XAVIER ENVIRONMENTAL

CCB # 150811 DEQ# 16702

December 28, 2009

Robert Medici
5031 SW Richardson Drive
Portland, OR 97239

RE: UST Decommissioning and Complex Soil-Only Risk-Based Cleanup
5031 SW Richardson Drive in Portland
DEQ File 26-09-1047

Dear Mr. Medici:

On June 10, 2009, Xavier Environmental, Inc. (XEI) dispatched Bob Brown to the referenced site to conduct a limited subsurface investigation. The purpose of the investigation was to further define the magnitude and vertical extent of the heating oil in the soil underlying the active 675-gallon UST, which is located under the front brick patio beneath roof overhangs, a front landing, and a window well, as indicated in the attached site plan. The remaining product was transferred into an aboveground storage tank after Universal Applicators had previously sampled the UST on May 21, 2009. XEI's samples were collected within six (6) inches of the UST's south end at a depth of 94 inches and 10, 14, and 17 feet below ground surface (BGS). The soil at these depths consisted of slightly sandy and micaceous silt.

Due to the elevated hydrocarbon concentration in these samples, additional work was conducted on-site on the following dates:

- June 17, 2009, collected a subslab air sample in the daylight basement
- August 18, 2009, uncovered and decommissioned the UST by cleaning its interior and removing its top and bottom,

- September 16, 2009, Mark Norbury collected center pit profile samples at 10 and 14 feet BGS, installed the infiltration gallery, and added oil-degrading microbes,
- November 9, 2009, John Harding removed the infiltration gallery and collected profile samples from the excavation's center and south end at eight (8), 10, and 14 feet BGS,
- November 20, 2009, collected a second subslab air sample from the same location as the first sample,
- December 21, 2009, backfilled the excavation, and
- December 22, 2009, collected lateral delineation samples.

Groundwater was not encountered in the deepest soil sample collected beneath the tankhold floor from slightly sand silt at 17 feet BGS. Beyond the excavation and plume in the downgradient direction, a geoprobe was advanced to 16 feet BGS (26 feet BGS relative to the UST) in slightly sandy silt and groundwater was not present in the hole after 24 hours. A total of 17 soil and two (2) air samples were collected to complete this closure. The additional soil samples came from native soil beneath and beyond the excavation to define the areal extent of the plume. Each soil sample was placed into a clean, pre-labeled glass jar and sealed with a Teflon®-lined lid. These samples were entered into a chain-of-custody (COC) and chilled pending transport to the analytical laboratory. Apex Laboratories (Apex) and Air Toxics LTD performed the required analyses within the Method holding times. Sample locations are illustrated in the attached figure.

Mssrs. Brown, Norbury, and Harding are licensed through the Oregon Department of Environmental Quality (DEQ) to perform these types of services under DEQ Heating Oil Tank (HOT) Services Supervisor license numbers 26532, 18070, and 18869, respectively. DEQ licenses XEI to conduct tank and related environmental services by way of HOT Services Provider license number 16702 and Construction Contractor's Board license number 150811.

SOURCES

Heating oil consists of a complex mixture of hydrocarbons produced by crude oil distillation. The principal constituents are C_{10} through C_{20} alkanes (mid-range distillates) with some aromatics. Consequently, Apex analyzed the soil samples to determine the concentrations of diesel-range total petroleum hydrocarbon (TPH), benzene, toluene, ethylbenzene, and xylenes (BTEX), and polynuclear aromatic hydrocarbons using DEQ Method NWTPH-Dx, EPA Method 8260B, and 8270-C SIM, respectively. The air samples were analyzed for benzene, ethylbenzene, naphthalene, TPH-D, and 2-propanol. Results of the laboratory analyses, reported in parts per million (ppm) for soil and micrograms per cubic meter (ug/m^3) for air, are summarized in the following tables. Analytical laboratory reports and their COCs are attached.

TABLE 1
SUMMARY OF SOIL TPH DIESEL DATA
DEQ METHOD NWTPH-Dx (ppm)
Method Detection Limit = "<" mg/Kg

Sample Identification		Sample Date	TPH
Universal Applicators Samples			
B1-N-94	(Below the north end of the UST, at 7.83 feet BGS*)	May 21, 2009	**9,840**
B2-S-94	(Below the south end of the UST, at 7.83 feet BGS)	May 21, 2009	**35,000**
XEI Duplicate Sample			
S@94"	(Below the south end of the UST, at 7.83 feet BGS)	June 10, 2009	**3,600**
Delineation Samples			
S@10'	(Below the south end of the UST, at 10 feet BGS)	June 10, 2009	**12,900**
S@14'	(Below the south end of the UST, at 14 feet BGS)	June 10, 2009	**3,820**
S@17'	(Below the south end of the UST, at 17 feet BGS)	June 10, 2009	<33.0
N@94"	(Below the north end of the UST, at 7.83 feet BGS)	June 11, 2009	**6,550**
5031-C@10.0'	(Below the center of the UST, at 10 feet BGS)	September 15, 2009	**4,410**
5031-C@14.0'	(Below the center of the UST, at 14 feet BGS)	September 15, 2009	**1,000**

Sample Identification		Sample Date	TPH
S@8	(Below the south end of the UST, at 8 feet BGS)	November 9, 2009	**12,500**
S@10	(Below the south end of the UST, at 10 feet BGS)	November 9, 2009	**8,720**
S@14	(Below the south end of the UST, at 14 feet BGS)	November 9, 2009	**2,470**
CP@8	(Below the center of the UST, at 8 feet BGS)	November 9, 2009	**8,340**
CP@10	(Below the center of the UST, at 10 feet BGS)	November 9, 2009	**2,270**
CP@14	(Below the center of the UST, at 14 feet BGS)	November 9, 2009	**1,190**
NH@16	(10 feet north of the UST, at 16 feet BGS)	December 22, 2009	<31.0
EH@16	(10 feet east of the UST, at 16 feet BGS)	December 22, 2009	<31.5
WH@16	(37' west of the UST, at 6 feet BGS, 16 feet BGS relative to UST)	December 22, 2009	<34.1
SH@16	(10 feet east of the excavation, at 16 feet BGS)	December 22, 2009	<30.2

*BGS = below ground surface

TABLE 2
SUMMARY OF SOIL BTEX+N DATA
EPA METHOD 8260B (ppm)
Method Detection Limits = "<" mg/Kg

Sample ID	Sample Date	Benzene	Toluene	Ethyl-Benzene	Xylenes	Naphthalene
S@94"	06/10/09	**0.0184**	<0.0738	**0.934**	**2.140**	**4.750**
N@94"	06/11/09	**0.0360**	<0.0667	**0.819**	**2.180**	**4.980**
S@8	11/09/09	**0.210**	**1.450**	**4.630**	**23.300**	**21.200**

TABLE 3
SUMMARY OF SOIL PAH DATA
EPA METHOD 8270C SIM (ppm)
Method Detection Limit = '<' mg/Kg

Constituent	S@94	N@94"	S@8
Acenaphthene	<0.311	<0.593	<0.960
Acenaphthylene	<0.106	<0.389	<0.884

Constituent	S@94	N@94"	S@8
Anthracene	<0.0944	<0.274	**0.675**
Benzo (a) anthracene	<0.0944	**0.399**	**0.196**
Benzo (a) pyrene	<0.0944	**0.458**	0.196
Benzo (b+k) fluoranthenes	<0.0944	**0.556**	0.196
Benzo (g,h,i) perylene	<0.0944	**0.310**	0.196
Chrysene	<0.0944	**0.548**	**0.204**
Dibenzo (a,h) anthracene	<0.0944	<0.203	0.196
Fluoranthene	<0.0944	**0.429**	**0.249**
Fluorene	**1.060**	**2.540**	**4.090**
Indeno (1,2,3 - c,d) pyrene	<0.0944	**0.269**	0.196
Naphthalene	NA	NA	**11.500**
Phenanthrene	**2.050**	**5.940**	**10.100**
Pyrene	**0.110**	**0.854**	**0.439**

TABLE 4
CONTAMINANTS OF CONCERN IN SOIL

Constituent	Sample Identification	Sample Depth (feet)	Concentration (mg/kg)
Benzene	S@8	8	0.210
Toluene	S@8	8	1.450
Ethylbenzene	S@8	8	4.630
Xylenes, total	S@8	8	23.300
Anthracene	S@8	8	0.675
Benzo (a) anthracene	N@94"	7.83	0.399
Benzo (a) pyrene	N@94"	7.83	0.458

Constituent	Sample Identification	Sample Depth (feet)	Concentration (mg/kg)
Benzo (b+k) fluoranthenes	N@94"	7.83	0.556
Benzo (g,h,i) perylene	N@94"	7.83	0.310
Chrysene	N@94"	7.83	0.548
Fluoranthene	N@94"	7.83	0.429
Fluorene	S@8	8	4.090
Indeno (1,2,3 - c,d) pyrene	N@94"	7.83	0.269
Naphthalene	S@8	8	21.200
Phenanthrene	S@8	8	10.100
Pyrene	S@8	8	0.439

RECEPTORS

Due to the plume's depth and its location away from the City right-of-way, the *construction/excavation worker* scenario was not considered. Land use at the subject site and the adjacent properties is *residential*.

PATHWAYS

As previously mentioned, groundwater was not encountered during the site investigation. The closest body of surface water in the topographic downgradient direction is the an intermittent tributary to Fanno Creek, located approximately 1,000 feet south of and 95 feet lower than the property.

Because the contaminants are located at least 6.83 feet BGS, significant hydrocarbon vapor is absent at the surface. In addition, the plume depth precludes any soil ingestion, inhalation, or dermal contact. In developing the conceptual site model, XEI

has reviewed the following seven (7) pathways and has either accepted or rejected each based on the accompanying discussions:

1. *Soil contaminants volatize and migrate to indoor air where they are inhaled:*
   Accepted - this is a potential pathway since some volatile contaminants are present;

2. *Soil contaminants volatize and migrate to outdoor air where they are inhaled:*
   Accepted - this is also a potential pathway since volatile contaminants are present;

3. *Soil contaminants leach to groundwater where they are ingested:*
   Accepted - this is a potential, yet incomplete pathway, since the site and neighborhood utilize the municipal water system and drinking water wells are absent;

4. *Soil contaminants are directly ingested, inhaled, or contacted:*
   Rejected – soil contaminants are not present less than 6.83 feet BGS and the plume does not approach the City easement;

5. *Groundwater contaminants volatize, migrate to indoor air, and are inhaled:*
   Rejected - groundwater was not encountered in or below the contaminated zone;

6. *Groundwater contaminants volatize and migrate to outdoor air and are inhaled:*
   Rejected - groundwater was not encountered in or below the contaminated zone; and

7. *Groundwater contaminants are directly ingested:*
   Rejected - groundwater was not encountered in or below the contaminated zone

TABLE 5
SUMMARY OF EXPOSURE PATHWAYS CONSIDERED

Potentially Exposed Population	Exposure Route, Medium, and Exposure Point	Was this Pathway Selected?	Reason for Selection or Exclusion
Current Land Use: Residential			
Residents	Volatization from soils with subsequent indoor air inhalation.	Yes	Volatile constituents are present.
Residents	Volatization from soils with subsequent outdoor air inhalation.	No	Volatile constituents are present, though with concentrations notably below their RBCs.
Residents	Leaching to groundwater followed by dermal contact or ingestion from downgradient wells.	Yes	Local, deeper groundwater could be used for domestic or agricultural purposes.
Construction and Excavation Workers	Soil ingestion, dermal contact, and inhalation	No	The plume is not shallow or near the municipal right-of-way.
Residents	Volatization from groundwater with subsequent indoor air inhalation.	No	Groundwater was not encountered.
Residents	Volatization from groundwater with subsequent outdoor air inhalation.	No	Groundwater was not encountered.
Residents	Tapwater ingestion & inhalation.	No	The municipal system serves the site and its contiguous neighbors and domestic wells are not nearby.

TABLE 6
CLEANUP LEVEL SUMMARY FROM APPENDIX A TABLE OF RBCs*
(FOR THE MOST CONSERVATIVE PATHWAYS)
↓

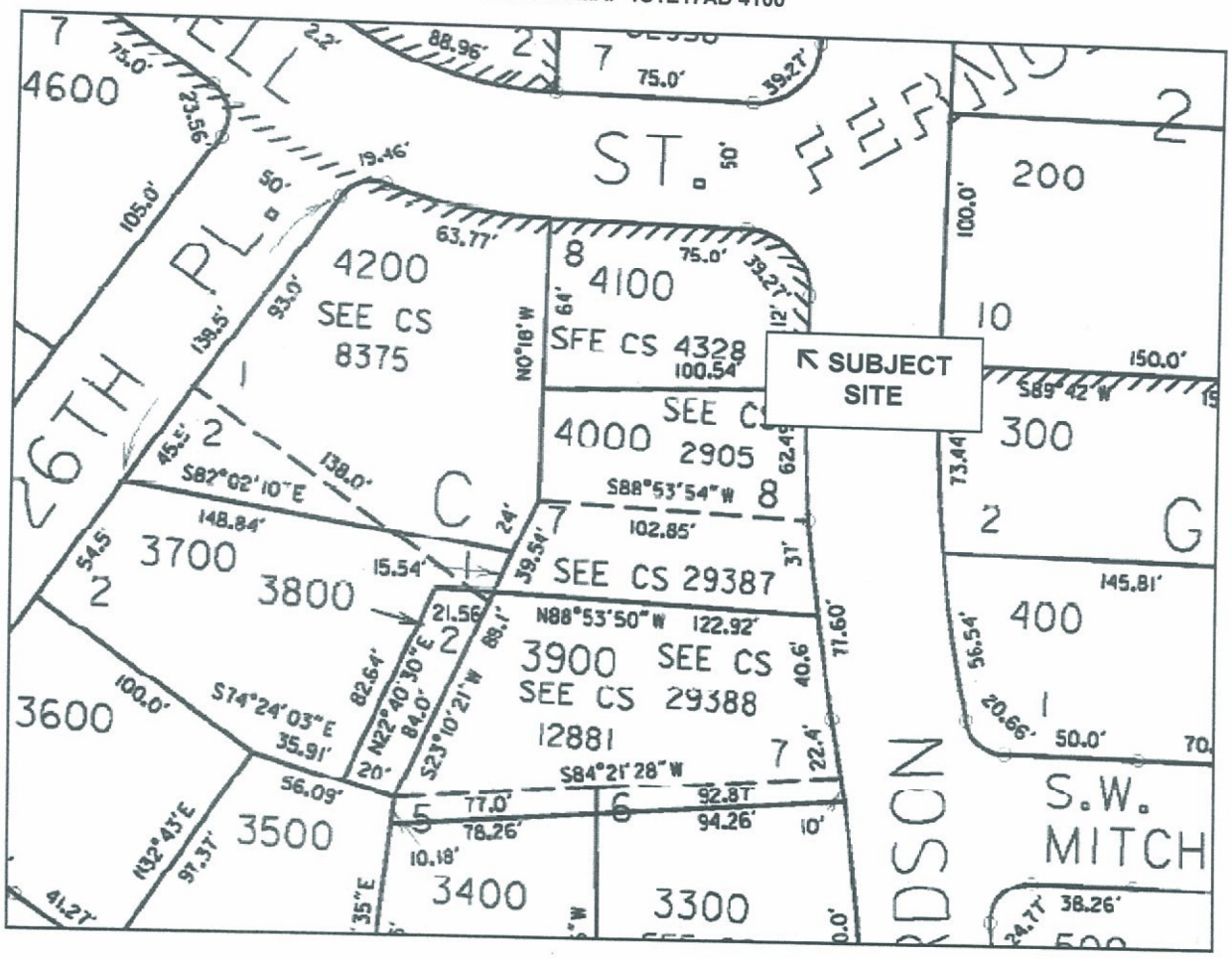
MEDIUM →	SOIL		Site Specific Analytical Results for
PATHWAY →	Intrusion	Leachate	Worst-Case Samples
RECEPTOR →	Residential	Residential	S@8 & N@94"
CONSTITUENT ↓	mg/Kg	mg/Kg	mg/Kg
Benzene	0.08	0.0093	**0.210**
Toluene	>C_{sat} (538)	140	**1.450**
Ethylbenzene	0.82	0.16	**4.630**
Xylenes, total	100	25	23.300
Anthracene	>Max	>C_{sat} (64)	0.675
Benzo (a) anthracene	NV	3.5	0.399
Benzo (a) pyrene	NV	0.9	0.458
Benzo (b+k) fluoranthenes	NV	>C_{sat} (14.15)	0.556
Chrysene	NV	>C_{sat} (3.18)	0.548
Fluoranthene	NV	>C_{sat} (110)	0.429
Fluorene	>Max	>C_{sat} (137)	4.090
Naphthalene	5.4	0.087	**21.200**
Pyrene	NV	>C_{sat} (70.9)	0.854

*RBCs = Risk-Based Concentrations, October 2009

GROUNDWATER USE SURVEY

As previously indicated, groundwater was not encountered and the municipal water system serves the subject site and these contiguous properties:

SURROUNDING PROPERTY ILLUSTRATION
ASSESSOR MAP 1S1E17AD 4100



Attached information gathered from the Oregon Water Resources Department (WRD) for Township 1 South, Range 1 East, and Sections 16 and 17 indicates that 552 well logs are present. Of these, two (2) are for domestic drinking water wells (one (1) of which is in Gresham), one (1) is for an irrigation well, two (2) are for Northwest Natural Gas anode ground bed wells, one (1) is for a slope stability study, and one (1) is for an

abandonment. The balance of the logs documented monitor wells and geotechnical holes.

The closest well is located approximately 1,900 feet south-southeast of and 50 feet lower than the site at 2224 SW Kanan Street. It produces from a basalt interflow zone between 280 and 300 feet deep.

The site is not located above the aquifers of the Portland Basin and is situated on the west flank of the Tualatin Mountains and these Columbia River Basalt (CRB) mountains form the southwestern boundary of the Portland Basin portion of the Willamette Lowland Aquifer system. The sedimentary valley fill that forms the aquifer is found on the opposite side of the Willamette River to the east of the site and at a lower altitude west of the site, at the southwestern fringe of the Tualatin Mountains. The site does not lie above the aquifer and, instead, is situated on slightly sandy silt which overlies the CRB at a depth in excess of 17 feet BGS. The subject site is at an elevation of approximately 545 feet and is not within any capture zones from community system wells.

POCKET VOLUME CALCULATION

Based on the previous analytical results and the attached Figure 2, the volume of remaining impacted soil is estimated at 119 bank cubic yards (BCY). This estimate is based on vertical migration under the former tank that diminishes above 17 feet BGS and on lateral migration defined by the probe holes, with the exception of the western and southern extent. The west lateral had to be placed on the opposite side of the house while the southern extent utilized visual evidence from the probe hole, as illustrated in Figure 3. The remaining volume is best approximated by a frustum of a cone with a height of 10.17 feet and top and base radii of 4.0 feet and 15 feet, respectively. The frustum's bottom radius averages the long and short axes of the actual plume.

Therefore, the volume can be calculated by the following formula:

$$\{1/3 \times \pi \times 10.17 \times [4.0^2 + (4.0 \times 15.0) + 15.0^2]\} \div 27 \text{ cubic feet per BCY} = 118.73 \text{ BCY}$$

VAPOR INTRUSION INVESTIGATION

Since the original benzene, ethylbenzene, and naphthalene concentrations at 94 inches BGS exceeded their respective Appendix A thresholds for the *Vapor Intrusion into Air* exposure pathway, a projection of the indoor air was required. Therefore, on June 17, 2009, a sub-slab (SS) sampling station was established adjacent to the utility room, as indicated on the site plan, Figure 1. Initially, a hole was drilled through the slab and approximately three (3) inches into the subsoil. After vacuuming the cuttings from the hole, Teflon tubing was sealed with paraffin wax from the surface to three (3) inches down in the four (4)-inch thick concrete slab. Thirty minutes later after the wax had hardened and the soil had equilibrated, the continuous tubing continued through the top of a stainless steel hood within which was placed a 2-propanol (isopropyl alcohol) soaked rag. Real-time leak detection was conducted for 10 minutes which drew approximately 200 milliliters per minute (ml/min) with a peristaltic pump into an Industrial Scientific LTX310 combustible gas indicator (CGI) calibrated to pentane. With a detection resolution of one (1) percent of the lower explosive limit (LEL), the CGI could potentially detect around 250 parts per million volume (ppmv) of 2-propanol. No 2-propanol was detected during the test. Since the 2,000 ml volume represented more than three (3) 'well volumes' (total volume of the tubing plus the drill rat hole), additional purging was not required.

Subsequently, a 6-liter Summa canister drew an average of 200 ml/min for 30 minutes. Following sample collection, the canister was resealed, entered into a chain-of-custody (COC), and transported back to Air Toxics LTD for analysis. The air sample was initially analyzed for ethylbenzene, naphthalene, and 2-propanol using EPA Modified Method TO-15LL. DEQ requested at a later date that the benzene concentration be

back-calculated. Laboratory results were verified through review of surrogate recovery percentages and the analyses of laboratory method blanks. The analytical results are presented in the following table.

TABLE 7
CLEANUP LEVEL FROM APPENDIX A TABLE OF RBCs*

MEDIUM →	SOIL GAS	Site Specific Analytical Result for Sample 5031 SS
PATHWAY →	Inhalation	
RECEPTOR →	Residential	
CONTAMINANT ↓	µg/m³	µg/m³
Benzene	62	4.0
Ethylbenzene	190	6.5
Naphthalene	14	**97**

*RBCs = Risk-Based Concentrations, October 2009

2-Propanol was detected at a concentration of approximately 330 µg/m³. A 10 percent (%) concentration equates to approximately 10,000,000 µg/m³ or 10,000 ug/L. Therefore, the detection in the sample equates to far less than 1% leakage.

Because excavation of the source is encumbered by the tank's burial depth, roof overhangs, and caving, imported sand and the likelihood that the plume is present under a portion of the basement slab, XEI diminished the toxicity of the plume by introducing oil-degrading microbes. Initially, the empty UST was completely uncovered, cut open, and entered to retrieve the sludge. The bottom of the tank was removed and an infiltration gallery was installed. The spacing of the borings was on two (2) foot centers with staggered truncating depths between 10 and 14 feet BGS. The holes were advanced down at an angle west into the basement foundation gravel and east outside the UST's footprint. Following oxygenation, a total of 20 gallons of the product was introduced via the piping into the heart of the plume and beneath the basement slab.

Additionally, on two (2) separate occasions, the product was sprayed on the floor of the tankhold.

A sample profile was developed while boring the infiltration gallery, as indicated in Table 1. We collected and analyzed samples on September 15, 2009, from beneath the center of the tank at 10 feet and 14 feet BGS to supplement sample results from under the south end of the UST. Following the removal of the gallery on November 9, 2009, we re-sampled beneath the south end and the center of the tank at eight (8), 10, and 14 feet BGS.

Due to the constituent concentrations in the south sample at eight (8) feet BGS, another sub-slab air sample was collected near the original location and it was analyzed for benzene, ethylbenzene, naphthalene, diesel-range TPH, and 2-propanol. The same procedures were used as with the initial sample with respect to equilibration and leak detection, but purging continued for an additional 10 minutes to compensate for the lower flow rate. This time, however, we used EPA Method TO-17 and drew 50 milliliters per minute for 10 minutes through a sorbent tube using a rotometer to throttle the peristaltic pump. The results are presented in the following table.

TABLE 8
CLEANUP LEVEL FROM APPENDIX A TABLE OF RBCs*

MEDIUM →	SOIL GAS and AIR	Site Specific Analytical Result for Sample 5031-SS
PATHWAY →	Inhalation	
RECEPTOR →	Residential	
CONTAMINANT ↓	µg/m³	µg/m³
SOIL GAS		
Benzene	62	<20
Ethylbenzene	190	<10
Naphthalene	14	<10

MEDIUM →	SOIL GAS and AIR	Site Specific Analytical Result for Sample 5031-SS
PATHWAY →	Inhalation	
RECEPTOR →	Residential	
CONTAMINANT ↓	$\mu g/m^3$	$\mu g/m^3$
AIR		
TPH-D	130	<10**

*RBCs = Risk-Based Concentrations, October 2009 **Calculated for AIR, attenuation factor (AF) = 200

ECOLOGICAL RISK

This residential site is obviously devoid of ecological important species and habitat. Further,

1) the remaining impacted soil is deeper than three (3) feet BGS,
2) surface water has not been affected since it is not in proximity to the site,
3) groundwater was not encountered and is therefore impacted groundwater is not migrating offsite in the direction of any surface water, and it is unlikely to reach any surface water, and consequently,
4) impacted groundwater is reasonably unlikely to encounter aquatic sediments.

FREE PRODUCT MOBILITY

Residual impact in the excavation exceeds the 10,000 ppm TPH-Dx threshold but none of the remaining impacted soil exhibited free product.

ADJACENT PROPERTY INVESTIGATIONS

According to the DEQ Facility Profiler and the Leaking Underground Storage Tanks (LUST) Database, the upgradient property across the street at 5030 SW Richardson Drive was closed under the Soil Matrix rules.

AFFECTED ADJACENT PROPERTY NOTIFICATION

The soil plume's contour does not extend off-site or into the utility right-of-way, so the residential neighbors, City of Portland, and other applicable utility companies will not receive a copy of this report.

WASTE MANAGEMENT AND DISPOSITION

The remaining product in the UST was transferred into an aboveground storage tank. Sludge recovered from the UST totaling 10 gallons is staged at XEI pending pickup by Wastexpress. The UST's top and bottom were staged at XEI pending delivery to Metro Metals Northwest, Inc. on October 1, 2009. Disposition documentation is attached.

CONCLUSIONS

Following analytical review that the constituent concentrations present in the soil plume, with exception of the benzene, ethylbenzene, and naphthalene were less than their respective 'Appendix A: Table of Risk-Based Concentrations' (RBCs) and that the final soil gas concentration was acceptable, the excavation was backfilled. This backfill, placed on December 21, 2009, consisted of crushed gravel to the original grade. The unsuitable clean sand overburden was transported off-site.

Based upon the laboratory data and site observations, it appears that the hydrocarbon release at this site had been on-going. The bioremediation was successful in terms of generally reducing the TPH soil concentrations by as much as 68 per cent (%) in the six (6) sample locations tested. However, two (2) sample locations showed increased concentrations. As suggested by the results of the second sub-slab air sample, the microbes were particularly successful in degrading the plume beneath the basement slab.

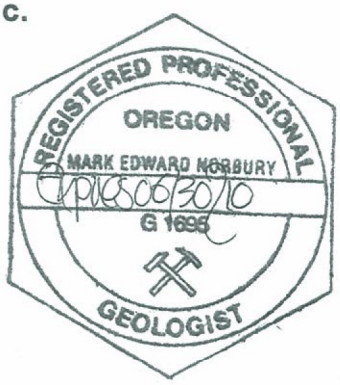
In the present setting, with the contaminant mass commencing at over 6.83 feet BGS there is limited human exposure risk from inhalation, ingestion, or dermal contact of the

impacted soil. Further constituent migration is not expected due to degradation of the hot spot source, the more viscous property of heating oil, the oil retention property of the silt, and the relatively low concentrations of the constituents in the clearance sample collected.

Pursuant to DEQ's *Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites* and comparing the site's data with their respective RBCs (please refer to Table 6 on Page 9), retrieving impacted soil should be unnecessary because the site cleanup goals have been met: indoor air is no longer being compromised and the property and its neighbors use water from the municipal system. Additionally, there is an absence of downgradient groundwater receptors. Therefore, based on the collective data and in accordance with DEQ regulations, no further action is anticipated for this site. XEI recommends continued attenuation for the remaining pocket and supports final closure for this project, and has sought concurrence from DEQ. We are available to answer any questions regarding this report.

Sincerely,

Xavier Environmental, Inc.



Mark Norbury, RG
Geohydrologist

Attachments

Cc: DEQ Northwest Region