)

Historical gasoline releases at the former fueling island area (likely from piping leaks) have locally impacted on-property soil and groundwater. The gasoline impacts originating in this area do not appear to extend off-property in soil, and extended only marginally off-property in groundwater. The chemicals of concern detected in this area include gasoline-range petroleum hydrocarbons (TPH-Gx) and the gasoline-related aromatic volatile organic compounds (AVOCs) ethylbenzene and xylenes. The residual soil contamination in this area covers an approximate 1,500-square-foot area between the depths of 5 and 14 feet bgs with a volume that could be up to 500 cubic yards. The maximum TPH-Gx concentration detected in this area was 11,500 mg/kg.

A small (1,700-square-foot) AVOC plume in groundwater was found to be associated with the fueling island area gasoline release, which only marginally extends off the property beneath the SE 28th Avenue right-of-way. The detected concentrations of AVOCs in the groundwater are all below applicable risk screening levels for the Site. The general lack of benzene in soil and groundwater samples, as well as the small size of the groundwater plume, suggests an older degraded release of gasoline in this area.

Solvent Releases at Oil-Water Separator Area (Area 2)

Historical chlorinated solvent [i.e. halogenated volatile organic compound (HVOC)] and petroleum (gasoline-, diesel-, and oil-range) releases have occurred at the former oil-water separator area, as determined from both soil and soil gas testing. Although these releases appear to have only locally impacted on-property soil between depths of approximately 1 and 4 feet bgs, they are the likely source for a solvent plume in the groundwater that extends off-property to the south approximately 800 to 900 feet from the source (described further below). The chemicals of potential concern detected in this area include tetrachloroethene (PCE), trichloroethene (TCE), vinyl chloride, and naphthalene. Soil and soil gas testing has indicated two possible soil source areas for VOCs within Area 2.

- ***Area 2a***

  Located just east and northeast of the former oil-water separator, Area 2a contained total HVOCs concentrations up to 6,282 micrograms/cubic meter (ug/m^3) in soil gas, with both TCE and PCE exceeding risk-screening levels for *Urban Residential Vapor Intrusion*. Area 2a also coincides with detected residual contamination in shallow soil.

  Maximum gasoline (more likely mineral spirits or equivalent), diesel, and oil-range petroleum hydrocarbons detected in soil of Area 2a were 463 mg/kg, 132 mg/kg, and 139 mg/kg, respectively. The maximum total HVOCs concentration detected in soil of this area was 8.7 mg/kg, and the maximum individual HVOC detection was for PCE at a concentration of 7.81 mg/kg.

  The zone of identified residual soil contamination in Area 2a covers approximately 100 square feet and less than 15 cubic yards for detectable petroleum hydrocarbons, but increases to an estimated 550 square feet and 60 cubic yards for soils with over 1 mg/kg total HVOCs.

- ***Area 2b***

  The western Area 2b, located approximately 15 feet west of the former oil-water separator, was identified by soil gas testing only (no residual soil contamination was observed here). Elevated concentrations of VOCs were found in only a single soil gas sample from this area (location S1) – at 9,990 ug/m^3 total HVOCs and 4,610 ug/m^3 total AVOCs. The detected levels of TCE, vinyl chloride, and naphthalene in soil gas at the shallow S1 location all exceeded their respective risk screening levels for *Urban Residential Vapor Intrusion*, but the Risk Assessment showed only TCE to pose a potential unacceptable risk. The elevated levels of VOCs in soil gas of Area 2b cover a relatively small area of about 40 square feet.

In summary, residual soil contamination in Area 2 appears to be the source for both the elevated soil gas levels in this area and the HVOC plume in groundwater. Risk Assessment indicates that *Vapor Intrusion* into future structures built on the property at Area 2 could be a concern (due to TCE).

<u>HVOC Plume in Groundwater</u>

The HVOC plume in groundwater that originates at the former oil-water separator area has migrated off the property to the southwest, and then turns to the south extending in total approximately 800 to 900 feet from the

source. The estimated area of the current HVOC plume is 1.9 acres at total HVOC concentrations greater than 1 microgram/liter (ug/L), and 0.75 acres at concentrations greater than 5 ug/L.

The chemical most frequently detected and found at the highest concentrations in the HVOC plume is PCE, which is believed to be the primary solvent that was released at the oil-water separator source area. The PCE degradation products of TCE and dichloroethene (DCE) are also found in the HVOC plume at lesser concentrations. Vinyl chloride has not been detected in groundwater.

Vertically, it is interpreted that the plume (at 1 ug/L total HVOCs) extends no deeper than 35 feet bgs on-property and 50 feet bgs off-property. Laterally, the plume is well defined by existing data points in all directions except to the south of MW-3s in the expected down-gradient direction. Two different methods (extrapolation of existing data and solute transport modeling) were used to estimate the current plume extent to the south, which indicated a plume length (to 1 ug/L) of about 800 to 900 feet. The Risk Assessment did not identify unacceptable risks relating to the HVOC plume in groundwater.

2.5 Risk Assessment

A Human Health Risk Assessment (HHRA) was conducted for the Site, which is presented in the RI Report (HAI, 2012). The Risk Assessment identified potential unacceptable risks related to some site-related chemicals, under the following scenarios:

Scenarios in Which Potential Unacceptable Risks Were Identified

Exposure Scenario	Exposure Pathway	Exposure Media	Chemical of Concern
Future On-Property Resident (*Urban Residential)*	• *Vapor Intrusion*	• Soil	• Gasoline • Ethylbenzene • Xylenes
		• Soil Gas	• TCE
Future On-Property Worker (*Occupational*)	• *Vapor Intrusion*	• Soil	• Ethylbenzene

Not included in the above table is chloroform in groundwater since it was not considered a site-related chemical in the one off-site area where it was found at elevated concentrations.

The Risk Assessment did not identify unacceptable risks for Site contaminants under current exposure conditions, either on-property or off-property. Accordingly, no remedial actions are necessary as long as the property remains in its current condition (i.e. as a paved vacant lot). Furthermore, it was concluded that Site-related chemicals in off-property areas would not pose unacceptable risks under future exposure scenarios.

Accordingly, the only potential unacceptable risk identified by the Risk Assessment relates to *Vapor Intrusion* (from soil/soil gas) into structures that may be built on the subject property in the future. This is the case for TPH-Gx (gasoline), ethylbenzene, xylenes, and TCE under an *Urban Residential* receptor scenario, and for ethylbenzene under an *Occupational* receptor scenario. Based on these results, remedial action would only be necessary if structures are built at the property in the future for residential and/or commercial purposes. Since such redevelopment was deemed a likely scenario in the foreseeable future, the preparation of a Feasibility Study was conducted.

2.6 Feasibility Study

Purpose of Feasibility Study (FS)

Since the potential for unacceptable risk (via *Vapor Intrusion* from soil) was identified for Site contaminants under a likely future use scenario (i.e. redevelopment of the property with a new structure), a Feasibility Study (HAI 2013a) was prepared for the Site. The primary goal of the FS was to identify a final remedial action that will be protective and feasible, and appropriately address identified Site risks.

Preferred Remedial Action Alternative Selected by the FS

Based on the individual and comparative analysis of the remedial action alternatives by the FS, as well as considerations regarding the current condition and possible plans for the property, implementation of *Institutional Controls* was recommended by the FS as the Preferred Remedial Action Alternative (referred to as Alternative B in the FS document).

Alternative B would have relied on institutional controls to prevent the construction of future structures at the Site without vapor mitigations systems in-place. Since there are no structures present at the property at the current time, there is no immediate need for remedial action at the Site. Also, Alternative B would have assured, through an Easement and Equitable Servitude (EES), that the appropriate measures would be taken in the future to address *Vapor Intrusion* and protect future occupants.

Although Alternative B suggested that *Vapor Intrusion* be addressed by requiring vapor mitigation systems in future structures, this exposure pathway could also be equally-well addressed through a soil removal action.

Easement and Equitable Servitude (EES)

Under Alternative B, the EES would be composed of restrictive covenants that would:

1) Prohibit any groundwater use at the property
2) Prohibit future single-family residential use at the property
3) Require that *Vapor Intrusion* be addressed for any future structures built at the property
4) Require monitoring/sampling to verify that implemented vapor mitigation measures are protective.

Revised Remedial Action Alternative – Soil Removal

DEQ commented on the FS document in a September 3, 2014 email. Although DEQ found the Alternative B approach acceptable, the agency suggested some modifications to the Preferred Remedial Action Alternative. DEQ believed that *Soil Removal* (Alternative E) was the best remedial action alternative, with implementation of a passive vapor mitigation system (Alternative C) as a contingency in case soil removal was unsuccessful in addressing the vapor intrusion concerns. The proposed institutional controls would then be an interim protective measure prior to redevelopment of the Site. Odyssey Property Holdings, Inc. has since concurred that *Soil Removal* is an acceptable remedial action that is compatible with potential future plans for the property, particularly if such an action will negate the need for installation of vapor mitigation systems in future structures.

DEQ also commented in the September 3, 2014 email that preparation of a Remedial Action Plan now (rather than in the future when site development occurs) would avoid the need to repeat the FS, DEQ Staff Report, and public approval process in the future. Based on this understanding, Odyssey Property Holdings, Inc. instructed HAI to prepare this Remedial Action Work Plan incorporating the DEQ's recommended Remedial Action Alternative (i.e. *Soil Removal*).

3.0 REMEDIAL ACTION PLAN

3.1 Remedial Action Components

As discussed in Section 2.6, DEQ and Odyssey Property Holdings, Inc. have agreed that *Soil Removal* (Alternative E) is the Preferred Remedial Action Alternative for the Site. This alternative, combined with *Institutional Controls* and as a contingency, a possible *Vapor Mitigation System* (Alternative C), then will act as the final remedy for the Site. In summary, the final remedy for the Site will include the following components:

Element 1: Implemented Now

- Institutional Controls (Restrictive Covenants/EES)
    - To prohibit use of groundwater for any purpose
    - To prohibit single-family residential use of the property
    - To require future soil removal to address *Vapor Intrusion* when a new structure is constructed at the property
    - To require monitoring/sampling to verify that implemented removal action is protective.

Element 2: Implemented in the Future

- Soil removal and off-site disposal at an appropriate facility (Section 3.6)
- Confirmation sampling (soil and soil gas) (Section 3.8)
- Decommissioning of heating oil tank by removal (Section 3.9).

Element 3: Contingency

- New structures to be constructed with vapor mitigation systems if soil removal proves unsuccessful at addressing *Vapor Intrusion.*

This Remedial Action Work Plan has been prepared to detail the remedial action elements that are to be implemented in the future when site redevelopment is to occur (i.e. for Element 2). Element 1 does not require further clarification here as the language of the EES will be negotiated with DEQ prior to the Record of Decision. In addition, Element 3 is not detailed here because it is a contingency only, and also because this element is so dependent on the design of future structures it is not practical to specify it now. If in the unlikely event Element 3 proves to be needed, then an amended Remedial Action Plan will be prepared at that time.

The remedial action plan discussed in this section is composed of the following relevant information and components:

Relevant Information

- Remedial Action Objectives (Section 3.2)
- Cleanup Levels (Section 3.3)
- Areas and Volumes of Affected Soil (Section 3.4)

Remedial Action Components

- Waste Profiling: Profiling of soils and waste characterization for disposal (Section 3.5)
- Soil Removal: Excavation/removal and off-site disposal of contaminated soil at an appropriately permitted landfill facility (Section 3.6)
- Groundwater Management: Management and disposal of any groundwater that is dewatered from the excavation pits, if needed (Section 3.7)
- Confirmation Sampling
    - Confirmatory sampling of remaining in-place soils (Section 3.8.1)
    - Soil gas sampling to verify the removal action meets cleanup goals (Section 3.8.2)
- UST Decommissioning: Removal of the abandoned heating oil tank at the property (Section 3.9).

3.2 Remedial Action Objectives

The Risk Assessment identified *Vapor Intrusion into Buildings* as the only exposure pathway of potential concern, but only if and when future structures are constructed at the property (no structures are present at the property at the current time). There are no identified unacceptable risks for Site contaminants under current exposure conditions, either on-property or off-property. Accordingly, no active remedial actions are necessary at this time, other than establishing *Institutional Controls* that would require remedial action in the future at the time when the Site is re-developed with new buildings.

The Remedial Action Objectives for the Site are as follows:

- Prevent migration of vapors from subsurface soils and soil gas into future structures constructed at the property at levels that would pose unacceptable risk under an *Urban Residential* use scenario.
- For occupants of future structures, prevent exposure to indoor air containing COCs (gasoline, ethylbenzene, xylenes, and TCE) that may be present due to *Vapor Intrusion* at levels that would pose unacceptable risks greater than:
    - $1x10^{-6}$ lifetime excess cancer risk for individual carcinogens
    - $1x10^{-5}$ lifetime excess cancer risk for multiple carcinogens
    - A Hazard Quotient of unity (1) for individual non-carcinogens
    - A Hazard Index of unity (1) for multiple non-carcinogens.

It is reasonably expected that the *Soil Removal* action presented in this Work Plan will successfully address the *Vapor Intrusion* pathway at the Site by removing the source of the vapors that are present in soil and soil gas.

Although contamination levels occurring in subsurface soils and groundwater do not present a current unacceptable risk to human health, residual contamination of soil and groundwater is present beneath the property. If contaminated media is encountered during future site development activities, special management and disposal of removed soil or dewatered groundwater will be required. Furthermore, certain uses of the contaminated media may not be appropriate. A Contaminated Media Management Plan (CMMP) has been prepared (HAI, 2013b) to address these issues.

3.3 Cleanup Levels

In order to assess whether the proposed soil removal activities will have adequately addressed the *Vapor Intrusion* risk at the Site, Cleanup Levels are presented here that will need to be met following completion of the soil removal action. The DEQ's generic Risk-Based Concentrations (RBCs)[4] for *Urban Residential Vapor Intrusion* are the proposed Cleanup Levels for this Site. Initially, the DEQ *Vapor Intrusion* RBCs for soil will be used to confirm cleanup of the soil during removal (Section 3.8.1). Once cleanup of soil is

[4] Oregon Department of Environmental Quality (2003, 2012). *Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites*. September 22, 2003 (RBCs updated June 2012).

completed, a soil gas monitoring event will also be conducted (as discussed in Section 3.8.2) to verify that the removal action has addressed the *Vapor Intrusion* pathway/risk. In this case, the DEQ Urban Residential RBCs for Soil Gas will be used as the Cleanup Levels.

If in the unlikely event soil gas testing shows that soil removal was not successful in addressing the *Vapor Intrusion* risk, then the contingency actions will be triggered and vapor mitigation systems will be installed within new structures at the property. In this case, sub-slab soil gas and/or indoor air monitoring may be conducted to verify that the remedial measures have addressed the *Vapor Intrusion* risk.

The applicable Cleanup Levels are listed below for those chemicals in which a potential unacceptable risk was identified for the Site. If other chemicals are detected in confirmation/monitoring samples they will also be compared to their respective *Urban Residential Vapor Intrusion* RBCs to verify appropriate cleanup has been achieved.

Cleanup Levels to Address *Vapor Intrusion*

Exposure Scenario	Exposure Media	COC	Cleanup Level *
Urban Residential	• Soil	• Gasoline • Ethylbenzene • Xylenes • TCE	94 mg/kg 2.2 mg/kg 100 mg/kg 0.32 mg/kg
	• Soil Gas	• Gasoline • Ethylbenzene • Xylenes • TCE	79,000 ug/m^3 530 ug/m^3 21,000 ug/m^3 200 ug/m^3
	• Indoor Air	• Gasoline • Ethylbenzene • Xylenes • TCE	390 ug/m^3 2.7 ug/m^3 100 ug/m^3 1.0 ug/m^3

* DEQ Risk-Based Concentration (RBC), June 2012
COC = chemical of concern
mg/kg = milligrams per kilogram
TCE = trichloroethene
ug/m^3 = micrograms per cubic meter

If the DEQ RBCs listed above, which act as the Cleanup Levels for this Site, are changed for any reason by the agency prior to implementation of the soil removal action, then the Cleanup Levels will also need to be correspondingly adjusted.

3.4 Areas and Volumes of Affected Soil

Section 2.4 summarized the areas of contamination identified at the Site. This section discusses only those areas of contamination where a potential unacceptable risk may be present at the property. In this case, the areas of potential concern are defined by the Cleanup Levels that are presented in Section 3.3 above.

There are two on-property areas of contaminated soil and/or soil gas with contaminant concentrations above acceptable risk levels at the property. These consist of the former fueling island area and the former oil-water separator area (Figure 3), as described below:

Fueling Island Area (Area 1)
Gasoline and some of its constituents are present in the Fueling Island area at concentrations above acceptable risk levels for the *Urban Residential Vapor Intrusion* scenario, including TPH-Gx (gasoline), ethylbenzene, and xylenes. This will be referred to as Area 1.

The area of concern for soil under the *Urban Residential Vapor Intrusion* scenario covers approximately 1,060 square feet between the depths of 5 and 13 to 14 feet bgs (Figure 3), with an estimated volume of 335 cubic yards. In addition, approximately 200 cubic yards of clean overburden soil are likely present from the ground surface to a depth of 5 feet bgs, overlying the contaminated soils.

Oil-Water Separator Area (Area 2)
TCE (in soil gas) was the only chemical found to be present in the oil-water separator area at concentrations above acceptable risk levels for the *Urban Residential Vapor Intrusion* scenario. Two small areas of concern are present for soil gas under the *Urban Residential Vapor Intrusion* scenario, which are referrer to as Areas 2a and 2b (Figure 3).

Although HVOCs in soil were not identified in the Risk Assessment to pose an unacceptable risk in the oil-water separator area, residual soil contamination is the likely source of the two areas of elevated soil gas in this area. This Work Plan assumes that contaminated soil removal will be implemented to address the elevated levels of HVOCs in soil gas. It is put

forth that a threshold of 1 mg/kg total HVOCs in soil would conservatively define a preliminary area for soil removal to address *Vapor Intrusion*, which would then be confirmed through subsequent confirmation soil and soil gas sampling.

For Area 2a, the volume of soil with HVOCs greater than 1 mg/kg to a depth of 4 feet bgs is approximately 85 cubic yards over an area of 560 square feet. There was one detection in soil of Area 2a that exceeded the risk-screening level for *Urban Residential Vapor Intrusion* (i.e. PCE at boring P-49 at a concentration of 7.81 mg/kg). PCE and TCE concentrations in soil gas of Area 2a also exceeded risk-screening levels for *Urban Residential Vapor Intrusion* at some locations. However, the Risk Assessment showed TCE (in soil gas) to be the only chemical to pose a potential unacceptable risk.

Area 2b is based on soil gas testing only, and only on elevated HVOCs in a single soil gas sample from location S1. The detected levels of TCE, vinyl chloride, and naphthalene in soil gas at the shallow S1 location all exceeded their respective risk screening levels for *Urban Residential Vapor Intrusion*, but the Risk Assessment showed only TCE to pose a potential unacceptable risk. Although soil testing in Area 2b did not identify HVOCs over 1 mg/kg in this area, soil removal is still proposed centered on the S1 location. Removal of soils from an approximate 40-square-foot area to a depth of 4 feet bgs is proposed for Area 2b, which equates to a volume of approximately 6 cubic yards.

Summary

The areas of concern in soil at the Site slated for removal, i.e. those areas where chemical concentrations exceed Cleanup Levels for *Vapor Intrusion*, are summarized on the following table.

Areas of Concern in Soil That Are Slated for Removal

Area of Concern	Exposure Scenario	Exposure Media	Chemicals of Concern	Depths (ft bgs)	Area (sq ft)	Volume (cys)
Area 1: Fueling Island Area	*Urban Residential, Occupational*	Soil	Gasoline Ethylbenzene Xylenes	5 - 13.5	1,060	335
Area 2: Oil-Water Separator Area	*Urban Residential*	Soil*	TCE (PCE) (Vinyl Chloride) (Naphthalene)	0 - 4	Area 2a: 560	85
					Area 2b: 40	6

* The likely source of the elevated levels of VOCs in soil gas
cys = cubic yards
ft bgs = feet below ground surface
sq ft = square feet
PCE = tetrachloroethene
TCE = trichloroethene
( ) = Chemicals in parentheses are those that exceeded risk-screening levels at individual locations, but where the Risk Assessment ultimately showed no unacceptable risk.

3.5 Waste Characterization and Profiling

Prior to the off-site disposal of the contaminated soils that are to be removed from the property in the future, the waste soils will need to profiled and permitted for disposal. While a large amount of existing test data is available, disposal facilities will not typically allow use of testing data that is over 1 to 2 years old to profile the soils for disposal. As such, it is assumed that additional testing and waste characterization will need to occur at the time that soil removal is planned.

Two Approaches to Profiling

Two approaches can be taken to profile the soils for disposal. One is to test the soils in-place prior to their removal, and the other approach is to test soils that have been removed and placed into stockpiles or drop boxes for temporary storage.

1) Profile Pre-Removal: This approach is often preferred because profiling prior to removal allows for the soils to be "live loaded" for direct transfer to the disposal facility during the soil removal process. However, for this Site, this approach would involve the extra expense of a separate

sampling event prior to removal since it is assumed the disposal facility will not accept existing test data for profiling purposes.

2) Profile Post-Removal: Although the approach of removing and temporarily stockpiling soils for profiling avoids a separate sampling event, it has the disadvantage of handling the soils twice prior to disposal, as well as the need for measures to appropriately manage stockpiled soils, such as the use of liners, covers, and berms.

Special Considerations for Soils from Oil-Water Separator Area

While much testing data is available for soils in the oil-water separator area, a full characterization/profiling to make a Resource Conservation and Recovery Act (RCRA) Hazardous Waste determination has not been performed. Existing testing of soils containing HVOCs from the oil-water separator area does not suggest that soils removed from this area in the future would need to be classified as a RCRA Characteristic Hazardous Waste. In addition, because the timing, volume, and nature of the HVOCs released in the oil-water separator area, as well as the operations and processes that utilized HVOCs at the Site, are not known, removed soils would not be classified as a RCRA Listed Hazardous Waste.

While the maximum detected concentration of PCE in soil of this area (7.81 mg/kg at P-49) was above the RCRA Land Disposal Restriction (LDR) treatment standard of 6 mg/kg, it is not believed that this in-place result will be representative of the waste as whole once it is removed from the ground. Accordingly, for the oil-water separator area, it is recommended that the soils be removed and placed in drop boxes or stockpiles prior to conducting profile sampling in order to collect representative samples of the waste soils.

Proposed Approach for Profiling Waste Soils

Because this Site will have two different waste streams with differing issues (i.e. concern for potential RCRA Hazardous Waste in the oil-water separator area, but not in the fuel island area), a phased approach to soil removal and profiling is proposed, with some profiling conducted pre-removal and some conducted post-removal.

The proposed approach is to conduct soil removal first in the oil-water separator area, and place these soils into a stockpile and/or drop boxes. These soils would then be sampled from the soil piles/drop boxes to obtain representative composite soil samples of this waste stream. All stockpiled soils should be placed on an impermeable liner, such as plastic sheeting, and covered and secured to prevent migration via wind or stormwater runoff. Drop boxes should be covered while waiting on test results and pending off-

site transport. The vendor providing the drop boxes should be made aware that they may be used to contain a RCRA Hazardous Waste.

While on-site for the removal activities in the oil-water separator area, a test pit will be dug in the fuel island area in order to obtain a pre-removal soil sample to profile this second waste stream. Once the profiling and waste characterization is completed, then contractors will be remobilized to the Site to conduct the removal of contaminated soils in the fuel island area, which can then be live-loaded into trucks for direct transport to the disposal facility.

Profile samples from the oil-water separator area (drop boxes) will be tested for petroleum hydrocarbons, VOCs, polychlorinated biphenyls (PCBs), and RCRA 8 Metals. Profile samples from the fuel island area will be tested for petroleum hydrocarbons, BTEX (benzene, toluene, ethylbenzene, and xylenes), and lead. Soil samples collected for VOC or BTEX analysis will be obtained utilizing EPA field preservation method 5035. Details for the profile sampling procedures and analytical parameters are discussed in Sections 4.2 and 4.7 of the Sampling and Analysis Plan.

If the results of the profile sampling and waste characterization indicate that the soils from the oil-water separator area are a RCRA Characteristic Hazardous Waste, then such soils will need to be managed and disposed as such. In this case, a RCRA Waste Site Identification Form will be submitted in order to obtain a RCRA Site ID Number. The waste soil will then be permitted for treatment/disposal at an appropriate RCRA facility. It is beyond the scope of this document to discuss all the requirements a generator of Hazardous Waste may have – it would be prudent to retain a qualified environmental consultant to assist in this matter. If the waste characterization shows that the soils from the oil-water separator area are not RCRA Hazardous Waste, then these waste soils may be permitted, managed, and disposed along with the petroleum-contaminated soil.

3.6 Soil Removal Plan

This section outlines the integral component of the proposed final remedy for the Site, i.e. the removal of contaminated soils that were found to pose a potential unacceptable risk to human health due to *Vapor Intrusion* into structures that may be built at the property in the future. The areas of concern in soil posing potential unacceptable risk were described in Section 3.4 above.

3.6.1 Guidelines for Contaminated Soil Removal

3.6.1.1 Phased Approach to Soil Removal

As discussed in Section 3.5, in order to meet the requirements for conducting representative profile sampling and waste characterization, the soil removal activities are proposed to take place in two phases, with the first phase conducted in the oil-water separator area, and the second phase in the fuel island area. Soils from the oil-water separator area will be placed into stockpiles or drop boxes for temporary storage until their waste classification can be determined and permitted for disposal at an appropriate facility. Soils from the fuel island area will be pre-permitted for disposal and will thus be live-loaded into trucks for direct transport to the designated disposal facility. A contingent third phase of removal would be conducted if confirmation sampling shows additional soils require removal to meet the cleanup goals. Activities conducted during the various phases of soil removal are summarized in the following table.

Proposed Phased Approach to Soil Removal

Area	Phase 1	Phase 2	Phase 3
Oil-Water Separator Area	Remove soils from designated area and place into stockpiles or drop boxes for temporary storage	Transport stockpiles or drop boxes to designated disposal facility	
	Conduct confirmation sampling of in-place soils	Conduct additional removal as needed	
	Collect profile samples from removed soils in stockpiles or drop boxes		
	Conduct waste determination; choose disposal facility; permit soils for disposal		
Fuel Island Area	Excavate test pit to collect profile samples from in-place soils	Remove soils from designated area and live-load into trucks for transport to designated disposal facility	Conduct additional removal as needed
	Conduct waste determination; choose disposal facility; permit soils for disposal	Conduct confirmation sampling of in-place soils	

3.6.1.2 Designated Areas of Soil Removal

The areas and volumes of contaminated soil at the Site that pose a potential unacceptable risk to human health due to *Vapor Intrusion* into future structures were discussed in Section 3.4. Based on this information, soil removal areas have been designated as shown on Figure 4 and as summarized on the following table.

Designated Removal Areas and Depths

Removal Area (Figure 4)		**Removal Depths** (ft bgs)	**Estimated Volume** (cys)	**Estimated Weight** (tons)
Fueling Island Area		5.0 – 13.5	335	470
Oil-Water Separator Area	East Area	0.0 – 4.0	85	120
	West Area	0.0 – 4.0	6	8

The removal zones in the oil-water separator area are divided into two subareas. The east area was designated in order to remove an area of obviously contaminated soil (stained with an odor and headspace vapors, as well as detected HVOCs), while the west area was designated to address a small "hot spot" of HVOCs that was detected only in soil gas of the S1/P-45 area where a zone of residual soil contamination may or may not be present.

Of note, the designated soil removal areas do not include all contaminated soils present at the property. These removal areas were determined based on the identified zones of soil that exceed *Vapor Intrusion* risk-screening criteria, i.e. the designated Cleanup Levels (Section 3.3). As such, some lower level residual soil contamination will be left in-place following completion of the proposed soil removal action.

In contrast, because the soil removal areas were determined based on extrapolation between various sample points, it is also possible that uncontaminated zones may be encountered prior to reaching the designated soil removal areas and depths. In this case, as guided by field screening and confirmed by soil sampling, there may be some locations where soil removal will not need to extend to the full designated soil removal zone (area and/or depth). However, as long as field screening (Section 3.6.2) indicates the presence of contamination in soil, removal will occur to the designated extent and depths.

Once the final limits of excavation are reached, confirmation samples will be collected to verify that Cleanup Levels were achieved (Section 3.8.1). If testing results show that Cleanup Levels were not achieved in remaining soils, then additional soil removal and confirmation testing will be conducted until Cleanup Levels are met in all areas.

3.6.1.3 Overburden Soils

At the fuel island area, it is anticipated that over much of the designated removal area, there may be up to 5 feet or more of "clean" overburden soil present above the zone of residual soil contamination. Since the source of contamination in this area is suspected to be piping leaks, it is also likely that there may be a zone of contamination that is present at shallower depths. Field screening (Section 3.6.2) will be used to determine at what depths contaminated soil is present in this area.

The "clean" overburden soil should be segregated and placed aside for temporary storage at the Site so that it may be used later as backfill for the excavation areas (if it meets geotechnical and chemical standards). Any soils that exhibit signs of residual soil contamination should not be placed into the overburden stockpile. Overburden soils that are to be stored for more than one day should be placed on an impermeable surface, such as pavement or plastic sheeting, and covered and secured to prevent migration via wind or stormwater runoff.

Five discrete soil samples will be collected from the soil pile to verify it is of acceptable chemical quality for use as backfill (Section 4.2.1 of Sampling and Analysis Plan).

3.6.1.4 Project Oversight

An Environmental Professional (EP) with experience in contaminated soil removal projects (either a field scientist or geologist), under the direct supervision of an Oregon Registered Geologist (RG), will be on-site to direct the soil removal activities. The EP's job will be to direct and document (written and photographic) the excavation of contaminated soil, and to ensure that the removed soils are appropriately managed. The EP will utilize maps of the designated soil removal areas, and employ field screening (Section 3.6.2), to guide the soil excavation activities. The EP will be on-site for all soil removal activities, and will conduct all field screening and field sampling as well.

3.6.1.5 Soil Disposal Facilities

The soil disposal facility or facilities that will be utilized to dispose of the soils removed from the Site will be chosen at the point in time when the soil removal action is slated to occur. All petroleum-contaminated soil must be disposed at a facility that is permitted by the DEQ to accept such soil, typically a Class II Landfill. If any soils are found to be classified as RCRA Hazardous Waste, these waste soils must be treated/disposed at a Class I Landfill permitted to accept such wastes.

3.6.1.6 Excavation Contractor

The excavation contractor that will be utilized to remove and transport the contaminated soils at the Site will be chosen at the point in time when the soil removal action is slated to occur. The excavation contractor should be experienced in the removal and disposal of contaminated materials, and its personnel be appropriately trained for Hazardous Waste Operations and Emergency Response (HAZWOPER) as per Occupational Safety and Health Administration (OSHA) requirements. The excavation contractor will need to provide excavation equipment capable of reaching depths of 15 feet bgs.

3.6.1.7 Health and Safety

The EP and the Contractor will be responsible for complying with the site Health and Safety Plan (HASP), which is included as Appendix A. Additionally, all on-site personnel that may potentially come in contact with contaminated soils must have completed HAZWOPER training as per OSHA requirements.

3.6.2 Field Screening

For the most part, maps of the designated soil removal areas will be utilized to determine the initial extent and depth of soil removal. In all cases, confirmation soil samples will be collected to verify that Cleanup Levels have been met (Section 3.8.1). However, in some cases, field screening will be used to guide the initial extent of removal while in the field.

Below is a general guide of how soil removal extent should be determined, and how field screening fits into this hierarchy. Soil removal should occur to the extent and depths shown on Figure 4, except in the circumstances listed below. Similarly, the soil removal effort should not extend beyond the limits and depths shown on Figure 4, even if field screening still shows residual soil contamination remaining, except in the circumstances listed below. In all

cases, confirmation soil samples will be collected to verify that Cleanup Levels have been met.

1) Fuel Island Area: If field screening by the visual, odor, sheen test, and headspace vapor methods do not indicate the presence of contamination, then removal may be halted prior to reaching the designated limits, and confirmation soil samples collected to verify Cleanup Levels have been met.

2) Oil-Water Separator Area – East Subarea:

    a. If field screening by the headspace vapor method does not indicate the presence of contamination (i.e. vapor levels register as zero), then removal may be halted prior to reaching the designated limits, and confirmation soil samples collected to verify Cleanup Levels have been met.

    b. If field screening identifies an area of residual contamination that extends to depths greater than 4 feet bgs, then the excavation should be extended to greater depths to address this zone. Confirmation soil samples will be collected to verify Cleanup Levels have been met.

3) Oil-Water Separator Area – West Subarea: Excavation should extend to the full extent of the zone shown on Figure 4 regardless of field screening. If field screening indicates an area of possible residual contamination, then the excavation should be extended to address this zone. Confirmation soil samples will be collected to verify Cleanup Levels have been met.

Field Characteristics of Soil Contamination

The following soil characteristics may indicate the presence of contamination:

- Visual staining (typically gray, bluish, or greenish in color)
- Chemical odors
- Visible sheen on the soil or when placed in water
- Headspace vapor reading greater than 0-1 ppm.

The field screening methods to be employed for identifying contaminated soil, will include the following methods: visual, olfactory, sheen test, and headspace vapor. Details regarding field screening procedures are included in Section 4.2.4 of the Sampling and Analysis Plan.

3.6.3 Site Controls

Loading of Contaminated Soils

The contaminated soils should be loaded directly into dump trucks or drop boxes for eventual transportation to the disposal facility. Loading should take place in a manner that prevents spilling, tracking, or dispersal of soil. All trucks should be appropriately covered and secured before leaving the site.

Soil with free water should not be loaded into trucks. If saturated soils are to be loaded into trucks, then a plastic liner must be used to prevent leakage of soils from the truck. If possible, the removal activities should be scheduled for late summer to avoid this situation as much as possible.

Staging/Temporary Storage of Soils in Stockpiles

Soils that are to be stored in short-term staging areas for more than one day should be placed on an impermeable surface, such as pavement or plastic sheeting, and covered and well secured to prevent migration via wind or stormwater runoff.

Erosion Control

Erosion and sediment control measures will need to be implemented to prevent off-site migration of soil in surface water runoff or as spillage to the municipal storm sewer catch basins located in the surrounding streets. Erosion control measures installed prior to removal activities may include silt fencing and straw waddle barriers, as necessary, and filter fabric in nearby catch basins to prevent sediment from entering these structures.

Vehicle Track-Off

Track-off of soil on vehicles and equipment should be controlled by using limited entrances and exits for vehicles, using specified on-site truck routes, keeping soil loading zones swept and clean, and the physical removal of soil from vehicles.

Before leaving the property, all vehicles are to be inspected for adhered soil. If present, adhered soil can be removed using hand tools and cleaned of loose soil with a broom. If this method of soil removal is found to be inefficient or ineffective, then a wheel wash area may need to be established where vehicles and equipment can be cleaned by water and/or power washer. Wheel wash water would need to be collected for appropriate disposal.

No track-off of excavated soil will be allowed. If any track-off is observed, soil removal activities should be halted immediately, and measures taken to cleanup the track-off and prevent future track-off.

Dust Control

To prevent the off-site transport of soil in the form of dust, dust control measures should be implemented as necessary. Wetting and/or covering of soils should be used to prevent the generation of visible dust. Limiting vehicle speeds is a dust control measure that can be implemented as needed.

3.6.4 Documentation of Soil Removal

Documentation of field procedures, observations, and measurements should be accomplished through the use of field logs, chain-of-custody, photographs, manifests (bills of lading), and weight tickets, as described in Section 4.8.3. A final *Project Completion Report* should be prepared to document the soil removal, sampling, and disposal activities (Section 5.3).

3.6.5 Site Restoration Activities

Once confirmation sampling indicates that Cleanup Levels in soil have been met, then the excavation pits may be backfilled with "clean" overburden backfill and imported clean fill. It should be confirmed that the soils used for backfill will be of acceptable geotechnical quality, and compaction testing is recommended. It is recommended that the excavation areas then be temporarily or permanently paved in order to prevent unnecessary leaching of contaminants that may have been left in place within soil. Furthermore, this capping of the excavation area will be necessary to obtain representative compliance soil gas samples (Section 3.8.2).

3.7 Groundwater Management

Uppermost groundwater in the vicinity of the Site seasonally ranges between depths of approximately 7 to 17 feet bgs, but is typically below depths of 10 feet bgs. Excavation of soil in the fuel island area is slated to reach a depth of 13.5 feet bgs. Depending on the time of year that soil removal occurs, some groundwater seepage into the excavation pit may occur.

Because management of groundwater during soil removal both complicates the project and increases costs, if possible, it is recommended that the soil removal activities be scheduled for late summer or early fall when it is expected that groundwater levels will be at their lowest. Soil removal

conducted during this season may be able to avoid the need for groundwater management altogether. If soil removal is not able to be scheduled during the dry season, then seepage of groundwater into the excavation pit should be anticipated, and the measures discussed in this section of the Work Plan be followed. Section 8.0 of the CMMP (HAI, 2013b) also discusses management of dewatered groundwater in detail.

NPDES 1200-C Permit

Because the Site is less than one acre in size, applying for an National Pollutant Discharge Elimination System (NPDES) 1200-C Stormwater Permit is not required for the soil removal activities at the property (dewatering is covered under the 1200-C permit). However, all erosion and sediment control measures that are stipulated by a 1200-C Permit should nonetheless be implemented for the Site. All groundwater dewatering activities should be performed in accordance with applicable DEQ stormwater management regulations, whether contaminated or not.

Groundwater Management

If groundwater seeps into the excavation pit prior to reaching the target depth of soil removal of 13.5 feet bgs, then this water should be pumped from the pit to allow continued excavation of soils below the water level. Since the presence of contaminants in this water is likely, the water should be pumped into a temporary storage tank for characterization prior to discharge. Once the stored water has been tested and permitted for disposal, it may then be discharged to the designated discharge point.

If sampling shows that contaminant levels exceed discharge limits, the water in the storage tank can be treated through sparging with air to remove the VOCs to acceptable levels prior to discharge.

Characterization of Dewatered Groundwater

Although groundwater has been thoroughly characterized in-place during the Remedial Investigation, additional testing of dewatered groundwater will likely be necessary or desirable to characterize any dewatered groundwater to be discharged from the Site. This will be done by collecting a representative sample of the water stored in the storage tank. The water sample will typically be collected as the tank nears capacity, but this depends on the timing of permitting and discharge and whether a second backup tank is available for use. Sampling from the storage tank where solids have had a chance to settle out is the preferable approach.

Unfiltered water samples should be collected in accordance with the procedures stated in Section 4.3 of the Sampling and Analysis Plan.

Typically, collection of only one water sample per storage tank is necessary, which is typically accomplished with a peristaltic pump or disposable bailer.

Because, metals testing is one of the parameters required for discharge permitting, every effort should be made to collect sediment-free samples with as little turbidity as possible that would be representative of the water to be discharged.

For permitting with the City of Portland for dewatering projects, the City indicates the following: “Minimum test parameters for baseline contaminants must include metals (arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, silver, and zinc), TPH (total petroleum hydrocarbons), and BTEX (benzene, toluene, ethylbenzene and xylene)” and “Test parameters for known contaminates of concern”, which for this site would include HVOCs.

City of Portland Permitting

All dewatering activities within the City of Portland must comply with the City’s Source Control requirements. Because, the property has documented groundwater contamination, any dewatering conducted at the Site will require testing and permitting with the City. For discharge permitting, the City will require submittal of Dewatering Form 4, Batch Discharge Application Form 5, and Submeter Application Form 6. Depending on the levels of contaminants in the water to be discharged, the City may allow discharge to the storm sewer, or may require discharge to the sanitary sewer system.

Since the City uses a number of different criteria on a site-by-site basis to determine the appropriate discharge location, it is not possible here to present one set of screening levels to determine a discharge location for Site. As stated in the Portland Stormwater Management Manual: “The laboratory analytical results will be assessed and compared against City code, water quality standards, local limits, or additional or other applicable standards for the receiving system. Based on the assessment of the data, the City will determine the best system to accept the discharge and choose the appropriate system using the criteria specified throughout the Dewatering and Discharges Section.”

Be aware that the discharges will be required to be metered, and that per gallon fees will apply. Typically, fees for discharge to the sanitary sewer are higher than those for discharge to the storm sewer, but discharges to the storm sewer may require more expensive pre-treatment.

3.8 Sampling for Confirmation of Cleanup

Two types of samples will be collected to verify that the soil removal activities have met the cleanup goals for the project, as discussed below.

- Confirmation Soil Sampling
- Soil Gas Sampling.

3.8.1 Confirmation Soil Sampling

Confirmation soil sampling will be conducted to document the levels of contamination left in-place following completion of the soil removal activities. Soil samples will be collected from the final limits of the excavation pits, and the testing results will be compared to the Cleanup Levels for Soil (Section 3.3) to verify that the cleanup goals have been met. If Cleanup Levels are not achieved then additional soil removal will be conducted until Cleanup Levels are met.

Preliminary confirmation soil sampling locations are shown on Figure 5. The actual sample locations will be adjusted based on field screening results. Samples are to be collected in the areas where remaining impacts are suspected to be of greatest magnitude. If field screening does not indicate the presence of residual contamination, then the samples should be collected from the locations shown on Figure 5. Samples will be collected from both the walls and floor of each of the final excavation pits, as well as from beneath each end of the heating oil UST that is to be removed. Soil samples collected for VOC or BTEX analysis will be obtained utilizing EPA field preservation method 5035. Sample collection procedures are presented in Section 4.2.2 of the Sampling and Analysis Plan.

<u>Number and Depth of Samples</u>
As a general guideline, the confirmation soil samples will be collected at a rate of approximately one sample for every 75 to 100 square feet of excavation pit area. Additional samples may be collected at the EP's discretion based on observations of soil conditions. The table below summarizes the number and depth of the confirmation samples to be collected from each area, as well as the parameters to be tested for.

Confirmation Samples, Depths, and Testing Parameters

Area	Excavation Pit	Sample Type	Number of Samples	Depth (feet bgs)*	Test Parameters
Area 1	Fuel Island Pit	Wall	8	10 - 11 **	TPH-Gx BTEX
		Floor	3	13.5 - 14	
Area 2a	O-W Separator: East Pit	Wall	6	2 - 4	TPH-Gx VOCs
		Floor	2	4 - 4.5	
Area 2b	O-W Separator: West Pit	Floor	1	4 - 4.5	VOCs
Area 3	Heating Oil Tank Pit	Floor	2	6 - 7	TPH-Dx

* Sample depth if no contamination is indicated by field screening; otherwise sample depth should be at zone of greatest impact.

** Or at the soil-water interface, if present

Past testing indicates that discoloration is a reliable characteristic at this site for identifying contaminated soils. Therefore, field screening (primarily visual) will be used to select the actual soil sample locations at the time of sampling.

3.8.2 Soil Gas Sampling

Since soil testing is typically the least reliable method for evaluating the potential for an unacceptable *Vapor Intrusion* condition, it is proposed that confirmation sampling at this Site will also include soil gas testing. This is particularly the case here since where the goal of the cleanup activities is to avoid the need to install vapor mitigation systems in future structures at the property. Accordingly, the confirmation soil gas testing is proposed to take place soon after the site has been restored to grade, but well before any new structure is slated to be built. It is important to establish that the soil removal activities have addressed the *Vapor Intrusion* pathway before a new structure is built. If the results of the soil gas testing show that Cleanup Levels for *Vapor Intrusion* are not met, then either additional soil removal may be conducted, or a vapor mitigation system may be proposed to DEQ for any new structure slated for construction at the property. Otherwise, if

the soil gas testing shows acceptable levels, then no additional remedial actions are needed at the Site.

Soil gas testing will take place once the confirmation soil sampling (Section 3.8.1) shows compliance with Cleanup Levels in remaining soils and after the excavation pits have been backfilled and re-paved. In order to gather representative soil gas samples, it is important to have the soil removal area at least temporarily capped with pavement, as well as to wait a period of time to allow for soil gas levels in the subsurface to re-stabilize. It is proposed that the soil gas testing take place at least one month following the completion of the soil removal and site restoration activities.

One soil gas testing event is proposed to take place from seven (7) temporary boring locations (SG1 through SG7), as shown on Figure 5. Two of the sample locations will be located within the two larger backfilled soil removal pits, and the other five locations will be placed into native soils surrounding these two areas. The proposed depth of soil gas sample collection is 5 feet bgs, and a second deeper soil gas sample will be collected at the two locations in the soil removal pits at a depth of approximately 12 feet bgs. The borings will be advanced by direct push method and the samples collected by the PRT method. Soil gas sample collection procedures are detailed in Section 4.4 of the Sampling and Analysis Plan. The soil gas samples will be tested for selected VOCs.

3.9 UST Decommissioning

An abandoned heating oil UST is suspected to be present on the eastern portion of the property, which is proposed for decommissioning by removal. From a scheduling standpoint it would make the most sense to decommission the heating oil tank while excavating equipment is on-site to conduct the soil removal activities. The decommissioning should be conducted by a licensed Heating Oil Tank Service Provider in accordance with the DEQ's heating oil tank rules, which will include the collection of two soil assessment samples, one from beneath each end of the tank location.

Prior testing at soil borings surrounding the tank did identify some residual soil contamination, but it is not present at a depth or magnitude that requires remedial action (maximum detected diesel concentration of 1,760 mg/kg). However, since contractors will already be mobilized and permitted to haul contaminated soil off-site to a disposal facility, it may make sense to remove about 5 cubic yards (or less) of contaminated soil from the west end of the tank. This would most likely allow for a simpler certified closure of this tank under the Soil Matrix rules, rather than by a risk-based closure.

4.0 SAMPLING AND ANALYSIS PLAN

This Sampling and Analysis Plan (SAP) includes a comprehensive description of procedures and sampling methodologies to be utilized to implement the various elements of the Remedial Action Plan (Section 3.0). Procedures and/or methodologies not included in this SAP, but which may be proposed in the future will be submitted to DEQ in addendum form, as needed. This SAP addresses the following types of samples that will be collected during the remedial actions:

- Soil Samples (Section 4.2)
    - Collected from excavated soils for profiling/characterization purposes (i.e. from soil piles and/or drop boxes)
    - Collected for field screening purposes to determine excavation extent
    - Collected from in-place soils for confirmation purposes (i.e. from excavations)
- Water Samples (Section 4.3) collected from tanks or pits to characterize dewatered groundwater for discharge
- Soil Gas Samples (Section 4.4) collected to verify that the *Vapor Intrusion* pathway has been addressed.

4.1 Data Quality Objectives

The overall project data quality objective is to provide valid data of known and documented quality in order to confirm that Cleanup Levels in soil and soil gas are met, and thus verifying that the *Vapor Intrusion* exposure pathway has been appropriately addressed. Data gathered during the remedial activities will provide the basis for decisions relating to the need for further investigation, risk analysis, and/or additional remedial measures. Specifically, data collected during this removal action will be used to meet the remedial action goals/objectives presented in Section 3.2.

The data quality assurance objectives for this project are to develop and implement procedures for collection of representative samples, and to provide chemical and physical data of known quality. In order to meet these data quality objectives, all field activities will be conducted according to the methods described in this SAP.

4.2 Soil Sampling Procedures – Grab Samples

4.2.1 Soil Sample Collection Procedures – From Stockpiles

There are two situations where collection of soil samples from stockpiles (or drop boxes) is proposed:

1) Soils removed from the oil-water separator area that will be temporarily placed into a stockpile or drop boxes pending profiling of these soils for off-site disposal (Section 3.5)

2) Overburden soils removed from the fuel island area that will be temporarily placed into a stockpile for potential later reuse on-site as backfill, assuming testing confirms the soils are "clean" (Section 3.6.1.3)

The soil stockpile samples should be collected as discrete grab samples at rates listed below:

Contaminated Soil Stockpile: Oil-Water Separator Area (Area 2)
It is estimated that about 90 cubic yards of contaminated soil will be removed from this area and placed into stockpiles and/or drop boxes. The sole purpose of sampling these soils is to profile and permit them for disposal. Disposal facilities typically indicate that a single 5-part composite sample is adequate for this purpose. Therefore, it is proposed that five soil grab samples be collected from the stockpiled soils, which will then be composited by the laboratory for analysis of one composite soil sample. The composite soil sample will be analyzed for TPH, VOCs, PCBs, and metals.

Overburden Soil Stockpile: Fuel Island Area (Area 1)
It is estimated that about 200 cubic yards of "clean" overburden soil will be removed from the fuel island area in order to reach the contaminated zone, which will be placed into stockpiles for temporary storage. The purpose of sampling these soils is to verify that their chemical quality is appropriate for reuse on site as backfill for the excavation pits. It is proposed that five soil grab samples be collected from the stockpiled soils, and that each of the discrete samples be analyzed for TPH as gasoline (TPH-Gx) and BTEX.

Sample Collection Procedures
The soil stockpile samples should be collected as discrete grab samples from at least 12 inches beneath the surface of the pile. The samples will be collected directly from the stockpile or drop box using a gloved hand (disposable nitrile glove) and/or decontaminated stainless steel trowel, and immediately placed into the appropriate sample containers. At a minimum,

each soil sample will be placed into an 4-ounce pre-cleaned glass sample jar provided by the laboratory, which is then capped with a Teflon-lined lid. Upon collection, all samples will be labeled and transferred to a chilled container for shipment to the analytical laboratory. Standard sampling protocols, including the use of chain-of-custody documentation, will be followed for all sampling procedures, as discussed in Section 4.8.2. The location and depth of each sample will be measured in the field, and noted on the field sampling forms.

4.2.2 Soil Sample Collection Procedures – From Excavation Pits

There are two situations where collection of soil samples from excavation pits is proposed:

1) From a test pit in the fuel island area (Area 1) to collect a pre-removal profile sample for disposal permitting (Section 3.5). This test pit will be excavated at the worst-case (boring P-9) area, and a soil sample collected from approximately 10-11 feet bgs. The soil sample will be tested for TPH, BTEX, and lead.

2) Twenty-two (22) confirmation soil samples will be collected from the final limits of four excavation pits at Areas 1, 2, and 3 to verify that the removal action meets the cleanup goals, as outlined in Section 3.8.1. The soil samples will be analyzed for various parameters as discussed in Section 3.8.1, and shown on Table 1.

The confirmation soil samples will be obtained from the walls and floor of each of the excavation pits. These soil samples will be collected manually as "grab samples" directly from the excavation pit if it is safe to enter (i.e. if it is less than 4 feet deep or is appropriately benched, sloped, or shored). If portions of the excavation are not safe to enter, the soil will be retrieved with an excavator bucket and then brought to the surface, or other safe location for sample collection.

Because VOC testing is proposed, the grab confirmation soil samples from Areas 1 and 2 will be collected directly from the excavation pit or excavator bucket using field preservation method EPA 5035 (Section 4.2.3). The grab confirmation soil samples from Area 3 will be collected directly from the excavation pit or excavator bucket using a gloved hand (disposable nitrile glove) and/or decontaminated stainless steel trowel, and immediately placed into the appropriate sample containers. Upon collection, all samples will be labeled and transferred to a chilled container for shipment to the analytical laboratory. Standard sampling protocols, including the use of chain-of-

custody documentation, will be followed for all sampling procedures, as discussed in Section 4.8.2.

The location and depth of each sample will be measured in the field. The sampling location information, including results of the field screening observations, will be noted on the field sampling forms.

Quality Assurance/Quality Control (QA/QC) Samples

Two QA/QC soil samples, specifically field duplicates, will be collected as part of the confirmation soil sampling program, one from the fuel island pit (Area 1), and one from the oil-water separator pit (Area 2a). The specific locations for collecting the field duplicate samples will be determined in the field based on observed conditions. The goal will be to collect the field duplicates from zones that display evidence of possible residual soil contamination, or in the absence of such indicators, from areas where nearby residual contamination was removed.

4.2.3 Field Preservation by EPA Method 5035

Soil samples intended for possible volatile organic compound (VOC) testing will be preserved in the field by EPA Method 5035. This involves using a laboratory-supplied plunger device to obtain a pre-determined volume of soil from the core (approximate weight of 5 grams), and placing the fixed volume of sample separately into two laboratory-supplied 40-ml VOA vials containing a fixed volume of methanol preservative. To assure that the correct volume of methanol is present in the vials (methanol can leak from the vials over time), containers should be delivered from the laboratory just before needed.

A step-by-step procedure for implementing EPA Method 5035 in the field is presented below. This procedure assumes the use of the Terra Core® sampler.

1) Verify the appropriate volume of methanol preservative in each VOA vial prior to collecting the soil sample
    a) Generally, the laboratory will have marked the level of methanol in the jar at the time of preparation
    b) If the level of methanol in the jar does not come up to the marked level, do not use this container
    c) Methanol evaporates quickly – do not leave containers open any longer than necessary to insert the soil sample.

2) Collect soil sample

   a) Soil samples should be collected from excavator bucket as soon as possible after it has been brought to the surface

   b) For soil samples obtained directly from the excavation pit, use the laboratory-supplied plunger to obtain the sample

   c) With the plunger seated in the handle, push the Terra Core® sampler into the freshly exposed soil until the chamber is filled (approximately 5 grams of soil)

   d) Wipe all soil from outside of Terra Core® sampler. Remove any excess soil that extends beyond the mouth of the sampler.

3) Placing soil sample into 40-ml VOA vials

   a) Rotate the plunger of the filled Terra Core® sampler 90 degrees and align with the slots in the body

   b) Open 40-ml VOA vile and place mouth of the Terra Core® sampler into the vial

   c) Extrude the soil sample into the VOA vial by pushing the Terra Core® plunger down. It is advisable to hold the VOA vial at an angle when extruding the soil sample to minimize splashing of the methanol

   d) Before capping the VOA vials, visually inspect that there is no material in the threads or lip of the vial to allow for an air-tight seal. Use wipes provided by laboratory to clean threads if necessary

   e) Obtain and transfer the sample rapidly (i.e. less than 10 seconds) to reduce volatilization losses.

4) Obtain additional sample

   a) Use above procedures to fill a second 40 ml VOA vial – the same Terra Core® sampler may be used

   b) Discard Terra Core® sampler after filling second 40 ml VOA vial

   c) Also fill an unpreserved 4-ounce glass sample jar with soil sample for dry weight and other analyses

5) Label and Store Sample

   a) Use existing label on 40 ml VOA vial to write sample information – do not add additional labels to the jar as they are pre-weighed and will affect test results

   b) Place all samples in a chilled thermally-insulated container for shipment to the analytical laboratory.

4.2.4 Soil Field Screening Procedures

As discussed in Section 3.6.2, field screening will be used in certain instances to guide the extent of soil removal while in the field, which will then be verified by confirmation soil sampling. Field screening will be conducted by the following methods: visual (staining/color), olfactory, sheen test, and headspace vapor. The results of field screening will be documented on field sampling forms.

The visual and olfactory methods are somewhat self-explanatory, in that the EP will be noting soils that exhibit staining (contamination is typically gray, bluish, or greenish in color) or unusual or chemical odors.

The presence of sheen will be assessed by placing clean tap water in a black pan and introducing approximately 5 grams of disaggregated soil to the water. The observation for the presence or lack of rainbow-like sheen is a relative indicator of contamination.

Organic vapor levels in the soil samples will be measured by the headspace vapor method utilizing a PhotoVac MicroTIP equipped with a photoionization detector (PID) and a 10.6 electron volt (eV) lamp. Immediately following the collection of the sample, approximately 4 ounces (100 grams) of soil will be placed in a one-quart plastic bag and sealed. The sample will then be set aside for an approximate 20-minute stabilization period where the sample is allowed to reach ambient temperature. The detector probe is then inserted into the bag to collect the headspace vapor sample. The results of the headspace screening will be recorded on the field logs in parts per million (ppm). The results of the headspace method will be used for qualitative screening purposes.

4.2.5 Soil Sample Description

The properties of all soil samples will be observed in the field by an HAI geologist or environmental scientist experienced in logging soils, under the supervision of an Oregon Registered Geologist (RG).

The properties described for coarse-grained soils will include grading, group name, group symbol, particle size range, density, color, moisture, and environmental field screening observations (see Section 4.2.4). The properties described for fine-grained soils will include group name, group symbol, plasticity, consistency, color, moisture, and environmental observations. All properties and observations will be noted on a field log form.

Soil description will be a field estimate of the Unified Soil Classification System (USCS) designation following the practices of the American Society of Testing and Materials (ASTM) Standard D 2488-93. The USCS soil type designation will not be confirmed by laboratory analyses.

4.3 Water Sampling Procedures

Water sampling will only be needed if groundwater seepage into the excavation pits necessitates dewatering to complete the soil removal activities as discussed in Section 3.7. It is assumed that this water will be pumped into temporary storage tanks, and that the water samples will be obtained from these tanks.

Unfiltered water samples should be collected from the storage tanks with a peristaltic pump (using disposable tubing) or a one-time use disposable bailer. Typically collection of only one water sample per storage tank is necessary.

The water sample should be carefully transferred to appropriate containers, which are completely filled such that no headspace is present that would allow the loss of volatiles. The sample bottles will then be transferred to a chilled container for shipment to the analytical laboratory. Standard sampling protocols, including the use of chain-of-custody documentation, will be followed for all sampling procedures as discussed in Section 4.8.2. The City should be consulted to determine the testing parameters for the water samples, which will likely include metals, TPH, and VOCs.

Because metals testing is one of the parameters required by the City for dewatering permitting, every effort should be made to collect sediment-free samples with as little turbidity as possible that would be representative of the water to be discharged.

4.4 Soil Gas Sampling Procedures

As discussed in Section 3.8.2, soil gas testing is proposed at this Site to verify that the soil removal activities have successfully addressed the *Vapor Intrusion* pathway before a new structure is built at the property. Accordingly, the confirmation soil gas testing is proposed to take place soon after the site has been restored to grade, but well before any new structure is slated to be built. The soil gas testing will take place once the confirmation soil sampling shows compliance with Cleanup Levels in remaining soils and after the excavation pits have been backfilled and re-paved. It is proposed

that the soil gas testing take place at least one month following the completion of the soil removal and site re-surfacing activities.

One soil gas testing event is proposed to take place at seven (7) temporary boring locations (SG1 through SG7), as shown on Figure 5. Two of the sample locations (SG6 and SG7) will be located within the two larger backfilled soil removal pits, and the other five locations will be placed into native soils surrounding these two areas. The proposed depth of soil gas sample collection is 5 feet bgs, and a second deeper soil gas sample will be collected at the two locations in the soil removal pits (SG6 and SG7) at a depth of approximately 12 feet bgs. QA/QC samples (field duplicate and equipment blank) will be collected during the soil gas testing event as discussed in Section 4.8.1.

4.4.1 Soil Gas Probe Installation Method

The soil gas samples will be collected from a driven probe utilizing direct push drilling techniques and the GeoProbe® post-run tubing (PRT) system. The PRT system allows for the insertion and sealing of internal tubing for soil gas sampling after driving the probe rods to the desired depth.

By directly driving the rods to the sampling depth without removal, this generally provides for an adequate seal against subsurface cross-flow in most soil types (this method is less suitable for low permeability, i.e. clayey, soils). Once the desired depth is reached, the expendable drive point is disengaged and the probe rods are pulled back approximately six inches to expose the subsurface soils. A surface seal, composed of a bentonite slurry is applied around the probe rods at the ground surface to prevent atmospheric leakage. New Teflon-lined polyethylene tubing (1/4-inch diameter) will be utilized for the collection of each sample.

The tubing is connected to a PRT adapter that is sent down the inside of the probe rods to the expendable point holder located at the designated sample depth, where the adapter is threaded into the holder. The tubing is then cut at surface and connected to the surface sample manifold using a ferrule connector. A leak detection enclosure is installed at the probe head, and the sample train is then ready for purging, leak testing, and sampling, as discussed below. Decontamination of soil gas sampling equipment is discussed in Section 4.5.

4.4.2 Purge Method and Volume

A soil gas sampling manifold should be used that allows for purging, real-time leak testing, and sampling without the disconnection of any components once assembled. An example schematic setup for soil gas sample collection using a custom manifold and downhole PRT system is shown on Figure 6. In this example, the full sample train is made up of the following components:

Down-Hole Sample Train

(replaced for each sample)

- Open hole at the designated depth (4.5-5.0 & 11.5-12.0 feet bgs)
- PRT expendable point holder
- PRT threaded adapter
- Teflon tubing from down-hole PRT adapter to ferrule connector at the surface

Surface Sample Train (custom soil gas sample manifold)

(re-used after decontamination for each sample)

- Ferrule connector to 2-way ball valve
- Vacuum gauge
- Flow meter with a flow control valve
- 2-way ball valve to allow air flow to either a peristaltic purge pump or to the Summa sample canister
- 2nd vacuum gauge
- 1-Liter Summa canister for soil gas sample
- Peristaltic pump for purging manifold and borehole
- Helium detector at exhaust end of peristaltic pump.

After connecting the soil gas sample manifold to the down-hole sample train, a vacuum leak test of the manifold can be conducted (see Section 4.4.4). Once the sample manifold is documented to be leak free, the system is now ready for purging. The two ball valves are adjusted to allow direct flow from the peristaltic pump to the down-hole sample train. The pump is turned on and the flow control valve is adjusted to limit the purge rate to approximately 200 ml/minute.

A pre-calculated volume of air should be purged from the sample point, which is equivalent to approximately two system volumes (i.e. the volume of the 6-inch long, 1.5-inch diameter, open hole plus the volume of the ¼-inch tubing and sample manifold). It is important not to over-purge the system, particularly in lower permeability soils, as this may trigger short-circuiting and/or leaks of atmospheric air into the point. Following purging, a leak test using helium as a tracer is conducted to verify an acceptable leak rate within the system (see Section 4.4.1.3).

4.4.3 Soil Gas Sample Collection

Following purging of the designated purge volume, and confirmation of an acceptable leak rate, the sample collection process will be initiated by adjusting the ball valve to redirect the air flow to the Summa canister. The valve on the pre-evacuated 1-liter Summa canister is then opened to begin soil gas sample collection. Sample collection should be at the same flow rate of approximately 200 ml/minute. A pre-adjusted flow controller attached to the Summa canister may be used to maintain the desired flow rate.

Sample collection is halted once the vacuum in the Summa canister drops to approximately 5 inches of mercury. The valve on the Summa canister is then closed, and the manifold adjusted to conduct a final a leak check using helium to verify acceptable leak rates during sampling. The Summa is then disconnected from the sample manifold, and canister prepared for shipment to the designated laboratory.

4.4.4 Leak Detection

During sampling at each soil gas location, leak tests will be conducted to ensure that valid soil gas samples are collected and the test results are useable. The leak tests will be conducted to verify that no breakthrough of atmospheric air has occurred down the probe rods or in the sample train. Two types of leak tests will be conducted: 1) a vacuum test of the surface sample train/manifold; and 2) a tracer test at the surface borehole seal and at other connection points not covered by the vacuum test.

Vacuum Leak Test

A vacuum test of the surface sample train/manifold will be conducted prior to sampling. To begin the test, the inlet end of the surface sample train is plugged. The peristaltic pump is then turned on to begin creating a vacuum within the manifold. Once a vacuum of greater than 10 inches of mercury is achieved, the pump is turned off and the vacuum gauges are monitored for at least one minute to verify that the vacuum holds and the manifold is leak free. If any leak is detected (i.e. a declining vacuum), then connections and fittings will be re-tightened and the vacuum leak test repeated until acceptable. After the vacuum test is successfully completed, no connections or fittings will be adjusted or undone until the sampling is completed.

Tracer Leak Test

The tracer test is designed to test all other possible leak points that are not tested by the vacuum test. These other possible leak points include: 1) the probe/borehole seal at the ground surface (for short-circuiting); 2) the

connection point between the down-hole sample train and the surface sample train; and 3) the down-hole threaded PRT adapter connection.

The preferred tracer gas to be used is helium since it will not interfere with the VOC analysis. The tracer test is conducted in the field in real time using a portable helium detector capable of detecting less than 1% helium in air.

The test is conducted by creating a leak check enclosure/tent that fits over the probe location where it exits the ground and encompasses the surface seal and the down-hole/surface sample train connection point (Figure 6). An effective leak check enclosure that is easy to implement is a flexible plastic bag that is fixed to the ground with a metal chain. This setup allows for tubing into and out of the enclosure (beneath the chain) with minimal exposure of the interior atmosphere to the exterior air. A tight seal is not necessary for construction of the leak check enclosure, as long as the atmosphere within the enclosure can continuously accept the tracer gas.

During purging and sampling, the tracer gas should be pumped continuously to two locations simultaneously using two separate runs of tubing. One helium discharge point will be from tubing lowered down hole to the PRT threaded adapter location; the other helium discharge point will be into the surface leak check enclosure. Prior to initiating purging, a sufficient volume of helium should be pumped to displace the air and create a helium atmosphere within the enclosure and probe rod. The helium is then continuously pumped during the purging and sampling period to maintain a helium atmosphere.

To verify an acceptable leak rate during purging, helium measurements should be taken from the discharge air exiting the peristaltic pump. If helium is detected at a level of greater than 5% helium, then all connections and seals will be checked and re-tightened or re-sealed, and the purging re-initiated until acceptable helium levels are met.

As a final check to verify that leaks or breakthrough did not occur during the sampling period, once sample collection is completed and the Summa canister valve is closed, a final check on helium levels should be conducted.

4.5 Decontamination Procedures

Soil Sample Equipment

All reusable soil sampling equipment will be decontaminated prior to initiating sampling activities, and between each sampling location, to prevent cross-contamination by using a detergent (Alconox) solution wash, followed by two separate potable water rinses.

Water Sample Equipment

No reusable equipment that comes in contact with the sample medium is utilized for the collection of the water samples, and therefore decontamination is not necessary in this case.

Soil Gas Sample Equipment

The stainless steel soil gas sampling manifold described in Section 4.4.1, is the only re-usable piece of equipment that comes in contact with the soil gas air flow. Accordingly, it will require decontamination after the collection of each sample by passing ambient air through the sample manifold. This is accomplished by running the peristaltic pump at a high rate (greater than 1 liter per minute) for over 4 minutes after disconnecting the manifold from the sample container and the down-hole sample train. This will allow for at least 100 manifold volumes of fresh air to pass through and decontaminate the system. Prior equipment blank testing of this manifold after collection of highly-contaminated samples and manifold decontamination as described above shows that this decontamination procedure reduces potential cross-contamination to below detectable levels.

Personal Protective Equipment

No reusable personal protective equipment that comes in contact with the sample medium should be utilized for this project, in which case decontamination is not necessary.

4.6 Investigative Derived Waste (IDW)

The sampling methods described in this work plan for soil, soil gas, and groundwater do not generate waste media. The one possible exception to this would be the digging of a test pit to collect the waste profile sample in the fuel island area (Section 4.2.2). In this case, the test pit spoils will be returned to the pit in the same order in which they were initially removed (thus minimizing the mixing of impacted and un-impacted soils). These soils will be removed later during the soil removal action.

All disposable personal protective equipment (gloves, etc.) and disposable sampling equipment generated during any the sampling activities will be disposed as solid waste.

4.7 Analytical Laboratory Testing Program

A summary of the sampling and analytical testing program is presented in Table 1, while a description of the analytical methods and sample container, preservation, and holding time requirements are presented in Table 2.

To assure the analytical testing results will meet project data quality objectives for compliance purposes (i.e. the ability to determine whether test results will meet *Vapor Intrusion* screening levels), analytical Method Reporting Levels (MRLs) for chemicals of interest were compared to the applicable risk-screening levels (i.e. DEQ RBCs for *Urban Residential Vapor Intrusion*) (Table 3). This comparison indicates that MRLs for the standard laboratory methods will be acceptably below risk-screening levels for chemicals in soil and soil gas.

4.7.1 Soil Testing Program

Depending on their purpose and location as indicated on Tables 1 and 2, soil samples will be analyzed for the following parameters by the following methods.

- Gasoline-Range Petroleum Hydrocarbons by NW Method TPH-Gx (or EPA 8260B)
- Diesel- and Oil-Range Petroleum Hydrocarbons by NW Method TPH-Dx
- VOCs and BTEX by EPA Method 8260B
- PCBs by EPA Method 8082A
- RCRA 8 Metals (total basis) by EPA Method 6020A (arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver).

Soil samples collected for VOC or BTEX analysis will be obtained utilizing EPA field preservation method 5035. In addition to Table 1, for the rationale, and number, location, and depth of soil samples refer to Section 3.5 for the waste profile samples, Section 3.6.1.3 for the overburden samples, and Section 3.8.1 for the confirmation soil samples.

4.7.2 Water Testing Program

Water samples collected from storage tanks for the purpose of permitting the water for discharge to the municipal sewer system will be analyzed for the following parameters (Section 3.7):

- Gasoline-Range Petroleum Hydrocarbons by NW Method TPH-Gx (or EPA 8260B)
- Diesel- and Oil-Range Petroleum Hydrocarbons by NW Method TPH-Dx
- VOCs by EPA Method 8260B
- 11 Metals (total basis) by EPA Method 6020A (arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, silver, zinc).

4.7.3 Soil Gas Testing Program

The soil gas samples collected into 1-liter Summa canisters will be shipped to a laboratory experienced in testing air samples (Section 3.8.2). The samples will be analyzed for VOCs by EPA Method TO-15. The samples will also be analyzed for gasoline-range fraction VOCs (TPH-Gx) by a modified EPA Method TO-15.

For soil gas testing, the laboratory will be asked to report only a select group of analytes that are either chemicals of concern for *Vapor Intrusion* at the property or are related chemicals of interest. The chemicals to be reported should include the following:

- Gasoline-Range VOCs (TPH-Gx)
- Benzene
- Toluene
- Ethylbenzene
- Xylenes
- Tetrachloroethene (PCE)
- Trichloroethene (TCE)
- cis-1,2-Dichloroethene (cis-1,2-DCE)
- trans-1,2-DCE
- Vinyl Chloride.

4.8 Quality Assurance Plan

4.8.1 Quality Control Samples

The following quality control (QC) methods will be employed for the soil sampling activities (also summarized in Table 1):

Field Duplicate Samples - Soil
Field duplicate samples will be collected and analyzed during the confirmation soil sampling activities at the following quantity:

- One duplicate sample from each of the two areas of soil removal (oil-water separator and fuel island areas), or at a rate of 5% of the total number of confirmation samples analyzed at the site, whichever is greater.

The field duplicate soil samples should be collected from areas within the excavation pit where contaminated soil is suspected to remain. Each field duplicate soil sample will be analyzed for gasoline-range petroleum hydrocarbons by NW TPH-Gx and VOCs by EPA Method 8260B.

Field Duplicate Samples – Soil Gas
A field duplicate sample will be collected and analyzed during the soil gas sampling activities. The duplicate sample is proposed to be collected from location SG1. The field duplicate soil gas sample will be analyzed for gasoline-range petroleum hydrocarbons by NW TPH-Gx and VOCs by EPA Method TO-15.

Equipment Blanks – Soil Gas
A field equipment blank will be collected during the soil gas testing event. Following decontamination of the soil gas manifold after sampling at the final location (SG7), ambient air will be passed through the unit and collected into a Summa canister. The soil gas equipment blank will be analyzed for gasoline-range petroleum hydrocarbons by NW TPH-Gx and VOCs by EPA Method TO-15.

Laboratory Quality Control (QC)
Laboratory QC for this project will involve standard EPA QC guidelines as described in Test Methods for Evaluating Solid Wastes - Physical/Chemical Methods (SW-846), and therefore will not be repeated here. Laboratory QC will include calibration standards, laboratory control samples, reagent blanks, matrix spikes, matrix spike duplicates, surrogate spikes, and laboratory blanks and duplicates.

4.8.2 Sample Handling Procedures

This section describes sample identification and chain-of-custody procedures that will be used for field activities. The purpose of these procedures is to ensure the quality of samples is maintained during collection, transportation, storage, and analysis.

4.8.2.1 Sample Containers

The sample container, preservation, and holding time requirements for the confirmation soil samples and the anticipated analytical methods are summarized on Table 2. All samples (except Summa cans) will be transferred to the appropriate sampling containers and placed into a chilled (4^{o}C) transport container for shipment to the laboratory. The chilled transport containers (coolers) will be utilized for temporary storage of the samples.

4.8.2.2 Sample Labels

A sample label will be attached to each sampling container prior to the sampling event. Information to be included on the label will include the following:

- "HAI" will be indicated on the label
- Sample number (see below)
- Date and time of sample collection
- Initials of person collecting the sample
- Analytical parameters, e.g. "TPH-Gx"

Individual samples will be identified using a unique sample number that includes a sample prefix consisting of a four-digit project number and a six-digit date code (yr/mo/day). The prefix will be followed by an individual sample collection number that will be assigned sequentially as the samples are collected (e.g. 7586-120714-005). The sample number suffix for the confirmation soil samples will begin at 001.

4.8.2.3 Chain-of-Custody Record and Shipment

Chain-of-custody procedures will be followed from the time of sample collection to the conclusion of laboratory analysis. Field chain-of-custody procedures include:

- Label containers with sample location and sample information plus the analytical parameter(s) that the container contents are intended for. Date, time and sampler information will be written on the label in the field.
- Complete chain-of-custody forms for all samples en route to laboratory. Upon transferring samples to the laboratory sample custodian, designated staff will sign, date and note the time of transfer on the chain-of-custody form.
- Ship samples in ice chests sealed with custody seals, unless relinquished directly to a laboratory representative. The integrity of the seals is established at the laboratory by the laboratory sample custodian.
- Ensure that the samples are in possession or view of field staff or in secure storage at all times.
- Transport samples to the laboratory as soon as possible, observing appropriate preservation and holding-time requirements.
- Notify the appropriate people that the samples had arrived.

Upon receipt of the samples at the laboratory, the laboratory sample custodian will inventory the samples by comparing sample labels to those on the chain-of-custody document. The custodian will enter the sample number into a laboratory tracking system by project code and sample designation. The custodian will assign a unique laboratory number to each sample and will be responsible for distributing the samples to the appropriate analyst or for storing samples in an appropriate secure area.

4.8.3 Documentation Procedures

Documentation of field procedures, observations, and measurements will be provided through the use of field logs, chain-of-custody, and photographs.

All data collection activities will be documented using waterproof field forms and indelible ink. All field entries will be signed, dated, and as detailed and descriptive as possible. If an incorrect entry is made on any form, it will be lined out, the correct information entered, and the correction will be initialed and dated by the person making the correction.

Overall documentation of the nature and timing of field activities should be provided daily with a Project Field Notes form. Equipment calibration should be documented on an Equipment Calibration Log.

4.8.4 Equipment Calibration and Maintenance Procedures

All field equipment should be calibrated prior to use according to the manufacturer's instructions. The results of calibrations and any records of repair will be maintained on a Project Field Notes form and Equipment Calibration Log. Equipment that fails calibration or fails to operate properly will be removed from service and segregated from the operational equipment. Such equipment will be repaired and re-calibrated if possible, or replaced. Preventive maintenance of field equipment is performed according to the procedures indicated in the manufacturer's manuals.

Laboratory analytical equipment and instruments will be calibrated in accordance with the laboratory's internal QA/QC program.

4.8.5 Data Validation and Usability

All field data will be summarized and recorded on appropriate field forms. Descriptive data including soil types, field screening results, and observations will be summarized in a final appropriate format on field sampling logs or tables.

Laboratory data will be recorded by a computer system that collects and compiles raw data. The analytical laboratory will conduct necessary QC calculations that will be summarized in final laboratory reports. All final laboratory reports will be included as an appendix or appendices to the final Project Completion Report. In addition, all analytical data will be summarized in tabular form.

Analytical data will be assessed to ensure that they are of acceptable quality. This assessment will include a review of the following:

- Sampling dates
- Requested analysis
- Chain-of-Custody documentation
- Sample preservation
- Holding times
- Method blanks
- Surrogate recoveries
- Matrix spike results
- Matrix spike/matrix spike duplicate analyses

- Laboratory duplicates
- Field duplicates
- Laboratory control samples
- Method reporting limits above requested levels
- Any additional comments or difficulties reported by the laboratory
- Overall laboratory assessment of data quality.

If the data are not considered to be of adequate quality, an appropriate data qualifier will be assigned. After the data have been reviewed and qualified, the data will be entered into computer databases and presented in tabular and graphical formats for interpretation.

All project-generated and compiled data and information will be reconciled with the project objectives to assess the overall success of sampling activities. This data assessment, including points of achievement and departure from project-specific objectives, will be discussed in the final *Project Completion Report*.

4.8.6 Quality Assurance Audits and Corrective Action

Quality assurance (QA) audits may be conducted during the investigation activities to review field sampling, sample handling, and decontamination techniques and assure they are suitable to meet project data quality objectives and are consistent with this SAP. Audits will be performed based on a review of field logs, forms, notes, and field inspections. In the event a field audit indicates work activities are not being performed in accordance with appropriate procedures detailed in this SAP, they will be remedied immediately and the activities evaluated for impact to project data quality objectives. The findings of all field audit procedures will be incorporated into the final *Project Completion Report*.

The analytical laboratory QA project manager will be responsible for monitoring consistency within the laboratory QA program. Following receipt, the analytical data and QC data will be reviewed and subject to data validation and evaluation as discussed in Section 4.8.5. In the event a QA problem is identified, the laboratory QA project manager will be notified to remedy the QA problem. In severe cases, the laboratory may be dismissed from further services. The laboratory QC results will be included in each analytical report and included in the final *Project Completion Report*.

5.0 PROJECT MANAGEMENT PLAN

5.1 Project Organization

Since the exact timing for implementation of this Work Plan is not known, a listing of the contractors to be employed is not presented here other than in a general sense.

Overall project management for implementation of the contaminated soil removal action activities, including planning, coordination, sampling, documentation, and reporting tasks, should be undertaken by a qualified environmental consultant with experience cleaning up and managing contaminated soil in Oregon under DEQ rules. All project work should be supervised by an Oregon Registered Geologist (RG) or Professional Engineer (PE) who has experience handling contaminated media.

Subcontractors will be utilized for a number of activities, including laboratory testing services, utility locating, excavation services, and tank decommissioning. Only Oregon-certified laboratories should be used for analytical testing of the soil, soil gas, and water samples. The excavation and tank decommissioning contractors (may be one and the same) should have experience with removal and management of contaminated soils and USTs, and should employ personnel with appropriate OSHA Hazardous Waste Operations (HAZWOPER) training.

All stakeholders should be invited to a pre-construction meeting to discuss this Remedial Action Work Plan in detail and clarify roles for implementing the plan.

5.2 Schedule

Since the exact timing for implementation of this Work Plan is not known, a specific schedule of work is not presented here. As previously stated, if at all possible, the work should be scheduled for late summer or early fall when groundwater levels may be at their lowest. This timing would likely make implementation of the soil removal activities less complicated, possibly avoiding the need to dewater and manage groundwater altogether.

Below is a potential schedule for implementing the various remedial action tasks, assuming that groundwater management will not be needed.

Conceptual Project Schedule

Task	Duration	Timeline
Begin Project	-	Week 1
Pre-Construction Meeting	1 Day	Week 1
Soil Removal in Oil-Water Separator Area (stockpile on-site); Test Pit in Fuel Island Area; Collect Profile Samples; Decommission UST	4 Days	Week 1
Await Test Results; Conduct Waste Determination; Permit Soils for Disposal	3 Weeks	Week 4
Transport Stockpile Soils to Off-Site Disposal Facility; Soil Removal in the Fuel Island Area & Transport Off-Site to Disposal Facility; Collect Confirmation Samples	1 Week	Week 5
Await Expedited Soil Test Results; Determine if Cleanup Levels Have Been Met	1 Week	Week 6
Contingent Task: Conduct Additional Soil Removal, If Necessary; Collect Confirmation Samples (if implemented add 2 weeks to Timeline)	2 Days	Not Included in Schedule
Backfill Excavation Pits and Re-Pave	1 Week	Week 7
Allow for Subsurface Stabilization of Soil Gas	4 Weeks	Week 11
Conduct Soil Gas Sampling Event	2 Days	Week 11
Await Soil Gas Testing Results	2 Weeks	Week 13
Prepare Project Completion Report	6 Weeks	Week 19
Submit Report; End Project	-	Week 20

5.3 Project Deliverable

Final Project Completion Report

Following completion of all soil and UST removal activities, a comprehensive *Project Completion Report* should be prepared to document the cleanup work and to demonstrate that the remedial actions met the cleanup goals for the project.

6.0 LIMITATIONS AND SIGNATURES

The information presented in this plan was collected, analyzed, and interpreted following the standards of care, skill, and diligence ordinarily provided by a professional in the performance of similar services as of the time the services were performed. This plan and the conclusions and/or recommendations contained in it are based solely upon research and/or observations, and physical sampling and analytical activities that were conducted.

Hahn and Associates, Inc.

Prepared by:

Digitally signed by Roger E. Brown
Date: 2015.01.09 09:05:31 -08'00'

Roger E. Brown, R.G.
Principal

Expires: 31 May 2015

Date January 8, 2015

7.0 REFERENCES

DEQ (2003). *Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites.* Oregon Department of Environmental Quality. September 22, 2003.

HAI (2012). *Remedial Investigation Report, Former Service Station Property, 5216 SE 28th Avenue, Portland, Oregon* (HAI Project No. 7586). Hahn and Associates, Inc. July 13, 2012.

HAI (2013a). Focused Feasibility Study, Former Service Station Property, 5216 SE 28th Avenue, Portland, Oregon (HAI Project No. 7586). September 27, 2013.

HAI (2013b). Contaminated Media Management Plan, Former Service Station Property, 5216 SE 28th Avenue, Portland, Oregon (HAI Project No. 7586). September 27, 2013.

8.0 GLOSSARY OF ABBREVIATIONS

AVOC	aromatic volatile organic compound
bgs	below existing ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CMMP	Contaminated Media Management Plan
COPC	chemical of potential concern
DCE	dichloroethene
DEQ	Oregon Department of Environmental Quality
ECSI	Environmental Cleanup Site Information
EES	Easement and Equitable Servitude
EP	Environmental Professional
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
HAI	Hahn and Associates, Inc.
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HHRA	Human Health Risk Assessment
HVOC	halogenated volatile organic compound
mg/kg	milligrams per kilogram
MRL	Method Reporting Level
NFA	no further action
NPDES	National Pollutant Discharge Elimination System
NW	Northwest Method
OAR	Oregon Administrative Rule
OSHA	Occupational Safety and Health Administration
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene
PE	Professional Engineer
PID	photoionization detector
PRT	Post Run Tubing

QA	quality assurance
QC	quality control
ppm	parts per million
RBC	DEQ Risk-Based Concentration
RBDM	DEQ Risk-Based Decision Making guidance document
RCRA	Resource Conservation and Recovery Act
RG	Oregon Registered Geologist
RI	Remedial Investigation
SAP	Sampling and Analysis Plan
TCE	trichloroethene
TPH	total petroleum hydrocarbons
TPH-Dx	TPH in the diesel and oil range
TPH-Gx	TPH in the gasoline range
ug/L	micrograms/liter
UST	underground storage tank
VOC	volatile organic compound

TABLES

TABLE 1 – Proposed Remedial Action Sampling Program

Media	Area No.: Name	Collected From	Sample Location	Number of Samples	Depth (feet bgs)	Test Parameters
Soil	**Waste Soil Profile Samples** (Section 3.5)					
	1: Fuel Island Area	Test Pit	P-9 Area	1	10 - 11	TPH-Gx, BTEX, Lead
	2: O-W Separator Area	Removed Soil (90 cubic yards)	Stockpile or Drop Box	5 to 1 [a]	>1.0 below top of pile	TPH-Gx, TPH-Dx, VOCs, PCBs, Metals [e]
	Overburden Soil Samples (Section 3.6.1.3)					
	1: Fuel Island Area	Removed Soil (200 cubic yards)	Stockpile	5	>1.0 below top of pile	TPH-Gx, BTEX
	Confirmation Soil Samples (Section 3.8.1 and Figure 5)					
	1: Fuel Island Pit	Excavation Pit	Wall	8	10 - 11 [b,c]	TPH-Gx, BTEX
			Floor	3	13.5 - 14.0	
	2a: O-W Separator: East Pit	Excavation Pit	Wall	6	2 - 4 [b]	TPH-Gx, VOCs
			Floor	2	4 - 4.5	
	2b: O-W Separator: West Pit	Excavation Pit	Floor	1	4 - 4.5	VOCs
	3: Heating Oil Tank Pit	Excavation Pit	Floor, below each end of tank	2	6 - 7	TPH-Dx
	QA/QC Field Duplicate	Excavation Pit	TBD [d]	2 (1 from each area)	TBD [d]	TPH-Gx, VOCs
Soil Gas	**Confirmation Soil Gas Samples** (Section 3.8.2 and Figure 5)					
	1 & 2: Fuel Island & O-W Separator Areas	PRT Borings	SG1 - SG7	7	4.5 - 5.0	TPH-Gx, VOCs
			SG6, SG7 (in former pits)	3	11.5 - 12.0	TPH-Gx, VOCs
	QA/QC Field Duplicate	PRT Boring	SG1	1	4.5 - 5.0	TPH-Gx, VOCs
	QA/QC Equipment Blank	Through Manifold	After SG7	1	4.5 - 5.0	TPH-Gx, VOCs
Water	**Dewatered Groundwater Profile Samples** (Section 3.7)					
	1: Fuel Island Area	Storage Tanks	Storage Tanks	1 per batch discharge	In tank	TPH-Gx, TPH-Dx, VOCs, Metals [f]

bgs = below ground surface
BTEX = benzene, toluene, ethylbenzene, xylenes
O-W = Oil-Water
PCBs = polychlorinated biphenyls
QA/QC = quality assurance / quality control
TBD = To be determined
TPH = total petroleum hydrocarbons
TPH-Dx = TPH in the diesel & oil range
TPH-Gx = TPH in the gasoline range
VOCs = volatile organic compounds

a = Composited to one sample for analysis at the laboratory
b = Sample depth if no contamination is indicated by field screening; otherwise sample depth should be at zone of greatest impact.
c = At the soil-water interface, if present
d = Collect from an area where contaminated soil is suspected
e = RCRA 8 Metals: arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver
f = Arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, silver, zinc

TABLE 2 – Sample Method, Container, Preservation, and Holding Time Requirements

Analytical Method Number	Instrument/ Detector	Sample Matrix	Preparatory Method	Sample Containers (per sample)	Preservation	Holding Time
NW Method TPH-Gx (by EPA 8260B) Gasoline-Range Quantification	GC/MS	Soil	EPA 5035 [1]	(2) 40-ml VOA vials	Methanol, Cool to 4ºC	14 days
				(1) 4-ounce glass (for dry weight)	Cool to 4ºC	
NW Method TPH-Dx Diesel- and Oil-Range Quantification	GC/FID	Soil	EPA 5030	4-ounce glass jar	Cool to 4ºC	14 days
		Water	Unfiltered	(1) 1-liter amber glass bottle	HCl pH<2, Cool to 4ºC	14 days
EPA Method 8260B Volatile Organic Compounds (VOCs); also Benzene, Toluene, Ethylbenzene, Xylenes (BTEX); TPH-Gx	GC/MS	Soil	EPA 5035 [1]	(2) 40-ml VOA vials	Methanol, Cool to 4ºC	14 days
				(1) 4-ounce glass (for dry weight)	Cool to 4ºC	
		Water	Unfiltered	(3) 40-ml VOA vials	HCl pH<2, Cool to 4ºC	14 days
EPA Method TO-15 VOCs, TPH-Gx	GC/MS	Soil Gas		(1) 1-liter Summa canister	Ambient temperature	30 days
EPA Method 8082A Polychlorinated Biphenyls (PCBs)	GC/ECD	Soil	EPA 3540C	4-ounce glass jar	Cool to 4ºC	14 days
EPA Method 6020A Metals (total basis)	ICP/MS	Soil	EPA 3051A	4-ounce glass jar	Cool to 4ºC	6 months Hg 28 days
		Water	Unfiltered	250-ml plastic bottle	HNO3 pH<2, Cool to 4ºC	6 months Hg 28 days

NOTE: C = degrees centigrade
ECD = electron capture detector
EPA = U.S. Environmental Protection Agency
FID = flame ionization detector
GC= gas chromatography
HCl = hydrochloric acid
Hg = mercury
HNO_3 = nitric acid
ICP = Inductively Coupled Plasma
ml = milliliter
MS = mass spectrometry
NW = Northwest Method
TPH = total petroleum hydrocarbons
VOA = volatile organic analyses

1= Field preservation with methanol

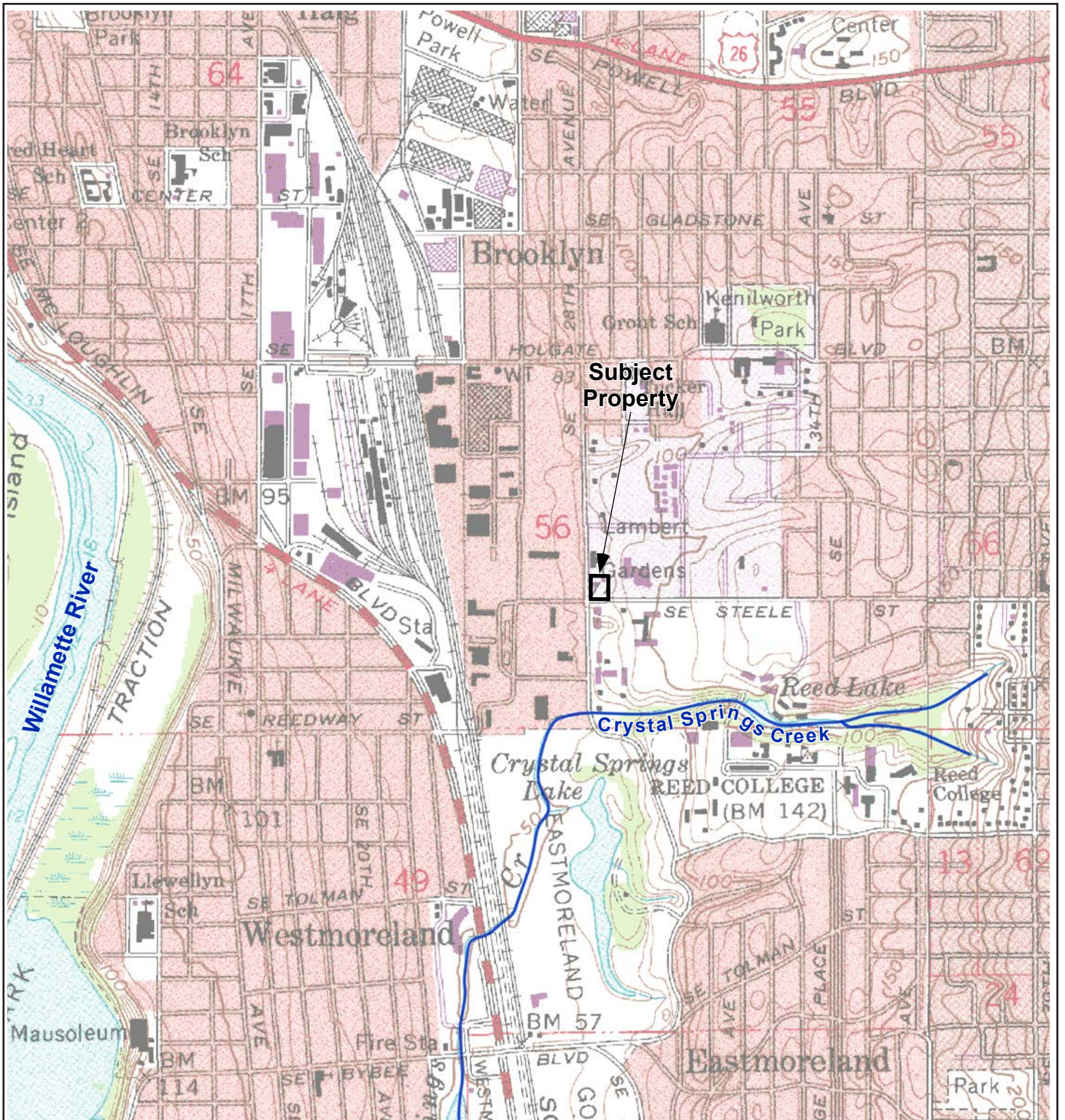
TABLE 3 - Target Laboratory Method Reporting Levels (for Confirmation Samples)

Analyte	Soil – mg/kg (ppm)		Soil Gas – ug/m^3	
	Screening Levels [a]	Laboratory MRL	Screening Levels [a]	Laboratory MRL [b]
Total Petroleum Hydrocarbons (TPH) by Northwest Methods			**EPA Method TO-15 modified**	
Gasoline-Range (TPH-Gx)	94.	25.	79,000.	656.
Select Volatile Organic Compounds (VOCs) by EPA 8260B			**EPA Method TO-15**	
Benzene	0.22	0.013	170.	2.6
Toluene	2,400.	0.050	1,000,000.	8.3
Ethylbenzene	2.2	0.025	530.	3.5
Xylenes	100.	0.050	21,000.	3.5
Naphthalene	18.	0.250	39.	24.5
1,2,4-Trimethylbenzene	82.	0.050	1,500.	3.9
1,3,5-Trimethylbenzene	-	0.050	-	5.3
iso-Propylbenzene	1,200.	0.050	83,000.	3.9
cis-1,2-Dichloroethene	-	0.025	-	3.2
trans-1,2-Dichloroethene	16.	0.025	13,000.	4.5
Tetrachloroethene (PCE)	6.6	0.025	5,100.	5.4
Trichloroethene (TCE)	0.25	0.025	200.	4.3
Vinyl Chloride	0.053	0.025	41.	2.0

DEQ = Oregon Department of Environmental Quality
EPA = U.S. Environmental Protection Agency
mg/kg = milligrams per kilogram
MRL = method reporting level
ppm = parts per million
RBC = DEQ Risk-Based Concentration
ug/m^3 = micrograms per cubic meter

a = DEQ RBC for Urban Residential Vapor Intrusion, June 2012 Update
b = MRL under ideal conditions (assumes dilution factor of 1.6)
Red Shade = Laboratory MRL exceeds lowest Screening Level

FIGURES



Base Map from the Lake Oswego (1981) and Gladstone (1984), Oregon USGS 7.5-Minute Quadrangles
Contour Interval: 10 Feet

NORTH

0 600 1200 2400

1"=1200' Scale in Feet

FIGURE 1
Location Map

Remedial Action Work Plan
Former Service Station
5216 SE 28th Avenue
Portland, Oregon

HAHN AND ASSOCIATES, INC.
Project No. 7586 January 2015

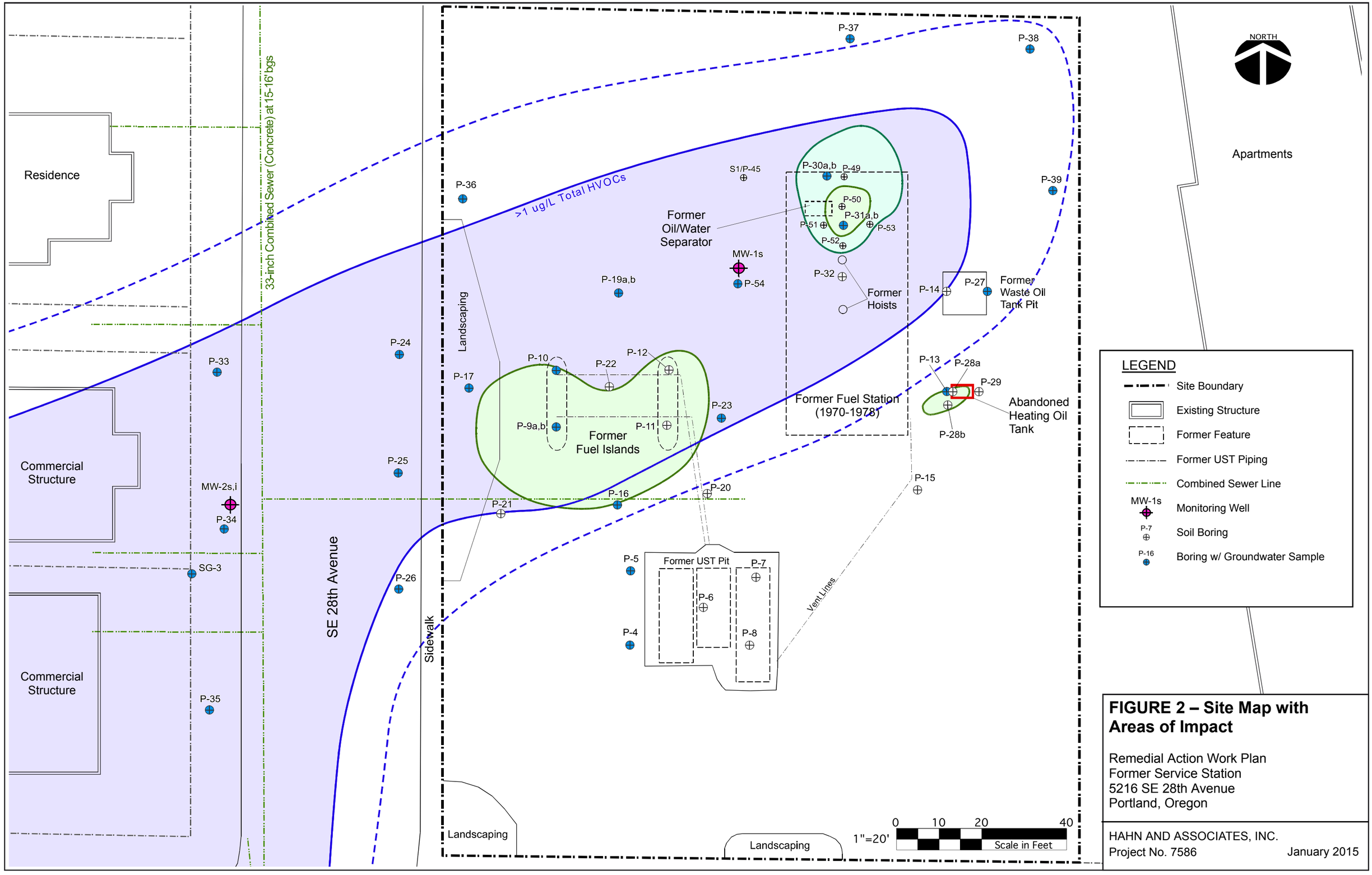


FIGURE 2 – Site Map with Areas of Impact

Remedial Action Work Plan
Former Service Station
5216 SE 28th Avenue
Portland, Oregon

HAHN AND ASSOCIATES, INC.
Project No. 7586 January 2015

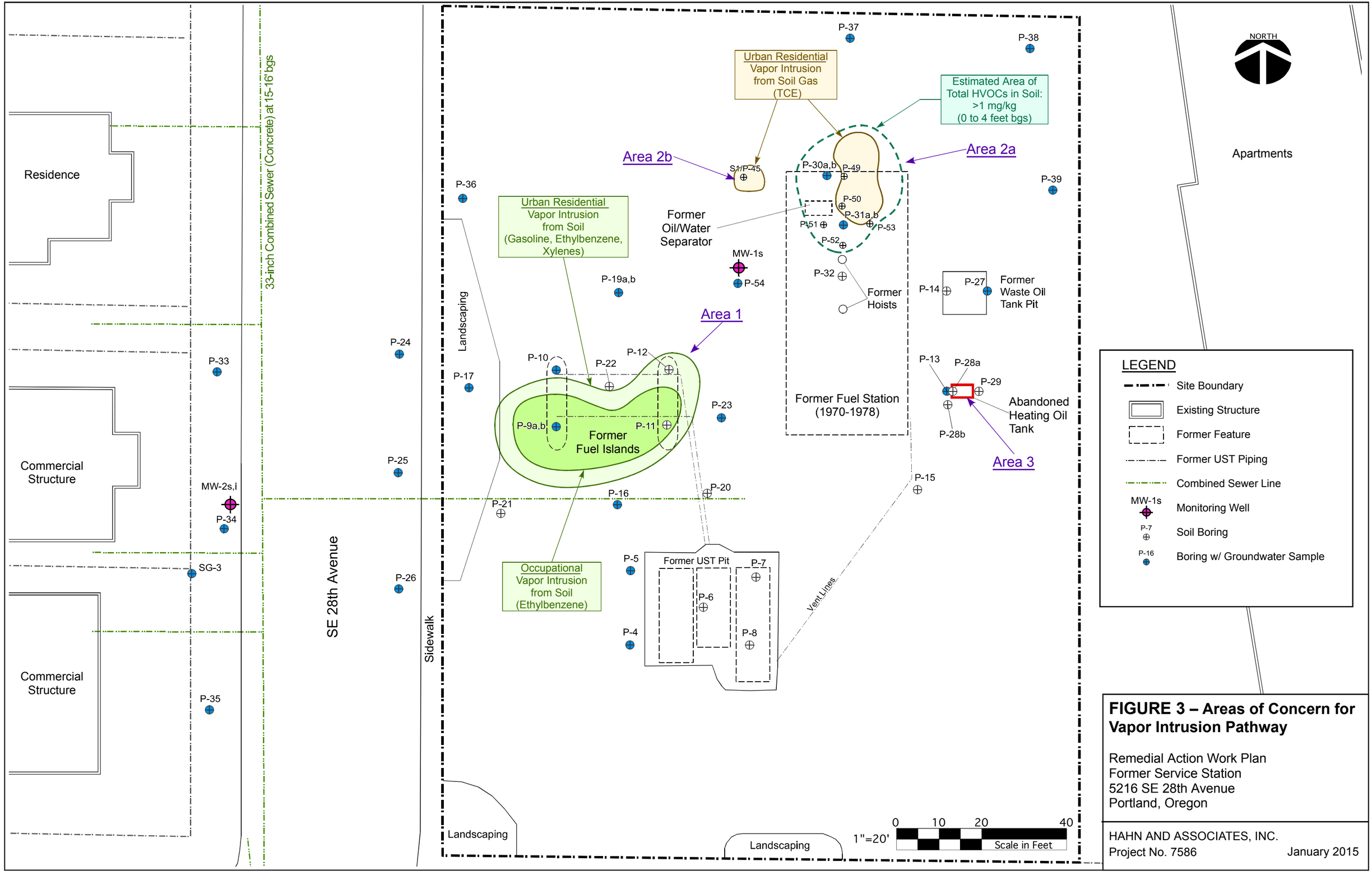


FIGURE 3 – Areas of Concern for Vapor Intrusion Pathway

Remedial Action Work Plan
Former Service Station
5216 SE 28th Avenue
Portland, Oregon

HAHN AND ASSOCIATES, INC.
Project No. 7586 January 2015

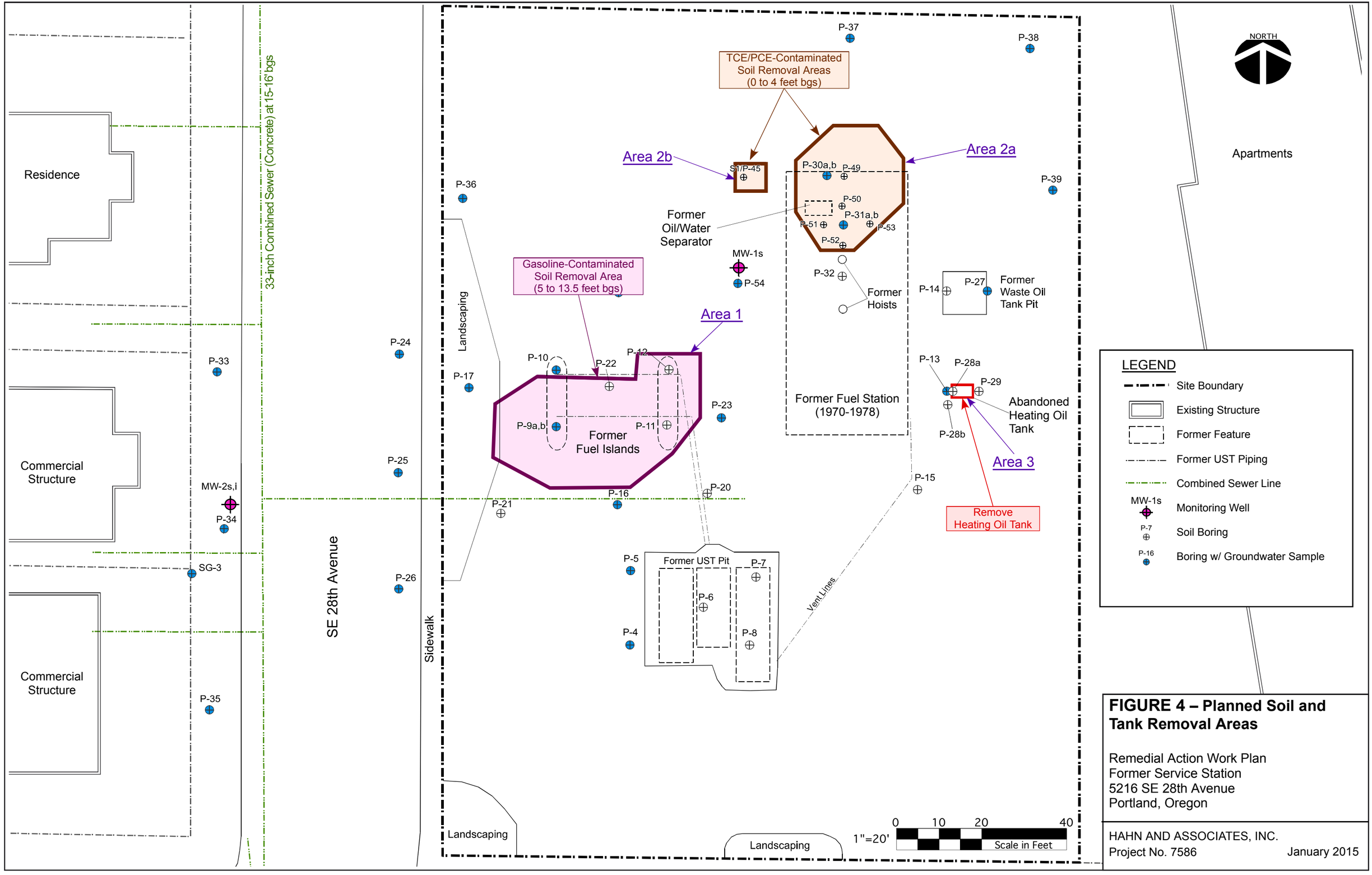


FIGURE 4 – Planned Soil and Tank Removal Areas

Remedial Action Work Plan
Former Service Station
5216 SE 28th Avenue
Portland, Oregon

HAHN AND ASSOCIATES, INC.
Project No. 7586 January 2015

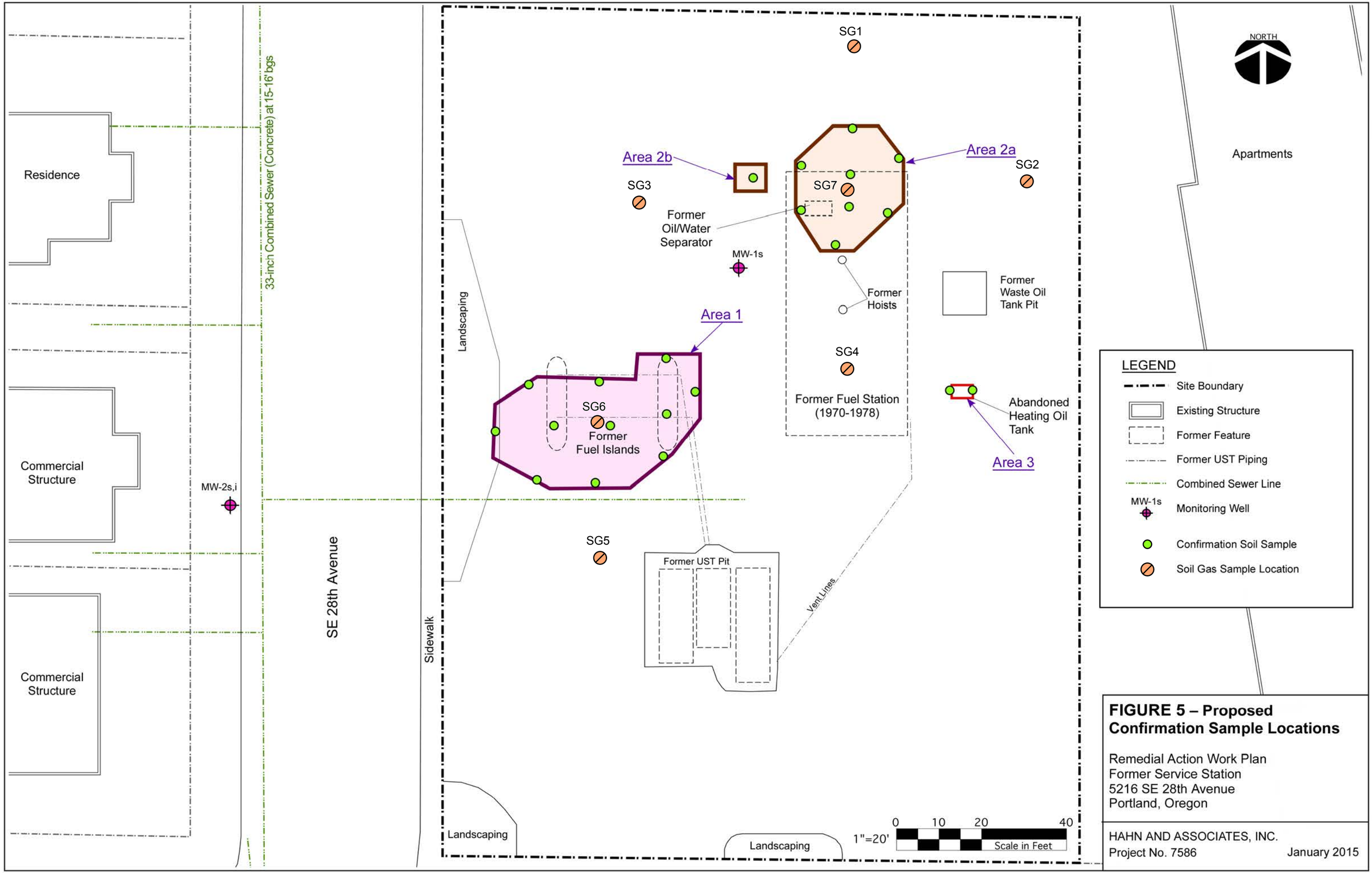
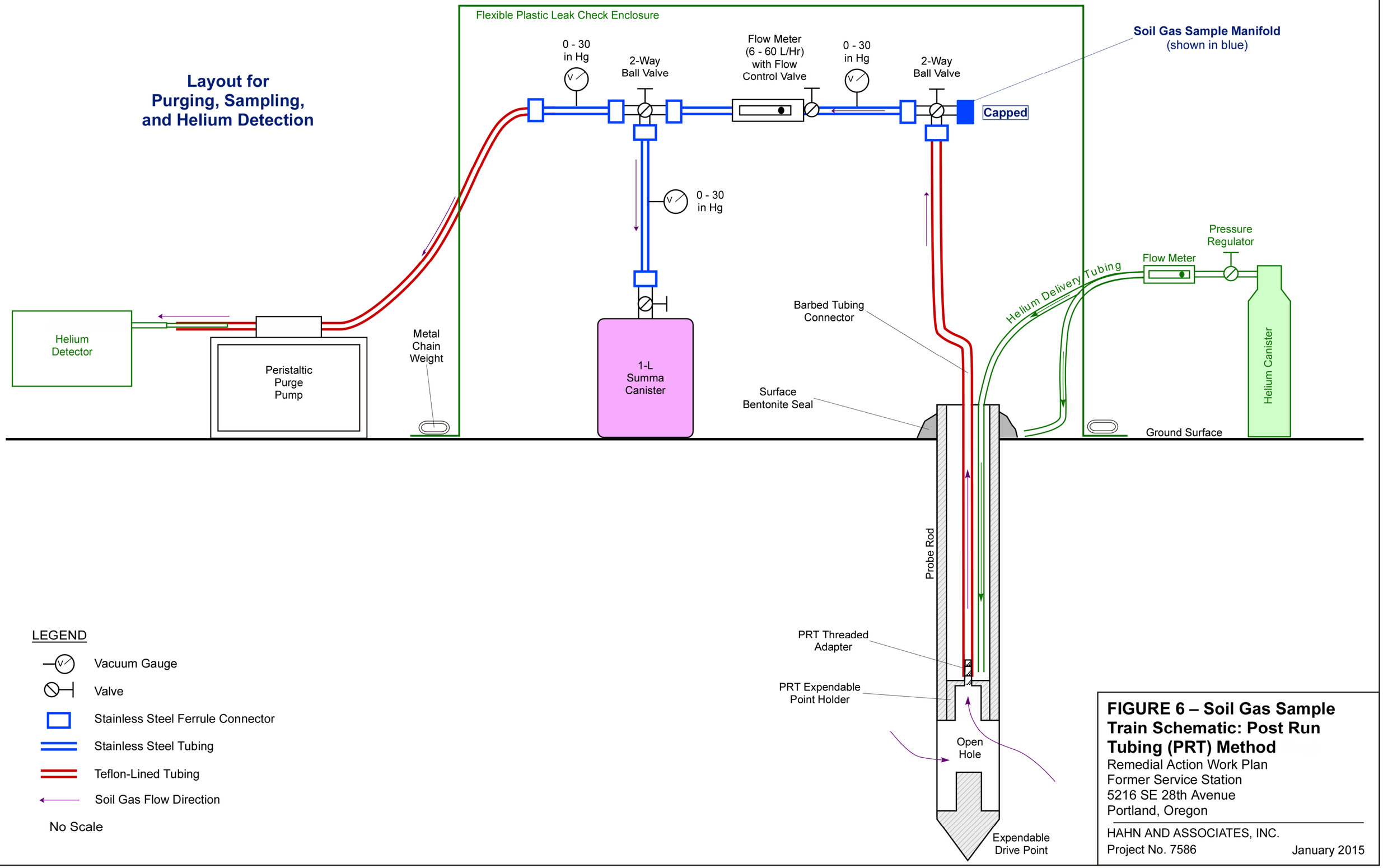


FIGURE 5 – Proposed Confirmation Sample Locations

Remedial Action Work Plan
Former Service Station
5216 SE 28th Avenue
Portland, Oregon

HAHN AND ASSOCIATES, INC.
Project No. 7586 January 2015

Layout for Purging, Sampling, and Helium Detection



LEGEND

- Vacuum Gauge
- Valve
- Stainless Steel Ferrule Connector
- Stainless Steel Tubing
- Teflon-Lined Tubing
- Soil Gas Flow Direction

No Scale

FIGURE 6 – Soil Gas Sample Train Schematic: Post Run Tubing (PRT) Method

Remedial Action Work Plan
Former Service Station
5216 SE 28th Avenue
Portland, Oregon

HAHN AND ASSOCIATES, INC.
Project No. 7586 January 2015

APPENDIX A

Site Health and Safety Plan

SITE HEALTH AND SAFETY PLAN

Former Service Station Property
5216 SE 28th Avenue
Portland, Oregon

January 8, 2015

Prepared for:

Odyssey Property Holdings, Inc.
Portland, Oregon

Prepared by:

Hahn and Associates, Inc.
Portland, Oregon

HAI Project No. 7586

TABLE OF CONTENTS

ATTACHMENTS

1.0 INTRODUCTION

This site-specific Health and Safety Plan (HASP) has been developed by Hahn and Associates, Inc. (HAI) as required by the Occupational Safety and Health Administration (OSHA) according to the Code of Federal Regulations (CFR) 29 CFR 1910.120, and is included as Appendix A of the *Remedial Action Work Plan* prepared for the Former Service Station Property site, 5216 SE 28th Avenue, Portland, Oregon. The primary component of the proposed remedial action is the removal of approximately 425 cubic yards of contaminated soil for off-site disposal. Details of the proposed remedial action are presented in the accompanying *Remedial Action Work Plan*.

The Site Health and Safety Plan includes discussion under the following section headings: Site Description; Organization and Coordination; Site Control; Hazard Evaluation; Personal Protective Equipment; Communication Procedures; Decontamination Procedures; and Site Safety and Health.

Based on the results of previous research and investigatory activities performed at the site, Level D protection is recommended for all work activities. However, the level of protection may be upgraded to Level C if applicable conditions within Section 6.2 of this plan are identified.

2.0 SITE DESCRIPTION

2.1 Physical Site Description

The 0.69-acre subject property is the location of a former automotive service/fuel station, and consists of Tax Lot 500, located at 5216 SE 28th Avenue (the "Site"). The ground surface is generally level at an elevation of approximately 75 feet mean sea level (msl) with a slight grade to the west toward SE 28th Avenue. The site is currently vacant with no existing structures. The property is primarily asphalt-paved with a small area of landscape adjacent to SE 28th Avenue.

2.2 Nature of Contamination

Investigation activities have identified hazardous substance releases at the site, which appear to be from two distinct sources at the property: 1) gasoline releases at the former fueling island area; and 2) petroleum hydrocarbon and chlorinated solvent releases at the former oil-water separator area.

Chemicals of Interest (COIs) identified based on the history of operations at the site, and the chemicals that were previously detected in site soils and groundwater include the following:

- Total petroleum hydrocarbons (TPH) (predominantly in the gasoline range, but also in the diesel- and oil range)
- Volatile aromatic compounds, such as benzene, toluene, ethylbenzene, and xylenes (BTEX), naphthalene, trimethylbenzenes (1,2,4-TMB and 1,3,5-TMB), propylbenzenes, and butylbenzenes
- Halogenated volatile organic compounds (HVOCs), including dichloroethenes (DCE), tetrachloroethene (PCE), trichloroethene (TCE), vinyl chloride (VC), 1,1,1-trichloroethane (1,1,1-TCA), and chloroform.

Chemicals of Concern for the site, for which potential unacceptable risk were identified (for Vapor Intrusion only), include the following:

- TPH as Gasoline
- Ethylbenzene
- Xylenes
- TCE.

No chemicals were identified in soil or groundwater at the site that exceed risk-screening levels for excavation or construction workers.

3.0 ORGANIZATION AND COORDINATION

3.1 Site Personnel/Team Organization

The team listed below assumes that HAI will be conducting the work, and that this work may occur in the near future. If another consultant is retained to manage the proposed remedial action, or if HAI personnel change, then the team listed below will need to be modified.

Team Member	Responsibility	Work Zone(s)
Roger Brown	HAI Project Supervisor	All
Eleanore Ramsey	HAI Health and Safety Officer	All
Jane-Clair Kerin	HAI Field Team Leader, Site Safety Coordinator	All
Field Team	Conduct field activities	All

3.2 Work Team Job Functions

Project Supervisor	Overall project management, HASP preparation and implementation
Health and Safety Officer	Administer HAI's Company Health and Safety Program and prepare accident reports
Site Safety Coordinator	Carry out all aspects of HASP in the field, ensure all HAI employees and subcontractors adhere to HASP
Field Team Leader	Supervise field effort, obtain samples, air monitoring, logging
Field Team Member(s)	Drilling, surveying, excavating

All personnel arriving or departing the site should log in and out with the Site Safety Coordinator. All activities on site must be cleared through the Field Team Leader.

4.0 SITE CONTROL

1) Conduct a daily site safety meeting to discuss each day's planned activities and review the HASP, particularly communications. Additional topics should include:

    a) Location of nearest telephone and posting of the emergency telephone numbers.

    b) Location of nearest hospital and post the location.

    c) Designation and location of emergency vehicle and location of operating keys.

    d) Day's weather report and weather conditions, in particular wind direction.

    e) A discussion of any unexpected conditions/hazards (windy conditions, etc.).

    f) Determine location of support zone and decontamination area.

    g) A discussion of work zones and any necessary modifications to levels of protection required.

    h) Review emergency site egress point(s).

2) Maintain access to the site and exclusion zones during the project duration. Exclusion zones should be developed and maintained during the work activities.

3) Team members don specified level of protection prior to entering any temporary exclusion zone. The entire decontamination process will be conducted prior to exiting.

5.0 HAZARD EVALUATION

There are two general forms of hazards possible at the site: 1) physical hazards; and 2) chemical hazards.

5.1 Physical Hazards

Physical hazards include heavy equipment, vehicles, utilities (overhead and underground), hazards such as slip, trip, and fall, and around surface water bodies. It is expected that all of these hazards will be present at the site. Personnel at the site should remain aware of such hazards at all times.

5.2 Chemical Hazards

Hazardous substances have been identified to be present in soil and groundwater at the site (Section 2.2). Based on risk assessment, the previously detected concentrations of chemicals at the site would not present unacceptable risks to personnel conducting site investigation and/or remedial action activities. However, unexpected higher concentrations of chemicals could potentially be encountered during the proposed soil removal activities at the site.

In general, primary exposure routes for the identified COIs include dermal contact, incidental oral ingestion of contaminant-laden soils and/or dust (collectively "direct contact"), and/or inhalation of vapors or dust.

Primary chemicals of potential concern (COPCs), that is those that would most-likely present a possible hazard to workers via direct contact or inhalation if found at higher levels, include those listed in the following table. Also listed in the table is the OSHA Permissible Exposure Limit (PEL) time-weighted average (TWA).

COPC	**PEL TWA** (mg/m^3)
Ethylbenzene	435. (100 ppm)
Xylenes	435. (100 ppm)
Tetrachloroethene (PCE)	678. (100 ppm)
Trichloroethene (TCE)	537. (100 ppm)

NIOSH guides to chemical hazards or material safety data sheets (MSDS) for the above chemicals of potential concern are included in Attachment A1. For a summary of symptoms via exposure routes for primary constituents refer to Attachment A1.

5.3 Hazard Zone Delineation

Physical hazards are of concern across the entire site and chemical hazards are of potential concern at the specific areas to be investigated. Accordingly, the entire site is considered to warrant Level D personal protective equipment (PPE).

6.0 PERSONAL PROTECTIVE EQUIPMENT

6.1 Basic Equipment and Levels of Protection

Level D: Work coveralls, steel toe/shank boots, safety glasses, hearing protection, hard hat, and high-visibility traffic vest.

Level D Plus: Level D plus Tyvek suits and/or chemical resistant disposable gloves during soil or groundwater sampling activities.

Level C: Level D plus dust-resistant Tyvek coveralls, disposable nitrile or vinyl gloves, half-face respirator with appropriate cartridge

HAI does not conduct work in Level A or Level B environments.

Level D PPE can be used when the atmosphere contains no known hazard; oxygen concentrations are not less than 19.5%; and work functions preclude splashes, immersion, or the potential for unexpected inhalation of a contact with hazardous levels of chemicals.

Level C PPE can be used when oxygen concentrations are not less than 19.5 %; atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any exposed skin; types of air contaminants have been identified, concentrations measured, and a cartridge or canister is available that can remove the contaminant; atmospheric contaminant concentrations do not exceed immediately dangerous to life and health (IDLH) levels; and job functions do not require self-contained breathing apparatus.

Modification of Level C PPE equipment will be the decision of the Site Safety Coordinator.

6.2 Applicability of Basic PPE and Safety Equipment

Zone	Level of Protection/PPE	Other Safety Equipment
All Areas	Level D	Emergency vehicle, first aid kit, blanket, fire extinguisher, mobile telephone, drinking water
Exclusion Zone, Contamination-Reduction Zone, Decontamination Line	Level D Plus	As above, plus decontamination water, eyewash, tape, chemical resistant gloves during sampling
Exclusion Zone, Contamination-Reduction Zone, Decontamination Line	Level C (if deemed necessary)	As above

Field screening of soil samples and monitoring the breathing zone around boreholes will be used to evaluate the need for upgrading PPE at the site as follows:

- In the event field screening indicates the presence of possible volatile environmental contamination, the breathing zone will be monitored for the presence of volatile vapors utilizing a Photovac MicroTip equipped with a photoionization detector and a 10.6 electron volt (eV) lamp.

- If concentrations of volatile vapors are detected in the breathing zone at total concentrations greater than 10 ppm for two consecutive

readings, the concentrations of ethylbenzene, xylenes, PCE, and TCE will be measured with a multistroke gas sampling pump.

- If ethylbenzene, xylenes, PCE, and/or TCE are identified at a concentration that exceeds 10% of the PEL TWA of 100 parts per million (ppm) (i.e. 10 ppm), then work will stop and the PPE will be upgraded to Level C, with organic vapor cartridges.

- If visible dust is observed that is the result of excavation within a zone of possible soil contamination, then dust control measures will be implemented, such as misting the air or wetting the soil. If dust control measures are not successful at eliminating visible dust, then work will stop and the PPE will be upgraded to Level C, with HEPA cartridges.

7.0 COMMUNICATION PROCEDURES

1) Daily Procedures

    a) Prior to beginning daily field activities, a tailgate meeting will be held in the Support/Clean zone to review project status, work objectives, zone delineation, present site conditions, levels of protection, individual team member responsibilities, access and egress points, and decontamination procedures.

2) Field Communication Procedures

    a) Field activities will be directed using oral communications with appropriate hand signals to be used.

    b) A minimum of one cellular phone will be on-site during all field activities and will be designated as the field phone for use by team members.

8.0 DECONTAMINATION PROCEDURES

1) Decontamination Procedures (for personnel, equipment, meters, samples, etc.):

    a) Personnel: Remove gloves and discard.

    b) Equipment: All drilling equipment will be steam-cleaned between drilling locations to prevent cross-contamination between borings. All soil sampling equipment will be decontaminated after each sample by using a detergent solution wash, followed by two potable water rinses.

2) Material Disposal Methods

    a) Contaminated Articles: Disposable personnel protective equipment and sampling equipment will be placed in plastic bags and disposed as solid waste. Bags of soiled equipment will not be accessible to the public prior to disposal (to eliminate scavenging of these articles).

    b) All soil cuttings from borings will be placed in 55-gallon drums or secure containment and characterized to determine appropriate disposal.

    c) All drilling decontamination and/or purge water will be placed in 55-gallon drums or secure containment and characterized to determine appropriate disposal.

Note: It is the responsibility of the Site Safety Coordinator to make sure that all pieces of equipment coming off site are properly decontaminated according to the procedures outlined above.

9.0 SITE SAFETY AND HEALTH

9.1 Designated Site Health and Safety Officers

The team listed below assumes that HAI will be conducting the work, and that this work may occur in the near future. If another consultant is retained to manage the proposed remedial action, or if HAI personnel change, then the team listed below will need to be modified.

HAI Project Supervisor Roger Brown, Principal (503) 796-0717 rogerb@hahnenv.com	HAI Corporate Management Roger Brown, Vice President (503) 796-0717 rogerb@hahnenv.com
HAI Health and Safety Officer Eleanore Ramsey, Sr. Environmental Scientist (503) 796-0717 elnr@hahnenv.com	HAI Site Safety Coordinator Jane-Clair Kerin, Sr. Environmental Scientist (503) 796-0717 janek@hahnenv.com

HAI Mailing Address:
Hahn and Associates, Inc.
434 NW 6th Avenue, Suite 203
Portland, Oregon 97209

(503) 796-0717 (phone)
(503) 227-2209 (fax)

9.2 Emergency Medical Care

Entity	Phone and/or Address
Police	911
Fire	911
Paramedic	911
Hospital	Providence Milwaukie Hospital 10150 SE 32nd Avenue (503) 513-8300 Contact: Emergency

Poison Control Center	Oregon Poison Center (503) 494-8968

9.3 Environmental Monitoring

It is not anticipated environmental monitoring will be necessary for the work activities at the site, unless field screening (visual, odor, sheen test, or vapor headspace) suggest otherwise. Based on the contaminant routes of exposure, it is expected that Level D PPE will be protective of site workers. If field screening indicates the presence of environmental contamination, then environmental monitoring will be implemented as per Section 6.2.

9.4 Work Limitations

1) Work will be performed only during daylight hours unless adequate lighting is provided.

2) No eating, drinking, or smoking within contamination zones.

3) No facial hair is acceptable that would interfere with respirator fit.

4) No contact lenses on site.

9.5 Emergency Procedures

1) Basic Procedures

   a) Stabilize injured person and remove from contamination zone, following the decontamination procedures as much as practicable

   b) Notify the Site Safety Coordinator

   c) The Site Safety Coordinator will direct activities during a medical emergency.

   d) Initiate first aid and immediately get medical attention for the injured party.

   e) Depending upon the type and severity of the injury, call the appropriate emergency response agency.

f) Notify the health and safety officer and HAI Corporate Management.

g) Prepare an incident report. The HAI Health and Safety Officer is responsible for ensuring its preparation and submittal to HAI Corporate Management within 48 hours

2) Site-specific Instructions

a) Acute exposure to hazardous materials:

i) Dermal: Wash exposed skin areas with clean water and reassess personnel protective equipment to include adequate splash protection. Call physician when exposure is suspected.

ii) Eye: Wash eye for 15 minutes with clean water and get immediate medical attention. Do not delay eyewash for any reason.

iii) Inhalation: Move exposed person to fresh air at once. If breathing has stopped, perform mouth-to-mouth resuscitation. Keep the affected person warm and at rest. Get medical attention as soon as possible.

3) Directions to Hospital
See map in Attachment A2 for directions from the site to the hospital.

10.0 PLAN APPROVAL

This Site Health and Safety Plan has been written for the use of HAI, its employees, and subcontractors. HAI claims no responsibility for its use by others. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if these conditions change.

Hahn and Associates, Inc.

Reviewed by:

Roger E. Brown, R.G.
Principal

Distribution of plan:
HAI Project Manager
Site Safety Coordinator

11.0 SIGNATURES

All site personnel have read the above plan, are familiar with its provisions, and will sign below prior to initiating work at the site each day.

NAME	SIGNATURE	COMPANY	DATE

12.0 GLOSSARY OF ABBREVIATIONS

COI	chemical of interest
COPC	chemical of potential concern
CFR	Code of Federal Regulations
HAI	Hahn and Associates, Inc.
mg/m^3	milligrams per cubic meter
MSDS	material safety data sheets
OEL	Occupational Exposure Level
OSHA	Occupational Safety and Health Administration
PCE	tetrachloroethene
PEL	Permissible Exposure Limit
PPE	personal protective equipment
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
TCE	trichloroethene
TWA	time-weighted average

ATTACHMENT A1

Summary of Chemical Hazards

NIOSH Publication 2005-149 **September 2005**

NIOSH Pocket Guide to Chemical Hazards

NPG Home | Introduction | Synonyms & Trade Names | Chemical Names | CAS Numbers | RTECS Numbers | Appendices | Search

Gasoline

CAS 8006-61-9

RTECS LX3300000

Synonyms & Trade Names
Motor fuel, Motor spirits, Natural gasoline, Petrol [Note: A complex mixture of volatile hydrocarbons (paraffins, cycloparaffins & aromatics).]

DOT ID & Guide
1203 128

Exposure Limits
NIOSH REL: Ca See Appendix A
OSHA PEL†: none

IDLH Ca [N.D.] See: IDLH INDEX

Conversion 1 ppm = 4.5 mg/m^3 (approx)

Physical Description
Clear liquid with a characteristic odor.

MW: 110 (approx)	BP: 102°F	FRZ: ?	Sol: Insoluble
VP: 38-300 mmHg	IP: ?		Sp.Gr(60°F): 0.72-0.76
Fl.P: -45°F	UEL: 7.6%	LEL: 1.4%	

Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.

Incompatibilities & Reactivities
Strong oxidizers such as peroxides, nitric acid & perchlorates

Measurement Methods
OSHA PV2028
See: NMAM or OSHA Methods

Personal Protection & Sanitation (See protection codes)
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet (flammable)
Change: No recommendation
Provide: Eyewash, Quick drench

First Aid (See procedures)
Eye: Irrigate immediately
Skin: Soap flush immediately
Breathing: Respiratory support
Swallow: Medical attention immediately

Respirator Recommendations NIOSH
At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus
Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus
Important additional information about respirator selection

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms Irritation eyes, skin, mucous membrane; dermatitis; headache, lassitude (weakness, exhaustion), blurred vision, dizziness, slurred speech, confusion, convulsions; chemical pneumonitis (aspiration liquid); possible liver, kidney damage; [potential occupational carcinogen]

Target Organs Eyes, skin, respiratory system, central nervous system, liver, kidneys

Cancer Site [in animals: liver & kidney cancer]

See also: INTRODUCTION

NIOSH Home | NIOSH Search | Site Index | Topic List | Contact Us

NIOSH Publication 2005-149 **September 2005**

NIOSH Pocket Guide to Chemical Hazards

NPG Home | Introduction | Synonyms & Trade Names | Chemical Names | CAS Numbers | RTECS Numbers | Appendices | Search

Ethyl benzene

CAS 100-41-4

$CH_3CH_2C_6H_5$

RTECS DA0700000

Synonyms & Trade Names
Ethylbenzol, Phenylethane

DOT ID & Guide
1175 130

Exposure Limits

NIOSH REL: TWA 100 ppm (435 mg/m^3) ST 125 ppm (545 mg/m^3)

OSHA PEL†: TWA 100 ppm (435 mg/m^3)

IDLH 800 ppm [10%LEL] See: 100414

Conversion 1 ppm = 4.34 mg/m^3

Physical Description
Colorless liquid with an aromatic odor.

MW: 106.2	BP: 277°F	FRZ: -139°F	Sol: 0.01%
VP: 7 mmHg	IP: 8.76 eV		Sp.Gr: 0.87
Fl.P: 55°F	UEL: 6.7%	LEL: 0.8%	

Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.

Incompatibilities & Reactivities
Strong oxidizers

Measurement Methods
NIOSH 1501; OSHA 7, 1002
See: NMAM or OSHA Methods

Personal Protection & Sanitation (See protection codes)
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet (flammable)
Change: No recommendation

First Aid (See procedures)
Eye: Irrigate immediately
Skin: Water flush promptly
Breathing: Respiratory support
Swallow: Medical attention immediately

Respirator Recommendations NIOSH/OSHA
Up to 800 ppm:
(APF = 10) Any chemical cartridge respirator with organic vapor cartridge(s)*
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
(APF = 25) Any powered, air-purifying respirator with organic vapor cartridge(s)*
(APF = 10) Any supplied-air respirator*
(APF = 50) Any self-contained breathing apparatus with a full facepiece
Emergency or planned entry into unknown concentrations or IDLH conditions:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus
Important additional information about respirator selection

Exposure Routes inhalation, ingestion, skin and/or eye contact

Symptoms Irritation eyes, skin, mucous membrane; headache; dermatitis; narcosis, coma

Target Organs Eyes, skin, respiratory system, central nervous system

See also: INTRODUCTION See ICSC CARD: 0268 See MEDICAL TESTS: 0098

NIOSH Publication 2005-149 **September 2005**

NIOSH Pocket Guide to Chemical Hazards

NPG Home | Introduction | Synonyms & Trade Names | Chemical Names | CAS Numbers | RTECS Numbers | Appendices | Search

m-Xylene

CAS 108-38-3

$C_6H_4(CH_3)_2$

RTECS ZE2275000

Synonyms & Trade Names
1,3-Dimethylbenzene; meta-Xylene; m-Xylol

DOT ID & Guide
1307 130

Exposure Limits

NIOSH REL: TWA 100 ppm (435 mg/m^3) ST 150 ppm (655 mg/m^3)

OSHA PEL†: TWA 100 ppm (435 mg/m^3)

IDLH 900 ppm See: 95476

Conversion 1 ppm = 4.34 mg/m^3

Physical Description
Colorless liquid with an aromatic odor.

MW: 106.2	BP: 282°F	FRZ: -54°F	Sol: Slight
VP: 9 mmHg	IP: 8.56 eV		Sp.Gr: 0.86
Fl.P: 82°F	UEL: 7.0%	LEL: 1.1%	

Class IC Flammable Liquid: Fl.P. at or above 73°F and below 100°F.

Incompatibilities & Reactivities
Strong oxidizers, strong acids

Measurement Methods
NIOSH 1501, 3800; OSHA 1002
See: NMAM or OSHA Methods

Personal Protection & Sanitation (See protection codes)
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet (flammable)
Change: No recommendation

First Aid (See procedures)
Eye: Irrigate immediately
Skin: Soap wash promptly
Breathing: Respiratory support
Swallow: Medical attention immediately

Respirator Recommendations NIOSH/OSHA
Up to 900 ppm:
(APF = 10) Any chemical cartridge respirator with organic vapor cartridge(s)*
(APF = 25) Any powered, air-purifying respirator with organic vapor cartridge(s)*
(APF = 10) Any supplied-air respirator*
(APF = 50) Any self-contained breathing apparatus with a full facepiece
Emergency or planned entry into unknown concentrations or IDLH conditions:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus
Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any

appropriate escape-type, self-contained breathing apparatus
Important additional information about respirator selection

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms Irritation eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis

Target Organs Eyes, skin, respiratory system, central nervous system, gastrointestinal tract, blood, liver, kidneys

See also: INTRODUCTION See ICSC CARD: 0085 See MEDICAL TESTS: 0243

NIOSH Publication 2005-149 **September 2005**

NIOSH Pocket Guide to Chemical Hazards

NPG Home | Introduction | Synonyms & Trade Names | Chemical Names | CAS Numbers | RTECS Numbers | Appendices | Search

o-Xylene

CAS 95-47-6

$C_6H_4(CH_3)_2$

RTECS ZE2450000

Synonyms & Trade Names
1,2-Dimethylbenzene; ortho-Xylene; o-Xylol

DOT ID & Guide
1307 130

Exposure Limits

NIOSH REL: TWA 100 ppm (435 mg/m^3) ST 150 ppm (655 mg/m^3)

OSHA PEL†: TWA 100 ppm (435 mg/m^3)

IDLH 900 ppm See: 95476

Conversion 1 ppm = 4.34 mg/m^3

Physical Description
Colorless liquid with an aromatic odor.

MW: 106.2	BP: 292°F	FRZ: -13°F	Sol: 0.02%
VP: 7 mmHg	IP: 8.56 eV		Sp.Gr: 0.88
Fl.P: 90°F	UEL: 6.7%	LEL: 0.9%	

Class IC Flammable Liquid: Fl.P. at or above 73°F and below 100°F.

Incompatibilities & Reactivities
Strong oxidizers, strong acids

Measurement Methods
NIOSH 1501, 3800; OSHA 1002
See: NMAM or OSHA Methods

Personal Protection & Sanitation (See protection codes)
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet (flammable)
Change: No recommendation

First Aid (See procedures)
Eye: Irrigate immediately
Skin: Soap wash promptly
Breathing: Respiratory support
Swallow: Medical attention immediately

Respirator Recommendations NIOSH/OSHA
Up to 900 ppm:
(APF = 10) Any chemical cartridge respirator with organic vapor cartridge(s)*
(APF = 25) Any powered, air-purifying respirator with organic vapor cartridge(s)*
(APF = 10) Any supplied-air respirator*
(APF = 50) Any self-contained breathing apparatus with a full facepiece
Emergency or planned entry into unknown concentrations or IDLH conditions:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus
Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any

appropriate escape-type, self-contained breathing apparatus
Important additional information about respirator selection

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms Irritation eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis

Target Organs Eyes, skin, respiratory system, central nervous system, gastrointestinal tract, blood, liver, kidneys

See also: INTRODUCTION See ICSC CARD: 0084 See MEDICAL TESTS: 0243

NIOSH Home | NIOSH Search | Site Index | Topic List | Contact Us

NIOSH Publication 2005-149 **September 2005**

NIOSH Pocket Guide to Chemical Hazards

NPG Home | Introduction | Synonyms & Trade Names | Chemical Names | CAS Numbers | RTECS Numbers | Appendices | Search

p-Xylene

CAS 106-42-3

$C_6H_4(CH_3)_2$

RTECS ZE2625000

Synonyms & Trade Names
1,4-Dimethylbenzene; para-Xylene; p-Xylol

DOT ID & Guide
1307 130

Exposure Limits

NIOSH REL: TWA 100 ppm (435 mg/m^3) ST 150 ppm (655 mg/m^3)

OSHA PEL†: TWA 100 ppm (435 mg/m^3)

IDLH 900 ppm See: 95476

Conversion 1 ppm = 4.41 mg/m^3

Physical Description
Colorless liquid with an aromatic odor. [Note: A solid below 56°F.]

MW: 106.2	BP: 281°F	FRZ: 56°F	Sol: 0.02%
VP: 9 mmHg	IP: 8.44 eV		Sp.Gr: 0.86
Fl.P: 81°F	UEL: 7.0%	LEL: 1.1%	

Class IC Flammable Liquid: Fl.P. at or above 73°F and below 100°F.

Incompatibilities & Reactivities
Strong oxidizers, strong acids

Measurement Methods
NIOSH 1501, 3800; OSHA 1002
See: NMAM or OSHA Methods

Personal Protection & Sanitation (See protection codes)
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet (flammable)
Change: No recommendation

First Aid (See procedures)
Eye: Irrigate immediately
Skin: Soap wash promptly
Breathing: Respiratory support
Swallow: Medical attention immediately

Respirator Recommendations NIOSH/OSHA
Up to 900 ppm:
(APF = 10) Any chemical cartridge respirator with organic vapor cartridge(s)*
(APF = 25) Any powered, air-purifying respirator with organic vapor cartridge(s)*
(APF = 10) Any supplied-air respirator*
(APF = 50) Any self-contained breathing apparatus with a full facepiece
Emergency or planned entry into unknown concentrations or IDLH conditions:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus
Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any

appropriate escape-type, self-contained breathing apparatus
Important additional information about respirator selection

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms Irritation eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis

Target Organs Eyes, skin, respiratory system, central nervous system, gastrointestinal tract, blood, liver, kidneys

See also: INTRODUCTION See ICSC CARD: 0086 See MEDICAL TESTS: 0243

NIOSH Publication 2005-149 **September 2005**

NIOSH Pocket Guide to Chemical Hazards

NPG Home | Introduction | Synonyms & Trade Names | Chemical Names | CAS Numbers | RTECS Numbers | Appendices | Search

1,2,4-Trimethylbenzene

CAS 95-63-6

$C_6H_3(CH_3)_3$

RTECS DC3325000

Synonyms & Trade Names
Asymmetrical trimethylbenzene, psi-Cumene, Pseudocumene [Note: hemimellitene is a mixture of the 1,2,3-isomer with up to 10% of related aromatics such as the 1,2,4-isomer.]

DOT ID & Guide

Exposure Limits

NIOSH REL: TWA 25 ppm (125 mg/m^3)

OSHA PEL†: none

IDLH N.D. See: IDLH INDEX

Conversion 1 ppm = 4.92 mg/m^3

Physical Description
Clear, colorless liquid with a distinctive, aromatic odor.

MW: 120.2	BP: 337°F	FRZ: -77°F	Sol: 0.006%
VP(56°F): 1 mmHg	IP: 8.27 eV		Sp.Gr: 0.88
Fl.P: 112°F	UEL: 6.4%	LEL: 0.9%	

Class II Flammable Liquid

Incompatibilities & Reactivities
Oxidizers, nitric acid

Measurement Methods
OSHA PV2091
See: NMAM or OSHA Methods

Personal Protection & Sanitation (See protection codes)
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet or contaminated
Change: No recommendation

First Aid (See procedures)
Eye: Irrigate immediately
Skin: Soap wash
Breathing: Respiratory support
Swallow: Medical attention immediately

Respirator Recommendations Not available.
Important additional information about respirator selection

Exposure Routes inhalation, ingestion, skin and/or eye contact

Symptoms Irritation eyes, skin, nose, throat, respiratory system; bronchitis; hypochromic anemia; headache, drowsiness, fatigue, dizziness, nausea, incoordination; vomiting, confusion; chemical pneumonitis (aspiration liquid)

Target Organs Eyes, skin, respiratory system, central nervous system, blood

See also: INTRODUCTION See ICSC CARD: 1433

NIOSH Publication 2005-149 September 2005

NIOSH Pocket Guide to Chemical Hazards

NPG Home | Introduction | Synonyms & Trade Names | Chemical Names | CAS Numbers | RTECS Numbers | Appendices | Search

1,3,5-Trimethylbenzene

CAS 108-67-8

$C_6H_3(CH_3)_3$

RTECS OX6825000

Synonyms & Trade Names
Mesitylene, Symmetrical trimethylbenzene, sym-Trimethylbenzene

DOT ID & Guide
2325 129

Exposure Limits

NIOSH REL: TWA 25 ppm (125 mg/m^3)

OSHA PEL†: none

IDLH N.D. See: IDLH INDEX

Conversion 1 ppm = 4.92 mg/m^3

Physical Description
Clear, colorless liquid with a distinctive, aromatic odor.

MW: 120.2	BP: 329°F	FRZ: -49°F	Sol: 0.002%
VP: 2 mmHg	IP: 8.39 eV		Sp.Gr: 0.86
Fl.P: 122°F	UEL: ?	LEL: ?	

Class II Flammable Liquid

Incompatibilities & Reactivities
Oxidizers, nitric acid

Measurement Methods
OSHA PV2091
See: NMAM or OSHA Methods

Personal Protection & Sanitation (See protection codes)
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet or contaminated
Change: No recommendation

First Aid (See procedures)
Eye: Irrigate immediately
Skin: Soap wash
Breathing: Respiratory support
Swallow: Medical attention immediately

Respirator Recommendations Not available.
Important additional information about respirator selection

Exposure Routes inhalation, ingestion, skin and/or eye contact

Symptoms Irritation eyes, skin, nose, throat, respiratory system; bronchitis; hypochromic anemia; headache, drowsiness, lassitude (weakness, exhaustion), dizziness, nausea, incoordination; vomiting, confusion; chemical pneumonitis (aspiration liquid)

Target Organs Eyes, skin, respiratory system, central nervous system, blood

See also: INTRODUCTION See ICSC CARD: 1155

NIOSH Publication 2005-149 **September 2005**

NIOSH Pocket Guide to Chemical Hazards

NPG Home | Introduction | Synonyms & Trade Names | Chemical Names | CAS Numbers | RTECS Numbers | Appendices | Search

Tetrachloroethylene

CAS 127-18-4

$Cl_2C=CCl_2$

RTECS KX3850000

Synonyms & Trade Names
Perchlorethylene, Perchloroethylene, Perk, Tetrachlorethylene

DOT ID & Guide
1897 160

Exposure Limits

NIOSH REL: Ca Minimize workplace exposure concentrations. See Appendix A

OSHA PEL†: †: TWA 100 ppm
C 200 ppm (for 5 minutes in any 3-hour period), with a maximum peak of 300 ppm

IDLH Ca [150 ppm] See: 127184

Conversion 1 ppm = 6.78 mg/m^3

Physical Description
Colorless liquid with a mild, chloroform-like odor.

MW: 165.8	BP: 250°F	FRZ: -2°F	Sol: 0.02%
VP: 14 mmHg	IP: 9.32 eV		Sp.Gr: 1.62
Fl.P: NA	UEL: NA	LEL: NA	

Noncombustible Liquid, but decomposes in a fire to hydrogen chloride and phosgene.

Incompatibilities & Reactivities
Strong oxidizers; chemically-active metals such as lithium, beryllium & barium; caustic soda; sodium hydroxide; potash

Measurement Methods
NIOSH 1003; OSHA 1001
See: NMAM or OSHA Methods

Personal Protection & Sanitation (See protection codes)
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet or contaminated
Change: No recommendation
Provide: Eyewash, Quick drench

First Aid (See procedures)
Eye: Irrigate immediately
Skin: Soap wash promptly
Breathing: Respiratory support
Swallow: Medical attention immediately

Respirator Recommendations NIOSH
At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus
Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus
Important additional information about respirator selection

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms Irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen]

Target Organs Eyes, skin, respiratory system, liver, kidneys, central nervous system

Cancer Site [in animals: liver tumors]

See also: INTRODUCTION See ICSC CARD: 0076 See MEDICAL TESTS: 0179

NIOSH Home | NIOSH Search | Site Index | Topic List | Contact Us

NIOSH Publication 2005-149 **September 2005**

NIOSH Pocket Guide to Chemical Hazards

NPG Home | Introduction | Synonyms & Trade Names | Chemical Names | CAS Numbers | RTECS Numbers | Appendices | Search

Trichloroethylene

CAS 79-01-6

$ClCH=CCl_2$

RTECS KX4550000

Synonyms & Trade Names
Ethylene trichloride, TCE, Trichloroethene, Trilene

DOT ID & Guide
1710 160

Exposure Limits

NIOSH REL: Ca See Appendix A See Appendix C

OSHA PEL†: TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 2 hours)

IDLH Ca [1000 ppm] See: 79016

Conversion 1 ppm = 5.37 mg/m^3

Physical Description
Colorless liquid (unless dyed blue) with a chloroform-like odor.

MW: 131.4	BP: 189°F	FRZ: -99°F	Sol(77°F): 0.1%
VP: 58 mmHg	IP: 9.45 eV		Sp.Gr: 1.46
Fl.P: ?	UEL(77°F): 10.5%	LEL(77°F): 8%	

Combustible Liquid, but burns with difficulty.

Incompatibilities & Reactivities
Strong caustics & alkalis; chemically-active metals (such as barium, lithium, sodium, magnesium, titanium & beryllium)

Measurement Methods
NIOSH 1022, 3800; OSHA 1001
See: NMAM or OSHA Methods

Personal Protection & Sanitation (See protection codes)
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet or contaminated
Change: No recommendation
Provide: Eyewash, Quick drench

First Aid (See procedures)
Eye: Irrigate immediately
Skin: Soap wash promptly
Breathing: Respiratory support
Swallow: Medical attention immediately

Respirator Recommendations NIOSH
At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus
Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus
Important additional information about respirator selection

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms Irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen]

Target Organs Eyes, skin, respiratory system, heart, liver, kidneys, central nervous system

Cancer Site [in animals: liver & kidney cancer]

See also: INTRODUCTION See ICSC CARD: 0081 See MEDICAL TESTS: 0236

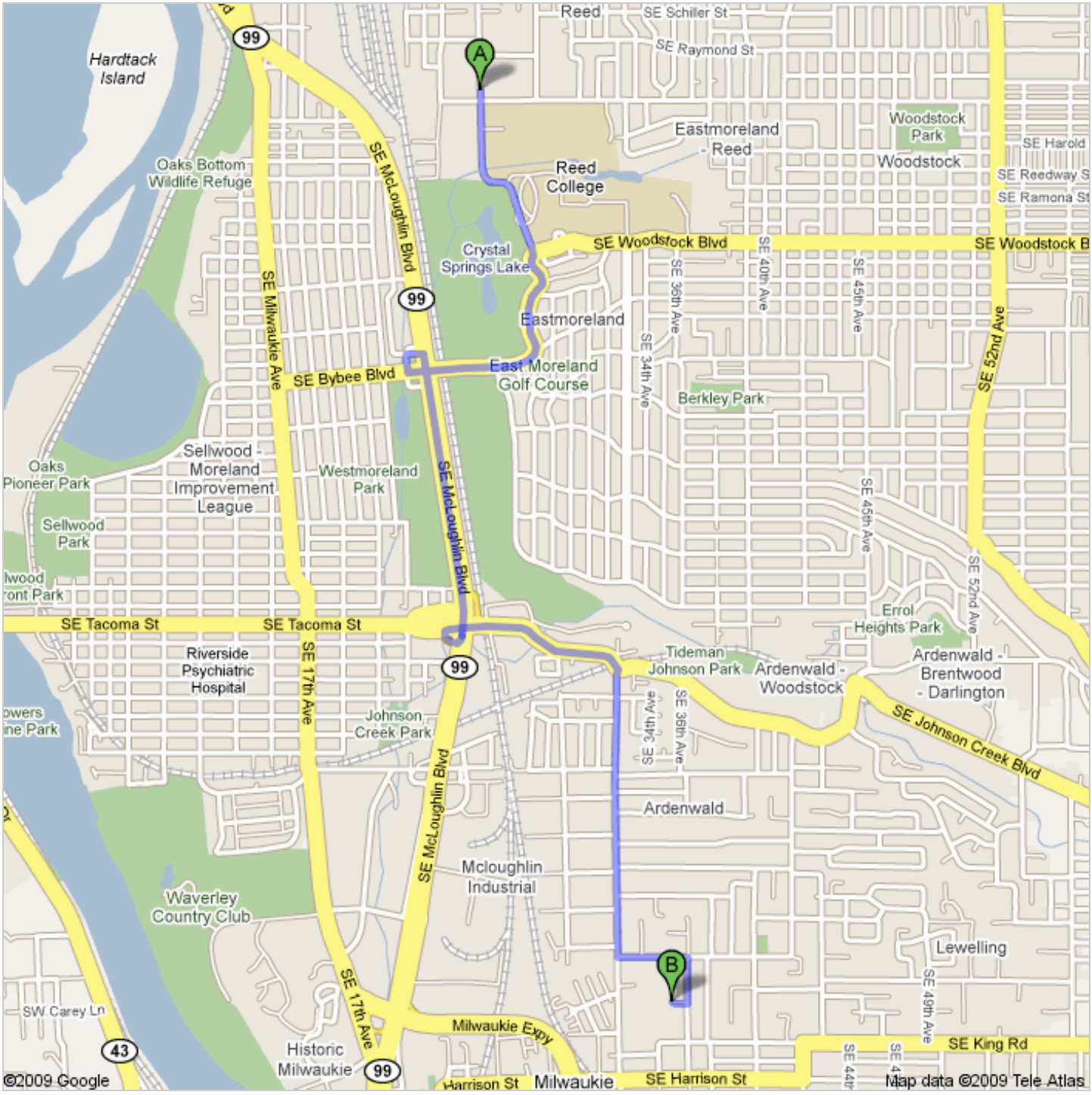
NIOSH Home | NIOSH Search | Site Index | Topic List | Contact Us

ATTACHMENT A2

Hospital Location Map

Google maps

Directions to Providence Milwaukie Hospital
10150 SE 32nd Ave, Milwaukie, OR 97222 - (503) 513-8300
3.7 mi – about **10 mins**



5216 SE 28th Ave, Portland, OR 97202

	1. Head **south** on **SE 28th Ave** toward **SE Steele St** About 1 min	go 0.5 mi total 0.5 mi
	2. Slight **right** to stay on **SE 28th Ave** About 2 mins	go 0.3 mi total 0.8 mi
	3. Slight **right** at **SE Tolman St**	go 407 ft total 0.9 mi
	4. Slight **right** at **SE Bybee Blvd**	go 0.3 mi total 1.1 mi
	5. Turn **right** at **SE 23rd Ave**	go 249 ft total 1.2 mi
	6. Turn **right** at **SE Glenwood St**	go 240 ft total 1.2 mi
99	7. Turn **right** at **SE McLoughlin Blvd/OR-99e** About 2 mins	go 0.8 mi total 2.0 mi
	8. Exit onto **SE Tacoma St** About 1 min	go 0.5 mi total 2.6 mi
	9. Slight **right** at **SE 32nd Ave**	go 190 ft total 2.6 mi
	10. Turn **right** to stay on **SE 32nd Ave** About 2 mins	go 0.8 mi total 3.4 mi
	11. Turn **left** at **SE Harvey St**	go 0.2 mi total 3.6 mi
	12. Turn **right** at **SE 36th Ave**	go 0.1 mi total 3.7 mi
	13. Turn **right** at **SE Dwyer Dr**	go 220 ft total 3.7 mi

Providence Milwaukie Hospital
10150 SE 32nd Ave, Milwaukie, OR 97222 - (503) 513-8300

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.