Vapor Intrusion Investigation

Howe Parcel
University of Washington - Tacoma
Tacoma, Washington
UW CPD Project No. 205864
Facility Number 1001/4539

for
University of Washington

July 26, 2018

GeoEngineers
Earth Science + Technology

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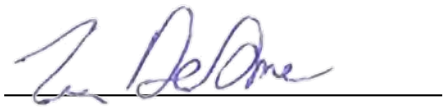

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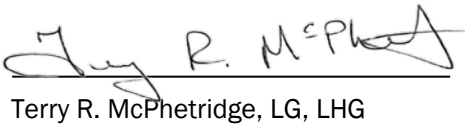

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1.0 INTRODUCTION

This report presents the results of the vapor intrusion (VI) evaluation at four University of Washington – Tacoma (UWT) buildings and the Federal Courthouse building along Pacific Avenue in Tacoma, Washington. UW implemented an interim action (IA) in July 2013 to address a tetrachloroethene (PCE)-contaminated groundwater plume that originated from the former Howe Parcel property at 1754 Pacific Avenue (Garretson Woodruff & Pratt [GWP] building (Facility Number 1001/4539). The IA consisted of a series of injections of EHC®. The main objective of the IA was to reduce volatile organic compounds (VOC) concentrations (primarily PCE and associated degradation products) in groundwater within the Howe Parcel PCE plume. Trichloroethene (TCE) and vinyl chloride concentrations have increased to concentrations greater than the Remedial Investigation Groundwater Screening Levels (RIGSL) during degradation of the PCE in the groundwater. Washington State Department of Ecology (Ecology) requested a vapor intrusion evaluation within the UWT buildings and Federal Courthouse due to the presence of TCE and vinyl chloride in the groundwater. The evaluation was completed in general accordance with Amendment No. 2 to the IA Work Plan (IAWP) – Howe Parcel dated April 12, 2017, and Ecology's Draft VI Guidance (Ecology 2016).

The buildings and surrounding area are shown in Figure 1. The estimated extent of the PCE groundwater plumes and wells are shown in Figures 2 and 3. Background information regarding the historical land use, geology and hydrogeology, previous investigations, IA and compliance groundwater monitoring are presented in the IAWP and groundwater monitoring reports between July 2013 and March 2018.

2.0 PRE-SAMPLING ACTIVITIES

GeoEngineers performed a visual survey of the buildings to evaluate access to sample locations and potential indoor air sources. Indoor air quality can be impacted by ambient (outdoor) air contamination or commercial products emitting VOCs (Ecology 2016).

2.1. UWT Buildings

GeoEngineers performed site visits to visually survey the interior of the UWT buildings on April 28, 2017 and May 2, 2017. The purpose of the April 28th visit was to verify sample locations and conduct utility locates for each proposed sub-slab soil vapor sampling location. The purpose of the May 2nd building survey was to evaluate potential indoor air sources. The UWT buildings consist of four separate buildings listed below and shown in Figure 4.

- Garretson Woodruff & Pratt (GWP) – FacNum 1001
- Birmingham Block [BB] – FacNum 1334
- Birmingham Hay & Seed [BHS] – FacNum 1000
- West Coast Grocery (WCG) – FacNum 1014

The GWP and BB buildings are connected by an open doorway and the BHS and WCG are connected by a common corridor/hallway on the ground floor. The buildings are constructed as a daylight basement and range in height between three and five stories. The ground floor is accessible from the east side of the buildings along Pacific Avenue. The GWP, BB and BHS buildings are slab on grade construction with

concrete and brick walls exterior walls and drywall interior walls. The WCG building consists of an approximately 2-foot-high crawl space on the west side of the building and 7-foot-high basement with concrete floor on the east side of the building. A utility corridor at ground level is located on the west side of the buildings. The utility corridor is accessible at several locations, including through the Joy building. The utility corridor is an unfinished and unoccupied space.

The ground floor of the four buildings is served by two heating, ventilation and air conditioning (HVAC) systems. One system serves the GWP building with the intake located on the roof of the BB building. The other system serves BB, BHS and WCG buildings with the intake located on the roof of the Joy building. The two systems operate independently 24 hours a day, seven days a week. The HVAC systems are recirculating air systems that continuously introduce a minimum amount of outside air and operate under positive pressure. In general, the spaces are ventilated except for the basement/crawl space located in the WCG, the utility corridor and the mechanical rooms. Observations specific to each building include the following.

- **GWP.** The GWP building a multiple story, mixed-use retail and classroom building. The ground floor is operated as the retail book store for the UWT. The floor is covered with a mixture of concrete, linoleum tiles and carpet. The walls did not appear to be recently painted. Compressed wood slat board and compressed wood cabinets make up most of the furniture. Standard cleaning chemicals such as Windex and Lysol were observed.
- **BB.** The BB building is a multiple story, mixed-use and classroom building. The ground floor is operated as restaurant/cafes and storage for the UWT bookstore. The walls did not appear to be recently painted. The floor is covered with linoleum tiles and the furniture consists of wood and plastic. Gas-supplied stoves and ovens were located within the kitchen of a restaurant with stove ventilation to the roof. Refrigerator units were observed to be electric. Standard cleaning chemicals were observed, and stoves and dishes are cleaned with industrial soaps of an unknown brand.
- **BHS.** The BHS building is a multiple story, mixed used retail and classroom building. The ground floor is operated as retail spaces that includes a hot dog stand, a bakery and part time children's classroom. Storage and utilities rooms are also located on the ground floor. The hotdog stand is open to a corridor whereas the bakery and classroom have enclosed spaces. Food preparation equipment is electrical. The children's classroom contained books, toys, computer parts and a 3D printer.

  The walls did not appear to be recently painted. The floor in the classroom was covered with exposed concrete, linoleum tiles and carpet, and the furniture consists of wood and plastic. An electrical/generator room and mechanical rooms are located within the southern portion of the building. Standard cleaning soaps used for kitchen dishes and cooking surfaces were observed. Cleaning chemicals were not observed in the classroom.
- **WCG**. The WCG building is a multiple story, mixed use retail and classroom building. The basement is not an occupied space. The retail area on the ground floor was vacant at the time of sampling (2017). The basement is exposed with a concrete floor, including un-floored crawl space in the west side of the building. Water was encountered seeping through the northeast corner of the basement forming pooled water.

  The flooring in the retail space was observed to be carpet. Cleaning chemicals were not observed in the basement. Cleaning chemicals were observed in the retail space, including several household cleaning products and an electric microwave oven on the counter.

- **Utility Corridor.** The utility corridor is present along the westside of the four buildings and connected to the other utility corridor on campus. Numerous electrical, communication and other utilities were observed in the utility corridor. Floor drains were observed throughout the corridor. The corridor did not appear to be connected to the HVAC system.
- **Roofs Near Air Intakes.** The roofs on the BB and Joy buildings are tar-coated flat roofs with abundant bird guano. Cleaning chemicals were not observed on the roofs.

2.2. Federal Courthouse

GeoEngineers completed a site visit on March 21, 2018 in the Federal Courthouse. The purpose of the site visit was to conduct utility locates for each proposed sub-slab soil vapor sampling location and to evaluate potential indoor air contaminant sources.

The building consists of slab on grade concrete floor. The ground floor is constructed as a daylight basement with a concrete retaining wall on the west side of the building. The ground floor is accessible from the outside on the north, east and south sides of the building and from an interior courtyard. The ground floor consists of office spaces, hallways, offices, prisoner holding cells and maintenance areas. The floor is typically carpet and the ceiling has fiber tiles. No new paint or flooring was observed. No chemical storage observed in the areas where sampling occurred.

Two parallel hallways are located on the west side of the building. The purpose of these hallways is to provide separate and secure passageways for court staff and prisoners to the courthouse and is accessible on the north and south ends of the building. Water staining was observed on the wall and ceiling within the hallway. The water appears to originate from the ceiling. The source of the water appears to be stormwater entering from the exterior surface of the building and not related to groundwater.

GeoEngineers' understanding of the HVAC system is based on conversations and information provided by the General Services Administration (GSA) in March 2017 and June 2018. In general, all the spaces are ventilated except for select closets. The HVAC operation schedule is 6 am to 6 pm, Monday through Friday, but may start operation earlier in the day for efficiency. The HVAC system operates on a slight positive pressure. In June 2018, we were provided maps showing ten air handling units (AHU) located on the roofs and two AHUs located on the southeast and southwest side of the building near the ground surface. The ground floor is served by AHU 1 through AHU 4. The remainder of the AHUs serve the fourth floor. The location intakes for the AHUs that serve the ground floor are located as follows:

- **AHU 1 and AHU 2**. Located on the northern building roof.
- **AHU 3**. Located on the southeast side of the building on the ground floor (parking level).
- **AHU 4**. Located on the southwest side of the building on the ground floor (Pacific Avenue level).

3.0 SOIL VAPOR AND AIR SAMPLING

Soil vapor and indoor/outdoor samples were collected during the sampling events. Sub-slab soil vapor samples were collected using Vapor Pin™ sampling devices. Sampling collection and handling was consistent with Ecology's Draft VI Guidance (Ecology 2016). The Vapor Pin™ sampling devices were installed following the manufacturers' standard operating procedures (SOPs). Air samples were collected

within the building and outside near the HVAC intakes (ambient air). The air samples were obtained by placing 6-liter Summa canisters equipped with an 8-hour flow controller at the locations. Outdoor air was sampled for evaluation because it represents another potential source of air contamination from general environmental sources (in addition to sub-slab soil vapors and common indoor sources) that could impact air inside the building. The differential pressure between the building air and beneath the slab was measured with the Omniguard 4 meter. Positive pressure indicates the building air pressure is greater than the sub-slab pressure. Negative pressure indicates the sub-slab pressure is greater than the building air pressure. The barometric pressure was measured with an INW Baroscout located in GeoEngineers Tacoma office. Sampling procedures are described in Appendix A. The differential pressure is shown in Tables 1 and 2. Graphs of the barometric pressure are shown in Appendix B.

3.1. UWT

A total of seven sub-slab soil vapor samples (H-BHS-SS1; H-BHS-SS2; H-GWP-SS1; H-BB-SS1; H-UT-SS1; H-UT-SS2; and H-WCG-SS1) were collected throughout four buildings on the UWT campus on May 2, 2017. A total of 11 indoor and outdoor samples (H-WCG-IA2; H-BB,BHS, WCG-OA1; H-GWP-IA2; H-BHS-IA1; H-UT-IA2; H-GWP-OA1; H-GWP-IA1; H-BHS-IA2; H-WCG-IA1; H-BB-IA1;and H-UT-IA1) were collected on May 3, 2017. The approximate air sampling locations are shown in Figures 3 and 4.

3.1.1. Weather and Differential Pressure

The weather conditions were sunny and humid with a temperature in the upper 60's°F during sampling activities performed on May 2 and 3, 2017. The barometric pressure dropped approximately 0.3 pounds per square inch (psi) between May 1st and 5th. The barometric pressure raised 0.001 psi the first two hours of sampling and then dropped 0.041 psi in the last six to seven hours during the indoor air sampling event. The dropping barometric pressure is an ideal condition for indoor air sampling because vapor intrusion is more likely to occur. The differential pressure between the building air and beneath the slab was observed to be slight positive or neutral during collection of the samples except sample H-BHS-SS1. Sample H-BHS-SS1 was collected within a maintenance closet not served by the HVAC units.

3.2. Federal Courthouse

A total of four sub-slab soil vapor samples (H-CH-SS1, H-CH-SS2, H-CH-SS3, H-CH-SS4) were collected on March 15, 2018. Four indoor air samples (H-CH-IA1, H-CH-IA2, H-CH-IA3, H-CH-IA) and three outdoor air samples (H-CH-OA1, H-CH-OA2 and H-CH-OA3) were collected on March 21, 2018. The outdoor air sampling equipment was not placed directly adjacent to the AHU during sampling. Therefore, the outdoor air sample results are not representative of air that is being supplied to the targeted indoor spaces and were not used in our evaluation. Approximate air sampling location are shown in Figures 3 and 5.

3.2.1. Weather and Differential Pressure

The weather conditions were sunny and partly cloudy with a temperature in the low 50's°F on March 15, 2018. The weather conditions were overcast and rainy with a temperature in the low 50's°F on March 21, 2018. The barometric pressure dropped approximately 0.4 pounds psi between March 19th and March 22nd. The barometric pressure dropped 0.084 psi during the indoor air sampling event. The dropping barometric pressure is an ideal condition for indoor air sampling because vapor intrusion is more likely to occur. The differential pressure between the building air and beneath the slab was observed to be slight positive or neutral during collection of the samples.

4.0 CHEMICAL ANALYTICAL RESULTS AND VAPOR INTRUSION EVALUATION

The sub-slab soil vapor, indoor air and outdoor air samples were submitted to Fremont Analytical, Inc. in Seattle, Washington for chemical analysis of PCE, TCE, 1,1-dichloroethene (1,1-DCE), cis-1,2[TD1]-DCE, trans-1,2-DCE and vinyl chloride by EPA Method TO-15 SIM (indoor and outdoor air) and U.S. Environmental Protection Agency (EPA) Method TO-15 (soil vapor). 1,1-DCE, cis-1,2-DCE and trans-1,2-DCE were analyzed even though these chemicals were either not detected or were detected at concentrations less than the RIGSL in groundwater. The presence or absence of these chemicals in indoor air/sub-slab soil vapor can provide an additional line of evidence regarding the occurrence of vapor intrusion because 1,1-DCE and cis-1,2-DCE are uncommon in consumer products and not typically found in indoor air (DTSC/Cal-EPA 2011). The chemical analytical packages and data validation are included in Appendix C.

4.1. Vapor Intrusion Evaluation Process

We used the following tiered approach to evaluate the potential for vapor intrusion in accordance with Ecology's Draft VI Guidance.

Step 1. Compare soil vapor results to the Model Toxics Control Act (MTCA) Method B Soil Vapor Screening Levels (SVSLs) and indoor air sample results to MTCA Method B Indoor Air Cleanup Level (IACL) published in Ecology's CLARC Master Spreadsheet dated August 2015.

Step 2. Adjust the indoor air results using the outdoor (ambient) air samples results if the detected concentrations in the indoor air sample exceed the Method B IACL. The ambient air samples were also used to estimate the background contribution to detected indoor air concentrations. Ecology's Draft VI Guidance states that detected indoor air concentrations can be adjusted (that is, corrected) by subtracting the detected outdoor air concentrations from the detected indoor air concentrations. Only the indoor air samples in UWT buildings were adjusted because the outdoor samples collected at the Courthouse were not collected near the AHU that served the location of the building where indoor air samples were collected.

Step 3. The adjusted indoor air concentration(s) was compared to MTCA Method B IACL. Additional analyses were completed using available lines of evidence, including the sub-slab vapor results and concentrations within the groundwater plume if the adjusted indoor air concentrations are greater than the respective MTCA Method B IACL. The purpose of the additional analyses is to evaluate the potential of false positives in indoor air samples.

Step 4. Compare the detected concentrations to the calculated commercial remediation action levels for indoor air if it appears vapor intrusion may be occurring using multiple lines of evidence. Ecology's Draft VI Guidance (2016) allows the development of remediation levels (air and sub-slab soil vapor) based on the current use of a building. The current use is occupational with adult full and part-time workers, short-term visitors and short-term prisoners. Adults are assumed to be the most highly exposed humans in an occupational building. GeoEngineers calculated MTCA Method B air remediation levels for TCE. The exposure assumptions for the MTCA Method B indoor air cleanup and remediation levels are as follows:

- Method B air cleanup levels: 365 days/year, 24 hours/day, 30 years
- Method B air remediation levels: 250 days/year, 8 hours/day, 20 years

These action levels were used to evaluate if current receptors (employees and the public) are protected (that is, whether the risk posed to current receptors based on actual exposures is less than acceptable levels).

4.2. UWT Buildings

4.2.1. Sub-Slab Soil Vapor Samples

PCE was detected at concentrations less than the MTCA Method B SVSL (320 micrograms per cubic meter [µg/m^3]) in the analyzed soil vapor samples. Other PCE breakdown products (TCE, 1,1-DCE, trans-1,2-DCE, cis-1,2-DCE and vinyl chloride) were not detected in the analyzed soil vapor samples.

4.2.2. Indoor and Outdoor Air

PCE was detected at concentrations less than the MTCA Method B Indoor IACL (9.6 µg/m^3) in the analyzed air samples.

TCE was detected at concentrations greater than the MTCA Method B IACL (0.37 µg/m^3) in two indoor locations (H-BB-IA1 [5.19 µg/m^3], H-GWP-IA2 [2.01 µg/m^3]) and one outdoor location (H-BB, BHS, WCG-OA1 [7.09 µg/m^3]). The indoor air samples H-BB-IA1 and H-GWP-IA2 were adjusted based on the outdoor air sample concentrations.

The adjusted indoor air TCE concentration was 0 µg/m^3 in sample H-BB-IA1 because the outdoor air sample was detected at a concentration greater than the indoor air sample. It appears that vapor intrusion is not occurring and the elevated TCE concentration in sample H-BB-A1 is sourced from an unknown indoor/outdoor source(s) based on the following lines of evidence.

- The adjusted air concentration is 0 µg/m^3 (Table 1).
- TCE was not detected in the sub-slab samples collected within the UWT buildings (Table 1 and Figure 4).
- The ratio of PCE to TCE in the indoor air sample H-BB-IA1 is one to two order magnitudes less than respective concentrations detected in other samples collected within the UWT buildings (Table 1). Theoretically, PCE and TCE would migrate from the sub-slab to indoor air at the same rate because advection/convection of soil vapor is generally the dominant transport mechanism influencing vapor intrusion from the sub-slab to indoor air. Therefore, a comparison of PCE and TCE concentrations was used to evaluate if indoor air sources are contributing to the TCE in the indoor air samples.
- 1,1-DCE and cis-1,2-DCE were not detected in sample H-BB-IA1. 1,1-DCE and cis-1,2-DCE are uncommon in consumer products and not typically found in indoor air (DTSC/Cal-EPA 2011).

The adjusted indoor air TCE concentration is 1.83 µg/m^3 in sample H-GWP-IA2. This adjusted indoor TCE concentration is greater than the MTCA Method B IACL. However, it appears that vapor intrusion is not occurring at this location because the source of the elevated TCE concentration in sample H-GWP-IA2 is related to unknown indoor/outdoor sources based on the following lines of evidence.

- TCE was not detected in the sub-slab samples collected nearby (Table 1 and Figure 4).
- The ratio of PCE to TCE in indoor air sample H-GWP-IA2 is one to two order magnitudes less than encountered in other locations in the building (Table 1). Theoretically, PCE and TCE would migrate from the sub-slab to indoor air at the same rate because advection/convection of soil vapor is generally the

dominant transport mechanism influencing vapor intrusion from the sub-slab to indoor air. Therefore, a comparison of PCE and TCE concentrations was used to evaluate if indoor air sources are contributing to the TCE in the indoor air samples.

- A basement is present beneath the sample H-WCG-IA2 location. An indoor air sample (H-WCG-IA1) was collected from the basement area with results indicating TCE was not detected at a concentration greater than the MTCA Method B IACL in this sample.
- The building generally has a neutral to positive pressure differential between the indoor air and the sub-slab.
- 1,1-DCE and cis-1,2-DCE were not detected in in sample H-GWP-IA2. 1,1-DCE and cis-1,2-DCE are uncommon in consumer products and not typically found in indoor air (DTSC/Cal-EPA 2011).
- The detected and adjusted TCE concentrations are less than the MTCA Method B calculated remediation level for commercial space visitors and full/part-time workers, and the EPA Region 10 short-term exposure value for commercial space.

Other PCE breakdown products (1,1-DCE, trans-1,2-DCE, cis-1,2-DCE and vinyl chloride) were either not detected or were detected at a concentration less than the MTCA Method B IACL in sample H-GWP-IA2.

4.3. Courthouse

4.3.1. Sub-Slab Soil Vapor Samples

PCE was detected at a concentration greater than the MTCA Method B SVSL (320 µg/m^3) in soil vapor sample H-CH-SS2 (1,030 µg/m^3). PCE was detected at concentrations less than the Method B SVSL in the remaining analyzed soil vapor samples.

TCE was detected at concentrations greater than the MTCA Method B SVSL (12 µg/m^3) in two soil vapor samples (H-CH-SS1 and H-CH-SS4). TCE was detected at concentrations less than the Method B SVSL in the remaining analyzed soil vapor samples.

Other PCE breakdown products (1,1-DCE, trans-1,2-DCE, cis-1,2-DCE and vinyl chloride) were either not detected or were detected at concentrations less than the MTCA Method B SVSL in the analyzed soil vapor samples.

4.3.2. Indoor and Outdoor Air

PCE was detected at concentrations less than the MTCA Method B IACL (9.6 µg/m^3) at the four indoor air and three outdoor sample locations.

TCE was detected at concentrations greater than the MTCA Method B IACL (0.37 µg/m^3) in the four indoor air samples (H-CH-IA1 through H-CH-IA4) ranging from 0.495 to 0.596 µg/m^3 and one outdoor air location (H-CH-OA3) at 0.565 µg/m^3. The outdoor air sample was collected on the ground surface near AHU 3 that serves the hallway on the ground floor. The detected concentrations of TCE in the indoor air samples were not adjusted because the outdoor air samples are not representative of air that is being supplied to the targeted indoor spaces as discussed in Section 3.2.

It is not clear if vapor intrusion may be occurring based on the ratios of PCE and TCE between the indoor air and sub-slab, and TCE concentrations between the sub-slab and indoor air. However, the detected

concentrations are less than MTCA Method B calculated remediation level for commercial space visitors and full/part-time workers and the EPA Region 10 short-term exposure value for commercial space and therefore, not a calculated risk to the occupants.

Other PCE breakdown products (1,1-DCE, trance-1,2-DCE, cis-1,2-DCE and vinyl chloride) were either not detected or were detected at concentrations less than the MTCA Method B IACL.

5.0 CONCLUSION

5.1. UWT

TCE was detected in the two indoor air samples at concentrations greater than the MTCA Method B IACL during the May 2017 sampling event. However, vapor intrusion does not appear to be occurring based on the multiple lines of evidence presented in Section 4.2. PCE and other breakdown products (1,1-DCE, trance-1,2-DCE, cis-1,2-DCE and vinyl chloride) were either not detected or were detected at concentrations less than the MTCA Method B IACL.

5.2. Federal Courthouse

TCE was detected at a concentration greater than the MTCA Method B IACL during the March 2018 sampling event. It is not clear if vapor intrusion is occurring, but the detected concentrations are less than MTCA Method B calculated remediation level for commercial space visitors and full/part-time workers and the EPA Region 10 short-term exposure value for commercial space. This indicates the TCE concentrations in indoor air are protective for current receptors (occupational workers and visitors). PCE and other breakdown products (1,1-DCE, trance-1,2-DCE, cis-1,2-DCE and vinyl chloride) were either not detected or were detected at concentrations less than the MTCA Method B IACL.

6.0 LIMITATIONS

We have prepared this report for the University of Washington for the vapor intrusion (VI) evaluation at four University of Washington – Tacoma (UWT) buildings and the Federal Courthouse in Tacoma, Washington.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. The conclusions, recommendations, and opinions presented in this report are based on our professional knowledge, judgment and experience. No warranty or other conditions, express or implied, should be understood.

Please refer to the appendix titled “Report Limitations and Guidelines for Use” for additional information pertaining to use of this report.

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Table 1

Summary of UWT Buildings Sub-Slab and Indoor Air Sampling Chemical Analytical Data

University of Washington - Tacoma - Howe

Tacoma, Washington

Building	Sample Identification[1]	Sample Date	Sample Type	Differential Pressure (inches of water)[2]	Ratio of PCE to TCE[3]	VOCs (µg/m^3)[4]							Helium (ppt)[5]
						PCE	TCE	Adjusted TCE[6]	1,1-DCE	cis-1,2-DCE	Trans-1,2-DCE	Vinyl Chloride	
Birmingham Hay & Seed	H-BHS-SS1	5/2/2017	Subslab Soil Vapor	-0.002	20.84	**22.3**	1.07 U	N/A	0.793 U	0.793 U	0.793 U	0.511 U	275 U
	H-BHS-SS2	5/2/2017	Subslab Soil Vapor	0.000	88.04	**94.2**	1.07 U	N/A	0.793 U	0.793 U	0.793 U	0.511 U	147 U
Birmingham Block	H-BB-SS1	5/2/2017	Subslab Soil Vapor	0.000	9.72	**10.4**	1.07 U	N/A	0.793 U	0.793 U	0.793 U	0.511 U	107 U
Garretson Woodruff & Pratt	H-GWP-SS1	5/2/2017	Subslab Soil Vapor	0.002	65.98	**70.6**	1.07 U	N/A	0.793 U	0.793 U	0.793 U	0.511 U	211 U
Utility Tunnel	H-UT-SS1	5/2/2017	Subslab Soil Vapor	0.000	59.16	**63.3**	1.07 U	N/A	0.793 U	0.793 U	0.793 U	0.511 U	334 U
	H-UT-SS2	5/2/2017	Subslab Soil Vapor	0.003	120.56	**129**	1.07 U	N/A	0.793 U	0.793 U	0.793 U	0.511 U	204 U
West Coast Grocery	H-WCG-SS1	5/2/2017	Subslab Soil Vapor	0.000	30.93	**33.1**	1.07 U	N/A	0.793 U	0.793 U	0.793 U	0.511 U	180 U
MTCA Method B Soil Vapor Screening Level (µg/m^3)						**320**	**12**	**N/A**	**3,000**	**NE**	**NE**	**9.3**	**NE**
Birmingham Block	H-BB-IA1	5/3/2017	Indoor Air	N/A	0.27	**1.42**	**5.19**	0	0.0357 U	0.0793 U	0.0238 U	0.217 U	--
Birmingham Hay & Seed	H-BHS-IA1	5/3/2017	Indoor Air	N/A	13.13	**1.20**	0.0914 U	N/A	0.0357 U	0.0793 U	**0.0820**	0.217 U	--
	H-BHS-IA2	5/3/2017	Indoor Air	N/A	13.35	**1.22**	0.0914 U	N/A	0.0357 U	**0.427**	**0.0469**	0.217 U	--
Garretson Woodruff & Pratt	H-GWP-IA1	5/3/2017	Indoor Air	N/A	9.07	**1.36**	**0.150**	0	0.0357 U	**0.500**	**0.0569**	0.217 U	--
	H-GWP-IA2	5/3/2017	Indoor Air	N/A	0.59	**1.19**	**2.01**	**1.83**	0.0357 U	0.0793 U	0.0238 U	0.217 U	--
Utility Tunnel	H-UT-IA1	5/3/2017	Indoor Air	N/A	7.00	**1.56**	**0.223**	N/A	0.0357 U	**0.521**	**0.101**	0.217 U	--
	H-UT-IA2	5/3/2017	Indoor Air	N/A	17.94	**1.64**	0.0914 U	N/A	0.0357 U	**0.426**	**0.0522**	0.217 U	--
West Coast Grocery	H-WCG-IA1	5/3/2017	Indoor Air	N/A	18.49	**1.69**	0.0914 U	N/A	0.0357 U	**0.416**	**0.0741**	0.217 U	--
	H-WCG-IA2	5/3/2017	Indoor Air	N/A	9.45	**1.55**	**0.164**	**0**	**0.0937**	**0.638**	**0.158**	0.217 U	--
BB, BHS, WCG Intake	H-BB, BHS, WCG-OA1	5/3/2017	Outdoor Air	N/A	0.29	**2.06**	**7.09**	N/A	0.0357 U	**0.430**	**0.0368**	0.217 U	--
GWP Intake	H-GWP-OA1	5/3/2017	Outdoor Air	N/A	7.17	**1.32**	**0.184**	N/A	**0.104**	**0.543**	**0.111**	0.217 U	--
MTCA Method B Indoor Air Cleanup Level (µg/m^3)[7,8]						**9.6**	**0.37**	**0.37**	**91**	**NE**	**NE**	**0.28**	--
MTCA Method B Calculated Indoor Air Remediation Level for Commercial Space Visitors (Adults and Children)[7,9]						**NC**	**7.7**	**7.7**	**NC**	**NC**	**NC**	**NC**	--
MTCA Method B Indoor Air Remediation Level for Commercial Space Full-Time Workers (Adults)[10,11]						**NC**	**4.1**	**4.1**	**NC**	**NC**	**NC**	**NC**	--
MTCA Method B Indoor Air Remediation Level for Commercial Space Part-Time Workers (Adults)[10,12]						**NC**	**7.0**	**7.0**	**NC**	**NC**	**NC**	**NC**	--
EPA Region 10 Air Concentrations for Short-Term Exposure For Commercial Space (Adults)[13]						**NE**	**8.4**	**8.4**	**NE**	**NE**	**NE**	**NE**	--

Notes:

[1] Sample identification Howe-Building/Location-Sample Type-Sample Number (i.e., H-UT-IA-1 = Howe-Utility Tunnel-Indoor Air- Sample 1).

[2] Pressure differential is shown as an average of the measurements observed on May 3, 2017 during indoor air sampling. The pressure differential was measured with the Omniguard 4 meter. Positive pressure indicates the building air pressure is greater than the sub-slab pressure. Negative pressure indicates the sub-slab pressure is greater than the building air pressure.

[3] The ratio of tetrachloroethene (PCE) to trichloroethene (TCE) is calculated using the PCE concentration divided by the TCE concentration.

[4] Samples were analyzed by United States Environmental Protection Agency (EPA) method TO-15-SIM. Sub-slab samples were analyzed by EPA method TO-15.

[5] Helium analyzed by GC/TCD.

[6] Adjusted trichloroethene (TCE) concentration is equal to the indoor air TCE concentration minus the outdoor air TCE concentration. If the calculated concentration is negative, then the concentration is presented as "0".

[7] Unrestricted Land Use and Commercial Space Visitor indoor air remediation levels (adults and children) were calculated using the Method B formula in Table 8 of MTCA guidance "Trichloroethylene Toxicity Information and MTCA Cleanup Levels (TCE), CAS # 79-01-6" dated September 2012. Both levels were calculated using this formula to account for increased toxicity in children relative to adults using age dependent adjustment factors in accordance with EPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. EPA/630/R-03/00F, March 2005. The only parameter modified in the Method B formula was exposure frequency. See Footnotes 8 and 9 for difference in exposure frequency between unrestricted land use and commercial space visitors.

[8] Model Toxics Control Act (MTCA) Method B Air Cleanup Level for Unrestricted Land Use (children and adults) based on an exposure frequency value of 1 (which assumes exposure 24 hours per day, 365 days per year).

[9] MTCA Method B Indoor Air Remediation Level for Commercial Space Visitors (children and adults) is based on an exposure frequency value of 0.047 (assumes 4 hours per day and 104 days per year [2 days per week]).

[10] The Commercial Space worker air levels (adults) were calculated using MTCA Method B air cleanup level Equation 750-2. The only parameters modified in the Method B formula was exposure frequency and exposure duration. The commercial worker exposure duration used was 20 years, which is consistent with the exposure duration for MTCA Method B industrial soil cleanup levels. See Footnotes 10 and 11 for the difference in exposure frequency between full-time and part-time workers.

[11] MTCA Method B Indoor Air Remediation Level for Commercial Space Full-Time Worker (adults) is based on an exposure frequency of 0.23 (assumes 8 hours per day and 250 days per year).

[12] MTCA Method B Indoor Air Remediation Level for Commercial Space Part-Time Worker (adults) based on an exposure frequency of 0.13 (assumes 8 hours per day and 146 days per year).

[13] EPA, 2012, OEA Recommendations Regarding Trichloroethylene Toxicity in Human Health Risk Assessments, EPA Region 10, Office of Environmental Assessment, December 13, 2012.

U = analyte was not detected at a concentration greater than the laboratory reporting limit

Bold font indicates the compound was detected.

Gray shading indicates the compound was detected at a concentration greater than the MTCA Method B Indoor Air Cleanup level.

See Table 3 for evaluation of the air samples with concentrations greater than the MTCA Method B Air Cleanup Level.

NE = Not Established
N/A = Not applicable
ppt = Parts per trillion
SS = Sub-slab Vapor
IA = Indoor Air
NC = Not Calculated
VOCs = Volatile organic compounds
OA = Outdoor Air
UT = Utility Tunnel
PCE = Tetrachloroethene
TCE = Trichloroethene
DCE = Dichloroethene
WCG = West Coast Grocery
GC/TCD = gas chromatography/thermal conductivity detec
-- = Sample not analyzed for this compound
EPA = United States Environmental Protection Agency
BB = Birmingham Block
BHS = Birmingham Hay & Seed
GWP = Garretson Woodruff & Pratt
µg/m^3 = microgram per cubic meter

Table 2

Summary of Tacoma Federal Courthouse Sub-slab and Indoor Air Sampling Chemical Analytical Data

University of Washington - Tacoma - Howe

Tacoma, Washington

Building	Sample Identification[1]	Sample Date	Sample Type	General Sample Location	Differential Pressure (inches of water)[2]	Ratio of PCE to TCE[3]	VOCs (µg/m^3)[4]						Helium (ppt)[5]
							PCE	TCE	1,1-DCE	cis-1,2-DCE	Trans-1,2-DCE	Vinyl Chloride	
Court House	H-CH-SS1	3/15/18	Subslab Soil Vapor	Demark Room	0.020	0.85	**20.1**	**23.7**	0.0357 U	**33.3**	0.0238 U	**0.413 J**	160 U
	H-CH-SS2	3/15/18	Subslab Soil Vapor	Conference Room in Probation Office	0.002	112	**1030**	**9.16**	0.0357 U	**0.147**	0.0238 U	0.217 U	160 U
	H-CH-SS3	3/15/18	Subslab Soil Vapor	Hallway Leading to Loading Dock	0.002	6.57	**3.64**	**0.554**	0.0357 U	**0.111**	0.0238 U	0.217 U	**60.90 J**
	H-CH-SS4	3/15/18	Subslab Soil Vapor	Kitchen in Federal Protective Services	0.000	5.75	**244**	**42.4**	0.0357 U	**3.61**	0.0238 U	0.217 U	180 U
	MTCA Method B Soil Vapor Screening Level (µg/m^3)[6]						**320**	**12**	**3,000**	**NE**	**NE**	**9.3**	**N/A**
	H-CH-IA1	3/21/18	Indoor Air	Demark Room	N/A	1.81	**1.08**	**0.596**	0.0357 U	**0.418**	0.0238 U	0.217 U	N/A
	H-CH-IA2	3/21/18	Indoor Air	Cubicle in Probation Office	N/A	4.10	**2.03**	**0.495**	0.0892 U	**0.173 J**	0.0595 U	0.543 U	N/A
	H-CH-IA3	3/21/18	Indoor Air	Pre-trial Office Waiting Room	N/A	4.05	**2.03**	**0.501**	0.0892 U	**0.175 J**	0.0595 U	0.543 U	N/A
	H-CH-IA4	3/21/18	Indoor Air	Front Cubicle in Marshal's Office	N/A	4.03	**2.03**	**0.504**	0.0892 U	**0.174 J**	0.0595 U	0.543 U	N/A
	H-CH-OA1	3/21/18	Outdoor Air	South Roof of Courthouse - 4th Floor Intake	N/A	N/A	**0.714**	0.0914 U	0.0357 U	0.0793 U	0.0238 U	0.217 U	N/A
	H-CH-OA2	3/21/18	Outdoor Air	North Roof of Courthouse - 4th Floor Intake	N/A	N/A	**0.630**	0.0914 U	0.0357 U	0.0793 U	0.0238 U	0.217 U	N/A
	H-CH-OA3	3/21/18	Outdoor Air	Parking Lot Near Entry - First Floor Hallway Intake	N/A	3.86	**2.18 J**	**0.565 J**	0.357 U	0.793 U	0.0238 U	2.17 U	N/A
MTCA Method B Indoor Air Cleanup Level (µg/m^3)[6,7]							**9.6**	**0.37**	**91**	**NE**	**NE**	**0.28**	**N/A**
MTCA Method B Calculated Indoor Air Remediation Level for Commercial Space Visitors (Adults and Children)[6,8]							**NC**	**7.7**	**NC**	**NC**	**NC**	**NC**	**NC**
MTCA Method B Indoor Air Remediation Level for Commercial Space Full-Time Workers (Adults)[9,10]							**NC**	**4.1**	**NC**	**NC**	**NC**	**NC**	**NC**
MTCA Method B Indoor Air Remediation Level for Commercial Space Part-Time Workers (Adults)[9,11]							**NC**	**7.0**	**NC**	**NC**	**NC**	**NC**	**NC**
EPA Region 10 Air Concentrations for Short-Term Exposure For Commercial Space (Adults)[12]							**NE**	**8.4**	**NE**	**NE**	**NE**	**NE**	**NE**

Notes:

[1] Sample identification Howe-Building/Location-Sample Type-Sample Number (i.e., H-UT-IA-1 = Howe-Utility Tunnel-Indoor Air- Sample 1).

[2] Pressure differential is shown as an average of the measurements observed on March 21, 2018 during indoor air sampling. The pressure differential was measured with the Omniguard 4 meter. Positive pressure indicates the building air pressure is greater than the sub-slab pressure. Negative pressure indicates the sub-slab pressure is greater than the building air pressure.

[3] The ratio of tetrachloroethene (PCE) to trichloroethene (TCE) is calculated using the PCE concentration divided by the TCE concentration.

[4] Samples were analyzed by United States Environmental Protection Agency (EPA) method TO-15-SIM.

[5] Helium analyzed by GC/TCD.

[6] Unrestricted Land Use and Commercial Space Visitor indoor air remediation levels (adults and children) were calculated using the Method B formula in Table 8 of MTCA guidance "Trichloroethylene Toxicity Information and MTCA Cleanup Levels (TCE), CAS # 79-01-6" dated September 2012. Both levels were calculated using this formula to account for increased toxicity in children relative to adults using age dependent adjustment factors in accordance with EPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. EPA/630/R-03/00F, March 2005. The only parameter modified in the Method B formula was exposure frequency. See Footnotes 7 and 8 for difference in exposure frequency between unrestricted land use and commercial space visitors.

[7] Model Toxics Control Act (MTCA) Method B Air Cleanup Level for Unrestricted Land Use (children and adults) based on an exposure frequency value of 1 (which assumes exposure 24 hours per day, 365 days per year).

[8] MTCA Method B Indoor Air Remediation Level for Commercial Space Visitors (children and adults) is based on an exposure frequency value of 0.047 (assumes 4 hours per day and 104 days per year [2 days per week]).

[9] The Commercial Space worker air levels (adults) were calculated using MTCA Method B air cleanup level Equation 750-2. The only parameters modified in the Method B formula was exposure frequency and exposure duration. The commercial worker exposure duration used was 20 years, which is consistent with the exposure duration for MTCA Method B industrial soil cleanup levels. See Footnotes 10 and 11 for the difference in exposure frequency between full-time and part-time workers.

[10] MTCA Method B Indoor Air Remediation Level for Commercial Space Full-Time Worker (adults) is based on an exposure frequency of 0.23 (assumes 8 hours per day and 250 days per year).

[11] MTCA Method B Indoor Air Remediation Level for Commercial Space Part-Time Worker (adults) based on an exposure frequency of 0.13 (assumes 8 hours per day and 146 days per year).

[12] EPA, 2012. OEA Recommendations Regarding Trichloroethylene Toxicity in Human Health Risk Assessments. EPA Region 10, Office of Environmental Assessment. December 13, 2012.

SS = Sub-slab Vapor | PCE = Tetrachloroethene | NE = Not Established | µg/m^3 = microgram per cubic meter | N/A = Not applicable

IA = Indoor Air | TCE = Trichloroethene | VOCs = Volatile organic compounds | GC/TCD = gas chromatography/thermal conductivity detector | ppt = Parts per trillion

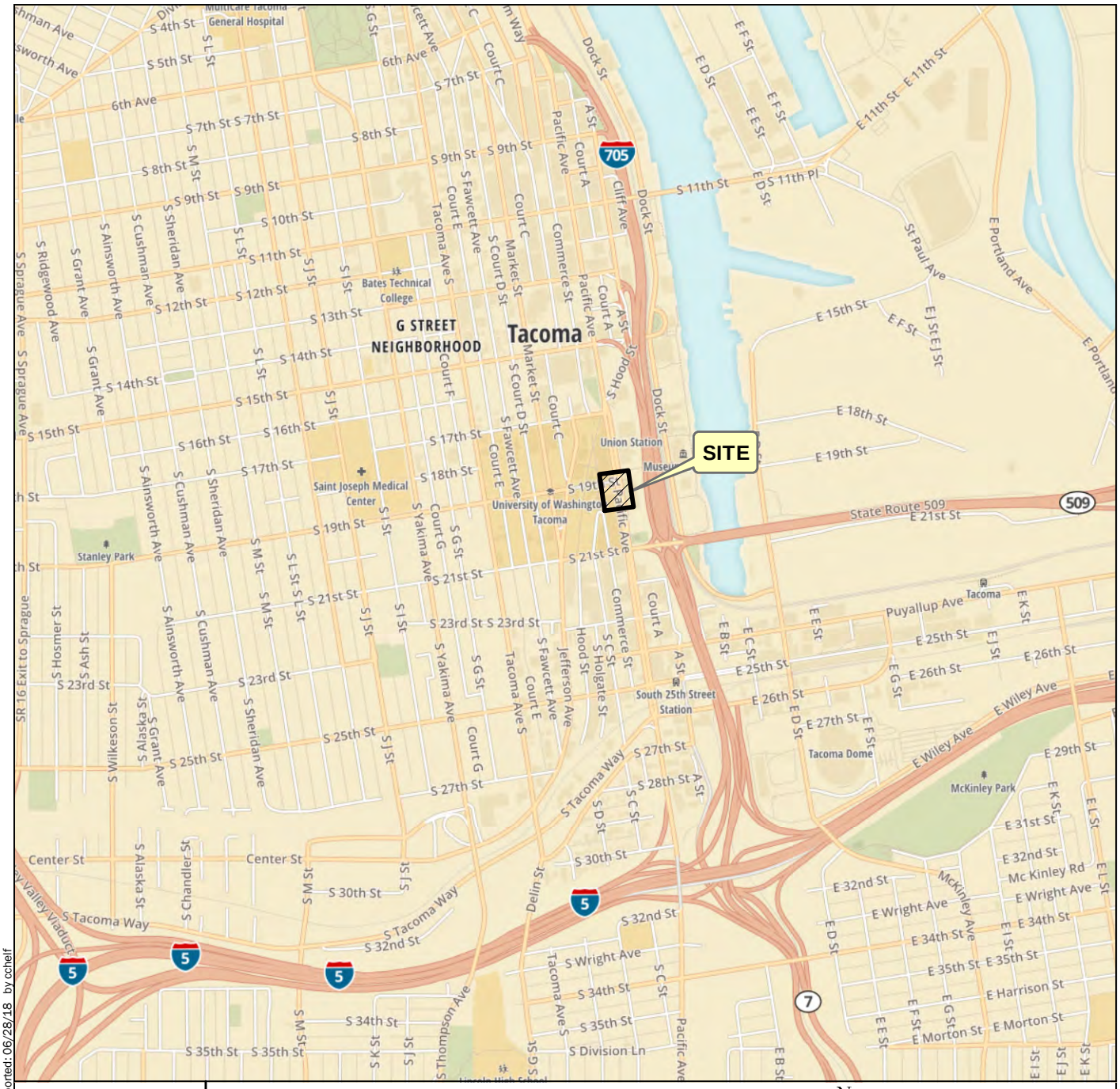
OA = Outdoor Air | DCE = Dichloroethene | NC = Not Calculated | EPA = United States Environmental Protection Agency

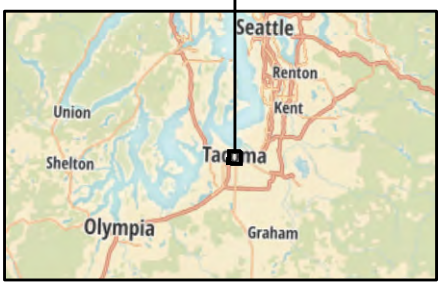
U = analyte was not detected at a concentration greater than the laboratory reporting limit

J = value is estimated by the laboratory

Bold font indicates the compound was detected.

Gray shading indicates the compound was detected at a concentration greater than the MTCA Method B Indoor Air Cleanup level.





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Feet

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: ESRI Data & Maps

Projection: NAD 1983 UTM Zone 10N

Vicinity Map

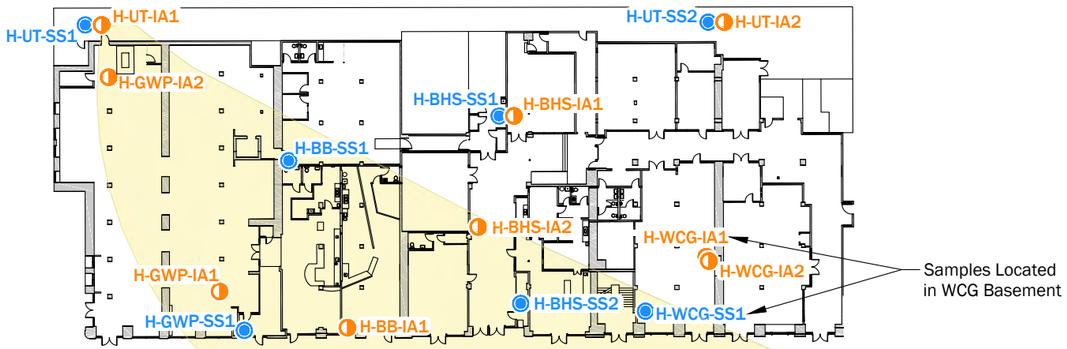
Howe Vapor Intrusion Investigation
University of Washington - Tacoma
Tacoma, Washington

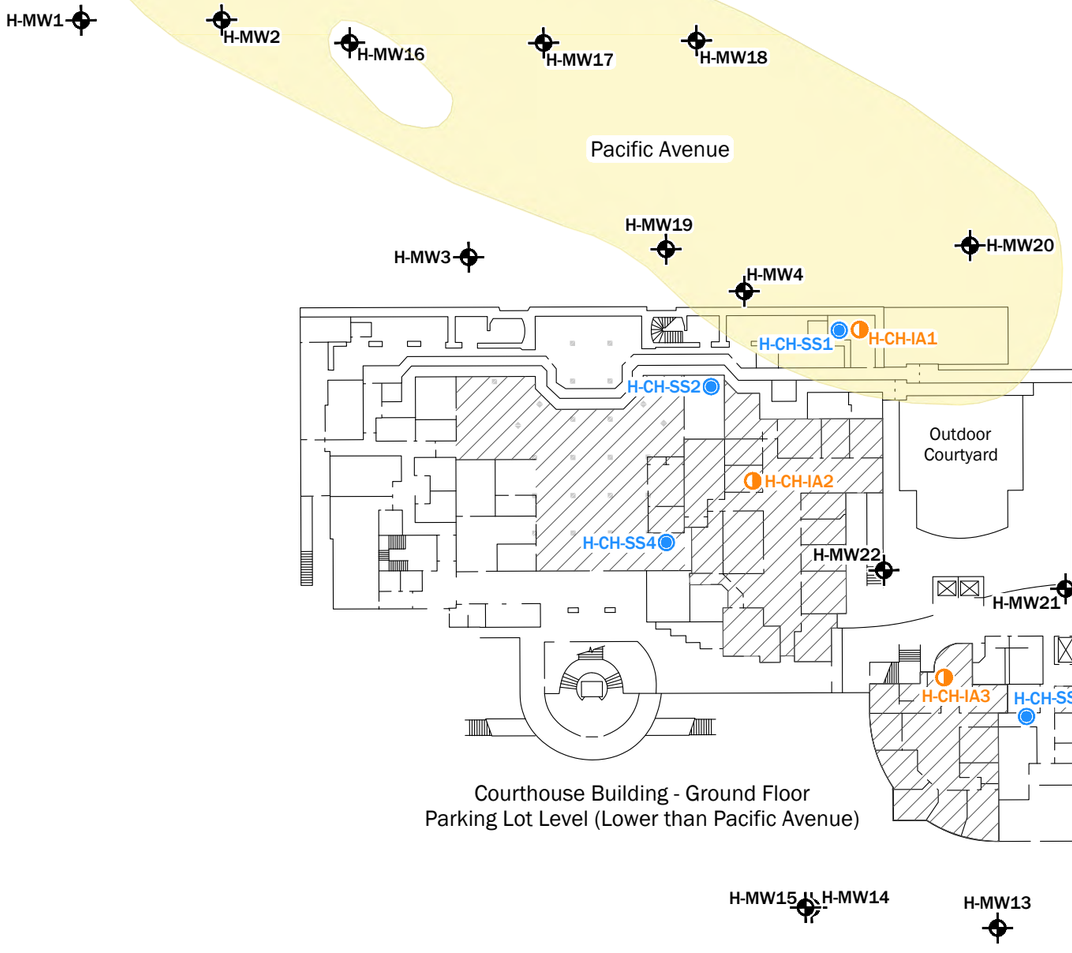
GeoEngineers

Figure 1

P:\0\0183108\GIS\MXDs\0183108802_F01_VIReport_VicinityMap.mxd Date Exported: 06/28/18 by cchelf

UWT Buildings - Pacific Avenue Level/Ground Floor





Courthouse Building - Ground Floor
Parking Lot Level (Lower than Pacific Avenue)

Legend

- Elevator
- Stairs
- H-MW3 — Existing Monitoring Well
- H-CH-SS3 — Subslab Vapor Sample
- H-CH-IA4 — Indoor Air Sample
- Areas with Regular Daily Occupancy
- March 2017 & May 2018 Approximate Lateral Extent of PCE Detected at Concentrations Greater Than RIGSL (5 µg/L)

Notes:

1. UWT = University of Washington - Tacoma
   WCG = West Coast Grocery
   TCE = trichloroethene
   PCE = tetrachloroethene
   RIGSL = remedial investigation groundwater screening level protective of indoor air.
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Background PDF from URS dated December 2010.

Projection: NAD83 WA State Planes, South Zone, US Foot

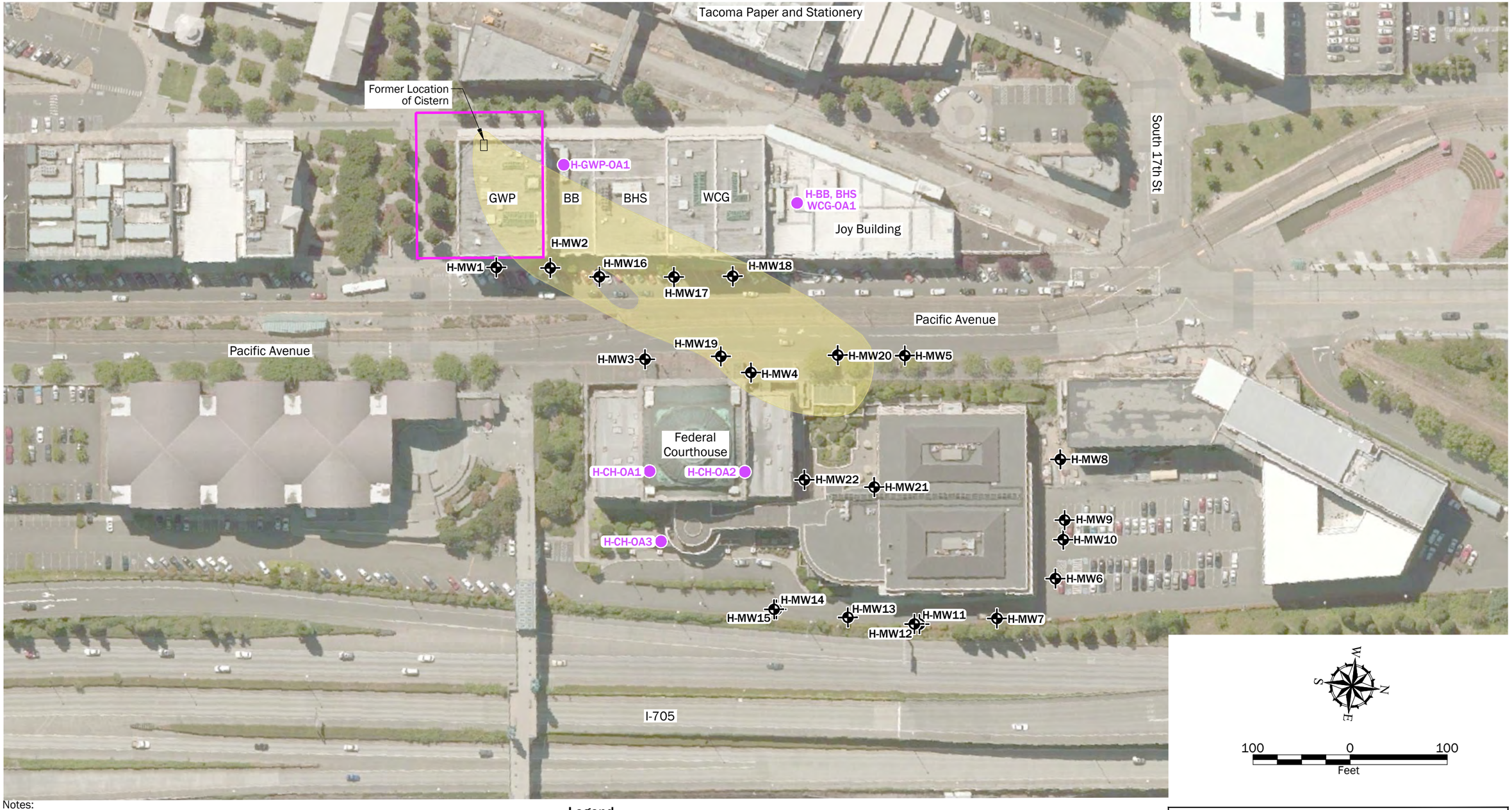
60 0 60
Feet

Overall Site Plan

Howe Vapor Intrusion Investigation
University of Washington - Tacoma
Tacoma, Washington

GeoEngineers

Figure 2



Notes:

1. UWT = University of Washington Tacoma
   GWP = Garretson Woodruff & Pratt
   BB = Birmingham Block
   BHS = Birmingham Hay & Seed
   WCG - West Coast Grocery
   0.50U = Not detected at concentrations greater than laboratory reporting limit (0.50 µg/L)
   µg/L = microgram per liter
   PCE = tetrachloroethene
   RIGSL = remedial investigation groundwater screening level protective of indoor air.
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Aerial by Microsoft Bing Images dated July 2014.
Projection: NAD83 WA State Planes, South Zone, US Foot

Legend

- H-MW1 — Existing Monitoring Well
- H-GWP-OA1 — Outdoor Air Sample Location
- Former Howe Parcel Location
- March 2017 and May 2018 Approximate Lateral Extent of PCE Detected at Concentrations Greater Than RIGSL (5 µg/L)

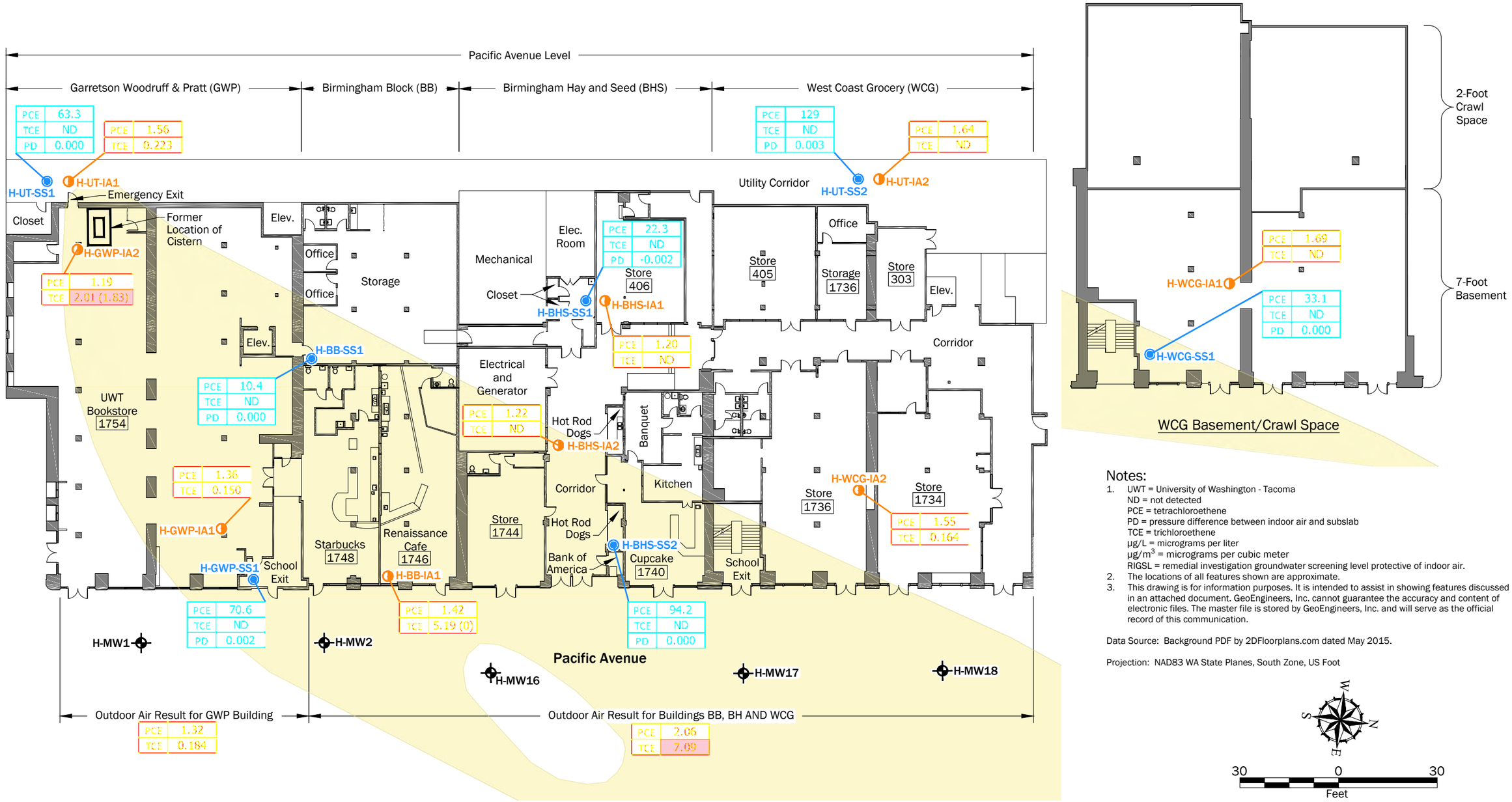
Outdoor Air Sample Locations

Howe Vapor Intrusion Investigation
University of Washington - Tacoma
Tacoma, Washington

GeoEngineers

Figure 3

P:\0183108\CAD\02\Howe Vapor Intrusion Report\018310801_F03_Outdoor Air Sample Locations.dwg TAB:F03 Date Exported: 07/25/18 .12:47 by lkillgore



Notes:

1. UWT = University of Washington - Tacoma
   ND = not detected
   PCE = tetrachloroethene
   PD = pressure difference between indoor air and subslab
   TCE = trichloroethene
   µg/L = micrograms per liter
   µg/m^3 = micrograms per cubic meter
   RIGSL = remedial investigation groundwater screening level protective of indoor air.
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Background PDF by 2DFloorplans.com dated May 2015.

Projection: NAD83 WA State Planes, South Zone, US Foot

30 0 30
Feet

Legend

- H-MW1 — Existing Monitoring Well
- H-WCG-SS3 — Subslab Vapor Sample
- H-WCG-IA4 — Indoor Air Sample
- March 2017 and May 2018 Approximate Lateral Extent of PCE Detected at Concentrations Greater Than RIGSL (5 µg/L)

Indoor Air Results		Subslab Results		
PCE	1.36	PCE	94.2	PCE Concentration in µg/m^3
TCE	0.150	TCE	ND	TCE Concentration in µg/m^3
		PD	0.0	Pressure Differential in Inches of Water

Text highlighted in red indicates detected concentration greater than MTCA Method B indoor air cleanup levels. Concentrations in parenthesis is the adjusted TCE concentration after outdoor air concentraion removed. TCE concentrations were only adjusted if the detected TCE concentration exceeded the MTCA Method B indoor air cleanup level.

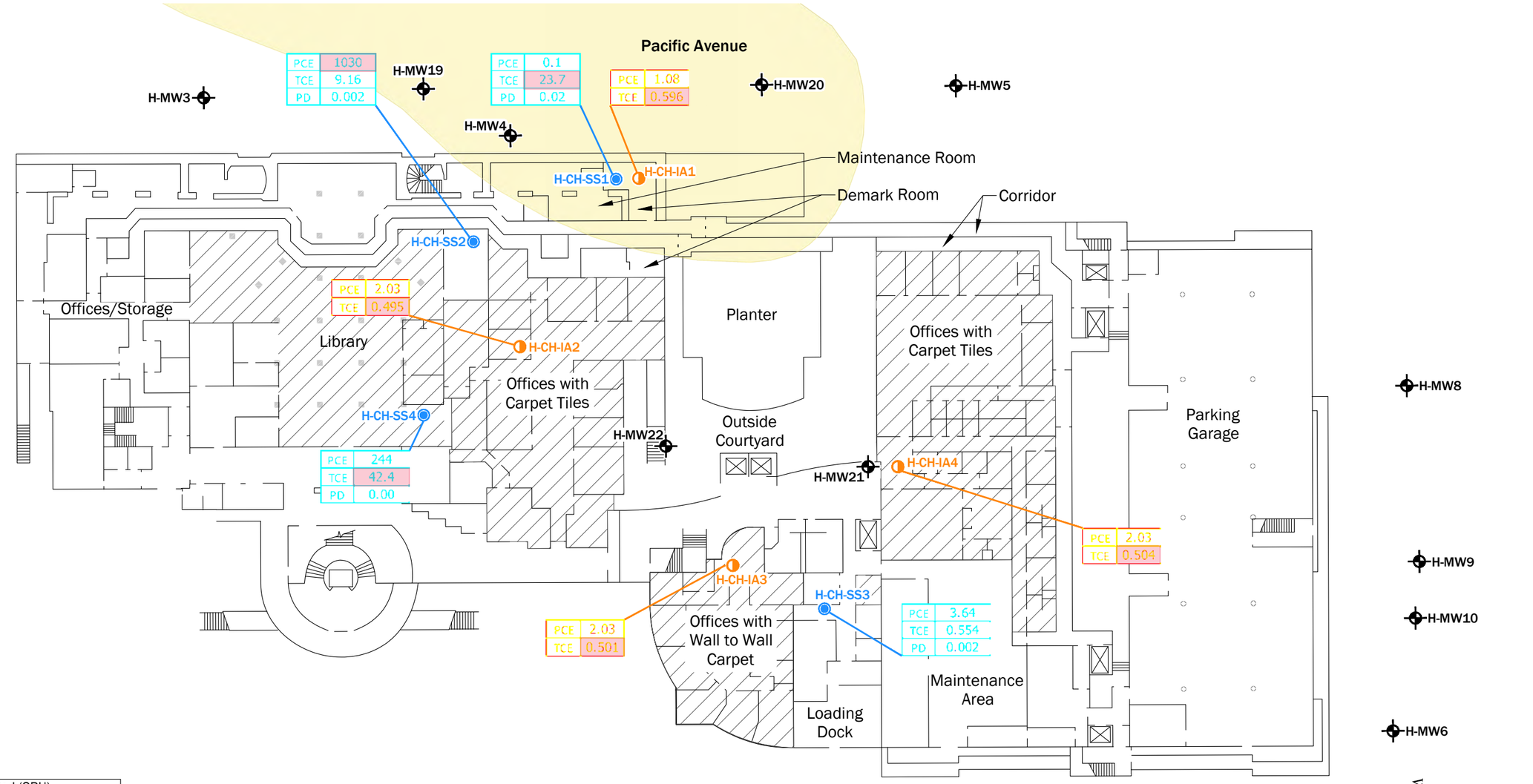
UWT Building Site Plan
Chemical Analytical Results

Howe Vapor Intrusion Investigation
University of Washington - Tacoma
Tacoma, Washington

GeoEngineers

Figure 4

P:\0\0183108\CAD\02\Howe Vapor Intrusion Report\0183108020_F04_UWT Building Site Plan.dwg TAB:F04 Date Exported: 07/25/18 - 12:49 by lkilgore



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Notes:

1. µg/L = micrograms per liter
   µg/m^3 = micrograms per cubic meter
   TCE = trichloroethene
   PCE = tetrachloroethene
   RIGSL = remedial investigation groundwater screening level protective of indoor air.
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Background PDF from URS dated December 2010.

Projection: NAD83 WA State Planes, South Zone, US Feet

Legend

- Elevator
- Stairs
- H-MW3 — Existing Monitoring Well
- H-CH-SS3 — Subslab Vapor Sample
- H-CH-IA4 — Indoor Air Sample
- Areas with Regular Daily Occupancy
- March 2017 and May 2018 Approximate Lateral Extent of PCE Detected at Concentrations Greater Than RIGSL (5 µg/L)

Indoor Air Results

PCE	1.08
TCE	0.596

Subslab Results

PCE	0.1
TCE	23.7
PD	0.02

PCE Concentration in µg/m^3
TCE Concentration in µg/m^3
Pressure Differential in Inches of Water

Text highlighted in red indicates detected concentration greater than MTCA Method B indoor air cleanup levels.

Federal Courthouse Site Plan

Howe Vapor Intrusion Investigation
University of Washington - Tacoma
Tacoma, Washington

GeoEngineers

Figure 5

P:\0183108\CAD\02\Howe Vapor Intrusion Report\0183108O2_F05_Courthouse Site Plan.dwg TAB:F05 Date Exported: 07/25/18 - 12:52 by kkilgore

APPENDIX A
Field Program

APPENDIX A
FIELD PROGRAM

General

Soil vapor probes, sub-slab soil vapor, indoor air and outdoor air samples were collected.

Sub-Slab Soil Vapor Probe Installation

Sub-slab soil vapor samples were collected inside the building using Vapor Pin™ sampling devices. The Vapor Pins™ were installed following the manufacturers' standard operating procedures (SOPs) attached to this appendix. Permanent pins were installed in December 2017.

General installation procedures for the sub-slab sampling device were as follows:

- Checked for buried obstacles (pipes, electrical lines, etc.) prior to proceeding. Applied Professional Services, Inc. completed a private utility locate and cleared the sub-slab soil vapor sample locations.
- Set up vacuum to collect drill cuttings.
- Drilled a 1.5-inch-diameter hole at least 1.75 inches into the slab (November 2017 only).
- Drilled a ⅝-inch-diameter hole through the slab and approximately 1 inch into the underlying soil to form a void.
- Removed the drill bit, brushed the hole with the bottle brush and removed the loose cuttings with the vacuum.
- Placed the lower end of sampling device assembly into the drilled hole. Placed the small hole located in the handle of the extraction/installation tool over the sampling device to protect the barb fitting and cap and tapped the sampling device into place using a dead-blow hammer. Aligned the extraction/installation tool parallel to the sampling device to avoid damaging the barb fitting.
- The silicone sleeve formed a slight bulge between the slab and the sample device shoulder during installation. Placed the protective cap on sampling device to prevent vapor loss prior to sampling.
- Covered the sampling device with a stainless-steel secured cover.
- Allowed at least 60 minutes for the sub-slab soil vapor conditions to equilibrate prior to sampling.

Sub-Slab Soil Vapor Sampling Procedure

The following procedure was followed to collect sub-slab soil vapor samples:

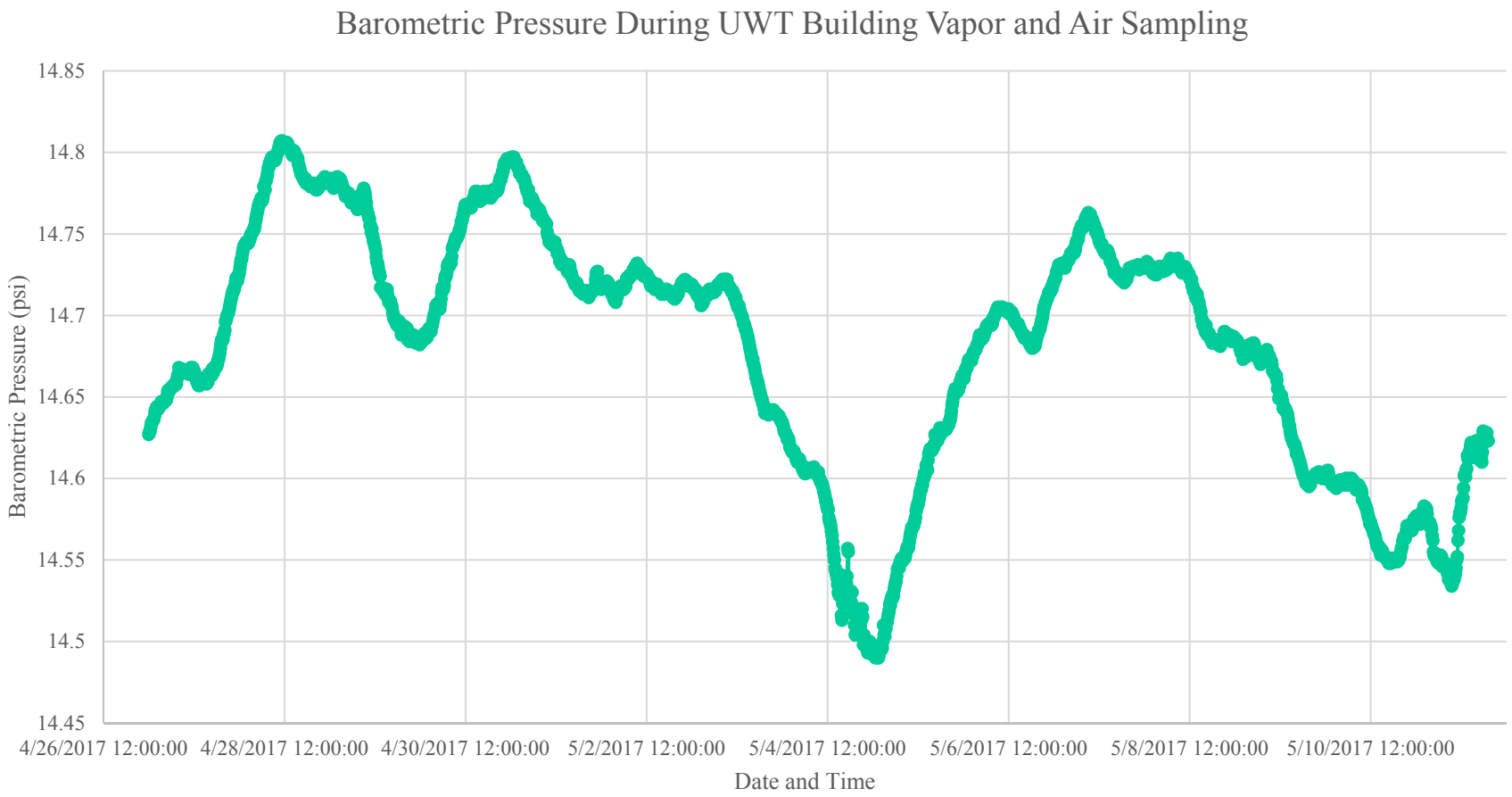
- New fluoropolymer (Teflon®) tubing was connected to the sub-slab soil vapor probe using the barb fitting on the top of the sampling device.
- The tubing (aboveground) was connected to a sampling manifold.
- The sampling manifold was vacuum-tested (shut-in test) by briefly introducing a vacuum to the aboveground portion of the sampling train and checking for loss of vacuum. If vacuum loss was observed, connections and fittings in the sample train were checked and adjusted followed by another vacuum test. This test was repeated until the sampling train demonstrated that tightness was achieved.

- A tracer gas shroud (clear plastic bag) was placed around the entire sample train (that is, the sub-slab soil vapor probe where it enters the ground surface, the 6.0-liter Summa canister and associated tubing and manifold).
    - The shroud was charged (filled) with a tracer gas (spec-grade 99.995 percent helium gas) and the tracer gas concentration within the shroud was measured using a hand-held monitor (Dielectric MGD-2002 Multi-Gas Leak Detector). The hand-held monitor is capable of measuring helium in air to a concentration of 0.5 percent) prior to, during and after completion of the sampling event. A Teflon tube with a ball valve was inserted under the shroud to connect with the compressed helium bottle to charge the shroud. This same tube was used to monitor the helium concentration within the shroud periodically throughout the sampling process. The purpose of the periodic monitoring is to make sure helium is in contact with the sample train and the ground surface while the sub-slab vapor sample is collected.
- The sampling train (aboveground and belowground components) was purged using a vacuum purge pump or a multi-gas meter. Purge volumes were calculated based on the flow rate of the purge pump and the volume of the soil vapor probe and sample train. The helium concentration within the sampling train was measured and recorded after purging three sampling train volumes. If the helium concentration in the sample train is greater than or equal to 5 percent of the helium concentration in the shroud, the bentonite seal was re-applied, fittings were tightened, and the previous purging and measurement tests was repeated (Cal-EPA/DTSC 2015).
- The soil vapor sample was obtained using a 1-liter evacuated Summa canister (with approximately 30 inches of mercury vacuum set by the laboratory) and tedlar bag (helium analysis) with a regulated flow rate of less than or equal to approximately 200 milliliters per minute (DTSC/Cal-EPA 2015). The canister was filled with soil vapor for approximately 5 minutes or until a vacuum equivalent of approximately 5 inches of mercury remains in the Summa canister, whichever comes first. The initial and final canister vacuums were recorded on a soil vapor sampling field form.
- The canisters were provided by a subcontracted analytical laboratory.

Air Sampling Methodology

Indoor and outdoor air samples were obtained by placing a laboratory-supplied evacuated 6-liter Summa canister equipped with an 8-hour flow controller. Tubing was connected to each canister to elevate the sample intake into the breathing zone at approximately 4 to 5 feet above the ground surface. The initial canister pressure start date and start time were recorded on a field data form. The inlet valve on the canister was opened to collect the sample. The canisters were filled until a vacuum equivalent of between 4 and 10 inches of mercury remained in each canister. At that time, the sample team closed the inlet valve and recorded the canister pressure and stop date and time on the field data form. Canisters were then prepared and delivered to the laboratory under chain-of-custody procedures for chemical analysis.

APPENDIX B
Barometric Pressure Graphs



Summary of Barometric Pressure During Federal Courthouse Vapor and Air Sampling

Howe Vapor Intrusion Investigation
Tacoma, Washington

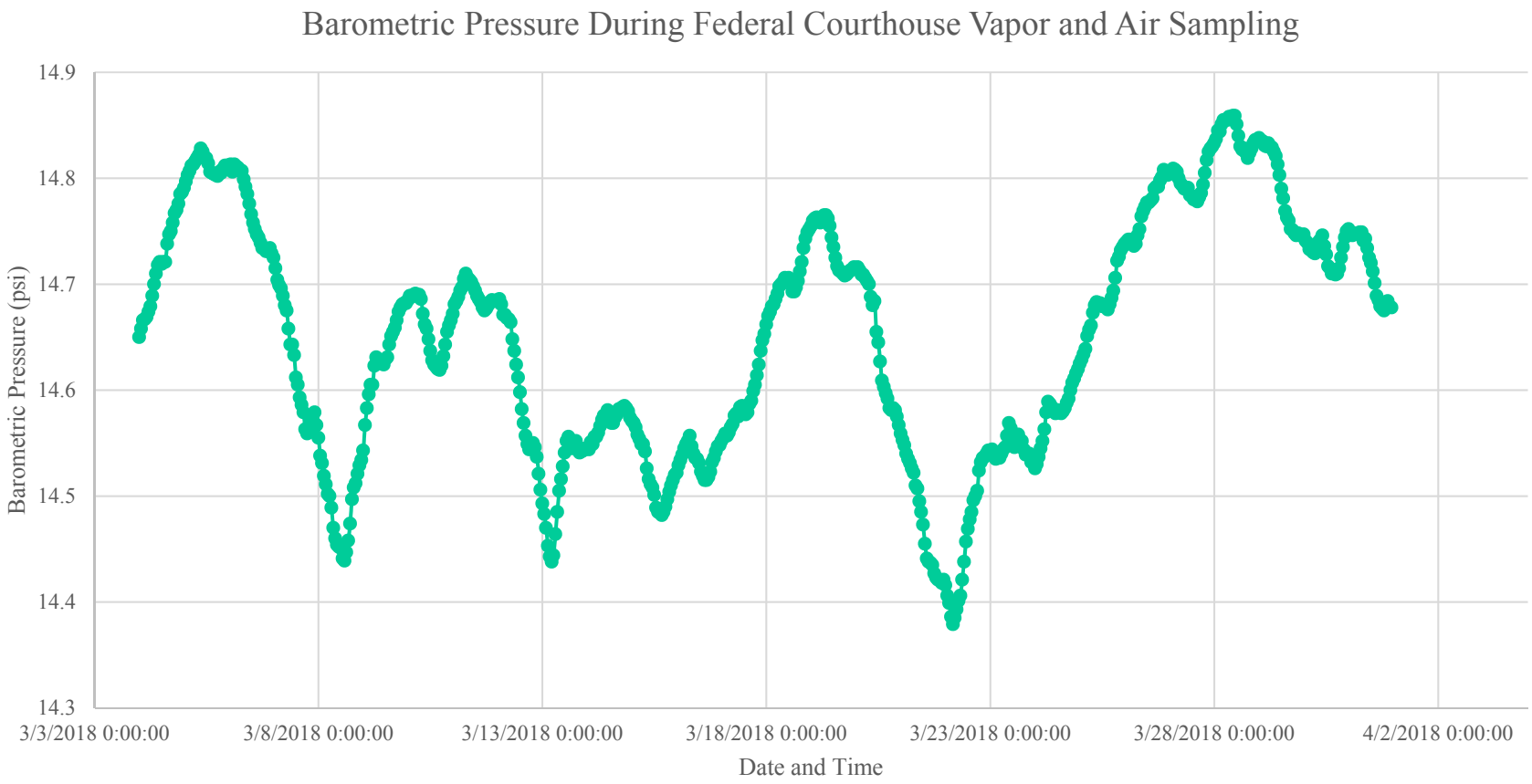
GeoEngineers

Figure B-1

Notes:

Psi = pounds per square inch
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: INW Baroscout in GeoEngineers Tacoma office



Summary of Barometric Pressure During Federal Courthouse Vapor and Air Sampling

Howe Vapor Intrusion Investigation
Tacoma, Washington

GeoEngineers

Figure B-2

Notes:

Psi = pounds per square inch
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
Data Source: INW Baroscout in GeoEngineers Tacoma office

APPENDIX C
Chemical Analytical Program

Data Validation Report

1101 Fawcett Avenue, Suite 200, Tacoma, Washington 98402, Telephone: 253.383.4940, Fax: 253.383.4923 www.geoengineers.com

Project: University of Washington – Tacoma, Howe Vapor Intrusion Evaluation
May 2017 and March 2018 Air Samples

GEI File No: 00183-108-02

Date: April 27, 2018

This report documents the results of a U.S. Environmental Protection Agency (EPA)-defined Stage 2A data validation (EPA Document 540-R-08-005; EPA 2009) of analytical data from the analyses of air samples collected as part of the May 2017 and March 2018 sampling events, and the associated laboratory quality control (QC) samples. The samples were obtained from the former Howe Parcel Site located at 1754 Pacific Avenue on the University of Washington – Tacoma (UWT) campus in Tacoma, Washington.

Objective and Quality Control Elements

GeoEngineers, Inc. (GeoEngineers) completed the data validation consistent with the EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (EPA 2016) (National Functional Guidelines) to determine if the laboratory analytical results meet the project objectives and are usable for their intended purpose. Data usability was assessed by determining if:

- The samples were analyzed using well-defined and acceptable methods that provide reporting limits below applicable regulatory criteria;
- The precision and accuracy of the data are well-defined and sufficient to provide defensible data; and
- The quality assurance/quality control (QA/QC) procedures utilized by the laboratory meet acceptable industry practices and standards.

The laboratory data was reviewed for the following QC elements:

- Data Package Completeness
- Chain-of-Custody Documentation
- Holding Times and Canister Vacuum/Pressure
- Surrogate Recoveries
- Method Blanks
- Matrix Spikes/Matrix Spike Duplicates
- Laboratory Control Samples/Laboratory Control Sample Duplicates
- Laboratory Duplicates

Validated Sample Delivery Groups

This data validation included review of the sample delivery groups (SDGs) listed below in Table 1.

TABLE 1. SUMMARY OF VALIDATED SAMPLE DELIVERY GROUPS

Laboratory SDG	Samples Validated
1705044	H-BB-SS1, H-BHS-SS1, H-BHS-SS2, H-GWR-SS1, H-UT-SS1, H-UT-SS2, H-WCG-SS1
1705073	H-BB, BHS, WCG-OA1, H-BB-IA1, H-BHS-IA1, H-BHS-IA2, H-GWP-IA1, H-GWP-IA2, H-GWP-OA1, H-UT-IA1, H-UT-IA2, H-WCG-IA1, H-WCG-IA2
1803195	H-CH-SS1, H-CH-SS2, H-CH-SS3, H-CH-SS4
1803284	H-CH-IA1, H-CH-IA2, H-CH-IA3, H-CH-IA4, H-CH-OA1, H-CH-OA2, H-CH-OA3

Chemical Analysis Performed

Fremont Analytical, Inc. (Fremont), located in Seattle, Washington, performed laboratory analysis on the air samples using one or more of the following methods:

- Volatile Organic Compounds (VOCs) by Methods EPA TO-15/TO-15-SIM; and
- Helium by Gas Chromatography-Thermal Conductivity Detector (GC-TCD).

Data Validation Summary

The results for each of the QC elements are summarized below.

Data Package Completeness

Fremont provided the required deliverables for the data validation according to the National Functional Guidelines. The laboratory followed adequate corrective action processes and the identified anomalies were discussed in the relevant laboratory case narrative.

Chain-of-Custody Documentation

Chain-of-custody (COC) forms were provided with the laboratory analytical reports. The COCs were accurate and complete when submitted to the laboratory.

Holding Times and Canister Vacuum/Pressure

The sample holding time is defined as the time that elapses between sample collection and sample analysis. Maximum holding time criteria exist for each analysis to help ensure that the analyte concentrations found at the time of analysis reflect the concentration present at the time of sample collection. Established holding times were met for the requested analysis.

The sample canisters are prepared at the laboratory with approximately 30 inches of mercury (inHg) vacuum. In the field, the sample canisters are filled for approximately 30 minutes or until a vacuum equivalent of approximately 5 inHg remains in the sample canister, whichever comes first.

There are two reasons for this:

- The more sample volume collected within the sample canister, the less inert nitrogen air that is added by the laboratory to create a necessary positive pressure within the sample canister (5 pounds per square inch), resulting in less dilution of the sample.
- Allows for determination of leakage (loss of sample volume) from the sample canister between the field and receipt at the laboratory.

The final canister vacuum is recorded in the field and by the laboratory upon receipt. In the field, the final vacuum on the sample canisters were generally between 0 and 12 inHg. At the laboratory, the final vacuum on the sample canisters were generally between 0 and 12 inHg. The final canister vacuums between the field and laboratory readings were acceptable within + or – 5 inHg and no anomalies were identified.

Surrogate Recoveries

A surrogate compound is a compound that is chemically similar to the organic analytes of interest, but unlikely to be found in an environmental sample. Surrogates are used for organic analyses and are added to the samples, standards, and blanks to serve as an accuracy and specificity check of each analysis. The surrogates are added to the samples at a known concentration and percent recoveries are calculated following analysis. The surrogate percent recoveries for field samples were within the laboratory control limits.

Method Blanks

Method blanks are analyzed to ensure that laboratory procedures and reagents do not introduce measurable concentrations of the analytes of interest. A method blank was analyzed with each batch of samples, at a frequency of 1 per 20 samples. For the sample batches, method blanks for the applicable methods were analyzed at the required frequency. None of the analytes of interest were detected above the reporting limits in the method blanks.

Matrix Spikes/Matrix Spike Duplicates

Since the actual analyte concentration in an environmental sample is not known, the accuracy of a particular analysis is usually inferred by performing a matrix spike (MS) analysis on one sample from the associated batch, known as the parent sample. One aliquot of the sample is analyzed in the normal manner and then a second aliquot of the sample is spiked with a known amount of analyte concentration and analyzed. From these analyses, a percent recovery is calculated. Matrix spike duplicate (MSD) analyses are generally performed for organic analyses as a precision check and analyzed in the same sequence as a matrix spike. Using the result values from the MS and MSD, the relative percent difference (RPD) is calculated. The percent recovery control limits for MS and MSD analyses are specified in the laboratory documents, as are the RPD control limits for MS/MSD sample sets.

The laboratory did not perform MS/MSD sample sets because the air sampling method EPA TO-15/TO-15-SIM does not require an internal accuracy and precision test sample aside from the LCS/LCSD.

Laboratory Control Samples/Laboratory Control Sample Duplicates

A laboratory control sample (LCS) is a blank sample that is spiked with a known amount of analyte and then analyzed. An LCS is similar to an MS, but without the possibility of matrix interference. Given that matrix interference is not an issue, the LCS/LCSD control limits for accuracy and precision are usually more rigorous than for MS/MSD analyses. Additionally, data qualification based on LCS/LCSD analyses would apply to the samples in the associated batch, instead of just the parent sample. The percent recovery control limits for LCS and LCSD analyses are specified in the laboratory documents, as are the RPD control limits for LCS/LCSD sample sets.

One LCS/LCSD analysis should be performed for every analytical batch or every 20 field samples, whichever is more frequent. The frequency requirements were met for each analysis and the percent recovery and RPD values were within the proper control limits, with the following exception:

SDG 1803195: (VOCs) The percent recovery for vinyl chloride was greater than the control limits in the LCS extracted on 3/19/2018. The positive result for vinyl chloride was qualified as estimated (J) in Sample H-CH-SS1. There were no positive results for this target analyte in the remaining associated field samples; therefore, no qualifications were required.

Laboratory Duplicates

Internal laboratory duplicate analyses are performed to monitor the precision of the analyses. Two separate aliquots of a sample are analyzed as distinct samples in the laboratory and the RPD between the two results is calculated. Duplicate analyses should be performed once per analytical batch. If one or more of the samples used has a concentration less than five times the reporting limit for that sample, the absolute difference is used instead of the RPD. The RPD control limits are specified in the laboratory documents. Laboratory duplicates were analyzed at the proper frequency and the specified acceptance criteria were met.

Overall Assessment

As was determined by this data validation, the laboratory followed the specified analytical methods. Accuracy was acceptable, as demonstrated by the surrogate and LCS/LCSD percent recovery values, with the exception noted above. Precision was acceptable, as demonstrated by the LCS/LCSD and laboratory duplicate RPD values.

The data are acceptable for the intended use, with the following qualification listed below in Table 2.

TABLE 2. SUMMARY OF QUALIFIED SAMPLES

Sample ID	Analyte	Qualifier	Reason
H-CH-SS1	Vinyl chloride	J	LCS Recovery

References

U.S. Environmental Protection Agency (EPA). Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use. EPA-540-R-08-005. January 2009.

U.S. Environmental Protection Agency (EPA). Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review. EPA-540-R-2016-002. September 2016.

Data Validation Report

1101 Fawcett Avenue, Suite 200, Tacoma, Washington 98402, Telephone: 253.383.4940, Fax: 253.383.4923 www.geoengineers.com

Project: University of Washington – Tacoma, Howe Groundwater Monitoring
March 2018 Groundwater Samples

GEI File No: 00183-108-02

Date: April 27, 2018

This report documents the results of a U.S. Environmental Protection Agency (EPA)-defined Stage 2A data validation (EPA Document 540-R-08-005; EPA 2009) of analytical data from the analyses of groundwater samples collected as part of the March 2018 sampling event, and the associated laboratory and field quality control (QC) samples. The samples were obtained from the former Howe Parcel Site located at 1754 Pacific Avenue on the University of Washington – Tacoma (UWT) campus in Tacoma, Washington.

Objective and Quality Control Elements

GeoEngineers, Inc. (GeoEngineers) completed the data validation consistent with the EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (EPA 2016) (National Functional Guidelines) to determine if the laboratory analytical results meet the project objectives and are usable for their intended purpose. Data usability was assessed by determining if:

- The samples were analyzed using well-defined and acceptable methods that provide reporting limits below applicable regulatory criteria;
- The precision and accuracy of the data are well-defined and sufficient to provide defensible data; and
- The quality assurance/quality control (QA/QC) procedures utilized by the laboratory meet acceptable industry practices and standards.

The laboratory data was reviewed for the following QC elements:

- Data Package Completeness
- Chain-of-Custody Documentation
- Holding Times and Sample Preservation
- Surrogate Recoveries
- Method and Trip Blanks
- Matrix Spikes/Matrix Spike Duplicates
- Laboratory Control Samples/Laboratory Control Sample Duplicates
- Field Duplicates

Validated Sample Delivery Groups

This data validation included review of the sample delivery group (SDG) listed below in Table 1.

TABLE 1. SUMMARY OF VALIDATED SAMPLE DELIVERY GROUPS

Laboratory SDG	Samples Validated
1803-154	H-MW1-180316, H-MW2-180316, H-MW3-180315, H-MW4-180315, H-MW5-180315, H-MW13-180314, H-MW15-180314, H-MW16-180316, DUP1-180316, H-MW17-180316, H-MW18-180316, H-MW19-180315, H-MW20-180315, H-MW21-180314, H-MW22-180314, Trip Blank

Chemical Analysis Performed

OnSite Environmental, Inc. (OnSite), located in Redmond, Washington, performed laboratory analysis on the groundwater samples using one or more of the following methods:

- Volatile Organic Compounds (VOCs) by Method SW8260C; and
- Ethane, Ethene, and Methane (Dissolved Gases) by Method RSK-175.

Data Validation Summary

The results for each of the QC elements are summarized below.

Data Package Completeness

OnSite provided the required deliverables for the data validation according to the National Functional Guidelines, with exception of the laboratory sample receipt form. The laboratory followed adequate corrective action processes and the identified anomalies were discussed in the relevant laboratory case narrative.

Chain-of-Custody Documentation

Chain-of-custody (COC) forms were provided with the laboratory analytical reports. The laboratory did not include the sample receipt forms that discuss anomalies with the samples once they are received by the laboratory. The COCs were accurate and complete when submitted to the laboratory.

Holding Times and Sample Preservation

The sample holding time is defined as the time that elapses between sample collection and sample analysis. Maximum holding time criteria exist for each analysis to help ensure that the analyte concentrations found at the time of analysis reflect the concentration present at the time of sample collection. Established holding times were met for each analysis. The samples were stored at the laboratory at the appropriate temperatures of between two and six degrees Celsius; however, since the laboratory did not include the sample receipt forms, the sample cooler temperatures could not be verified that they were within the control limits upon arrival at the laboratory.

Surrogate Recoveries

A surrogate compound is a compound that is chemically similar to the organic analytes of interest, but unlikely to be found in an environmental sample. Surrogates are used for organic analyses and are added

to the samples, standards, and blanks to serve as an accuracy and specificity check of each analysis. The surrogates are added to the samples at a known concentration and percent recoveries are calculated following analysis. The surrogate percent recoveries for field samples were within the laboratory control limits.

Method and Trip Blanks

Method blanks are analyzed to ensure that laboratory procedures and reagents do not introduce measurable concentrations of the analytes of interest. A method blank was analyzed with each batch of samples, at a frequency of 1 per 20 samples. For the sample batches, method blanks for the applicable methods were analyzed at the required frequency. None of the analytes of interest were detected above the reporting limits in the method blanks.

Trip blanks are analyzed to provide an indication as to whether volatile compounds have cross-contaminated other like samples within the transportation process to the laboratory. None of the target analytes were detected above the reporting limits in the trip blank.

Matrix Spikes/Matrix Spike Duplicates

Since the actual analyte concentration in an environmental sample is not known, the accuracy of a particular analysis is usually inferred by performing a matrix spike (MS) analysis on one sample from the associated batch, known as the parent sample. One aliquot of the sample is analyzed in the normal manner and then a second aliquot of the sample is spiked with a known amount of analyte concentration and analyzed. From these analyses, a percent recovery is calculated. Matrix spike duplicate (MSD) analyses are generally performed for organic analyses as a precision check and analyzed in the same sequence as a matrix spike. Using the result values from the MS and MSD, the relative percent difference (RPD) is calculated. The percent recovery control limits for MS and MSD analyses are specified in the laboratory documents, as are the RPD control limits for MS/MSD sample sets.

There were no MS/MSD analyses performed on the associated field samples.

Laboratory Control Samples/Laboratory Control Sample Duplicates

A laboratory control sample (LCS) is a blank sample that is spiked with a known amount of analyte and then analyzed. An LCS is similar to an MS, but without the possibility of matrix interference. Given that matrix interference is not an issue, the LCS/LCSD control limits for accuracy and precision are usually more rigorous than for MS/MSD analyses. Additionally, data qualification based on LCS/LCSD analyses would apply to the samples in the associated batch, instead of just the parent sample. The percent recovery control limits for LCS and LCSD analyses are specified in the laboratory documents, as are the RPD control limits for LCS/LCSD sample sets.

One LCS/LCSD analysis should be performed for every analytical batch or every 20 field samples, whichever is more frequent. The frequency requirements were met for each analysis and the percent recovery and RPD values were within the proper control limits.

Field Duplicates

In order to assess precision, field duplicate samples are collected and analyzed along with the reviewed sample batches. The duplicate samples are analyzed for the same parameters as the associated parent

samples. Precision is determined by calculating the RPD between each pair of samples. If one or more of the sample analytes has a concentration less than five times the reporting limit for that sample, then the absolute difference is used instead of the RPD. The RPD control limit for water samples is 35 percent.

SDG 1803-154: One field duplicate sample pair, H-MW16-180316 and DUP1-180316, was submitted with this SDG. The precision criteria for the target analytes were met for this sample pair.

Overall Assessment

As was determined by this data validation, the laboratory followed the specified analytical methods. Accuracy was acceptable, as demonstrated by the surrogate and LCS/LCSD percent recovery values. Precision was acceptable, as demonstrated by the LCS/LCSD and field duplicate RPD values.

No analytical results were qualified. The data are acceptable for the intended use.

References

U.S. Environmental Protection Agency (EPA). Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use. EPA-540-R-08-005. January 2009.

U.S. Environmental Protection Agency (EPA). Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review. EPA-540-R-2016-002. September 2016.

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GeoEngineers - Tacoma
Tricia DeOme
1101 S Fawcett Ave
Tacoma, WA 98401

RE: UWT-Howe-VI
Work Order Number: 1705044

May 09, 2017

Attention Tricia DeOme:

Fremont Analytical, Inc. received 7 sample(s) on 5/3/2017 for the analyses presented in the following report.

Helium by GC/TCD
Volatile Organic Compounds by EPA Method TO-15

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

Date: *05/09/2017*

CLIENT: GeoEngineers - Tacoma
Project: UWT-Howe-VI
Work Order: 1705044

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1705044-001	H-BHS-SS2	05/02/2017 8:59 AM	05/03/2017 1:30 PM
1705044-002	H-BHS-SS1	05/02/2017 9:38 AM	05/03/2017 1:30 PM
1705044-003	H-GWR-SS1	05/02/2017 10:17 AM	05/03/2017 1:30 PM
1705044-004	H-BB-SS1	05/02/2017 10:45 AM	05/03/2017 1:30 PM
1705044-005	H-UT-SS1	05/02/2017 11:17 AM	05/03/2017 1:30 PM
1705044-006	H-UT-SS2	05/02/2017 11:43 AM	05/03/2017 1:30 PM
1705044-007	H-WCG-SS1	05/02/2017 12:16 PM	05/03/2017 1:30 PM

Case Narrative

WO#: **1705044**
Date: **5/9/2017**

CLIENT: GeoEngineers - Tacoma
Project: UWT-Howe-VI

WorkOrder Narrative:
I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Air samples are reported in ppbv and ug/m3.

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Standard temperature and pressure assumes 24.45 = (25C and 1 atm).

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

CLIENT: GeoEngineers - Tacoma
Project: UWT-Howe-VI

Lab ID: 1705044-001 **Collection Date:** 5/2/2017 8:59:00 AM
Client Sample ID: **H-BHS-SS2** **Matrix:** Air

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Helium by GC/TCD				Batch ID: R35971		Analyst: WC
Helium	ND	147		ppt	1	5/5/2017 3:53:00 PM

Lab ID: 1705044-002 **Collection Date:** 5/2/2017 9:38:00 AM
Client Sample ID: **H-BHS-SS1** **Matrix:** Air

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Helium by GC/TCD				Batch ID: R35971		Analyst: WC
Helium	ND	275		ppt	1	5/5/2017 4:01:00 PM

Lab ID: 1705044-003 **Collection Date:** 5/2/2017 10:17:00 AM
Client Sample ID: **H-GWR-SS1** **Matrix:** Air

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Helium by GC/TCD				Batch ID: R35971		Analyst: WC
Helium	ND	211		ppt	1	5/5/2017 4:08:00 PM

CLIENT: GeoEngineers - Tacoma
Project: UWT-Howe-VI

Lab ID: 1705044-004 **Collection Date:** 5/2/2017 10:45:00 AM
Client Sample ID: **H-BB-SS1** **Matrix:** Air

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Helium by GC/TCD				Batch ID: R35971		Analyst: WC
Helium	ND	107		ppt	1	5/5/2017 4:13:00 PM

Lab ID: 1705044-005 **Collection Date:** 5/2/2017 11:17:00 AM
Client Sample ID: **H-UT-SS1** **Matrix:** Air

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Helium by GC/TCD				Batch ID: R35971		Analyst: WC
Helium	ND	334		ppt	1	5/5/2017 4:19:00 PM

Lab ID: 1705044-006 **Collection Date:** 5/2/2017 11:43:00 AM
Client Sample ID: **H-UT-SS2** **Matrix:** Air

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Helium by GC/TCD				Batch ID: R35971		Analyst: WC
Helium	ND	204		ppt	1	5/5/2017 4:25:00 PM

Analytical Report

Work Order: **1705044**
Date Reported: **5/9/2017**

CLIENT: GeoEngineers - Tacoma
Project: UWT-Howe-VI

Lab ID: 1705044-007 **Collection Date:** 5/2/2017 12:16:00 PM
Client Sample ID: **H-WCG-SS1** **Matrix:** Air

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Helium by GC/TCD				Batch ID: R35971		Analyst: WC
Helium	ND	180		ppt	1	5/5/2017 4:31:00 PM

Client: **GeoEngineers - Tacoma**
WorkOrder: 1705044
Project: UWT-Howe-VI

Client Sample ID: H-BHS-SS2
Lab ID: 1705044-001A
Sample Type: Summa Canister

Date Sampled: 5/2/2017
Date Received: 5/3/2017

Volatile Organic Compounds by EPA Method TO-15

Analyte	Concentration (ppbv)	Concentration (ug/m³)	Reporting Limit (ppbv)	Reporting Limit (ug/m³)	Qual	Method	Date/Analyst	
1,1-Dichloroethene (DCE)	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
cis-1,2-Dichloroethene	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
Tetrachloroethene (PCE)	13.9	94.2	4.80	32.6		EPA-TO-15	05/05/2017	WC
trans-1,2-Dichloroethene	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
Trichloroethene (TCE)	<0.200	<1.07	0.200	1.07		EPA-TO-15	05/04/2017	WC
Vinyl chloride	<0.200	<0.511	0.200	0.511		EPA-TO-15	05/04/2017	WC
Surr: 4-Bromofluorobenzene	99.4 %Rec	--	70-130	--		EPA-TO-15	05/04/2017	WC

Client: **GeoEngineers - Tacoma**
WorkOrder: 1705044
Project: UWT-Howe-VI

Client Sample ID: H-BHS-SS1
Lab ID: 1705044-002A
Sample Type: Summa Canister

Date Sampled: 5/2/2017
Date Received: 5/3/2017

Volatile Organic Compounds by EPA Method TO-15

Analyte	Concentration (ppbv)	Concentration (ug/m³)	Reporting Limit (ppbv)	Reporting Limit (ug/m³)	Qual	Method	Date/Analyst	
1,1-Dichloroethene (DCE)	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
cis-1,2-Dichloroethene	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
Tetrachloroethene (PCE)	3.29	22.3	0.300	2.03		EPA-TO-15	05/04/2017	WC
trans-1,2-Dichloroethene	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
Trichloroethene (TCE)	<0.200	<1.07	0.200	1.07		EPA-TO-15	05/04/2017	WC
Vinyl chloride	<0.200	<0.511	0.200	0.511		EPA-TO-15	05/04/2017	WC
Surr: 4-Bromofluorobenzene	101 %Rec	--	70-130	--		EPA-TO-15	05/04/2017	WC

Client: **GeoEngineers - Tacoma**
WorkOrder: 1705044
Project: UWT-Howe-VI

Client Sample ID: H-GWR-SS1
Lab ID: 1705044-003A
Sample Type: Summa Canister

Date Sampled: 5/2/2017
Date Received: 5/3/2017

Volatile Organic Compounds by EPA Method TO-15

Analyte	Concentration (ppbv)	Concentration (ug/m³)	Reporting Limit (ppbv)	Reporting Limit (ug/m³)	Qual	Method	Date/Analyst	
1,1-Dichloroethene (DCE)	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
cis-1,2-Dichloroethene	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
Tetrachloroethene (PCE)	10.4	70.6	4.80	32.6		EPA-TO-15	05/05/2017	WC
trans-1,2-Dichloroethene	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
Trichloroethene (TCE)	<0.200	<1.07	0.200	1.07		EPA-TO-15	05/04/2017	WC
Vinyl chloride	<0.200	<0.511	0.200	0.511		EPA-TO-15	05/04/2017	WC
Surr: 4-Bromofluorobenzene	102 %Rec	--	70-130	--		EPA-TO-15	05/04/2017	WC

Client: **GeoEngineers - Tacoma**
WorkOrder: 1705044
Project: UWT-Howe-VI

Client Sample ID: H-BB-SS1
Lab ID: 1705044-004A
Sample Type: Summa Canister

Date Sampled: 5/2/2017
Date Received: 5/3/2017

Volatile Organic Compounds by EPA Method TO-15

Analyte	Concentration (ppbv)	Concentration (ug/m³)	Reporting Limit (ppbv)	Reporting Limit (ug/m³)	Qual	Method	Date/Analyst	
1,1-Dichloroethene (DCE)	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
cis-1,2-Dichloroethene	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
Tetrachloroethene (PCE)	1.54	10.4	0.300	2.03		EPA-TO-15	05/04/2017	WC
trans-1,2-Dichloroethene	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
Trichloroethene (TCE)	<0.200	<1.07	0.200	1.07		EPA-TO-15	05/04/2017	WC
Vinyl chloride	<0.200	<0.511	0.200	0.511		EPA-TO-15	05/04/2017	WC
Surr: 4-Bromofluorobenzene	102 %Rec	--	70-130	--		EPA-TO-15	05/04/2017	WC

Client: **GeoEngineers - Tacoma**
WorkOrder: 1705044
Project: UWT-Howe-VI

Client Sample ID: H-UT-SS1
Lab ID: 1705044-005A
Sample Type: Summa Canister

Date Sampled: 5/2/2017
Date Received: 5/3/2017

Volatile Organic Compounds by EPA Method TO-15

Analyte	Concentration (ppbv)	Concentration (ug/m³)	Reporting Limit (ppbv)	Reporting Limit (ug/m³)	Qual	Method	Date/Analyst	
1,1-Dichloroethene (DCE)	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
cis-1,2-Dichloroethene	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
Tetrachloroethene (PCE)	9.33	63.3	0.300	2.03		EPA-TO-15	05/04/2017	WC
trans-1,2-Dichloroethene	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
Trichloroethene (TCE)	<0.200	<1.07	0.200	1.07		EPA-TO-15	05/04/2017	WC
Vinyl chloride	<0.200	<0.511	0.200	0.511		EPA-TO-15	05/04/2017	WC
Surr: 4-Bromofluorobenzene	100 %Rec	--	70-130	--		EPA-TO-15	05/04/2017	WC

Client: **GeoEngineers - Tacoma**
WorkOrder: 1705044
Project: UWT-Howe-VI

Client Sample ID: H-UT-SS2
Lab ID: 1705044-006A
Sample Type: Summa Canister

Date Sampled: 5/2/2017
Date Received: 5/3/2017

Volatile Organic Compounds by EPA Method TO-15

Analyte	Concentration (ppbv)	Concentration (ug/m³)	Reporting Limit (ppbv)	Reporting Limit (ug/m³)	Qual	Method	Date/Analyst	
1,1-Dichloroethene (DCE)	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
cis-1,2-Dichloroethene	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
Tetrachloroethene (PCE)	19.0	129	4.80	32.6		EPA-TO-15	05/05/2017	WC
trans-1,2-Dichloroethene	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
Trichloroethene (TCE)	<0.200	<1.07	0.200	1.07		EPA-TO-15	05/04/2017	WC
Vinyl chloride	<0.200	<0.511	0.200	0.511		EPA-TO-15	05/04/2017	WC
Surr: 4-Bromofluorobenzene	100 %Rec	--	70-130	--		EPA-TO-15	05/04/2017	WC

Client: **GeoEngineers - Tacoma**
WorkOrder: 1705044
Project: UWT-Howe-VI

Client Sample ID: H-WCG-SS1
Lab ID: 1705044-007A
Sample Type: Summa Canister

Date Sampled: 5/2/2017
Date Received: 5/3/2017

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Volatile Organic Compounds by EPA Method TO-15								
	(ppbv)	(ug/m³)	(ppbv)	(ug/m³)				
1,1-Dichloroethene (DCE)	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
cis-1,2-Dichloroethene	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
Tetrachloroethene (PCE)	4.87	33.1	0.300	2.03		EPA-TO-15	05/04/2017	WC
trans-1,2-Dichloroethene	<0.200	<0.793	0.200	0.793		EPA-TO-15	05/04/2017	WC
Trichloroethene (TCE)	<0.200	<1.07	0.200	1.07		EPA-TO-15	05/04/2017	WC
Vinyl chloride	<0.200	<0.511	0.200	0.511		EPA-TO-15	05/04/2017	WC
Surr: 4-Bromofluorobenzene	102 %Rec	--	70-130	--		EPA-TO-15	05/04/2017	WC

Work Order: 1705044
CLIENT: GeoEngineers - Tacoma
Project: UWT-Howe-VI

QC SUMMARY REPORT

Helium by GC/TCD

Sample ID	**LCS-R35971**	SampType: **LCS**			Units: **ppt**		Prep Date: **5/5/2017**		RunNo: **35971**	
Client ID:	**LCSW**	Batch ID: **R35971**					Analysis Date: **5/5/2017**		SeqNo: **689142**	
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Helium	112	100	100.0	0	112	80	120				

Sample ID	**MB-R35971**	SampType: **MBLK**			Units: **ppt**		Prep Date: **5/5/2017**		RunNo: **35971**	
Client ID:	**MBLKW**	Batch ID: **R35971**					Analysis Date: **5/5/2017**		SeqNo: **689143**	
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Helium	ND	100									

Sample ID	**1705044-001AREP**	SampType: **REP**			Units: **ppt**		Prep Date: **5/5/2017**		RunNo: **35971**	
Client ID:	**H-BHS-SS2**	Batch ID: **R35971**					Analysis Date: **5/5/2017**		SeqNo: **689135**	
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Helium	ND	147						0		30	

Work Order: 1705044
CLIENT: GeoEngineers - Tacoma
Project: UWT-Howe-VI

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method TO-15

Sample ID **LCS-SCAN** SampType: **LCS** Units: **ppbv** Prep Date: **5/3/2017** RunNo: **35944**
Client ID: **LCSW** Batch ID: **R35944** Analysis Date: **5/3/2017** SeqNo: **688574**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	5.17	0.200	5.000	0	103	70	130				
1,1-Dichloroethene (DCE)	4.89	0.200	5.000	0	97.8	70	130				
trans-1,2-Dichloroethene	5.45	0.200	5.000	0	109	70	130				
cis-1,2-Dichloroethene	4.96	0.200	5.000	0	99.2	70	130				
Trichloroethene (TCE)	5.63	0.200	5.000	0	113	70	130				
Tetrachloroethene (PCE)	5.11	0.300	5.000	0	102	70	130				
Surr: 4-Bromofluorobenzene	11.4		10.00		114	70	130				

Sample ID **LCSD-R35944** SampType: **LCSD** Units: **ppbv** Prep Date: **5/4/2017** RunNo: **35944**
Client ID: **LCSW02** Batch ID: **R35944** Analysis Date: **5/4/2017** SeqNo: **688569**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	5.17	0.200	5.000	0	103	70	130	5.167	0.0259	30	
1,1-Dichloroethene (DCE)	4.90	0.200	5.000	0	98.1	70	130	4.891	0.249	30	
trans-1,2-Dichloroethene	4.85	0.200	5.000	0	97.0	70	130	5.449	11.6	30	
cis-1,2-Dichloroethene	4.83	0.200	5.000	0	96.7	70	130	4.960	2.60	30	
Trichloroethene (TCE)	5.40	0.200	5.000	0	108	70	130	5.628	4.08	30	
Tetrachloroethene (PCE)	5.07	0.300	5.000	0	101	70	130	5.107	0.729	30	
Surr: 4-Bromofluorobenzene	10.6		10.00		106	70	130		0		

Sample ID **MB-R35944** SampType: **MBLK** Units: **ppbv** Prep Date: **5/4/2017** RunNo: **35944**
Client ID: **MBLKW** Batch ID: **R35944** Analysis Date: **5/4/2017** SeqNo: **688571**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	ND	0.200									
1,1-Dichloroethene (DCE)	ND	0.200									
trans-1,2-Dichloroethene	ND	0.200									
cis-1,2-Dichloroethene	ND	0.200									
Trichloroethene (TCE)	ND	0.200									
Tetrachloroethene (PCE)	ND	0.300									

Work Order: 1705044
CLIENT: GeoEngineers - Tacoma
Project: UWT-Howe-VI

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method TO-15

Sample ID **MB-R35944** SampType: **MBLK** Units: **ppbv** Prep Date: **5/4/2017** RunNo: **35944**
Client ID: **MBLKW** Batch ID: **R35944** Analysis Date: **5/4/2017** SeqNo: **688571**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Surr: 4-Bromofluorobenzene	9.41		10.00		94.1	70	130				

Sample Log-In Check List

Client Name:	**GEIT**	Work Order Number:	**1705044**
Logged by:	**Clare Griggs**	Date Received:	**5/3/2017 1:30:00 PM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes	☑	No ☐	Not Present	☐
2.	How was the sample delivered?	UPS				

Log In

3.	Coolers are present?	Yes	☐	No ☑	NA	☐
		Air Samples				
4.	Shipping container/cooler in good condition?	Yes	☑	No ☐		
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes	☐	No ☐	Not Required	☑
6.	Was an attempt made to cool the samples?	Yes	☐	No ☐	NA	☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes	☐	No ☐	NA	☑
8.	Sample(s) in proper container(s)?	Yes	☑	No ☐		
9.	Sufficient sample volume for indicated test(s)?	Yes	☑	No ☐		
10.	Are samples properly preserved?	Yes	☑	No ☐		
11.	Was preservative added to bottles?	Yes	☐	No ☑	NA	☐
12.	Is there headspace in the VOA vials?	Yes	☐	No ☐	NA	☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes	☑	No ☐		
14.	Does paperwork match bottle labels?	Yes	☑	No ☐		
15.	Are matrices correctly identified on Chain of Custody?	Yes	☑	No ☐		
16.	Is it clear what analyses were requested?	Yes	☑	No ☐		
17.	Were all holding times able to be met?	Yes	☑	No ☐		

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes	☐	No ☐	NA	☑

Person Notified:		Date	
By Whom:		Via:	☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:			
Client Instructions:			

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Air Chain of Custody Record & Laboratory Services Agreement

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Date: 5/2/17 Page: 1 of: 2

Laboratory Project No (Internal): 1705044

Project Name: UWT-HOWE-VI

Special Remarks: * TO-15 ~~SIM~~ LIST; TCE, PCE, vinyl chloride, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE

Project No: 0183-108-01

Client: GeoEngineers

Address: 1101 S. Fawcett Ave

Location: Tacoma, WA

City, State, Zip: Tacoma, WA, 98402

Collected by: Paul Robinette / Roger Chaney

Telephone: 253-383-0409

Reports to (PM): TRICIA DEDRICK

Fax: 253-383-4923

Email (PM): tdecome@geoengineers.com

Sample Name	Canister / Flow Reg Serial #	Sample Date & Time	Sample Type (Matrix) *	Container Type **	Sample Volume	Fill Time	Flow Rate	Internal: Initial Evacuation Pressure (mtorr)	Field Initial Sample Pressure (" Hg)	Field Final Sample Pressure (" Hg)	Analysis Requested	Internal: Receipt Date	Internal: Final Pressure ("Hg)
1 H-BHS-SS2	4682	5/2	S	CAN	1L	5		10mtorr	28	2	TO-15-~~SIM~~* HELIUM		-3
		859							859	859			
2 H-BHS-SS1	4685	5/2	S	CAN	1L	5		10mtorr	30	6	TO-15-~~SIM~~* HELIUM		-9
		938							938	938			
3 H-GWP-SS1	4879	5/2	S	CAN	1L	5		10mtorr	30	4	TO-15-~~SIM~~* HELIUM		-8
		1017							1017	1022			
4 H-BB-SS1	4680	5/2	S	CAN	1L	4		10mtorr	28	2	TO-15-~~SIM~~* HELIUM		-4
		1045							1045	1049			
5 H-DT-SS1	4683	5/2	S	CAN	1L	3		10mtorr	30	4	TO-15-~~SIM~~* HELIUM		-12 *
		1117							1117	1120			

* Matrix Codes: AA = Ambient Air IA = Indoor Air L = Landfill S = Subslab / Soil Gas

** Container Codes: BV = 1 Liter Bottle Vac CAN = Canister CYL = High Pressure Cylinder F = Filter S = Sorbent Tube TB = Tedlar Bag

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished	Date/Time	Received	Date/Time
x [signature]	5/2/17 1400	x [signature]	5/3/17 1330
Relinquished	Date/Time	Received	Date/Time
x		x	

Turn-Around Time:

- [x] ~~Standard~~
- [ ] 3 Day
- [ ] 2 Day
- [ ] Next Day
- Same Day _____ (specify)

Air Chain of Custody Record & Laboratory Services Agreement

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Date: 5/2/17 Page: 2 of: 2

Project Name: UWT-HOWE-UI

Project No: 0183-108-01

Location: Tacoma, WA

Collected by: Paul Robinette, Roger Chang

Reports to (PM): Tricia DeCime

Email (PM): Tdecime@geoengineers.com

Laboratory Project No (Internal):

Special Remarks:
* TO-15-~~SIM~~, List: TCE, PCE, Vinyl Chloride, 1,1-DCE, cis-1,2-DCE, Trans-1,2-DCE

Client: GeoEngineers

Address: 1101 S Fawcett Ave

City, State, Zip: Tacoma, WA, 98402

Telephone: 253-383-0409

Fax: 253-383-4923

	Sample Name	Canister / Flow Reg Serial #	Sample Date & Time	Sample Type (Matrix) *	Container Type **	Sample Volume	Fill Time	Flow Rate	Internal: Initial Evacuation Pressure (mtorr)	Internal: Field Initial Sample Pressure (" Hg)	Internal: Field Final Sample Pressure (" Hg)	Analysis Requested	Internal: Receipt Date	Internal: Final Pressure ("Hg)
1	H-UT-SS2	4693 /	5/2 1143	S	CAN	1L	5		10mtorr 5/2	>30 1143	4 1148	TO-15-~~SIM~~ * Helium		-5
2	H-WCG-SS1	5023 /	5/2 1216	S	CAN	1L	5		10mtorr 5/2	>30 1216	4 1221	TO-15-~~SIM~~ * Helium		-4
3		4691 /			CAN	1L			10mtorr					-30
4		4905 /			CAN	1L			10mtorr					+30 *
5		4880 /			CAN	1L			10mtorr					-30

* Matrix Codes: AA = Ambient Air IA = Indoor Air L = Landfill S = Subslab / Soil Gas

** Container Codes: BV = 1 Liter Bottle Vac CAN = Canister CYL = High Pressure Cylinder F = Filter S = Sorbent Tube TB = Tedlar Bag

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished	Date/Time	Received	Date/Time
x Roger C	5/2/17 1400	x	5/3/17 1330
Relinquished	Date/Time	Received	Date/Time
x		x	

Turn-Around Time:

- [x] Standard
- [ ] 3 Day
- [ ] 2 Day
- [ ] Next Day
- Same Day _____ (specify)

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

GeoEngineers - Tacoma
Tricia DeOme
1101 S Fawcett Ave
Tacoma, WA 98401

RE: HOWE VI
Work Order Number: 1705073

May 15, 2017

Attention Tricia DeOme:

Fremont Analytical, Inc. received 11 sample(s) on 5/5/2017 for the analyses presented in the following report.

Volatile Organic Compounds-EPA Method TO-15 (SIM)

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

Date: *05/15/2017*

CLIENT: GeoEngineers - Tacoma
Project: HOWE VI
Work Order: 1705073

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1705073-001	H-WCG-IA2	05/03/2017 3:17 PM	05/05/2017 10:47 AM
1705073-002	H-BB, BHS, WCG-OA1	05/03/2017 4:29 PM	05/05/2017 10:47 AM
1705073-003	H-GWP-IA2	05/03/2017 3:36 PM	05/05/2017 10:47 AM
1705073-004	H-BHS-IA1	05/03/2017 2:53 PM	05/05/2017 10:47 AM
1705073-005	H-UT-IA2	05/03/2017 3:08 PM	05/05/2017 10:47 AM
1705073-006	H-GWP-OA1	05/03/2017 4:22 PM	05/05/2017 10:47 AM
1705073-007	H-GWP-IA1	05/03/2017 3:57 PM	05/05/2017 10:47 AM
1705073-008	H-BHS-IA2	05/03/2017 1:10 PM	05/05/2017 10:47 AM
1705073-009	H-WCG-IA1	05/03/2017 3:28 PM	05/05/2017 10:47 AM
1705073-010	H-BB-IA1	05/03/2017 2:57 PM	05/05/2017 10:47 AM
1705073-011	H-UT-IA1	05/03/2017 3:24 PM	05/05/2017 10:47 AM

Case Narrative

WO#: **1705073**
Date: **5/15/2017**

CLIENT: GeoEngineers - Tacoma
Project: HOWE VI

WorkOrder Narrative:
I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Air samples are reported in ppbv and ug/m3.

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Standard temperature and pressure assumes 24.45 = (25C and 1 atm).

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Client: **GeoEngineers - Tacoma**
WorkOrder: 1705073
Project: HOWE VI

Client Sample ID: H-WCG-IA2
Lab ID: 1705073-001A
Sample Type: Summa Canister

Date Sampled: 5/3/2017
Date Received: 5/5/2017

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Volatile Organic Compounds-EPA Method TO-15 (SIM)								
	(ppbv)	(ug/m³)	(ppbv)	(ug/m³)				
1,1-Dichloroethene (DCE)	0.0236	0.0937	0.00900	0.0357		EPA-TO-15SIM	05/12/2017	WC
cis-1,2-Dichloroethene	0.161	0.638	0.0200	0.0793		EPA-TO-15SIM	05/12/2017	WC
Tetrachloroethene (PCE)	0.229	1.55	0.0500	0.339		EPA-TO-15SIM	05/12/2017	WC
trans-1,2-Dichloroethene	0.0399	0.158	0.00600	0.0238		EPA-TO-15SIM	05/12/2017	WC
Trichloroethene (TCE)	0.0306	0.164	0.0170	0.0914		EPA-TO-15SIM	05/12/2017	WC
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	05/12/2017	WC
Surr: 4-Bromofluorobenzene	93.6 %Rec	--	70-130	--		EPA-TO-15SIM	05/12/2017	WC

Client: **GeoEngineers - Tacoma**
WorkOrder: 1705073
Project: HOWE VI

Client Sample ID: H-BB, BHS, WCG-OA1
Lab ID: 1705073-002A
Sample Type: Summa Canister

Date Sampled: 5/3/2017
Date Received: 5/5/2017

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Volatile Organic Compounds-EPA Method TO-15 (SIM)								
	(ppbv)	(ug/m³)	(ppbv)	(ug/m³)				
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	05/12/2017	WC
cis-1,2-Dichloroethene	0.108	0.430	0.0200	0.0793		EPA-TO-15SIM	05/12/2017	WC
Tetrachloroethene (PCE)	0.303	2.06	0.0500	0.339		EPA-TO-15SIM	05/12/2017	WC
trans-1,2-Dichloroethene	0.00928	0.0368	0.00600	0.0238		EPA-TO-15SIM	05/12/2017	WC
Trichloroethene (TCE)	1.32	7.09	0.0170	0.0914		EPA-TO-15SIM	05/12/2017	WC
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	05/12/2017	WC
Surr: 4-Bromofluorobenzene	93.0 %Rec	--	70-130	--		EPA-TO-15SIM	05/12/2017	WC

Client: **GeoEngineers - Tacoma**
WorkOrder: 1705073
Project: HOWE VI

Client Sample ID: H-GWP-IA2
Lab ID: 1705073-003A
Sample Type: Summa Canister

Date Sampled: 5/3/2017
Date Received: 5/5/2017

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Volatile Organic Compounds-EPA Method TO-15 (SIM)								
	(ppbv)	(ug/m³)	(ppbv)	(ug/m³)				
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	05/12/2017	WC
cis-1,2-Dichloroethene	<0.0200	<0.0793	0.0200	0.0793		EPA-TO-15SIM	05/12/2017	WC
Tetrachloroethene (PCE)	0.176	1.19	0.0500	0.339		EPA-TO-15SIM	05/12/2017	WC
trans-1,2-Dichloroethene	<0.00600	<0.0238	0.00600	0.0238		EPA-TO-15SIM	05/12/2017	WC
Trichloroethene (TCE)	0.374	2.01	0.0170	0.0914		EPA-TO-15SIM	05/12/2017	WC
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	05/12/2017	WC
Surr: 4-Bromofluorobenzene	90.8 %Rec	--	70-130	--		EPA-TO-15SIM	05/12/2017	WC

Client: **GeoEngineers - Tacoma**
WorkOrder: 1705073
Project: HOWE VI

Client Sample ID: H-BHS-IA1
Lab ID: 1705073-004A
Sample Type: Summa Canister

Date Sampled: 5/3/2017
Date Received: 5/5/2017

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Volatile Organic Compounds-EPA Method TO-15 (SIM)								
	(ppbv)	(ug/m³)	(ppbv)	(ug/m³)				
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	05/12/2017	WC
cis-1,2-Dichloroethene	<0.0200	<0.0793	0.0200	0.0793		EPA-TO-15SIM	05/12/2017	WC
Tetrachloroethene (PCE)	0.177	1.20	0.0500	0.339		EPA-TO-15SIM	05/12/2017	WC
trans-1,2-Dichloroethene	0.0207	0.0820	0.00600	0.0238		EPA-TO-15SIM	05/12/2017	WC
Trichloroethene (TCE)	<0.0170	<0.0914	0.0170	0.0914		EPA-TO-15SIM	05/12/2017	WC
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	05/12/2017	WC
Surr: 4-Bromofluorobenzene	92.6 %Rec	--	70-130	--		EPA-TO-15SIM	05/12/2017	WC

Client: **GeoEngineers - Tacoma**
WorkOrder: 1705073
Project: HOWE VI

Client Sample ID: H-UT-IA2
Lab ID: 1705073-005A
Sample Type: Summa Canister

Date Sampled: 5/3/2017
Date Received: 5/5/2017

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Analyte	Concentration (ppbv)	Concentration (ug/m³)	Reporting Limit (ppbv)	Reporting Limit (ug/m³)	Qual	Method	Date/Analyst	
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	05/12/2017	WC
cis-1,2-Dichloroethene	0.107	0.426	0.0200	0.0793		EPA-TO-15SIM	05/12/2017	WC
Tetrachloroethene (PCE)	0.242	1.64	0.0500	0.339		EPA-TO-15SIM	05/12/2017	WC
trans-1,2-Dichloroethene	0.0132	0.0522	0.00600	0.0238		EPA-TO-15SIM	05/12/2017	WC
Trichloroethene (TCE)	<0.0170	<0.0914	0.0170	0.0914		EPA-TO-15SIM	05/12/2017	WC
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	05/12/2017	WC
Surr: 4-Bromofluorobenzene	93.6 %Rec	--	70-130	--		EPA-TO-15SIM	05/12/2017	WC

Client: **GeoEngineers - Tacoma**
WorkOrder: 1705073
Project: HOWE VI

Client Sample ID: H-GWP-OA1
Lab ID: 1705073-006A
Sample Type: Summa Canister

Date Sampled: 5/3/2017
Date Received: 5/5/2017

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Volatile Organic Compounds-EPA Method TO-15 (SIM)								
	(ppbv)	(ug/m³)	(ppbv)	(ug/m³)				
1,1-Dichloroethene (DCE)	0.0262	0.104	0.00900	0.0357		EPA-TO-15SIM	05/12/2017	WC
cis-1,2-Dichloroethene	0.137	0.543	0.0200	0.0793		EPA-TO-15SIM	05/12/2017	WC
Tetrachloroethene (PCE)	0.195	1.32	0.0500	0.339		EPA-TO-15SIM	05/12/2017	WC
trans-1,2-Dichloroethene	0.0280	0.111	0.00600	0.0238		EPA-TO-15SIM	05/12/2017	WC
Trichloroethene (TCE)	0.0342	0.184	0.0170	0.0914		EPA-TO-15SIM	05/12/2017	WC
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	05/12/2017	WC
Surr: 4-Bromofluorobenzene	92.0 %Rec	--	70-130	--		EPA-TO-15SIM	05/12/2017	WC

Client: **GeoEngineers - Tacoma**
WorkOrder: 1705073
Project: HOWE VI

Client Sample ID: H-GWP-IA1
Lab ID: 1705073-007A
Sample Type: Summa Canister

Date Sampled: 5/3/2017
Date Received: 5/5/2017

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Analyte	Concentration (ppbv)	Concentration (ug/m³)	Reporting Limit (ppbv)	Reporting Limit (ug/m³)	Qual	Method	Date/Analyst	
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	05/12/2017	WC
cis-1,2-Dichloroethene	0.126	0.500	0.0200	0.0793		EPA-TO-15SIM	05/12/2017	WC
Tetrachloroethene (PCE)	0.200	1.36	0.0500	0.339		EPA-TO-15SIM	05/12/2017	WC
trans-1,2-Dichloroethene	0.0144	0.0569	0.00600	0.0238		EPA-TO-15SIM	05/12/2017	WC
Trichloroethene (TCE)	0.0279	0.150	0.0170	0.0914		EPA-TO-15SIM	05/12/2017	WC
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	05/12/2017	WC
Surr: 4-Bromofluorobenzene	93.6 %Rec	--	70-130	--		EPA-TO-15SIM	05/12/2017	WC

Client: **GeoEngineers - Tacoma**
WorkOrder: 1705073
Project: HOWE VI

Client Sample ID: H-BHS-IA2
Lab ID: 1705073-008A
Sample Type: Summa Canister

Date Sampled: 5/3/2017
Date Received: 5/5/2017

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Volatile Organic Compounds-EPA Method TO-15 (SIM)								
	(ppbv)	(ug/m³)	(ppbv)	(ug/m³)				
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	05/12/2017	WC
cis-1,2-Dichloroethene	0.108	0.427	0.0200	0.0793		EPA-TO-15SIM	05/12/2017	WC
Tetrachloroethene (PCE)	0.180	1.22	0.0500	0.339		EPA-TO-15SIM	05/12/2017	WC
trans-1,2-Dichloroethene	0.0118	0.0469	0.00600	0.0238		EPA-TO-15SIM	05/12/2017	WC
Trichloroethene (TCE)	<0.0170	<0.0914	0.0170	0.0914		EPA-TO-15SIM	05/12/2017	WC
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	05/12/2017	WC
Surr: 4-Bromofluorobenzene	92.9 %Rec	--	70-130	--		EPA-TO-15SIM	05/12/2017	WC

Client: **GeoEngineers - Tacoma**
WorkOrder: 1705073
Project: HOWE VI

Client Sample ID: H-WCG-IA1
Lab ID: 1705073-009A
Sample Type: Summa Canister

Date Sampled: 5/3/2017
Date Received: 5/5/2017

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Volatile Organic Compounds-EPA Method TO-15 (SIM)								
	(ppbv)	(ug/m³)	(ppbv)	(ug/m³)				
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	05/12/2017	WC
cis-1,2-Dichloroethene	0.105	0.416	0.0200	0.0793		EPA-TO-15SIM	05/12/2017	WC
Tetrachloroethene (PCE)	0.249	1.69	0.0500	0.339		EPA-TO-15SIM	05/12/2017	WC
trans-1,2-Dichloroethene	0.0187	0.0741	0.00600	0.0238		EPA-TO-15SIM	05/12/2017	WC
Trichloroethene (TCE)	<0.0170	<0.0914	0.0170	0.0914		EPA-TO-15SIM	05/12/2017	WC
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	05/12/2017	WC
Surr: 4-Bromofluorobenzene	93.1 %Rec	--	70-130	--		EPA-TO-15SIM	05/12/2017	WC

Client: **GeoEngineers - Tacoma**
WorkOrder: 1705073
Project: HOWE VI

Client Sample ID: H-BB-IA1
Lab ID: 1705073-010A
Sample Type: Summa Canister

Date Sampled: 5/3/2017
Date Received: 5/5/2017

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Volatile Organic Compounds-EPA Method TO-15 (SIM)								
	(ppbv)	(ug/m³)	(ppbv)	(ug/m³)				
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	05/12/2017	WC
cis-1,2-Dichloroethene	<0.0200	<0.0793	0.0200	0.0793		EPA-TO-15SIM	05/12/2017	WC
Tetrachloroethene (PCE)	0.210	1.42	0.0500	0.339		EPA-TO-15SIM	05/12/2017	WC
trans-1,2-Dichloroethene	<0.00600	<0.0238	0.00600	0.0238		EPA-TO-15SIM	05/12/2017	WC
Trichloroethene (TCE)	0.965	5.19	0.0170	0.0914		EPA-TO-15SIM	05/12/2017	WC
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	05/12/2017	WC
Surr: 4-Bromofluorobenzene	90.7 %Rec	--	70-130	--		EPA-TO-15SIM	05/12/2017	WC

Client: GeoEngineers - Tacoma
WorkOrder: 1705073
Project: HOWE VI

Client Sample ID: H-UT-IA1
Lab ID: 1705073-011A
Sample Type: Summa Canister

Date Sampled: 5/3/2017
Date Received: 5/5/2017

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Analyte	Concentration (ppbv)	Concentration (ug/m³)	Reporting Limit (ppbv)	Reporting Limit (ug/m³)	Qual	Method	Date/Analyst	
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	05/12/2017	WC
cis-1,2-Dichloroethene	0.131	0.521	0.0200	0.0793		EPA-TO-15SIM	05/12/2017	WC
Tetrachloroethene (PCE)	0.230	1.56	0.0500	0.339		EPA-TO-15SIM	05/12/2017	WC
trans-1,2-Dichloroethene	0.0254	0.101	0.00600	0.0238		EPA-TO-15SIM	05/12/2017	WC
Trichloroethene (TCE)	0.0415	0.223	0.0170	0.0914		EPA-TO-15SIM	05/12/2017	WC
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	05/12/2017	WC
Surr: 4-Bromofluorobenzene	93.9 %Rec	--	70-130	--		EPA-TO-15SIM	05/12/2017	WC

Work Order: 1705073
CLIENT: GeoEngineers - Tacoma
Project: HOWE VI

QC SUMMARY REPORT

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Sample ID **LCS-R36104** SampType: **LCS** Units: **ppbv** Prep Date: **5/12/2017** RunNo: **36104**
Client ID: **LCSW** Batch ID: **R36104** Analysis Date: **5/12/2017** SeqNo: **691550**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	2.19	0.0850	2.500	0	87.7	70	130				
1,1-Dichloroethene (DCE)	2.44	0.00900	2.500	0	97.7	70	130				
trans-1,2-Dichloroethene	2.34	0.00600	2.500	0	93.5	70	130				
cis-1,2-Dichloroethene	2.58	0.0200	2.500	0	103	70	130				
Trichloroethene (TCE)	2.58	0.0170	2.500	0	103	70	130				
Tetrachloroethene (PCE)	2.46	0.0500	2.500	0	98.5	70	130				
Surr: 4-Bromofluorobenzene	10.2		10.00		102	70	130				

Sample ID **MB-R36104** SampType: **MBLK** Units: **ppbv** Prep Date: **5/12/2017** RunNo: **36104**
Client ID: **MBLKW** Batch ID: **R36104** Analysis Date: **5/12/2017** SeqNo: **691551**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	ND	0.0850									
1,1-Dichloroethene (DCE)	ND	0.00900									
trans-1,2-Dichloroethene	ND	0.00600									
cis-1,2-Dichloroethene	ND	0.0200									
Trichloroethene (TCE)	ND	0.0170									
Tetrachloroethene (PCE)	ND	0.0500									
Surr: 4-Bromofluorobenzene	9.19		10.00		91.9	70	130				

Sample ID **1705073-011AREP** SampType: **REP** Units: **ppbv** Prep Date: **5/13/2017** RunNo: **36104**
Client ID: **H-UT-IA1** Batch ID: **R36104** Analysis Date: **5/13/2017** SeqNo: **691882**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	ND	0.0850						0		30	
1,1-Dichloroethene (DCE)	ND	0.00900						0		30	
trans-1,2-Dichloroethene	0.0285	0.00600						0.02543	11.5	30	
cis-1,2-Dichloroethene	0.131	0.0200						0.1314	0.229	30	
Trichloroethene (TCE)	0.0427	0.0170						0.04148	2.88	30	
Tetrachloroethene (PCE)	0.232	0.0500						0.2295	1.11	30	

Work Order: 1705073
CLIENT: GeoEngineers - Tacoma
Project: HOWE VI

QC SUMMARY REPORT

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Sample ID **1705073-011AREP** SampType: **REP** Units: **ppbv** Prep Date: **5/13/2017** RunNo: **36104**
Client ID: **H-UT-IA1** Batch ID: **R36104** Analysis Date: **5/13/2017** SeqNo: **691882**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Surr: 4-Bromofluorobenzene	9.49		10.00		94.9	70	130		0		

Sample Log-In Check List

Client Name:	**GEIT**	Work Order Number:	**1705073**
Logged by:	**Erica Silva**	Date Received:	**5/5/2017 10:47:00 AM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Courier		

Log In

3.	Coolers are present?	Yes ☐	No ☑	NA ☐
		Air samples		
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Required ☑
6.	Was an attempt made to cool the samples?	Yes ☐	No ☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes ☐	No ☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
9.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
10.	Are samples properly preserved?	Yes ☑	No ☐	
11.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
14.	Does paperwork match bottle labels?	Yes ☑	No ☐	
15.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
16.	Is it clear what analyses were requested?	Yes ☑	No ☐	
17.	Were all holding times able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes ☐	No ☐	NA ☑

Person Notified:		Date	
By Whom:		Via:	☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:			
Client Instructions:			

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Air Chain of Custody Record & Laboratory Services Agreement

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Date: 5/3/17 Page: 1 of: 4

Laboratory Project No (Internal): 1705073

Special Remarks: * VOC LIST: TCE, PCE, vinyl chloride, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE

Client: GeoEngineers
Address: 1101 S. FAWCETT #200
City, State, Zip: TACOMA, WA 98402
Telephone: 253-383-4940
Fax: 253-383-4923

Project Name:
Project No: 0183-108-01
Location: TACOMA, WA
Collected by: PAUL ROBICHETTE
Reports to (PM): TRICIA DEDOMENICO
Email (PM): tdedomenico@geoengineers.com

Sample Name	Canister / Flow Reg Serial #	Sample Date & Time	Sample Type (Matrix) *	Container Type **	Sample Volume	Fill Time	Flow Rate	Internal: Initial Evacuation Pressure (mtorr)	Field Initial Sample Pressure (" Hg)	Field Final Sample Pressure (" Hg)	Analysis Requested	Internal: Receipt Date	Internal: Final Pressure ("Hg)
1 H-WCG-IA2	17235	5/3	IA	CAN	6L	8:11		10mtorr	-30	-5	EPA-TO-15-SIM*	5/5/17	-4
	FR8-21	1517							754	157			
2 H-BB, BHS, WCG-OA1	12671	5/3	AA	CAN	6L	7:15		10mtorr	-30	-4	EPA-TO-15-SIM*	5/5/17	-4
	FR8-25	1629							914	162			
3 H-GWP-IA2	12669	5/3	IA	CAN	6L	7:03		10mtorr	-30	-4	EPA-TO-15-SIM*	5/5/17	-4
	FR8-27	1536							833	1536			
4 H-BHS-IA1	12672	5/3	IA	CAN	6L	6:55		10mtorr	-28	-5	EPA-TO-15-SIM*	5/5/17	-4
	FR8-12	1453							756	1453			
5 H-DT-IA2	15899	5/3	IA	CAN	6L	7:20		10mtorr	-30	-6	EPA-TO-75-SIM*	5/5/17	-4
	FR8-31	1508							748	1508			

* Matrix Codes: AA = Ambient Air IA = Indoor Air L = Landfill S = Subslab / Soil Gas

** Container Codes: BV = 1 Liter Bottle Vac CAN = Canister CYL = High Pressure Cylinder F = Filter S = Sorbent Tube TB = Tedlar Bag

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished: x [signature] Date/Time: 5/4 0900
Relinquished: x Date/Time:

Received: x [signature] Date/Time: 5/5/17 1047
Received: x Date/Time:

Turn-Around Time:
- [X] Standard
- [ ] 3 Day
- [ ] 2 Day
- [ ] Next Day
- Same Day _____ (specify)

Air Chain of Custody Record & Laboratory Services Agreement

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Date: 5/3/17 Page: 2 of: 4

Laboratory Project No (Internal): 1705073

Project Name: HOWE VI

Special Remarks: * VOC LIST: TCE, PCE, vinyl chloride, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE

Client: GeoEngineers

Project No: 0183-108-01

Address: 1101 S. FAWCETT #200

Location: TACOMA, WA

City, State, Zip: TACOMA, WA 98402

Collected by: PAUL ROBINETTE

Telephone: 253-383-4940

Reports to (PM): TRICA DEDOME

Fax: 253-383-4923

Email (PM): tdedome@geoengineers.com

Sample Name	Canister / Flow Reg Serial #	Sample Date & Time	Sample Type (Matrix) *	Container Type **	Sample Volume	Fill Time	Flow Rate	Internal: Initial Evacuation Pressure (mtorr)	Internal: Field Initial Sample Pressure ("Hg)	Internal: Field Final Sample Pressure ("Hg)	Analysis Requested	Internal: Receipt Date	Internal: Final Pressure ("Hg)
1 H-GWP-OA1	13966	5/3	AA	CAN	6L	7:18		10mtorr	-30	-5	EPA-TO-15-SIM*	5/5/17	-4
	FV3	1622							904	1622			
2 H-GWP-IA1	10944	5/3	IA	CAN	6L	7:19		10mtorr	-30	-4	EPA-TO-15-SIM*	5/5/17	-5
	FR8-08	1557							838	1557			
3 H-BHS-IA2	17639	5/3	IA	CAN	6L	5:10		10mtorr	-24	-4	EPA-TO-15-SIM*	5/5/17	-5
	FR8-30	1310							800	1310			
4 H-WCG-IA1	17237	5/3	IA	CAN	6L	7:22		10mtorr	-30	-4	EPA-TO-15-SIM*	5/5/17	-5
	FR8-6	1528							806	1528			
5 not used	15422	-		CAN	6L			10mtorr				5/5/17	-30
	FR8-11												

* Matrix Codes: AA = Ambient Air IA = Indoor Air L = Landfill S = Subslab / Soil Gas

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Relinquished	Date/Time	Received	Date/Time
x [signature]	5/4/17 0900	x [signature]	5/5/17 1047
Relinquished	Date/Time	Received	Date/Time
x		x	

Turn-Around Time:

- [x] Standard
- [ ] 3 Day
- [ ] 2 Day
- [ ] Next Day
- Same Day _____ (specify)

Air Chain of Custody Record & Laboratory Services Agreement

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Date: 5/3/17 Page: 3 of: 4

Laboratory Project No (Internal): 1705073

Project Name: HOWE VI

Special Remarks: *VOC LIST: TCE, PCE, vinyl chloride, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE

Client: GeoEngineers

Project No: 0183-108-01

Address: 1101 S. FAWCETT #200

Location: TACOMA, WA

City, State, Zip: TACOMA, WA 98402

Collected by: PAUL ROBICHETTE

Telephone: 253.383-4940

Reports to (PM): TRICIA DEDOMENICO

Fax: 253.383-4923

Email (PM): tdedomenico@geoengineers.com

Sample Name	Canister / Flow Reg Serial #	Sample Date & Time	Sample Type (Matrix) *	Container Type **	Sample Volume	Fill Time	Flow Rate	Internal: Initial Evacuation Pressure (mtorr)	Field Initial Sample Pressure (" Hg)	Field Final Sample Pressure (" Hg)	Analysis Requested	Internal: Receipt Date	Internal: Final Pressure ("Hg)
1 NOT USED	17644 / FR8-18			CAN	6L			10mtorr				5/5/17	-30
2 NOT USED	17240 / FR8-22			CAN	6L			10mtorr	Ø / 0730	Ø / 0730		5/5/17	-2
3 H-BB-IA1	17241 / FR8-3	5/3 / 1457	IA	CAN	6L	7:28		10mtorr	-30 / 729	-4 / 1457	EPA-TO-15 SIMS *	5/5/17	-4
4 NOT USED	13968 / FR8-13			CAN	6L			10mtorr				5/5/17	0
5 NOT USED	15900 / FR8-07			CAN	6L			10mtorr				5/5/17	-2

* Matrix Codes: AA = Ambient Air IA = Indoor Air L = Landfill S = Subslab / Soil Gas

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Relinquished	Date/Time	Received	Date/Time
x [signature]	5/4 0900	x [signature]	5/5/17 1047
Relinquished	Date/Time	Received	Date/Time
x		x	

Turn-Around Time:

- [x] Standard
- [ ] 3 Day
- [ ] 2 Day
- [ ] Next Day
- Same Day _____ (specify)

Air Chain of Custody Record & Laboratory Services Agreement

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Date: 5/3/17 Page: 4 of: 4

Laboratory Project No (Internal): 1705073

Project Name: HOUSE VI

Special Remarks: *VOC LIST: TCE, PCE, vinyl chloride, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE

Project No: 0193-108-01

Location: TACOMA, WA

Collected by: PAUL ROBINETTE

Reports to (PM): TRICIA DeBOER

Email (PM): tdeboer@geoengineers.com

Client: GeoEngineers

Address: 1101 S. FAWCETT #200

City, State, Zip: TACOMA, WA 98402

Telephone: 253-383-4940

Fax: 253-383-4923

	Sample Name	Canister / Flow Reg Serial #	Sample Date & Time	Sample Type (Matrix) *	Container Type **	Sample Volume	Fill Time	Flow Rate	Internal: Initial Evacuation Pressure (mtorr)	Field Initial Sample Pressure (" Hg)	Field Final Sample Pressure (" Hg)	Analysis Requested	Internal: Receipt Date	Internal: Final Pressure ("Hg)
1	H-UT-IA1	17238	5/3	IA	CAN	6L	7:41		10mtorr	-30	-5	EPA-TO-15-SIM*	5/5/17	-4
		FR8-15	1524							743	1524			
2														
3														
4														
5														

* Matrix Codes: AA = Ambient Air IA = Indoor Air L = Landfill S = Subslab / Soil Gas

** Container Codes: BV = 1 Liter Bottle Vac CAN = Canister CYL = High Pressure Cylinder F = Filter S = Sorbent Tube TB = Tedlar Bag

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Relinquished	Date/Time	Received	Date/Time
x Paul Robinette	5/4 0900	x	
Relinquished	Date/Time	Received	Date/Time
x		x	5/5/17 1047

Turn-Around Time:

- ☐ Standard
- ☐ 3 Day
- ☐ 2 Day
- ☐ Next Day
- Same Day _____ (specify)

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

GeoEngineers
Tricia DeOme
600 Stewart Street, Suite 1700
Seattle, WA 98101

RE: UWT-Howe
Work Order Number: 1803195

March 20, 2018

Attention Tricia DeOme:

Fremont Analytical, Inc. received 4 sample(s) on 3/16/2018 for the analyses presented in the following report.

Helium by GC/TCD
Volatile Organic Compounds-EPA Method TO-15 (SIM)

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

Date: *03/20/2018*

CLIENT: GeoEngineers
Project: UWT-Howe
Work Order: 1803195

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1803195-001	H-CH-SS4	03/15/2018 8:32 AM	03/16/2018 2:04 PM
1803195-002	H-CH-SS2	03/15/2018 8:53 AM	03/16/2018 2:04 PM
1803195-003	H-CH-SS1	03/15/2018 8:05 AM	03/16/2018 2:04 PM
1803195-004	H-CH-SS3	03/15/2018 9:24 AM	03/16/2018 2:04 PM

Case Narrative

WO#: **1803195**
Date: **3/20/2018**

CLIENT: GeoEngineers
Project: UWT-Howe

WorkOrder Narrative:
I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Air samples are reported in ppbv and ug/m3.

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Standard temperature and pressure assumes 24.45 = (25C and 1 atm).

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

CLIENT: GeoEngineers
Project: UWT-Howe

Lab ID: 1803195-001 **Collection Date:** 3/15/2018 8:32:00 AM
Client Sample ID: **H-CH-SS4** **Matrix:** Air

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Helium by GC/TCD				Batch ID: R42326		Analyst: BT
Helium	ND	180	D	ppt	1.8	3/20/2018 1:30:00 PM

Lab ID: 1803195-002 **Collection Date:** 3/15/2018 8:53:00 AM
Client Sample ID: **H-CH-SS2** **Matrix:** Air

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Helium by GC/TCD				Batch ID: R42326		Analyst: BT
Helium	ND	140	D	ppt	1.4	3/20/2018 1:37:00 PM

Lab ID: 1803195-003 **Collection Date:** 3/15/2018 8:05:00 AM
Client Sample ID: **H-CH-SS1** **Matrix:** Air

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Helium by GC/TCD				Batch ID: R42326		Analyst: BT
Helium	ND	160	D	ppt	1.6	3/20/2018 1:52:00 PM

Analytical Report

Work Order: **1803195**
Date Reported: **3/20/2018**

CLIENT: GeoEngineers
Project: UWT-Howe

Lab ID: 1803195-004 **Collection Date:** 3/15/2018 9:24:00 AM
Client Sample ID: **H-CH-SS3** **Matrix:** Air

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Helium by GC/TCD				Batch ID: R42326		Analyst: BT
Helium	60.9	220	JD	ppt	2.2	3/20/2018 2:02:00 PM

Client: **GeoEngineers**
WorkOrder: 1803195
Project: UWT-Howe

Client Sample ID: H-CH-SS4
Lab ID: 1803195-001A
Sample Type: Summa Canister

Date Sampled: 3/15/2018
Date Received: 3/16/2018

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Analyte	Concentration (ppbv)	Concentration (ug/m³)	Reporting Limit (ppbv)	Reporting Limit (ug/m³)	Qual	Method	Date/Analyst	
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	03/19/2018	BT
cis-1,2-Dichloroethene	0.912	3.61	0.0200	0.0793		EPA-TO-15SIM	03/19/2018	BT
Tetrachloroethene (PCE)	36.0	244	0.500	3.39	I	EPA-TO-15SIM	03/19/2018	BT
trans-1,2-Dichloroethene	<0.00600	<0.0238	0.00600	0.0238		EPA-TO-15SIM	03/19/2018	BT
Trichloroethene (TCE)	7.88	42.4	0.0170	0.0914		EPA-TO-15SIM	03/19/2018	BT
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	03/19/2018	BT
Surr: 4-Bromofluorobenzene	109 %Rec	--	70-130	--		EPA-TO-15SIM	03/19/2018	BT

NOTES:
I - Indicates an analyte with an internal standard that does not meet established acceptance criteria.

Client: **GeoEngineers**
WorkOrder: 1803195
Project: UWT-Howe

Client Sample ID: H-CH-SS2
Lab ID: 1803195-002A
Sample Type: Summa Canister

Date Sampled: 3/15/2018
Date Received: 3/16/2018

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Volatile Organic Compounds-EPA Method TO-15 (SIM)								
	(ppbv)	(ug/m³)	(ppbv)	(ug/m³)				
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	03/19/2018	BT
cis-1,2-Dichloroethene	0.0370	0.147	0.0200	0.0793		EPA-TO-15SIM	03/19/2018	BT
Tetrachloroethene (PCE)	152	1,030	0.500	3.39	I	EPA-TO-15SIM	03/20/2018	BT
trans-1,2-Dichloroethene	<0.00600	<0.0238	0.00600	0.0238		EPA-TO-15SIM	03/19/2018	BT
Trichloroethene (TCE)	1.71	9.16	0.0170	0.0914		EPA-TO-15SIM	03/19/2018	BT
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	03/19/2018	BT
Surr: 4-Bromofluorobenzene	113 %Rec	--	70-130	--		EPA-TO-15SIM	03/19/2018	BT

NOTES:
I - Indicates an analyte with an internal standard that does not meet established acceptance criteria.

Client: **GeoEngineers**
WorkOrder: 1803195
Project: UWT-Howe

Client Sample ID: H-CH-SS1
Lab ID: 1803195-003A
Sample Type: Summa Canister

Date Sampled: 3/15/2018
Date Received: 3/16/2018

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Analyte	Concentration (ppbv)	Concentration (ug/m³)	Reporting Limit (ppbv)	Reporting Limit (ug/m³)	Qual	Method	Date/Analyst	
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	03/19/2018	BT
cis-1,2-Dichloroethene	8.39	33.3	0.0200	0.0793		EPA-TO-15SIM	03/19/2018	BT
Tetrachloroethene (PCE)	2.96	20.1	0.0500	0.339		EPA-TO-15SIM	03/19/2018	BT
trans-1,2-Dichloroethene	<0.00600	<0.0238	0.00600	0.0238		EPA-TO-15SIM	03/19/2018	BT
Trichloroethene (TCE)	4.41	23.7	0.0170	0.0914		EPA-TO-15SIM	03/19/2018	BT
Vinyl chloride	0.162	0.413	0.0850	0.217	*	EPA-TO-15SIM	03/19/2018	BT
Surr: 4-Bromofluorobenzene	113 %Rec	--	70-130	--		EPA-TO-15SIM	03/19/2018	BT

NOTES:
* - Flagged value is not within established control limits.

Client: **GeoEngineers**
WorkOrder: 1803195
Project: UWT-Howe

Client Sample ID: H-CH-SS3
Lab ID: 1803195-004A
Sample Type: Summa Canister

Date Sampled: 3/15/2018
Date Received: 3/16/2018

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Analyte	Concentration (ppbv)	Concentration (ug/m³)	Reporting Limit (ppbv)	Reporting Limit (ug/m³)	Qual	Method	Date/Analyst	
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	03/19/2018	BT
cis-1,2-Dichloroethene	0.0280	0.111	0.0200	0.0793		EPA-TO-15SIM	03/19/2018	BT
Tetrachloroethene (PCE)	0.536	3.64	0.0500	0.339		EPA-TO-15SIM	03/19/2018	BT
trans-1,2-Dichloroethene	<0.00600	<0.0238	0.00600	0.0238		EPA-TO-15SIM	03/19/2018	BT
Trichloroethene (TCE)	0.103	0.554	0.0170	0.0914		EPA-TO-15SIM	03/19/2018	BT
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	03/19/2018	BT
Surr: 4-Bromofluorobenzene	112 %Rec	--	70-130	--		EPA-TO-15SIM	03/19/2018	BT

Work Order: 1803195
CLIENT: GeoEngineers
Project: UWT-Howe

QC SUMMARY REPORT

Helium by GC/TCD

Sample ID	**LCS-R42326**	SampType: **LCS**			Units: **ppt**		Prep Date: **3/20/2018**		RunNo: **42326**	
Client ID:	**LCSW**	Batch ID: **R42326**					Analysis Date: **3/20/2018**		SeqNo: **816194**	
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Helium	113	100	100.0	0	113	80	120				

Sample ID	**MBLK-R42326**	SampType: **MBLK**			Units: **ppt**		Prep Date: **3/20/2018**		RunNo: **42326**	
Client ID:	**MBLKW**	Batch ID: **R42326**					Analysis Date: **3/20/2018**		SeqNo: **816193**	
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Helium	ND	100									

Sample ID	**1803195-004AREP**	SampType: **REP**			Units: **ppt**		Prep Date: **3/20/2018**		RunNo: **42326**	
Client ID:	**H-CH-SS3**	Batch ID: **R42326**					Analysis Date: **3/20/2018**		SeqNo: **816195**	
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Helium	60.5	220						0		30	JD

Work Order: 1803195
CLIENT: GeoEngineers
Project: UWT-Howe

QC SUMMARY REPORT

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Sample ID **LCS SIM 2PPBV-R4232** SampType: **LCS** Units: **ppbv** Prep Date: **3/19/2018** RunNo: **42322**
Client ID: **LCSW** Batch ID: **R42322** Analysis Date: **3/19/2018** SeqNo: **816168**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	3.01	0.0850	2.000	0	150	70	130				S
1,1-Dichloroethene (DCE)	2.26	0.00900	2.000	0	113	70	130				
trans-1,2-Dichloroethene	2.12	0.00600	2.000	0	106	70	130				
cis-1,2-Dichloroethene	2.15	0.0200	2.000	0	107	70	130				
Trichloroethene (TCE)	2.42	0.0170	2.000	0	121	70	130				
Tetrachloroethene (PCE)	2.37	0.0500	2.000	0	118	70	130				
Surr: 4-Bromofluorobenzene	4.58		4.000		115	70	130				

NOTES:
S - Outlying spike recovery observed (high bias). Detections will be qualified with a *.

Sample ID **MBLK SIM-R42322** SampType: **MBLK** Units: **ppbv** Prep Date: **3/19/2018** RunNo: **42322**
Client ID: **MBLKW** Batch ID: **R42322** Analysis Date: **3/19/2018** SeqNo: **816169**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	ND	0.0850									
1,1-Dichloroethene (DCE)	ND	0.00900									
trans-1,2-Dichloroethene	ND	0.00600									
cis-1,2-Dichloroethene	ND	0.0200									
Trichloroethene (TCE)	ND	0.0170									
Tetrachloroethene (PCE)	ND	0.0500									
Surr: 4-Bromofluorobenzene	3.75		4.000		93.8	70	130				

Sample ID **1803195-004AREP** SampType: **REP** Units: **ppbv** Prep Date: **3/19/2018** RunNo: **42322**
Client ID: **H-CH-SS3** Batch ID: **R42322** Analysis Date: **3/19/2018** SeqNo: **816174**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	ND	0.0850						0		30	
1,1-Dichloroethene (DCE)	ND	0.00900						0		30	
trans-1,2-Dichloroethene	ND	0.00600						0		30	
cis-1,2-Dichloroethene	0.0276	0.0200						0.02795	1.33	30	
Trichloroethene (TCE)	0.109	0.0170						0.1031	5.47	30	

Work Order: 1803195
CLIENT: GeoEngineers
Project: UWT-Howe

QC SUMMARY REPORT

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Sample ID **1803195-004AREP** SampType: **REP** Units: **ppbv** Prep Date: **3/19/2018** RunNo: **42322**
Client ID: **H-CH-SS3** Batch ID: **R42322** Analysis Date: **3/19/2018** SeqNo: **816174**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Tetrachloroethene (PCE)	0.563	0.0500						0.5364	4.80	30	
Surr: 4-Bromofluorobenzene	4.55		4.000		114	70	130		0		

Sample ID **1803195-001AREP** SampType: **REP** Units: **ppbv** Prep Date: **3/20/2018** RunNo: **42322**
Client ID: **H-CH-SS4** Batch ID: **R42322** Analysis Date: **3/20/2018** SeqNo: **816176**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Tetrachloroethene (PCE)	47.1	0.500						35.96	26.8	30	I

NOTES:
I - Indicates an analyte with an internal standard that does not meet established acceptance criteria.

Sample Log-In Check List

Client Name:	**GEI**	Work Order Number:	**1803195**
Logged by:	**Clare Griggs**	Date Received:	**3/16/2018 2:04:00 PM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Courier		

Log In

3.	Coolers are present?	Yes ☐	No ☑	NA ☐
		Air Samples		
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Required ☑
6.	Was an attempt made to cool the samples?	Yes ☐	No ☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes ☐	No ☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
9.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
10.	Are samples properly preserved?	Yes ☑	No ☐	
11.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
14.	Does paperwork match bottle labels?	Yes ☑	No ☐	
15.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
16.	Is it clear what analyses were requested?	Yes ☑	No ☐	
17.	Were all holding times able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes ☑	No ☐	NA ☐

Person Notified:	Tricia DeOme	Date	3/16/2018
By Whom:	Clare Griggs	Via:	☑ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:	Confirming method.		
Client Instructions:	TO15 SIM		

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Air Chain of Custody Record & Laboratory Services Agreement

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Laboratory Project No (Internal): 1803195

Date: 3/15/18 Page: of:

Special Remarks:

Project Name: UWT-HOWE

Project No: 0183-108-01

Location: Tacoma, WA

Collected by: PDR, RC

Reports to (PM): Tricia DeOme

Email (PM): TdeOme@Geoengineers.com

Client: GeoEngineers

Address: 1101 S. Fawcett Ave Suite 200

City, State, Zip: Tacoma, WA, 98402

Telephone: 253-383-4440

Fax:

	Sample Name	Canister / Flow Reg Serial #	Sample Date & Time	Sample Type (Matrix) *	Container Type **	Sample Volume	Fill Time	Flow Rate	Internal Initial Evacuation Pressure (mtorr)	Field Initial Sample Pressure ("Hg)	Field Final Sample Pressure ("Hg)	Analysis Requested	Internal Receipt Date	Internal Final Pressure ("Hg)
1	~~H-CH-I42~~	17241 / FR8-01	3/15/18 / 0855	IA	CAN	6L	8 hr		10mtorr / 2/28/18 1100	-30 / 0855	-24 / 1432	volume not received Hold 3/16/18 cg		-24
2	H-CH-SS4	4687	3/15/18 / 0832	S	CAN	1L			10mtorr / 3/5/18 1200	-30 / 0832	-3 / 0833	PCE, TCE, 1,1-DCE, cis-1-2-DCE Trans-1-2-DCE, Vinyl Chloride Method TO-15-SIM and Helium		-4
3	H-CH-SS2	5023	3/15/18 / 0853	S	CAN	1L			10mtorr / 3/5/18 1200	-30 / 0853	-2 / 0854			-2
4	H-CH-SS1	4694	3/15/18 / 0805	S	CAN	1L			10mtorr / 3/5/18 1200	-30 / 0805	-3 / 0806			-3
5		3487			CAN	1L			10mtorr / 3/5/18 1200					-30

* Matrix Codes: AA = Ambient Air IA = Indoor Air L = Landfill S = Subslab / Soil Gas

** Container Codes: BV = 1 Liter Bottle Vac CAN = Canister CYL = High Pressure Cylinder F = Filter S = Sorbent Tube TB = Tedlar Bag

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished x [signature]	Date/Time 3/16/18 11:05am	Received x [signature]	Date/Time 3/16/18 11:05
Relinquished x [signature]	Date/Time	Received x [signature]	Date/Time 3/16/18 1404

Turn-Around Time:

- [X] Standard
- [ ] 3 Day
- [ ] 2 Day
- [ ] Next Day
- Same Day _____ (specify)

Air Chain of Custody Record & Laboratory Services Agreement

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Date: 3/15/18 Page: of:

Project Name: UWT- HOWE

Project No: 0183-108-01

Location: Tacoma, WA

Collected by: PDR, RC

Reports to (PM): Tricia DeOme

Email (PM): TdeOme@geoengineers.com

Laboratory Project No (Internal):

Special Remarks:

Client: GeoEngineers

Address: 1101 S. Fawcett Ave Suite 200

City, State, Zip: Tacoma, WA, 98402

Telephone: 253-383-4940

Fax:

Sample Name	Canister / Flow Reg Serial #	Sample Date & Time	Sample Type (Matrix) *	Container Type **	Sample Volume	Fill Time	Flow Rate	Internal: Initial Evacuation Pressure (mtorr)	Field Initial Sample Pressure (" Hg)	Field Final Sample Pressure (" Hg)	Analysis Requested	Internal: Receipt Date	Internal: Final Pressure ("Hg)
1 H-Clt-SS3	5024	3/15/18 0924	S	CAN	1L			10mtorr 3/7/18 1100	-30 6924	-2 0925	PCE, TCE, 1,1-DCE, cis-1,2-DCE Trans-1,2-DCE, vinyl chloride Method TO-15Sim and Helium		-3
2	4905			CAN	1L			10mtorr 3/7/18 1100					
3	4693			CAN	1L			10mtorr 3/7/18 1100					-30
4	12672			CAN	6L			10mtorr 2/28/18 1100					
5	17644			CAN	6L			10mtorr 3/7/18 1800					

* Matrix Codes: AA = Ambient Air IA = Indoor Air L = Landfill S = Subslab / Soil Gas

** Container Codes: BV = 1 Liter Bottle Vac CAN = Canister CYL = High Pressure Cylinder F = Filter S = Sorbent Tube TB = Tedlar Bag

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished	Date/Time	Received	Date/Time
x [signature]	3/16/18 11:05 am	x [signature]	3/16/18 11:05
Relinquished x [signature]	Date/Time	Received x [signature]	Date/Time 3/16/18 1401

Turn-Around Time:

- [x] Standard
- [ ] 3 Day
- [ ] 2 Day
- [ ] Next Day
- Same Day _____ (specify)

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

GeoEngineers - Tacoma
Tricia DeOme
1101 S Fawcett Ave
Tacoma, WA 98401

RE: Howe IV
Work Order Number: 1803284

April 09, 2018

Attention Tricia DeOme:

Fremont Analytical, Inc. received 7 sample(s) on 3/22/2018 for the analyses presented in the following report.

Volatile Organic Compounds-EPA Method TO-15 (SIM)

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

Date: *04/09/2018*

CLIENT: GeoEngineers - Tacoma
Project: Howe IV
Work Order: 1803284

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1803284-001	H-CH-OA1	03/21/2018 2:15 PM	03/22/2018 11:20 AM
1803284-002	H-CH-OA2	03/21/2018 2:27 PM	03/22/2018 11:20 AM
1803284-003	H-CH-OA3	03/21/2018 2:00 PM	03/22/2018 11:20 AM
1803284-004	H-CH-IA1	03/21/2018 2:35 PM	03/22/2018 11:20 AM
1803284-005	H-CH-IA2	03/21/2018 2:32 PM	03/22/2018 11:20 AM
1803284-006	H-CH-IA3	03/21/2018 2:00 PM	03/22/2018 11:20 AM
1803284-007	H-CH-IA4	03/21/2018 2:30 PM	03/22/2018 11:20 AM

Case Narrative

WO#: **1803284**
Date: **4/9/2018**

CLIENT: GeoEngineers - Tacoma
Project: Howe IV

I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Air samples are reported in ppbv and ug/m3.

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Standard temperature and pressure assumes 24.45 = (25C and 1 atm).

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Client: **GeoEngineers - Tacoma**
WorkOrder: 1803284
Project: Howe IV

Client Sample ID: H-CH-OA1
Lab ID: 1803284-001A
Sample Type: Summa Canister

Date Sampled: 3/21/2018
Date Received: 3/22/2018

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Volatile Organic Compounds-EPA Method TO-15 (SIM)								
	(ppbv)	(ug/m³)	(ppbv)	(ug/m³)				
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	03/29/2018	BT
cis-1,2-Dichloroethene	<0.0200	<0.0793	0.0200	0.0793		EPA-TO-15SIM	03/29/2018	BT
Tetrachloroethene (PCE)	0.105	0.714	0.0500	0.339		EPA-TO-15SIM	03/29/2018	BT
trans-1,2-Dichloroethene	<0.00600	<0.0238	0.00600	0.0238		EPA-TO-15SIM	03/29/2018	BT
Trichloroethene (TCE)	<0.0170	<0.0914	0.0170	0.0914		EPA-TO-15SIM	03/29/2018	BT
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	03/29/2018	BT
Surr: 4-Bromofluorobenzene	108 %Rec	--	70-130	--		EPA-TO-15SIM	03/29/2018	BT

Client: **GeoEngineers - Tacoma**
WorkOrder: 1803284
Project: Howe IV

Client Sample ID: H-CH-OA2
Lab ID: 1803284-002A
Sample Type: Summa Canister

Date Sampled: 3/21/2018
Date Received: 3/22/2018

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Volatile Organic Compounds-EPA Method TO-15 (SIM)								
	(ppbv)	(ug/m³)	(ppbv)	(ug/m³)				
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	03/29/2018	BT
cis-1,2-Dichloroethene	<0.0200	<0.0793	0.0200	0.0793		EPA-TO-15SIM	03/29/2018	BT
Tetrachloroethene (PCE)	0.0928	0.630	0.0500	0.339		EPA-TO-15SIM	03/29/2018	BT
trans-1,2-Dichloroethene	<0.00600	<0.0238	0.00600	0.0238		EPA-TO-15SIM	03/29/2018	BT
Trichloroethene (TCE)	<0.0170	<0.0914	0.0170	0.0914		EPA-TO-15SIM	03/29/2018	BT
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	03/29/2018	BT
Surr: 4-Bromofluorobenzene	106 %Rec	--	70-130	--		EPA-TO-15SIM	03/29/2018	BT

Client: **GeoEngineers - Tacoma**
WorkOrder: 1803284
Project: Howe IV

Client Sample ID: H-CH-OA3
Lab ID: 1803284-003A
Sample Type: Summa Canister

Date Sampled: 3/21/2018
Date Received: 3/22/2018

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Analyte	Concentration (ppbv)	Concentration (ug/m³)	Reporting Limit (ppbv)	Reporting Limit (ug/m³)	Qual	Method	Date/Analyst	
1,1-Dichloroethene (DCE)	<0.0900	<0.357	0.0900	0.357		EPA-TO-15SIM	04/08/2018	EM
cis-1,2-Dichloroethene	<0.200	<0.793	0.200	0.793		EPA-TO-15SIM	04/08/2018	EM
Tetrachloroethene (PCE)	0.321	2.18	0.500	3.39	J	EPA-TO-15SIM	04/08/2018	EM
trans-1,2-Dichloroethene	<0.0600	<0.238	0.0600	0.238		EPA-TO-15SIM	04/08/2018	EM
Trichloroethene (TCE)	0.105	0.565	0.170	0.914	J	EPA-TO-15SIM	04/08/2018	EM
Vinyl chloride	<0.850	<2.17	0.850	2.17		EPA-TO-15SIM	04/08/2018	EM
Surr: 4-Bromofluorobenzene	92.8 %Rec	--	70-130	--		EPA-TO-15SIM	04/08/2018	EM

Client: **GeoEngineers - Tacoma**
WorkOrder: 1803284
Project: Howe IV

Client Sample ID: H-CH-IA1
Lab ID: 1803284-004A
Sample Type: Summa Canister

Date Sampled: 3/21/2018
Date Received: 3/22/2018

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Volatile Organic Compounds-EPA Method TO-15 (SIM)								
	(ppbv)	(ug/m³)	(ppbv)	(ug/m³)				
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	03/29/2018	BT
cis-1,2-Dichloroethene	0.105	0.418	0.0200	0.0793		EPA-TO-15SIM	03/29/2018	BT
Tetrachloroethene (PCE)	0.159	1.08	0.0500	0.339		EPA-TO-15SIM	03/29/2018	BT
trans-1,2-Dichloroethene	<0.00600	<0.0238	0.00600	0.0238		EPA-TO-15SIM	03/29/2018	BT
Trichloroethene (TCE)	0.111	0.596	0.0170	0.0914		EPA-TO-15SIM	03/29/2018	BT
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	03/29/2018	BT
Surr: 4-Bromofluorobenzene	115 %Rec	--	70-130	--		EPA-TO-15SIM	03/29/2018	BT

Client: **GeoEngineers - Tacoma**
WorkOrder: 1803284
Project: Howe IV

Client Sample ID: H-CH-IA2
Lab ID: 1803284-005A
Sample Type: Summa Canister

Date Sampled: 3/21/2018
Date Received: 3/22/2018

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Analyte	Concentration (ppbv)	Concentration (ug/m³)	Reporting Limit (ppbv)	Reporting Limit (ug/m³)	Qual	Method	Date/Analyst	
1,1-Dichloroethene (DCE)	<0.0225	<0.0892	0.0225	0.0892		EPA-TO-15SIM	04/08/2018	EM
cis-1,2-Dichloroethene	0.0436	0.173	0.0500	0.198	J	EPA-TO-15SIM	04/08/2018	EM
Tetrachloroethene (PCE)	0.300	2.03	0.125	0.848		EPA-TO-15SIM	04/08/2018	EM
trans-1,2-Dichloroethene	<0.0150	<0.0595	0.0150	0.0595		EPA-TO-15SIM	04/08/2018	EM
Trichloroethene (TCE)	0.0921	0.495	0.0425	0.228		EPA-TO-15SIM	04/08/2018	EM
Vinyl chloride	<0.213	<0.543	0.213	0.543		EPA-TO-15SIM	04/08/2018	EM
Surr: 4-Bromofluorobenzene	91.4 %Rec	--	70-130	--		EPA-TO-15SIM	04/08/2018	EM

Client: **GeoEngineers - Tacoma**
WorkOrder: 1803284
Project: Howe IV

Client Sample ID: H-CH-IA3
Lab ID: 1803284-006A
Sample Type: Summa Canister

Date Sampled: 3/21/2018
Date Received: 3/22/2018

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Analyte	Concentration (ppbv)	Concentration (ug/m³)	Reporting Limit (ppbv)	Reporting Limit (ug/m³)	Qual	Method	Date/Analyst	
1,1-Dichloroethene (DCE)	<0.0225	<0.0892	0.0225	0.0892		EPA-TO-15SIM	04/08/2018	EM
cis-1,2-Dichloroethene	0.0441	0.175	0.0500	0.198	J	EPA-TO-15SIM	04/08/2018	EM
Tetrachloroethene (PCE)	0.300	2.03	0.125	0.848		EPA-TO-15SIM	04/08/2018	EM
trans-1,2-Dichloroethene	<0.0150	<0.0595	0.0150	0.0595		EPA-TO-15SIM	04/08/2018	EM
Trichloroethene (TCE)	0.0933	0.501	0.0425	0.228		EPA-TO-15SIM	04/08/2018	EM
Vinyl chloride	<0.213	<0.543	0.213	0.543		EPA-TO-15SIM	04/08/2018	EM
Surr: 4-Bromofluorobenzene	91.0 %Rec	--	70-130	--		EPA-TO-15SIM	04/08/2018	EM

Client: **GeoEngineers - Tacoma**
WorkOrder: 1803284
Project: Howe IV

Client Sample ID: H-CH-IA4
Lab ID: 1803284-007A
Sample Type: Summa Canister

Date Sampled: 3/21/2018
Date Received: 3/22/2018

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Analyte	Concentration (ppbv)	Concentration (ug/m³)	Reporting Limit (ppbv)	Reporting Limit (ug/m³)	Qual	Method	Date/Analyst	
1,1-Dichloroethene (DCE)	<0.0225	<0.0892	0.0225	0.0892		EPA-TO-15SIM	04/08/2018	EM
cis-1,2-Dichloroethene	0.0438	0.174	0.0500	0.198	J	EPA-TO-15SIM	04/08/2018	EM
Tetrachloroethene (PCE)	0.300	2.03	0.125	0.848		EPA-TO-15SIM	04/08/2018	EM
trans-1,2-Dichloroethene	<0.0150	<0.0595	0.0150	0.0595		EPA-TO-15SIM	04/08/2018	EM
Trichloroethene (TCE)	0.0937	0.504	0.0425	0.228		EPA-TO-15SIM	04/08/2018	EM
Vinyl chloride	<0.213	<0.543	0.213	0.543		EPA-TO-15SIM	04/08/2018	EM
Surr: 4-Bromofluorobenzene	91.4 %Rec	--	70-130	--		EPA-TO-15SIM	04/08/2018	EM

Work Order: 1803284
CLIENT: GeoEngineers - Tacoma
Project: Howe IV

QC SUMMARY REPORT

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Sample ID **LCS-R42736** SampType: **LCS** Units: **ppbv** Prep Date: **4/8/2018** RunNo: **42736**
Client ID: **LCSW** Batch ID: **R42736** Analysis Date: **4/8/2018** SeqNo: **825523**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	1.85	0.0850	2.000	0	92.7	70	130				
1,1-Dichloroethene (DCE)	1.86	0.00900	2.000	0	93.2	70	130				
trans-1,2-Dichloroethene	1.88	0.00600	2.000	0	94.1	70	130				
cis-1,2-Dichloroethene	1.92	0.0200	2.000	0	96.2	70	130				
Trichloroethene (TCE)	1.90	0.0170	2.000	0	95.1	70	130				
Tetrachloroethene (PCE)	1.90	0.0500	2.000	0	95.1	70	130				
Surr: 4-Bromofluorobenzene	4.00		4.000		100	70	130				

Sample ID **MB-R42736** SampType: **MBLK** Units: **ppbv** Prep Date: **4/8/2018** RunNo: **42736**
Client ID: **MBLKW** Batch ID: **R42736** Analysis Date: **4/8/2018** SeqNo: **825524**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	ND	0.0850									
1,1-Dichloroethene (DCE)	ND	0.00900									
trans-1,2-Dichloroethene	ND	0.00600									
cis-1,2-Dichloroethene	ND	0.0200									
Trichloroethene (TCE)	ND	0.0170									
Tetrachloroethene (PCE)	ND	0.0500									
Surr: 4-Bromofluorobenzene	3.61		4.000		90.3	70	130				

Sample ID **1804086-001AREP** SampType: **REP** Units: **ppbv** Prep Date: **4/8/2018** RunNo: **42736**
Client ID: **BATCH** Batch ID: **R42736** Analysis Date: **4/8/2018** SeqNo: **825530**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	0.0517	0.0850						0.05227	1.14	30	J
1,1-Dichloroethene (DCE)	0.0166	0.00900						0.01525	8.24	30	
trans-1,2-Dichloroethene	0.168	0.00600						0.1691	0.581	30	
cis-1,2-Dichloroethene	2.53	0.0200						2.524	0.188	30	
Trichloroethene (TCE)	5.53	0.0170						5.586	1.08	30	
Tetrachloroethene (PCE)	17.0	0.0500						17.22	1.18	30	

Work Order: 1803284
CLIENT: GeoEngineers - Tacoma
Project: Howe IV

QC SUMMARY REPORT

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Sample ID **1804086-001AREP** SampType: **REP** Units: **ppbv** Prep Date: **4/8/2018** RunNo: **42736**
Client ID: **BATCH** Batch ID: **R42736** Analysis Date: **4/8/2018** SeqNo: **825530**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Surr: 4-Bromofluorobenzene	3.74		4.000		93.5	70	130		0		

Sample ID **1804097-010AREP** SampType: **REP** Units: **ppbv** Prep Date: **4/8/2018** RunNo: **42736**
Client ID: **BATCH** Batch ID: **R42736** Analysis Date: **4/8/2018** SeqNo: **825541**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	ND	0.0850						0	0	30	
1,1-Dichloroethene (DCE)	ND	0.00900						0	0	30	
trans-1,2-Dichloroethene	ND	0.00600						0	0	30	
cis-1,2-Dichloroethene	ND	0.0200						0	0	30	
Trichloroethene (TCE)	0.132	0.0170						0.1326	0.363	30	
Tetrachloroethene (PCE)	0.126	0.0500						0.1242	1.29	30	
Surr: 4-Bromofluorobenzene	3.75		4.000		93.7	70	130		0		

Work Order: 1803284
CLIENT: GeoEngineers - Tacoma
Project: Howe IV

QC SUMMARY REPORT

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Sample ID **1803346-008AREP** SampType: **REP** Units: **ppbv** Prep Date: **3/28/2018** RunNo: **42503**
Client ID: **BATCH** Batch ID: **R42503** Analysis Date: **3/28/2018** SeqNo: **819920**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	0.264	0.0850						0.2786	5.51	30	
trans-1,2-Dichloroethene	0.0230	0.00600						0.02340	1.55	30	
cis-1,2-Dichloroethene	1.26	0.0200						1.327	4.90	30	
Trichloroethene (TCE)	15.6	0.0170						17.57	11.9	30	
Tetrachloroethene (PCE)	0.137	0.0500						0.1523	10.5	30	
Surr: 4-Bromofluorobenzene	4.22		4.000		106	70	130		0		

Sample ID **LCS-R42503C** SampType: **LCS** Units: **ppbv** Prep Date: **3/29/2018** RunNo: **42503**
Client ID: **LCSW** Batch ID: **R42503** Analysis Date: **3/29/2018** SeqNo: **822202**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	2.13	0.0850	2.000	0	106	70	130				
1,1-Dichloroethene (DCE)	2.07	0.00900	2.000	0	104	70	130				
trans-1,2-Dichloroethene	2.10	0.00600	2.000	0	105	70	130				
cis-1,2-Dichloroethene	2.01	0.0200	2.000	0	101	70	130				
Trichloroethene (TCE)	2.15	0.0170	2.000	0	107	70	130				
Tetrachloroethene (PCE)	2.06	0.0500	2.000	0	103	70	130				
Surr: 4-Bromofluorobenzene	4.84		4.000		121	70	130				

Sample ID **MBLK-R42503C** SampType: **MBLK** Units: **ppbv** Prep Date: **3/29/2018** RunNo: **42503**
Client ID: **MBLKW** Batch ID: **R42503** Analysis Date: **3/29/2018** SeqNo: **822203**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	ND	0.0850									
1,1-Dichloroethene (DCE)	ND	0.00900									
trans-1,2-Dichloroethene	ND	0.00600									
cis-1,2-Dichloroethene	ND	0.0200									
Trichloroethene (TCE)	ND	0.0170									
Tetrachloroethene (PCE)	ND	0.0500									
Surr: 4-Bromofluorobenzene	3.82		4.000		95.6	70	130				

Work Order: 1803284
CLIENT: GeoEngineers - Tacoma
Project: Howe IV

QC SUMMARY REPORT

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Sample ID **MBLK-R42503C** SampType: **MBLK** Units: **ppbv** Prep Date: **3/29/2018** RunNo: **42503**
Client ID: **MBLKW** Batch ID: **R42503** Analysis Date: **3/29/2018** SeqNo: **822203**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Sample Log-In Check List

Client Name:	**GEIT**	Work Order Number:	**1803284**
Logged by:	**Clare Griggs**	Date Received:	**3/22/2018 11:20:00 AM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Courier		

Log In

3.	Coolers are present?	Yes ☐	No ☑	NA ☐
		Air Samples		
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Required ☑
6.	Was an attempt made to cool the samples?	Yes ☐	No ☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes ☐	No ☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
9.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
10.	Are samples properly preserved?	Yes ☑	No ☐	
11.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
14.	Does paperwork match bottle labels?	Yes ☑	No ☐	
15.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
16.	Is it clear what analyses were requested?	Yes ☑	No ☐	
17.	Were all holding times able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes ☐	No ☐	NA ☑

Person Notified: _____ Date _____

By Whom: _____ Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person

Regarding: _____

Client Instructions: _____

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Air Chain of Custody Record & Laboratory Services Agreement

Date: 3/21/18 Page: 1 of: 2

Laboratory Project No (Internal): 1803284

Special Remarks: * PCE, TCE, 1-1, DCE, cis-1-2, DCE, TRANS-1-2, DCE, vinyl Chloride

Project Name: HOUSE IV

Project No: 0183-108-02

Location: TACOMA

Collected by: PAUL ROBINETTE

Reports to (PM): TRICIA DEDOME

Email (PM): tdedome@geoengineers.com

Client: GeoEngineers

Address: 11015. Fawcett Ave

City, State, Zip: TACOMA, WA, 98402

Telephone: 253-383-4940

Fax: 253-383-4923

Sample Name	Canister / Flow Reg Serial #	Sample Date & Time	Sample Type (Matrix) *	Container Type **	Sample Volume	Fill Time	Flow Rate	Internal: Initial Evacuation Pressure (mtorr)	Field Initial Sample Pressure ("Hg)	Field Final Sample Pressure ("Hg)	Analysis Requested	Internal: Receipt Date	Internal: Final Pressure ("Hg)
1 H-CH-OA1	1078 / FR8-13	3/21/18 1415	AA	CAN	6L	8 hr		10mtorr / 3/16/18 1530	-30 / 755	0 / 1415	* TO-15	3/22/18	0
2 H-CH-OA2	17646 / FR8-20	3/21/15 1427	AA	CAN	6L	8 hr		10mtorr / 3/16/18 1530	-30 / 748	-10 / 1422	* TO-15	3/22/18	-9
3 H-CH-OA3	17644 / FR8-16	3/21/15 1400	AA	CAN	6L	8 hr		10mtorr / 3/7/18 1100	-20 / -30	-12 / 1422	* TO-15	3/22/18	-12
4 H-CH-IA1	15421 / FR8-09	3/21/15 1435	IA	CAN	6L	8 hr		10mtorr / 3/7/18 1100	-30 / 802	-9 / 1435	* TO-15	3/22/18	-9
5 H-CH-IA2	17648 / FR8-31	3/21/15 1432	IA	CAN	6L	8 hr		10mtorr / 3/16/18 1530	-30 / 739	-8 / 1432	* TO-15	3/22/18	-8

* Matrix Codes: AA = Ambient Air IA = Indoor Air L = Landfill S = Subslab / Soil Gas

** Container Codes: BV = 1 Liter Bottle Vac CAN = Canister CYL = High Pressure Cylinder F = Filter S = Sorbent Tube TB = Tedlar Bag

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished	Date/Time	Received	Date/Time
x [signature]	3/22/18 8:55am	[signature]	3-22-18 8:55 AM
x [signature]	3-22-18 11:20 AM	[signature]	3/22/18 1120

Turn-Around Time:

- [x] Standard
- [ ] 3 Day
- [ ] 2 Day
- [ ] Next Day
- Same Day _____ (specify)

Air Chain of Custody Record & Laboratory Services Agreement

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Date: 3/21/18 Page: 2 of: 2

Laboratory Project No (Internal):

Special Remarks: AT SAME AS PE-1

Client: GeoEngineers

Address: 1101 S. FAWCETT AVE

City, State, Zip: TACOMA, WA

Telephone: 253-383-4940

Fax: 253-383-4923

Project Name: HOME IV

Project No: 0153-108-02

Location: TACOMA

Collected by: PAUL ROBINETTE

Reports to (PM): SAME AS PE-1

Email (PM):

	Sample Name	Canister / Flow Reg Serial #	Sample Date & Time	Sample Type (Matrix) *	Container Type **	Sample Volume	Fill Time	Flow Rate	Internal: Initial Evacuation Pressure (mtorr)	Field Initial Sample Pressure (" Hg)	Field Final Sample Pressure (" Hg)	Analysis Requested	Internal: Receipt Date	Internal: Final Pressure ("Hg)
1	NOT USED/TEST	~~17636~~ / ~~FR8-18~~	/		CAN	6L	8 hr		10mtorr / 3/16/18 1530				3/22/18	
2	H-CH-IA3	13968 / FR8-21	3/21/18 / 1400	IA	CAN	6L	8 hr		10mtorr / 3/16/18 1530	-30 / 743	-12 / 1400	* TO-15	3/22/18	-8
3	H-CH-IA4	15902 / FR8-07	3/21/18 / 1430	IA	CAN	6L	8 hr		10mtorr / 3/16/18 1530	-30 / 743	-5 / 1430	* TO-15	3/22/18	-4
4														
5														

* Matrix Codes: AA = Ambient Air IA = Indoor Air L = Landfill S = Subslab / Soil Gas

** Container Codes: BV = 1 Liter Bottle Vac CAN = Canister CYL = High Pressure Cylinder F = Filter S = Sorbent Tube TB = Tedlar Bag

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished	Date/Time	Received	Date/Time
x [signature]	3/22/18 8:55am	x [signature]	3-22-18 8:55AM
x [signature]	3-22-18 11:20 AM	x [signature]	3/22/18 18 1120

Turn-Around Time:

- ☐ Standard
- ☐ 3 Day
- ☐ 2 Day
- ☐ Next Day
- Same Day _____ (specify)

APPENDIX D
Report Limitations and Guidelines for Use

APPENDIX D
REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

This appendix provides information to help you manage your risks with respect to the use of this report. Please confer with GeoEngineers if you need to know more about how these "Report Limitations and Guidelines for Use" apply to your project or property.

Read These Provisions Closely

It is important to recognize that environmental engineering and geoscience practices (geotechnical engineering, geology and environmental science) are less exact than other engineering and natural science disciplines. GeoEngineers includes these explanatory "limitations" provisions in our reports to help reduce the risk of misunderstandings or unrealistic expectations that lead to disappointments, claims and disputes.

Environmental Services Are Performed for Specific Purposes, Persons and Projects

GeoEngineers has performed this vapor intrusion (VI) evaluation in general accordance with the scope and limitations of our proposal, dated May 10, 2018. This report has been prepared for the exclusive use of University of Washington. This report is not intended for use by others, and the information contained herein is not applicable to other properties.

GeoEngineers structures its services to meet the specific needs of its clients. For example, an ESA study conducted for a property owner may not fulfill the needs of a prospective purchaser of the same property. Because each environmental study is unique, each environmental report is unique, prepared solely for the specific client and property. Use of this report is not recommended for any purpose or project other than as expressly stated in this report.

This Environmental Report is Based on a Unique Set of Project-Specific Factors

This report has been prepared for the vapor intrusion (VI) evaluation at four University of Washington – Tacoma (UWT) buildings and the Federal Courthouse in Tacoma, Washington. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this Project. Unless GeoEngineers specifically indicates otherwise, it is important not to rely on this report if it was:

- not prepared for you,
- not prepared for your Project,
- not prepared for the specific site explored, or
- completed before Project changes were made.

If changes to the Project or property occur after the date of this report, GeoEngineers cannot be responsible for any consequences of such changes in relation to this report unless we have been given the opportunity

1 Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org.

to review our interpretations and recommendations in the context of such changes. Based on that review, we can provide written modifications or confirmation, as appropriate.

Reliance Conditions for Third Parties

This report was prepared for the exclusive use of the party(ies) to whom this report is addressed. No other party may rely on the product of our services unless we agree to such reliance in advance and in writing. Within the limitations of the agreed Project scope, schedule and budget, our services have been executed in accordance with our Agreement with the Client and generally accepted environmental practices in this area at the time this report was prepared.

Understand That Geotechnical Issues Have Not Been Addressed

Unless geotechnical engineering was specifically included in our scope of service, this report does not provide any geotechnical findings, conclusions, or recommendations, including but not limited to, the suitability of subsurface materials for construction purposes.

Do Not Separate Documentation from the Report

Environmental reports often include supplemental documentation, such as maps, figures and table. Do not separate such documentation from the report. Further, do not, and do not permit any other party to redraw or modify any of the supplemental documentation for incorporation into other professionals' instruments of service.

Environmental Regulations Change and Evolve

Some substances may be present in the vicinity of the subject property in quantities or under conditions that may have led, or may lead, to contamination of the subject property, but are not included in current local, state or federal regulatory definitions of hazardous substances or do not otherwise present current potential liability. GeoEngineers cannot be responsible if the standards for appropriate inquiry, or regulatory definitions of hazardous substances, change or if more stringent environmental standards are developed in the future.

Uncertainty May Remain Even After This Investigation is Completed

Performance of an investigation is intended to reduce uncertainty regarding the potential for contamination in connection with a property, but no investigation can wholly eliminate that uncertainty. Our interpretation of subsurface conditions in this study is based on field observations and chemical analytical data from widely spaced sampling locations. It is always possible that contamination exists in areas that were not explored, sampled or analyzed.

Subsurface Conditions Can Change

This environmental report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by man-made events such as construction on or adjacent to the subject property, by new releases of hazardous substances, new information or technology that become available subsequent to the report date, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. Please contact GeoEngineers before applying this report for its intended purpose so that GeoEngineers may evaluate whether changed conditions affect the continued applicability of the report.

Soil and Groundwater End Use

The cleanup levels referenced in this report are site- and situation-specific. The cleanup levels may not be applicable for other properties or for other on-site uses of the affected soil and/or groundwater. Note that hazardous substances may be present in some of the on-site soil, vapor and/or groundwater at detectable concentrations that are less than the referenced cleanup levels. GeoEngineers should be contacted prior to the export of soil or groundwater from the subject property or reuse of the affected soil or groundwater on-site to evaluate the potential for associated environmental liabilities. GeoEngineers will not assume responsibility for potential environmental liability arising out of the transfer of soil and/or groundwater from the subject property to another location, or the reuse of such soil and/or groundwater on-site in any instances that we did not recommend, know of, or control.

Most Environmental Findings Are Professional Opinions

Our interpretations of subsurface conditions are based on field observations and chemical analytical data from widely spaced sampling locations at the subject property. Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied its professional judgment to render an informed opinion about subsurface conditions throughout the property. Actual subsurface conditions may differ significantly from those indicated in this report. Our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

Do Not Redraw the Exploration Logs

Environmental scientists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in an environmental report should never be redrawn for inclusion in other design documents. Only photographic or electronic reproduction that preserves the entire original boring log is acceptable, but separating logs from the report can create increase the risk of potential misinterpretation.

Biological Pollutants

GeoEngineers' Scope of Work specifically excludes the investigation, detection, prevention or assessment of the presence of Biological Pollutants. Accordingly, this report does not include any interpretations, recommendations, findings or conclusions regarding the detecting, assessing, preventing or abating of Biological Pollutants, and no conclusions or inferences should be drawn regarding Biological Pollutants as they may relate to this Project. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria and viruses, and/or any of their byproducts.

A Client that desires these specialized services is advised to obtain them from a consultant who offers services in this specialized field.