Feasibility Study Pilot Test Report, Air Sparge/Soil Vapor Extraction Ecology Facility/Site No.: 2551 Agreed Order No.: DE-10947

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G-Logics Project

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Dear Mr. Sandhu and Mr. Hetrick:

This report presents the purpose, approach, and results of a Feasibility Study Pilot Test performed to assess the effectiveness of Air Sparge and Soil Vapor Extraction remedial technologies at the Boeing Field Chevron Site (Figure 1). This work has been performed as part of a Feasibility Study per the Agreed Order between Mr. and Ms. Sandhu, RPNP Corporation, Chevron Environmental Management Company, and the Washington Department of Ecology. Accordingly, results of the pilot test will be incorporated into the pending Feasibility Study, which will be used to identify a preferred cleanup alternative for the Site.

Should you require additional information or have any questions, please contact us at your convenience. Thank you again for this opportunity to be of service.

Sincerely,
G-Logics, Inc.

Rory L. Galloway, LG, LHG
Principal

Dan Hatch
Project Manager

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Project Geologist

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1.0 INTRODUCTION AND OBJECTIVES

G-Logics has prepared this report to document the recently-completed air sparge/soil-vapor extraction Feasibility Study Pilot Test (pilot test) conducted at the Boeing Field Chevron site (the Site), located at 10805 E. Marginal Way in Tukwila, Washington (Figure 1, Photo 1). The pilot test was performed in accordance with the Feasibility Study Pilot Test Workplan, dated February 4, 2019 and approved by the Washington Department of Ecology (Ecology) on February 6, 2019. The findings of this test are intended to facilitate preparation of a Feasibility Study (FS), which is required per the current Agreed Order for the Site (Agreed Order No. DE 10947).

The pilot test was performed to assess the feasibility of air sparge (AS) and soil-vapor extraction (SVE) technologies as a full-scale remedial method at the Site. Specifically, the pilot test assessed the following.

1. The ability to extract soil gas and contaminant vapor from the vadose zone.
2. The contaminant mass recovery volumes/rate, and what specific chemical constituents are being removed.
3. The ability to inject air into the upper and lower saturated zones at flowrates sufficient to result in effective hydrocarbon contaminant removal and at pressure less than formation fracture pressures.
4. The vapor transmissivity of the confining layer between the lower and upper saturated zones.
5. The ability to inject air into the lower saturated zone without increasing the potential for soil-vapor intrusion exposure.

The following primary test phases were completed to meet the pilot study objectives:

- **Days 1 and 2: SVE Step Test** – This phase evaluated the effects of applying SVE to vadose zone soils at the Site. This test assessed the potential vacuum radius of influence (ROI) that can be achieved, the influence of vacuum on groundwater-elevation conditions in the upper-saturated zone and potential hydrocarbon removal rates that could be achieved in vadose-zone soils.
- **Day 2: AS/SVE Test in the upper-saturated zone –** The second phase of the pilot test evaluated the effects of applying SVE to vadose zone soils while AS was concurrently applied within the upper-saturated zone. Specifically, this test assessed the ability to inject air into the upper-

saturated zone, the effects of the AS on the potential vacuum ROI, the influence on groundwater elevation conditions in the upper-saturated zone, and the potential hydrocarbon recovery rates (as influenced by the AS).

- **Day 3: AS/SVE Test in the lower-saturated zone** – This phase of testing assessed the ability to inject air into the lower saturated zone and evaluated the vapor transmissivity between the lower and upper-saturated zones.

2.0 BACKGROUND

Results from this pilot test further refine the findings presented in the Draft Remedial Investigation (DRI) report prepared by G-Logics, dated November 22, 2017. The findings presented in the DRI indicate that petroleum-range hydrocarbon contaminants (predominantly gasoline-range organics (GRO) and benzene) are impacting soil, groundwater, and soil vapor at the Site. The following section summarizes our current understanding of site conditions based on the completed Site-exploration efforts.

2.1 Nature and Extent of Contamination

G-Logics has identified two groundwater-bearing zones, separated by a confining layer that is present between an approximate depth of 11 feet and 19 feet below the ground surface. The upper-saturated zone consists of approximately 1-3 feet of saturated soils above the confining layer. The lower-saturated zone exists beneath the confining layer, to a depth of at least 35 feet (the deepest exploration at the Site). Previous findings suggest that the lower-saturated zone is tidally influenced, but the upper saturated zone is not. Additionally, at both high and low tide, the lower-saturated zone exhibits a potentiometric surface above the bottom elevation of the confining layer (illustrated on Figure 3).

Petroleum contamination has been observed in both the upper and lower-saturated zones. Light non-aqueous phase liquid (LNAPL) recently has been measured in only one well (IP-7, screened within the lower saturated zone) but has been present historically at multiple locations in the western portion of the Boeing Field Chevron Property.

Contaminant impacts to soil and groundwater at the Site have been found to be greatest in upper saturated zone and found in the western portion of the Property (see Figures 2 and 3). Contaminant impacts also appear to extend westward into the adjoining City of Tukwila right-of-way at lesser concentrations than found on the subject property.

The DRI data indicate that GRO and benzene contaminants remain present at the Site at depths ranging from approximately 5 to 18 feet below the ground surface and are present in both the upper and lower saturated zones. GRO and benzene impacts to soil and groundwater also extend west, off-Property, into the right-of-way of Tukwila International Boulevard (TIB).

2.2 Remedial Technology Selection for the Pilot Test

G-Logics completed a preliminary evaluation of remedial technologies likely to be considered in the Site FS. G-Logics determined that in addition to AS/SVE, potential remedial technologies to be evaluated for the Site include, but are not limited to, groundwater pump-and-treat, enhanced in-situ biological remediation, in-situ chemical oxidation, and excavation and disposal. Each of these remedial technologies will be fully evaluated in the pending FS in addition to any other potentially applicable technologies that are identified.

Based on our preliminary evaluation of these technologies with respect to the Site conditions, G-Logics and the project proponents believe that AS/SVE could be an efficient and cost-effective remedial technology. However, pilot testing of these technologies was warranted to evaluate their feasibility for full-scale implementation.

2.3 Test-Area Selection

The pilot-test area is shown on Photograph 1 and on Figure 2. The test was focused in the area of greatest contaminant impacts to the Site, based on existing DRI data (discussed in Section 2.1). This area also has been the location of several previous remedial excavations, which can introduce heterogeneous conditions into the subsurface. However, as this is the area of the Site that would most likely be targeted for future remedial action, it is our opinion that targeting this area for the test was appropriate.

3.0 INSTALLATION OF TEST WELLS

To conduct the pilot test, G-Logics installed six additional wells in the area of greatest contaminant impacts at the Site (Figure 2). Well construction information, such as depth, screened interval, and diameter, are discussed below, illustrated on Figure 3, and included in the attached boring logs (Appendix A).

- One 4-inch diameter well (SVE-1) was installed for testing SVE during each phase of the pilot test. This well was screened from an approximate depth of 5 to 9 feet in the vadose zone (above the upper saturated zone).
- G-Logics installed one 2-inch well (AS-1) for AS injection testing in the upper-saturated zone. This well was screened from approximately 12 to 14 feet. A sump (length of blank 2-inch casing beneath the screened interval) was installed from 14 to 16 feet to capture fine sediment.
- G-Logics installed one 2-inch well (AS-2) for AS injection into the lower-saturated zone. This well was screened from approximately 28 to 30 feet (with sump from 30 to 33 feet).
- G-Logics also installed three 2-inch wells (TW-1, TW-2, and TW-3) as observation wells for the pilot test. These wells served as additional monitoring points in the vadose zone for measurement of subsurface conditions during each phase of the pilot test. TW-1, TW-2, and TW-3 were screened from 5 to 9 feet, and are located approximately 10, 20, and 50 feet from SVE-1, respectively.

Well-installation activities are described below.

3.1 Underground Utility Clearance

Numerous subsurface utilities are present in the planned drilling areas. Before beginning fieldwork, G-Logics contacted public and private utility-locating services. Subsurface utility locations were identified by marking their inferred location on the ground surface. Additionally, at each boring location, the first five feet of soils were removed using air-knife/vacuum-extraction methods.

3.2 Soil Borings and Soil Sampling

Borings AS-1, AS-2, TW-1, TW-2, and TW-3 were completed using standard air-knife and direct-push drilling methods. Boring SVE-1 was air knifed to the completed depth of 9 feet to provide adequate annular space for the planned 4-inch well. Hand-auger sampling equipment also was used within the first five to seven feet of each boring where air-knife drilling occurred (9 feet for SVE-1). Specifically, SVE-1 was air-knifed to the completed depth of 9 feet to accommodate a four-inch casing-diameter necessary for the soil-vapor extraction design. Boring locations are shown on Figures 2 and 3.

Soil samples were collected continuously to evaluate the nature and extent of the confining layer. Soils were field screened for odors, soil staining, and/or discoloration. Samples also were screened for the presence of volatile organic compounds using a photoionization detector (PID), with the readings noted on our boring logs (Appendix A).

Representative samples from the borings were submitted to Fremont Analytical laboratory and analyzed for gasoline-range organics (GRO), diesel-range organics (DRO), heavy-oil range organics (ORO), benzene, toluene, ethylbenzene, and xylenes (BTEX), methyl tert butyl ether (MTBE), 1,2-dichloroethane (EDC), 1,2-dibromoethane (EDB), and lead. Soil-sample analytical results are presented in Section 5.1 and summarized in Table 1.

3.3 SVE Well Construction

G-Logics installed one SVE well (SVE-1) in the location presented on Figures 2 and 3. Air-knife The screen interval (5 ft to 9 ft below the ground surface) was chosen to be deep enough to prevent short-circuiting to the surface, but shallow enough to prevent the well screen from being flooded during periods of high water table.

This SVE well was constructed of 4-inch diameter Schedule 40 polyvinyl chloride (PVC) piping, with four feet of 0.020-inch slotted screen. The well was completed with 10/20 silica-sand filter pack extending to approximately one foot above the top of the screened interval. The remainder of the boring was backfilled with bentonite chips and then hydrated. The surface was completed with a flush-mounted monument and a concrete seal.

3.4 AS Well Construction

G-Logics installed two AS wells as part of the pilot study (Figure 2). Well AS-1 was completed at the bottom of the upper-saturated zone, just above the silt aquitard (screened from 12 to 14 feet deep). AS well AS-2 was completed approximately 10 feet below the bottom of known contamination (screened from 30 to 32 feet deep), within the lower-saturated zone (see Figure 3).

The AS wells were constructed of 2-inch diameter Schedule 40 PVC, with a 2-foot length of 0.010-inch slotted screen for the sparge point. Below the screen section, a 2 to 3-foot sump (comprised of blank PVC well casing) was installed to act as a silt/fines trap. The wells were completed with 10/20 silica-sand filter pack extending to approximately 1 foot above the top of the screened interval. The remainder of the boring was backfilled with bentonite chips and then hydrated. The surface was completed with a flush-mounted

monument and a concrete seal. The top of the AS wells was completed with a slip-to-thread reducer bushing glued to the casing.

3.5 Observation Well Construction

For the pilot test, three observation wells were installed at locations shown on Figures 2 and 3. Observation wells were constructed of 2-inch PVC casing with 0.020-inch machine-slotted screened intervals. The observation wells were screened at the same interval as SVE-1 (from approximately 5 to 9 feet deep) to assess ROI during the SVE phase of the study. TW-1 was located approximately 10 feet from SVE-1, while TW-2 was placed approximately 22 feet from SVE-1. TW-3 was placed approximately 50 feet south of SVE-1.

The observation wells were completed with 10/20 silica-sand filter pack extending to approximately 0.5 foot above the top of the screened interval. The remainder of the boring was backfilled with bentonite chips and then hydrated. The surface was completed with a flush-mounted monument and a concrete seal.

3.6 Well Development and Sampling

Well development was performed only on the AS wells as they are the only wells installed into the water table. After AS-well construction, the wells were developed. Over pumping, or removing water from the well at a rapid rate, was the devolvement technique used in both wells. A 12-volt DC submersible pump, decontaminated between each well, was lowered to near the bottom of the well screen and moved through the screened interval during well development. LNAPL was not observed to be present in either of the two wells.

After the AS-well installations and development, and following an equilibration period of at least 48 hours, groundwater samples were collected from each of the AS wells. Groundwater sampling was conducted in accordance with the methods identified in the G-Logics workplan dated February 4, 2019.

Collected groundwater samples were submitted to Fremont Analytical laboratory and analyzed for GRO, DRO, ORO, BTEX, MTBE, EDC, EDB, and total lead. Groundwater analytical results are presented in Section 5.2 and are summarized in the attached Table 2.

4.0 PILOT TEST SETUP AND PERFORMANCE

The pilot test was conducted in three phases. The first phase (Day 1) evaluated SVE within the vadose zone (approximately 0-9 feet below the ground surface). The second and third phases (Days 2 and 3) evaluated the introduction of AS within the upper and lower saturated zones. A representative of Kennedy Jenks was present during the pilot test to observe field activities on behalf of Ecology. Their observations were documented in a technical memorandum, provided in Appendix C.

4.1 Pilot Test Setup

The following section describes the equipment used during the pilot test. Figure 4 presents a Piping and Instrumentation Diagram (P&ID). Photographs of the equipment are attached to the report. Additional photographs are included in Appendix C.

4.1.1 SVE Test Equipment

The SVE system consisted of the following components.

4.1.1.1 SVE Wellhead and Test Assembly

A 4-inch to 2-inch reducing rubberized flexible connector secured the 4-inch SVE-well casing to a 2-inch diameter schedule 40 PVC pipe. The 2-inch PVC pipe was then connected to the test assembly.

The SVE test assembly consisted of the following equipment (Photos 2 through 4).

- On day 1, a manifold of three rotameters were used to measure specific/graduated flow ranges. Each rotameter was preceded and succeeded by a shut-off valve. On day 2, the rotameter manifold was replaced with a straight section of 2-inch PVC (see Section 4.5.5).
- A sampling port to collect PID readings, soil-vapor samples, and to connect pressure gauges for vacuum measurements.
- A section of clear, 2-inch diameter pipe, 24-inches in length to monitor for the presence of liquid in the extracted vapor stream from the SVE well.
- A 3/8-inch diameter hot-wire anemometer port for the measurement of air velocity and temperature at the test assembly on Day 2 (see Section 4.5.5).
- A 10-gallon translucent plastic moisture-reduction tank and dilution valve. The dilution valve intake was fitted with a dedicated rotameter. The moisture-reduction tank included a vacuum-relief valve to prevent tank implosion.

4.1.1.2 Blower System

G-Logics used a Rotron EN505AX58ML 2-horsepower, 230-volt, single-phase explosion-proof regenerative blower. This blower can produce a maximum flow of 160 standard cubic feet per minute (scfm), and a maximum vacuum of 60 inches of water (inH_2O). A portable generator, set up downwind and away from sampling locations, was used to power the blower. Dedicated vacuum gauges were fitted to the inlet of the moisture-reduction tank and to the blower inlet.

Recovered effluent vapors were treated through a 55-gallon activated-carbon vessel before being discharged to the atmosphere (away from the breathing zone) via a discharge pipe (Photo 5). Sample ports were installed in the discharge pipe to collect PID and hot-wire anemometer readings, accordingly.

4.1.2 AS Pilot Test Equipment

The second and third phases of the pilot-testing program included the introduction of air sparging during SVE-equipment operation. To conduct the AS test in the upper-saturated zone, air was injected into well AS-1. During the AS test in the lower-saturated zone, air was injected into well AS-2 while monitoring was performed in nearby observation points. AS-well construction is discussed in Section 3.4. These well locations are shown on Figures 2 and 3.

The planter strip immediately west of the proposed test area is currently unpaved and covered with landscaping gravel. To assess potential air leakage during air sparging, this unpaved area was covered with 6 mil plastic sheeting, and visually checked for inflation (Photo 7).

Beginning at each air-sparge wellhead, the AS system consisted of the following (Photo 6).

- A wellhead assembly, which included the following components,
    - An approximately 18”-long riser pipe threaded onto the well casing via a slip-to-threaded bushing.
    - A pressure gauge tapped into the side of the 18” pipe.
    - A quick-connect coupler threaded to a reducer bushing at the end of the 18” pipe
- A flexible pneumatic hose connected the AS wellhead to the compressor-system components.

- A flow-meter manifold consisting of one rotameter (0-10 CFM) and pressure gauge, preceded by a shut-off valve.
- Steel piping connecting the rotameter manifold to the compressor. A pressure gauge, temperature gauge, pressure regulator, and pressure-reducing valve were installed in the steel pipe.
- An 80-gallon pressure tank with electric auto-drain valve.
- A 5.5 horsepower, 240-volt, single-phase rotary-vane compressor (Hydrovane V04). The compressor can provide up to 19.5 scfm at 100 psi.

4.1.3 Observation-Well Monitoring Equipment

Each observation well was fitted with a removable rubberized flexible connector cap and valved barbed fitting (wellhead adapter) to allow the temporary connection of a differential-pressure gauge manifold (multiple gauges measuring a wide range of pressure/vacuum). This pressure gauge manifold was used to assess any pressure differences between the subsurface and the atmosphere created during the operation of the pilot test. The wellhead adapter also allowed for the collection of PID readings during the air-sparge phases of the pilot test.

4.2 SVE Step Test

The first phase of the pilot test consisted of performing step tests solely on the SVE system, using the test well SVE-1 and the observation wells described in Section 4.2.1. The step tests were performed in increasing increments of applied vacuum to evaluate the subsurface response in vadose zone soils, as measured in the surrounding observation wells. Specifically, the SVE test consisted of four increased vacuum steps (10, 19.5, 22, and 27 inH_2O) on day 1. Three additional steps (13, 24, and 35 inH_2O) were completed on day 2 (prior to introducing air-sparge).

Data collected during this phase of the pilot test was used to assess the following (see Section 5.3):

- The observable vacuum ROI in the vadose zone achieved with SVE at the tested vacuums;
- The influence of SVE on shallow groundwater elevations in the upper-saturated zone;
- Potential hydrocarbon mass-recovery rates that could be achieved by SVE application to vadose-zone soils.

4.2.1 SVE Step Test – Observation Wells

The observation wells used during the SVE step test consisted of wells TW-1, TW-2, TW-3, IP-4, and MW-26S.

4.2.2 SVE Step Test – Pre-Test Equilibration and Baseline Data Collection

The identified observation wells and SVE-1 were opened and allowed to stabilize for approximately 10 minutes. Initial groundwater depths were then measured. Observation wells were then fitted with wellhead adapters and an initial round of subsurface-atmospheric baseline pressure readings were collected.

4.2.3 SVE Step Test Initiation and Dilution-Air Adjustment

The test began by starting the vacuum blower and allowing it to run on 100-percent dilution air. At the end of this period, the SVE-system operating parameters were recorded (Table 3) and a vapor sample was collected for laboratory analysis (VS-1). With 100% dilution air, a vacuum of approximately 10 inH_2O was achieved at SVE-1. Accordingly, no dilution-air adjustment was needed for the first vacuum step. Approximately 22 scfm of airflow was extracted from SVE-1 at this vacuum.

4.2.4 SVE Step Test Monitoring

During each incremental step, vacuum measurements were collected from the SVE-1 wellhead and from observation wells at approximately 5 to 10-minute intervals (see Table 3). SVE-system parameters also were recorded at each vacuum step. Un-diluted samples were collected directly from the SVE wellhead (see Section 4.5.3). Select vapor samples were submitted for laboratory analysis based on PID field-screening measurements. Each step was concluded once subsurface vacuum measurements were observed to stabilize, based on the discretion of the field engineer. The test was concluded approximately 3 hours after initiation.

4.3 Upper-Saturated Zone AS/SVE Test

The air-sparging test in the upper saturated zone began after a second day of SVE testing had been performed to allow for a greater applied vacuum at the test well and with higher soil gas extraction rates.

This phase of testing utilized SVE-1, sparge well AS-1, and the observation wells described below. System parameters and field observations collected during this phase are summarized in Table 4.

4.3.1 Upper-Saturated Zone AS/SVE Test – Observation Wells

The observation wells used for this phase of the pilot test consisted of wells TW-1, TW-2, TW-3, IP-4, and MW-26S.

4.3.2 Upper-Saturated Zone AS/SVE Test – Baseline Data Collection

Prior to the start of the upper-saturated zone AS/SVE test, background pressures, DTW, dissolved oxygen (DO), and head space vapor concentrations were measured in AS-1, SVE-1, and the observation wells.

4.3.3 SVE System Operation

Following the baseline data collection, the SVE system was operated for approximately 1.5 hours (see Section 4.2). Based on preliminary field observations from the completed vacuum step tests (VOC concentrations, subsurface vacuum response), SVE system parameters were set at 37 inches of vacuum for the SVE/AS test (the maximum that the blower could apply). Flow rates ranging from 84 scfm to 96 scfm were achieved at this vacuum during the duration of the test (Table 4).

4.3.4 Upper-Saturated Zone AS/SVE Test – AS Test Initiation

Prior to beginning the AS test, a water-level measurement was collected from the AS-1 sparge test well. With the SVE system running, the compressor unit was then started, with the bypass valve on the air-supply manifold in the fully open position and the valve on the rotameter manifold fully closed. The pressure regulator was then adjusted to 5 psi and the rotameter manifold was slowly opened and the bypass valve slowly closed until air flow was established and indicated on the rotameter. An initial injection breakthrough pressure of less than 1 psi was required to establish flow into the lower aquifer.

Following breakthrough, the pressure regulator was adjusted until the target flowrate of 10 scfm was reached. SVE and AS system operating parameters also were recorded prior to recording observation-well responses.

4.3.5 Upper-Saturated Zone AS/SVE Test – AS Testing and System Monitoring

The AS compressor was operated at static flowrate setting of 10 CFM for 1.5 hours. Pressure and PID measurements were recorded in the observation wells at 20 to 30-minute intervals. Vapor samples also were collected (from the SVE wellhead) for field screening every 20 to 30 minutes during the sparge test to determine the potential additional contributions to recovery concentrations resulting from sparging. Visual checks for

bubbling and DTW measurements were completed in observation wells once before, once during, and once at the end of the test. Dissolved oxygen was measured in the observation wells once before and once at the conclusion of the test.

Routinely during the sparge-injection test, the ground surface near the AS well was wetted with potable city water from an exterior hose connection at the service station to identify areas where injected air may escape to the ground surface without being captured by the SVE system. A PID also was used to assess for elevated VOC concentrations in the air beneath the applied planter-strip sheeting (Section 4.1.2). Indications of air leakage (such as the formation of bubbles in wetted concrete, or elevated PID readings beneath the applied sheeting) were not observed during the testing.

4.4 Lower-Saturated Zone AS/SVE Test

The third phase of the pilot test was conducted to assess air sparging in the lower saturated zone. This phase of testing is was performed on the third day of the study and utilized air sparge well AS-2 and extraction well SVE-1, as well as the observation wells described below in Section 4.4.1. System parameters and field observations collected during this phase are summarized in Table 5.

4.4.1 Lower-Saturated Zone AS/SVE Test – Observation Wells

To assess the feasibility of using AS injection in the lower-saturated zone in combination with SVE in the vadose zone, subsurface response data was collected within the vadose zone (wells TW-1. TW-2, TW-3), upper-saturated zone (wells AS-1, IP-4, MW-26S, MW-28S), and the lower-saturated zone (wells IP-3, IP-5, IP-7, MW-26D, and MW-28D).

4.4.2 Lower-Saturated Zone – Pre-Test Equilibration and Baseline Data Collection

The observation wells and AS-2 were opened and allowed to stabilize for approximately 10 minutes prior to recording baseline background pressures. Initial groundwater depths and DO were then measured. Observation wells were fitted with wellhead adapters and an initial round of subsurface-atmospheric pressure and PID readings were collected.

4.4.3 SVE System Operation

Following the baseline data collection, the SVE system was operated for approximately 1 hour at 37 inches of vacuum and recovery flow rates ranging from 87 scfm to 96 scfm.

4.4.4 Lower-Saturated Zone – AS Test Initiation

The compressor unit was started, with the bypass valve on the air-supply manifold in the fully open position and the valve on the rotameter manifold fully closed. The pressure regulator was then adjusted to 18 psi and the rotameter manifold was slowly opened and the bypass valve slowly closed until air flow was indicated on the rotameter. An initial injection breakthrough pressure of approximately 6 psi was required to establish flow into the lower aquifer.

Following breakthrough, the pressure regulator was adjusted, and the air flow was increased until the target flowrate of approximately 10 scfm was reached. This flow was maintained for the duration of the test.

4.4.5 Lower-Saturated Zone – AS Testing and System Monitoring

The AS/SVE system was operated at a static setting for approximately 2 hours. Two rounds of pressure, PID, and DTW measurements were recorded in the observation wells following the start of the AS test (Table 5). Vapor samples also were collected periodically (from the SVE wellhead) for field screening during the sparge test (Table 5). Dissolved oxygen was measured in the observation wells once before and once at the conclusion of the test. In addition, observation wells were periodically opened, and a small diameter video scope was lowered to near the surface of the water to look for bubbling (Photo 8).

4.5 Data Collection and Field Analysis

Data-collection and field-analytical methods for groundwater monitoring, vacuum/pressure measurements, vapor-sample collection and screening, and dissolved-oxygen measurements are discussed below.

4.5.1 Groundwater Depth Measurements

Water-level measurements were referenced to the top of the well casing. The static-water level was measured in each monitoring well using a conductivity type water-level probe. The tape on the probe was used to obtain a depth-to-water measurement, from the reference point, to within 0.01 feet. All elevation data collected from wells at the site are referenced to their surveyed elevations provided by PLS, Inc. Land Surveyors.

4.5.2 Differential-Pressure Measurements (Observation Wells)

Pressure measurements were made relative to atmospheric pressure using Dwyer Magnehelic® differential pressure gauges. Differential pressure at SVE-1 and the observation wells were measured using a series of differential pressure gauges with sensitivity ranges from 0 to 50 inH_2O.

4.5.3 Vapor-Sample Collection and Field Screening

Vapor concentrations were screened at the SVE-1 wellhead using a PID (calibrated to a 100-ppmv isobutylene calibration standard). At the beginning of day 1, an initial vapor sample (VS-1) was collected from the blower inlet (downstream of the dilution valve). On day 1 of the pilot test, vapor samples were collected from the wellhead of SVE-1 into 1-liter Tedlar® bags via a dedicated rotary-vane compressor pump. On days 2 and 3, vapor samples were collected using a negative-pressure sample chamber to draw samples into the Tedlar® bags. The negative-pressure chamber allowed for the sample bag to be filled directly from the wellhead via dedicated polyethylene tubing, without the sample passing through the pump.

A total of 14 samples were submitted for laboratory analysis for GRO and BTEX compounds over the three days of testing. Vapor-sampling results are discussed in Section 5.6.

4.5.4 Dissolved Oxygen Measurements

DO was measured in observation wells using a down-well optical DO meter. Measurements were collected once before, and once after each of the AS tests (upper and lower saturated zones).

4.5.5 SVE Air Flow Measurements

As discussed in Section 4.1.1, SVE air flow was measured on day 1 using a set of three Dwyer Visi-Float® rotameters with graduated flow ranges (Photo 2). On days 2 and 3, the rotameter manifold was replaced with a straight section of 2-inch PVC pipe in order to achieve a higher applied vacuum and flow rate. A hot-wire anemometer was then used to measure flow velocity in linear feet per minute (lfpm) and temperature (°F) at two locations: a port installed in the clear section of pipe upstream of the blower inlet (referred to as “blower inlet” in Tables 3, 4, and 5) and a port installed downstream of the carbon-treatment vessel on the exhaust pipe (referred to as the “blower exhaust”).

Rotameter and anemometer measurements were converted to scfm using the following equation (Dwyer Instruments, Inc., 2009):

$$scfm = acfm \times \left(\sqrt{\frac{P(a) \times T(s)}{P(s) \times T(a)}} \right)$$

Where P(a) is the actual pressure (14.7 psia + gauge pressure (psig)), P(s) is the standard pressure (14.7 psia, 0 psig), T(a) is the actual temperature (460 R + measured temperature (F)), and T(s) is standard temperature (530 R).

5.0 PILOT TEST OBSERVATIONS

The observations and findings of this feasibility study pilot test are discussed below. Analytical results obtained during this study are summarized on Tables 1, 2, and 6. Boring logs for the completed test wells are included in Appendix A. Boring logs also are included in Appendix A for existing wells used as observation points during the pilot test. Analytical laboratory reports for the analyzed soil, groundwater, and air samples are attached as Appendix B of this report. Chain of custody forms also are included in Appendix B.

5.1 Soil-Boring Observations and Findings

Six borings were advanced to depths ranging from 9 to 35 feet below the ground surface during the installation of pilot-test wells. A mixture of loose, brown, silty, gravelly sand with variable amounts of concrete, brick, asphalt, and wood debris was generally encountered to a depth of approximately 9 feet in all of the boring locations. Gray-brown silt with fine-grained sand was observed to 11 feet, underlain by two feet of saturated, fine-grained silty sand (upper saturated zone, 11 to 13 feet below the ground surface). Gray-brown silt with fine-grained sand and reedy, grassy vegetation was observed from 13 to 19 feet (confining unit). The deepest boring, AS-2, encountered black to dark gray, fine to very coarse-grained, saturated sand from 19 feet to the explored depth of 35 feet (within the lower saturated zone). An annotated photograph of the recovered soil from boring AS-2 is included as Figure 5. Soil analytical results are presented in Table 1.

5.2 Groundwater Observations and Findings

During drilling, the upper- and lower-saturated zones were first encountered at approximately 11 feet and 19 feet below the ground surface, respectively. Static

groundwater was measured at approximately 8.5 feet below the ground surface in the upper saturated zone (well AS-1) and 14.1 feet below the ground surface in the lower saturated zone (well AS-2). Analytical results from the collected groundwater samples are presented in Table 2.

5.3 SVE Step Test

The observations and findings of the SVE step test are discussed below.

5.3.1 Vacuum Response/Radius of Influence

During each successive vacuum step test, the corresponding subsurface vacuum responses were measured at each observation well. Applied test-well vacuums and field-observed vacuum measurements are presented in Table 3, Graph 1, and summarized below. The applied vacuums are listed in the far-left column. Distances and direction from SVE-1 are shown at the top of the remaining corresponding columns. Moving from left to right represents a north-to-south transect of the study area, with SVE-1 near the center of the observation wells (gray column). Vacuum responses at, or greater than 1% of the applied test-well vacuum are shown in bold.

c

Applied Vacuum (inH_2O)	Subsurface Response (% of applied vacuum at SVE-1)					
	MW-26S 50' North	**TW-2 20' North**	**TW-1 10' North**		**IP-4 10' South**	**TW-3 50' South**
10	0.3%	**1%**	**6%**		**4%**	0.1%
13	0.3%	**1%**	**6%**		**4%**	0.2%
19.5	0.4%	**1%**	**6%**		**2%**	0.1%
22	0.4%	**2%**	**7%**		**2%**	0.1%
27	0.4%	**2%**	**6%**		0.2%	0.1%
35	0.3%	**1%**	**6%**		**4%**	0.1%

The data show a stronger vacuum response to the north of SVE-1. Also shown above is a conspicuous loss of vacuum in well IP-4 at 27 inH_2O. This was due to a faulty wellhead adapter connection, which was repaired before the next step.

Based on the presented vacuum response data, an ROI of 20 feet has been estimated for SVE-1 (Figure 6, see Section 6.1 for further discussion). Subsurface vacuum-response data also is illustrated on Graph 2.

5.3.2 Soil Gas Extraction Rates

The lowest applied test vacuum of 10 inH_2O produced a corresponding flow rate (vapor-extraction rate) of approximately 22 scfm. This yielded a vacuum-to-flow ratio of approximately 0.45. The highest applied test vacuum of 27 inH_2O during the same day of testing produced 67 scfm. This produced the same vacuum-to-flow relationship of 0.45. The highest overall vacuum of 37 inH_2O was applied to SVE-1 on days 2 and 3. This yielded a vapor-extraction rate of approximately 90 scfm, with a vacuum-to-flow ratio of 0.44. Based on the above observations, vapor-extraction rates from SVE-1 generally correlate linearly with the applied test-well vacuums (Graph 3, see Section 6.1 for further discussion).

5.3.3 Day 1 Mass-Recovery Rates

Over the course of the pilot test, several soil-gas samples were collected at the SVE wellhead. During day 1, recovered GRO vapor concentrations ranged from 304,000 µg/m^3 (74.3 ppmv) in sample VS-5 to 438,000 µg/m^3 (107 ppmv) in sample VS-3. Based on the measured flow rates and the vapor-sample concentrations, estimated GRO mass-recovery rates ranged from approximately 0.7 pounds per day (lbs/day) during Step 1 to 1.64 lbs/day during Step 4 (See Tables 6 and 7).

5.4 Upper Saturated Zone AS/SVE Test Observations and Findings

The observations and findings of the upper saturated zone AS/SVE test are discussed below. Field measurements are summarized in Table 4.

5.4.1 Sparge Injection Pressure

A breakthrough pressure of less than 1 psi was required at the well head to initiate airflow into the sparge well. A flowrate of 10 scfm was achieved with a pressure of 2 psi at the sparge wellhead.

5.4.2 Air-Sparge Short Circuit Indications

As discussed in Section 4.3.5, elevated headspace VOC concentrations under the plastic sheeting, billowing of plastic, and bubbles on wetted concrete were not observed during the testing.

5.4.3 Air-Sparge Radius of Influence

Approximately 2 feet of water was observed to be present above the screen of AS-1. During active sparging of 10 scfm into the upper saturated zone, an assessment of the presence of

bubbles was performed in the observation wells. No bubbles were detected in any of the wells, with the nearest wells being 10 feet away from the sparge well.

The table below depicts the subsurface pressures measured in the observation wells prior to and during the sparge test (also shown on Graph 4). The test intervals are listed in the far-left column. Distances and direction from AS-1 are shown at the top of the corresponding columns. Moving from left to right represents a north-to-south transect of the study area, with AS-1 near the center of the observation wells (see Section 6.2 for discussion).

Test Interval	Measured Subsurface Pressures (inH_2O)				
	MW-26S	**TW-2**	**TW-1**	**IP-4**	**TW-3**
	50' North	**20' North**	**10' North**	**10' South**	**50' South**
SVE Start	-0.04	-0.16	-0.76	-0.56	-0.02
SVE Step 2	-0.08	-0.33	-1.4	-0.97	-0.02
SVE Step 3	-0.11	-0.5	-2	-1.35	-0.03
AS Start	-0.11	-0.51	-2.1	-1.25	-0.04
AS End	-0.11	-0.53	-1.9	-2.9	-0.06

Based on the data presented above, introduction of air sparging into the upper saturated zone did not produce a positive subsurface-pressure response in the observation wells.

5.4.4 Hydraulic Mounding

Groundwater depths were measured in observation wells prior to, during, and immediately after air sparging to determine whether significant groundwater mounding was occurring as a result of sparging. Groundwater-elevation measurements for each observation are summarized below.

Test Interval	Groundwater Elevation (Ft Above MSL)				
	MW-26S	**TW-2**	**TW-1**	**IP-4**	**TW-3**
	50' North	**20' North**	**10' North**	**10' South**	**50' South**
SVE Start	10.82	10.85	10.9	11.12	10.69
AS Start	10.73	10.79	10.88	11.10	10.51
AS End	10.83	10.81	10.88	11.69	10.76

Based on the data presented above, introduction of air sparging into the upper saturated zone failed to produce a significant change in groundwater elevations.

5.4.5 Day 2 Observation Well VOC Response and Mass Recovery Rates

Over the course of the sparge test in the upper saturated zone, headspace VOC concentrations were measured to assess observable increases in soil gas concentrations in the observation wells as a result of sparging. These measurements are summarized in the table below.

Test Interval	Headspace VOCs (ppmv)				
	MW-26S	**TW-2**	**TW-1**	**IP-4**	**TW-3**
	50' North	**20' North**	**10' North**	**10' South**	**50' South**
SVE Start	14	0.8	1.6	250	205
AS Start	14	1.4	0.9	160	86
13:38:00 PM	24	1	2	230	24
14:01:00 PM	14	1.4	1	230	23
Sparge End	35	1.3	1	230	35

Vapor samples were collected at the SVE wellhead during the Upper Saturated Zone AS/SVE test. During this period, recovered GRO vapor concentrations ranged from 321,000 µg/m^3 (78.4 ppmv) in sample VS-8 to 401,000 µg/m^3 (98.0 ppmv) in sample VS-6.

Based on the measured flow rates and the vapor-sample concentrations during day 2, G-Logics has estimated a GRO mass-recovery rate of approximately 3.20 lbs/day prior to initiation of air sparging, decreasing to 2.56 lbs/day approximately 1.5 hours after sparge initiation (Tables 4 and 7).

5.5 Lower Saturated Zone AS/SVE Test Observations and Findings

The observations and findings of the lower saturated zone AS/SVE test are discussed below. Field measurements are summarized in Table 5.

5.5.1 Lower Saturated Zone Air-Sparge Radius of Influence

Approximately 12 feet of saturated zone was observed to be present between the top of the screen of AS-2, and the bottom of the confining layer.

Within approximately 1 hour and 15 minutes of AS-initiation, bubbles were detected in the upper saturated zone wells AS-1 (4-feet south of AS-2) and IP-4 (within 10 feet of AS-2). The data are summarized below and presented on Table 5 and Graph 6.

Test Interval	Upper Saturated Zone Well Pressure (inH_2O) and Bubbling						
	AS-1	**TW-1**	**IP-4**	**TW-2**	**TW-3**	**MW-26S**	**MW-28S**
Distance from AS-2 (ft)	4’	10’	10’	20’	50’	50’	100’
Baseline	0	-0.01	-0.09	-0.01	0	0	-0.01
SVE Start	-0.13	-2.2	-0.5	-0.5	-0.04	-0.15	0
AS Start	-0.09	-2.1	-0.06	-0.5	-0.04	-0.12	0
Mid-AS	29*	-2.4	0.05*	-0.55	-0.06	-0.1	-0.02
AS End	3*	-2.35	-0.02*	-0.65	-0.1	-0.18	-0.02

**Bubbling Observed in well AS-1. Occasional bubbles also were observed in IP-4*

Vigorous boiling was observed in the lower saturated zone wells IP-3, IP-5, and IP-7. IP-7 is approximately 35 feet from AS-2. In addition, pressure increases were observed as far as 100 feet from the injection well in the lower saturated zone (see below).

Test Interval	Lower Saturated Zone Pressure Responses, (inH_2O) and Bubbling				
	IP-5	**IP-3**	**IP-7**	**MW-26D**	**MW-28D**
Distance from AS-2 (ft)	12’	25’	35’	50’	100’
Baseline	0	0.02	2.5	0.29	-0.38
SVE Start	14	-3.45	14.5	3.25	-2.2
AS Start	17.5	-4.3	16.5	-3.1	8
Mid-AS	50*	12.5*	50*	11.5	8
AS End	50*	50*	50*	1.4	3

**Bubbling Observed in wells IP-3, IP-5, and IP-7*

5.5.2 Lower Saturated Zone Hydraulic Mounding

Groundwater depths were measured in observation wells prior to, during, and immediately after air sparging to determine whether significant groundwater mounding was occurring as a result of sparging. Groundwater-elevation measurements are summarized below for wells screened in the upper saturated zone. The net increase/decrease in groundwater elevations during the lower-saturated zone AS/SVE test also are presented on Graph 8.

Test Interval	Groundwater Elevation, Upper Saturated Zone Wells (Ft Above MSL)						
	AS-1	**TW-1**	**TW-2**	**IP-4**	**TW-3**	**MW-26S**	**MW-28S**
SVE Start	10.54	10.85	10.88	10.79	11.09	10.8	10.79
AS Start	8.96	10.77	10.87	10.49	11.07	10.8	10.8
AS End	10.64	10.76	10.87	10.59	11.08	10.8	10.79
%Change	**1%**	**-1%**	**0%**	**-2%**	**0%**	**0%**	**0%**

Groundwater-elevation measurements are summarized below for wells screened in the lower saturated zone.

Test Interval	Groundwater Elevation, Lower Saturated Zone Wells (Ft Above MSL)					
	IP-5	**IP-3**	**IP-7**	**MW-26D**	**MW-28D**	**Tidal Stage & Trend[1]**
SVE Start	4.85	5.05	3.06	4.99	5.07	Low, Rising
AS Start	8.98	6.51	---	6.27	5.91	Low, Rising
AS End	10.18	8.03	9.41	6.61	6.24	Low, Rising

1 NOAA-Station 9447029, Duwamish Waterway, Eighth Ave S

Based on the data presented above, introduction of air sparging into the lower saturated zone did not produce a significant change in groundwater elevations in wells screened in the upper saturated zone. However, increased groundwater elevations were observed in wells screened in the lower saturated zone. The timing of this increase corelates with a rising tide, as shown in the table above.

5.4.3 Day 3 Observation Well VOC Response and Mass-Recovery Rates

Over the course of the sparge test in the lower saturated zone, headspace VOC concentrations were measured to assess observable increases in soil gas concentrations in the observation wells as a result of sparging. These measurements are summarized in the tables below and presented on Graph 7.

Test Interval	Upper Saturated Zone Headspace VOCs (ppmv)						
	AS-1	TW-1	TW-2	IP-4	TW-3	MW-26S	MW-28S
Baseline	39	4	3	100	75	4	6
SVE Start	44	140	48	100	92	5	5
AS Start	45	16	8.3	115	52	9.6	11
Mid-Sparge	40	87	80	115	22	3	14
AS End	120	80	6.3	195	10	18	6

At the conclusion of the upper saturated zone AS test, elevated VOC concentrations were detected in upper-saturated zone wells AS-1 and IP-4.

Test Interval	Lower Saturated Zone Headspace VOCs (ppmv)				
	IP-5	IP-3	IP-7[2]	MW-26D	MW-28D
Baseline	75	14	P	1	76
SVE Start	157	151	P	178	131
AS Start	139	85	P	201	177
Mid-Sparge	106	69	P	380	313
AS End	376	193	P	5	13

2 "P" indicates LNAPL present in well during testing, headspace VOCs not measured.

Air sparging in the lower saturated zone appears to have resulted in elevated VOC concentrations in wells screened in the lower saturated zone.

During the lower saturated zone AS/SVE test, recovered GRO vapor concentrations ranged from as low as 359,000 µg/m^3 (87.8 ppmv) in sample VS-12 to 586,000 µg/m^3 (143 ppmv) in sample VS-9 (Table 6). Based on the vapor-sample results and flow rates measured during day 3 (Tables 5 and 7), G-Logics has estimated a GRO mass-recovery rate of approximately 5.05 lbs/day at SVE initiation, decreasing to 2.91 lbs/day just prior to the introduction of AS. During the AS portion of the test, mass-recovery rates ranged from 2.87 to 3.23 lbs/day 1.5 hours after sparge initiation.

6.0 DISCUSSION

The findings of the pilot test are discussed in the following sections.

6.1 SVE Discussion

The SVE test allowed for the estimation of practical limits of the radial vacuum influence at the Site, the soil-gas extraction rates, and the amount of contaminant mass that would require treatment if implemented on a full-scale.

The Radius of Influence (ROI) may be expressed as the lateral distance at which 1% of the applied test-well vacuum can be measured in the subsurface (Kuo, 1999). As presented in Section 5.3.1, a significant subsurface response was observed in nearby shallow observation wells from the onset of the test. Specifically, within minutes of starting the SVE test (and at subsequent vacuum steps), subsurface vacuums greater than 1 to 2% of the applied test-well vacuum were observed in wells within an approximate 20-foot radius of the test well (Graph 1). Similar vacuums were sustained throughout the test. Accordingly, an estimated ROI of 20 feet is estimated for use as a design parameter for spacing soil vapor extraction wells (see Graph 2).

As discussed in Section 5.3.2, vapor-extraction rates from SVE-1 generally correlated linearly with the applied test-well vacuums (see Graph 3). This finding indicates that higher vapor-extraction rates would be achievable at higher applied vacuums. Additionally, flow out of the subsurface does not appear to be limited by the geology at the tested vacuums. This also indicates that the well construction and/or equipment used may be the limiting factor for vapor-recovery rates if SVE is operated at the Site.

6.2 Upper Saturated Zone AS/SVE Discussion

As shown in Section 5.4, the observable impacts of sparging were very limited in the upper saturated zone. Specifically, subsurface pressure, headspace-vapor concentrations, and groundwater elevations appeared to be unaffected by the introduction of air sparging (Graphs 4 and 5). This could be attributed to the limited thickness of water present in the upper saturated zone and the unconfined nature of the soils above this zone.

This finding limits the ability to put a measurable boundary on the radius of effective sparging in this saturated zone. It can be assumed, however, that the radius of sparging influence is less than 10 feet. Additionally, indications of a preferential pathway of injected air to the ground surface were not observed during the testing (see Section 5.4.2).

6.3 Lower Saturated Zone AS/SVE Discussion

Increases in water levels were observed in wells screened in the lower-saturated zone while sparging in the lower-saturated zone. Conversely, groundwater elevations in wells screened within the upper saturated zone did not appear to change appreciably during the same testing event (Graph 8). Groundwater mounding (due to air sparging) can cause the unintentional migration of contaminated groundwater as a result of an artificially increased hydraulic gradient. However, it should be noted that the observed groundwater-elevation changes in the lower saturated zone may be partly due to the influence of tidal fluctuations. Controlling for the potential tidal influences on the data collected during the sparge test is beyond the scope of this pilot test.

While sparging in the lower saturated zone, subsurface pressure, headspace VOC concentrations, and DO responses were modest or non-existent in wells screened within the upper-saturated zone (Graphs 6 and 7). Wells AS-1 (located adjacent to the sparge point) and IP-4 (located approximately 10 feet SE of the sparge point) were the only upper-saturated zone wells where bubbling was observed. While energetic “boiling” was observed in AS-1, the bubbling rate in IP-4 was approximately 4 bubbles per minute. Based on this finding, vapor transmissivity is likely to be limited across the confining layer.

As shown in Section 5.5, strong subsurface pressure responses were observed in wells screened in the lower-saturated zone during sparging (Graphs 6, 7, and 8) with vigorous bubbling detected as far as 35 feet from the injection well. However, the increase in pressures observed in the deeper wells may be due to the effect of rising tide on these wells. The observation of vigorous bubbling in well IP-7 indicates a much wider ROI than was determined in the upper saturated zone, and likely a predominantly lateral pathway for injected air. The larger ROI is likely due to the presence of the confining layer above the sparge point and the depth of sparging below the water table. The lateral distance of lower saturated zone sparge influence suggests that injected air may not be recoverable by an extraction system operating in the vadose zone at the Site.

Therefore, it is possible that air introduced into the lower saturated zone (at any flowrate) would travel laterally along the bottom of the confining layer, rather than vertically across the confining layer into the vadose zone (where it could be recovered by an SVE system). This is further supported by observations of bubbling in well IP-7 (screened in lower saturated zone), which is approximately 35 feet from AS-2. Accordingly, further consideration of air sparging within the lower-saturated zone is not recommended.

6.4 Mass-Recovery Rates Discussion

Over the duration of the test, GRO vapor concentrations ranged from a minimum of 304,000 µg/m^3 (74.3 ppmv) during Step 4 of day 1 to a maximum of 585,000 µg/m^3 (143 ppmv), captured at the start of the test on day 3 (Tables 6 and 7).

Mass-recovery rates were generally unaffected by the introduction of sparging in either saturated zone and instead appear to be directly proportional to flow rate. These results are presented in Section 5.0 and summarized on Table 7. This finding is consistent with other observations regarding the effectiveness of AS in either of the saturated zones.

7.0 SUMMARY AND CONCLUSIONS

The BFC feasibility study pilot test was successful in collecting site-specific data to evaluate the feasibility and potential effectiveness of utilizing soil vapor extraction (SVE) and/or air sparge (AS) remediation technologies for future full-scale remediation at the Site.

As stand-alone remediation technologies, SVE and AS are not considered as viable alternatives for future consideration for this Site.

By itself, SVE would address only the petroleum contaminant mass present in vadose zone soils that would be accessible via movement of air through the subsurface. Results of the RI indicate that a significant portion of the hydrocarbon mass present in soil at the Site exists in saturated soils in the upper saturated zone, lower saturated zone, and the silty confining layer separating them. Therefore, implementation of an active remediation strategy focused solely on remediation of vadose zone soils is unlikely to be effective.

AS by itself is not considered viable because this technology would likely result in an uncontrolled release of hydrocarbon impacted soil vapor with the potential to impact indoor and/or outdoor ambient air conditions in the vicinity of the remediation area.

When combined, AS and SVE remediation technologies have the potential to complement one another, with AS providing for remediation of saturated zone soils and groundwater through “air-stripping” of hydrocarbons while SVE provides remediation of vadose zone soils and capture of hydrocarbon-laden vapors generated by the AS process. However, data collected during the BFC feasibility study pilot test suggest that the contaminant distribution and geologic conditions at this Site are not favorable for full-scale AS/SVE implementation.

In the upper-saturated zone, a sufficient depth of water is generally not present to allow effective sparging. During AS/SVE testing in the upper saturated zone, hydrocarbon mass recovery rates appeared to decrease slightly in response to sparge injection, which is possibly due to the introduction of unimpacted ambient air into the vadose zone by the AS system.

Results of sparge testing in the lower-saturated zone indicate that communication of soil vapors between the lower- and upper-saturated zone is possible but likely limited, as evidenced by bubbling observed in two of the upper-saturated zone wells during the lower-saturated zone sparge test. In addition, hydrocarbon mass recovery rates did not increase during sparge operations in either of the saturated zones. Specifically, these findings indicate that air injected into the lower saturated zone would not be recoverable.

8.0 LIMITATIONS

This document was prepared in accordance with generally accepted professional practices, for similar services, locations, and at the time the work was performed. The results and discussions are intended exclusively for the purpose outlined herein and for the Site location and project indicated. Opinions and recommendations presented herein are based solely upon our visual observations and field screening, and the analysis of the soil, groundwater, and soil-gas/vapor samples collected during the Feasibility Study Pilot Test. The information presented in this report reflects site conditions existing at the time of our assessment and does not necessarily apply to future changes or other prior conditions at the site of which G-Logics, Inc. is not aware and has not had the opportunity to evaluate. Our services were not intended to identify all environmental problems, do not eliminate all risk, and were limited to the information described above. Other activities that are not specifically described in this document are excluded and are therefore not part of our services.

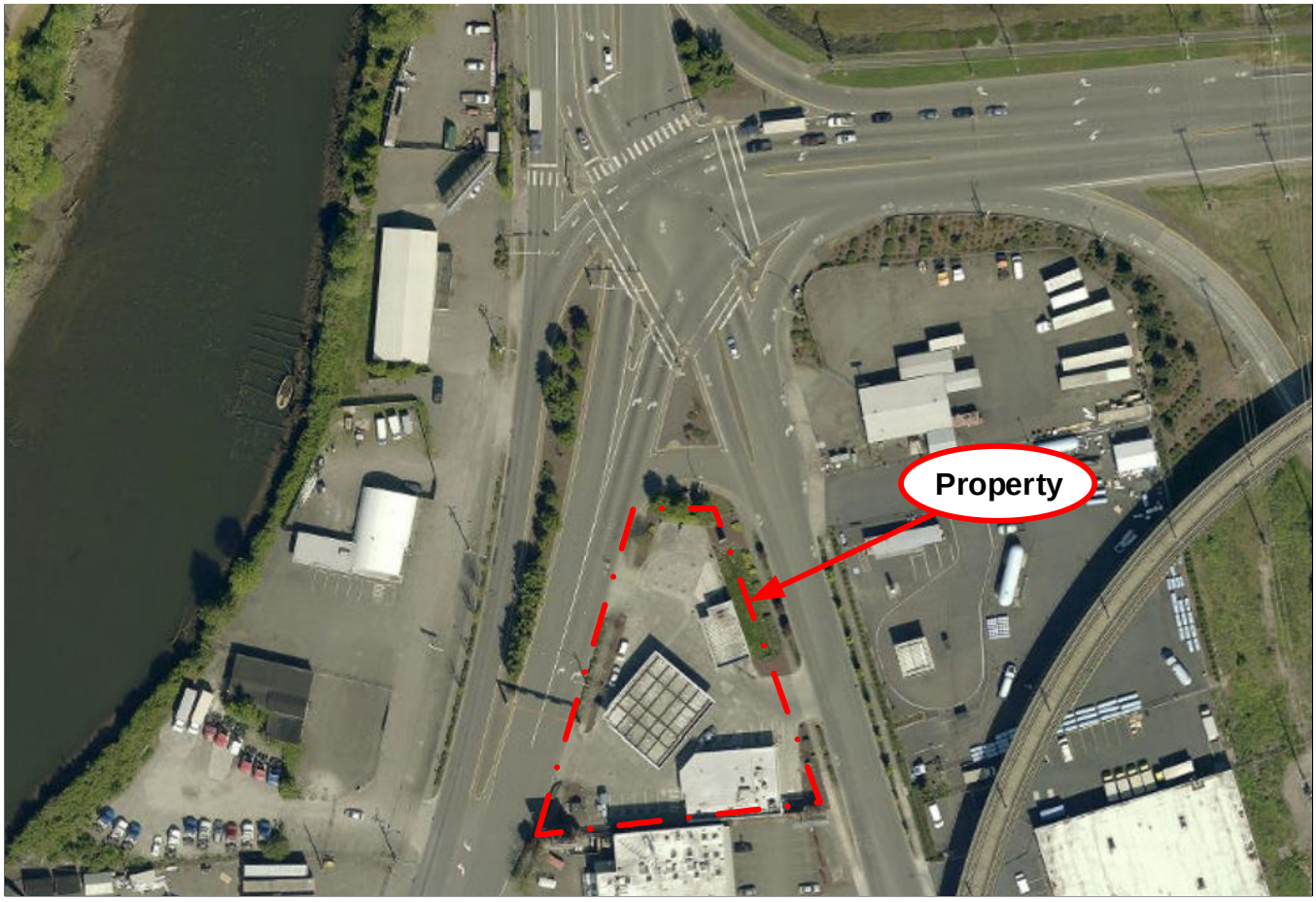
No warranty, either express or implied, is made.

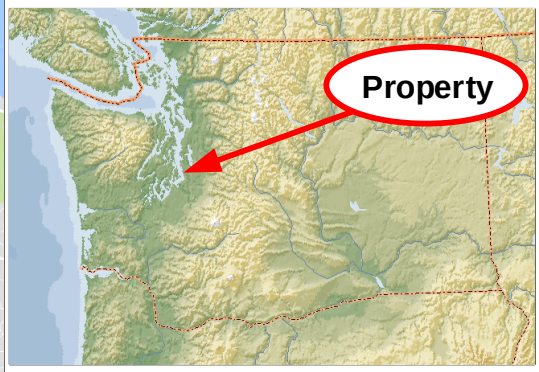
9.0 REFERENCES

Dwyer Instruments, Inc., 2009, *VFC Series Visi-Float® Flowmeter Specifications – Installation and Operating Instructions*, Bulletin F-48.

Kuo, 1999, *Practical Design Calculations for Groundwater and Soil Remediation*.

FIGURES





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Property Location Maps

Boeing Field Chevron

10805 East Marginal Way South

Tukwila, Washington

Figure

1

Mapping Reference: Delorme, King County iMap, and Google Maps

East Marginal Way South

Tukwila International Boulevard

Car Wash

Current Station Store

Pump-Island Canopy

MW-26S

MW-26D

TW-2

TW-1

IP-7

SVE-1

IP-4

AS-2

AS-1

IP-3

IP-5

TW-3

MW-28D

MW-28S

Legend

- Pilot Test AS/SVE Well
- Pilot Test Observation Well
- AS-1 — Red Text Indicates Recently-Installed Well (April 2019)
- Approximate Property Boundary

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Approximate Drawing Scale: 1" = 20'

0 ft. 12 ft. 20 ft. 40 ft.

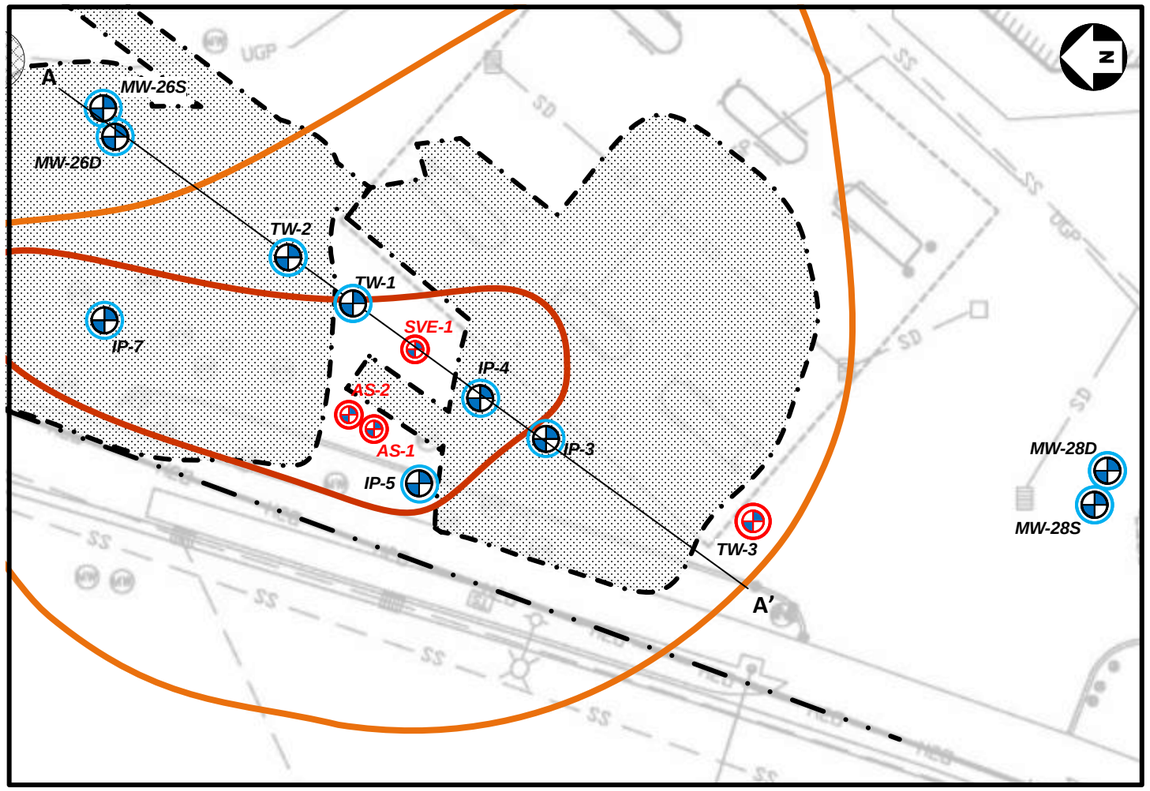
Note: This figure contains information in color. Black & white photocopies may not be suitable for review.

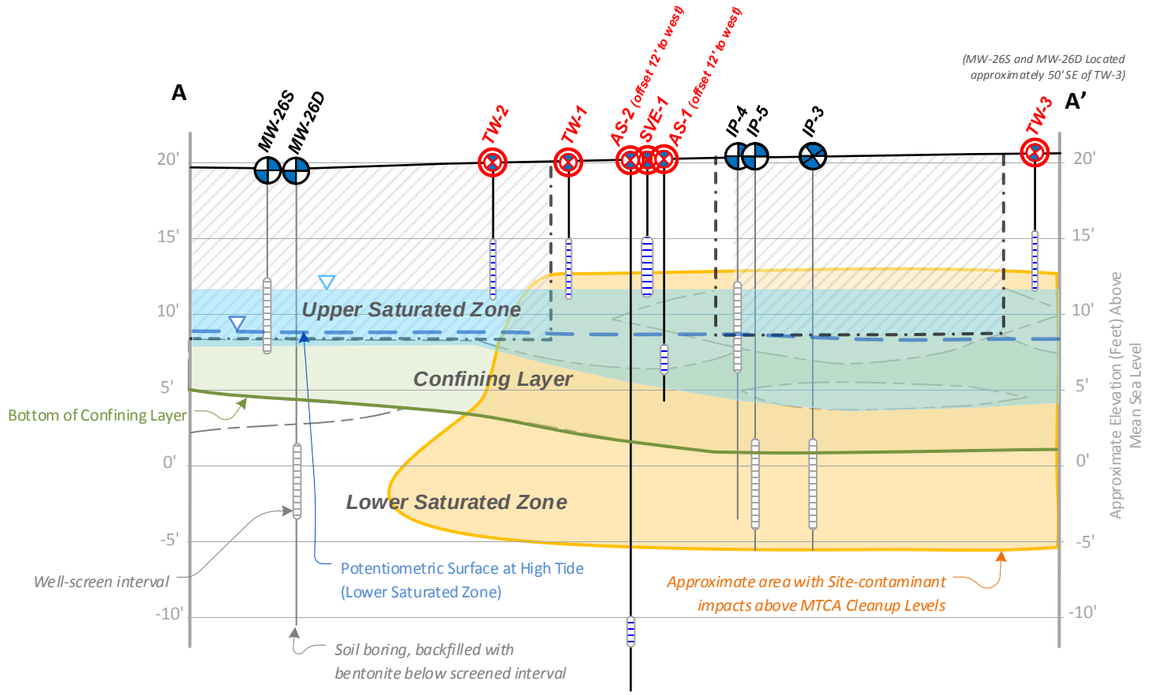
Feasibility Study Pilot Test Wells
Boeing Field Chevron
10805 East Marginal Way South
Tukwila, WA

Figure 2

Project File: 01-0410-O F2 Pilot Test Area.vsd

Mapping Reference: PLS Survey, G-Logics Field Measurements

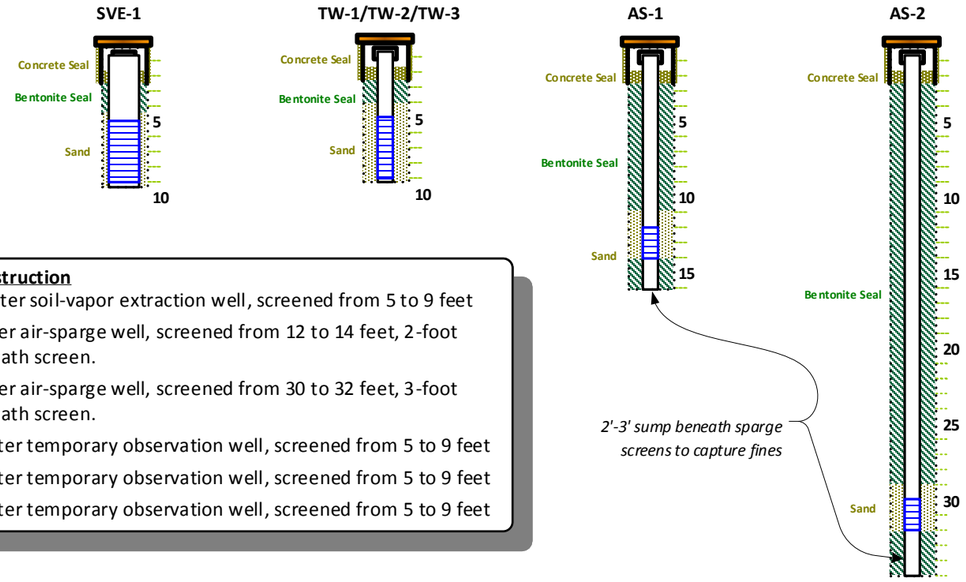




Legend

- Pilot-Test Well
- Observation Well
- Historical Site Exploration Location
- Property Boundary
- Current UST Location (Approximate)
- Approximate Extent of Previous Remedial Excavations (work performed by others)
- Approximate Extent of GRO above MTCA Cleanup Levels Protective of Surface Water (800 µg/L) in Lower Saturated Zone (LSZ)
- Approximate Extent of GRO above 1,000 µg/L in LSZ

Note: See RI text for discussion of previous explorations and remedial efforts. Interpreted contaminant distributions are based on November, 2018 groundwater sampling results.



Pilot-Test Well Construction

SVE-1: 4-inch diameter soil-vapor extraction well, screened from 5 to 9 feet

AS-1: 2-inch diameter air-sparge well, screened from 12 to 14 feet, 2-foot sump installed beneath screen.

AS-2: 2-inch diameter air-sparge well, screened from 30 to 32 feet, 3-foot sump installed beneath screen.

TW-1: 2-inch diameter temporary observation well, screened from 5 to 9 feet

TW-2: 2-inch diameter temporary observation well, screened from 5 to 9 feet

TW-3: 2-inch diameter temporary observation well, screened from 5 to 9 feet

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Note: This figure contains information in color. Black & white photocopies may not be suitable for review.

Approximate Drawing Scale: 1" = 20'

0 ft. 12 ft. 20 ft. 40 ft.

Cross-Section, Pilot-Test Wells

Boeing Field Chevron

10805 East Marginal Way South

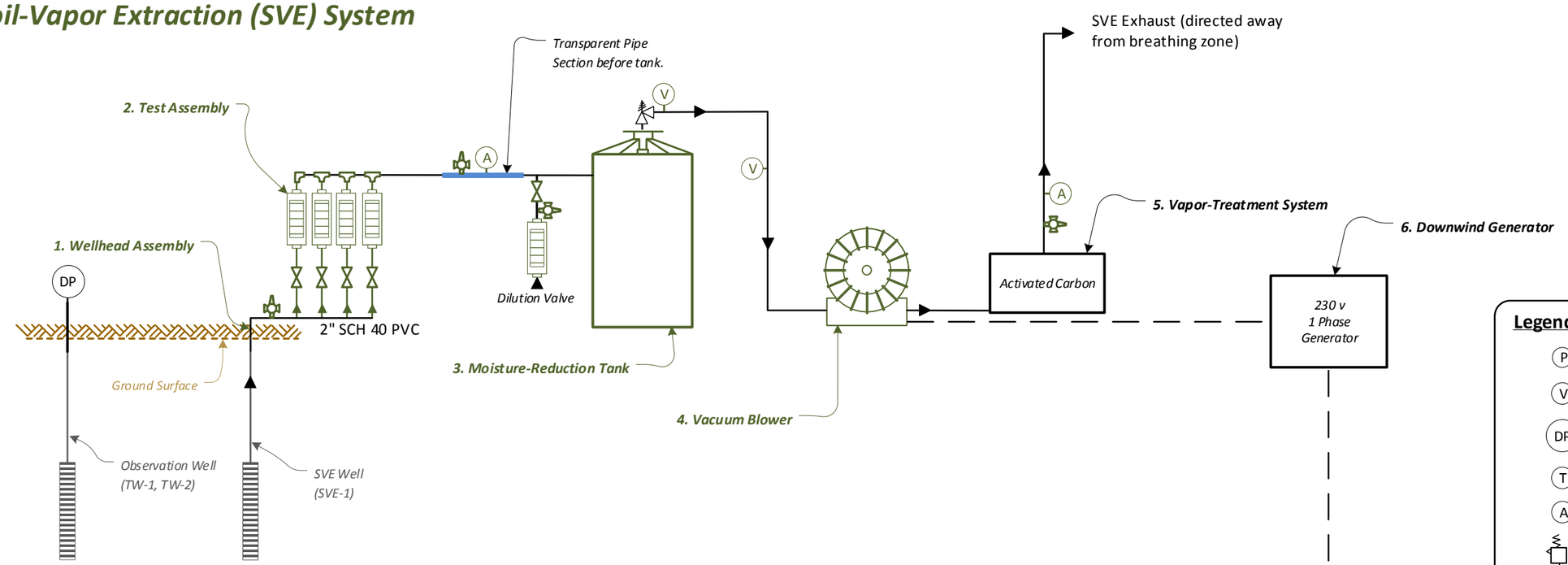
Tukwila, Washington

Figure 3

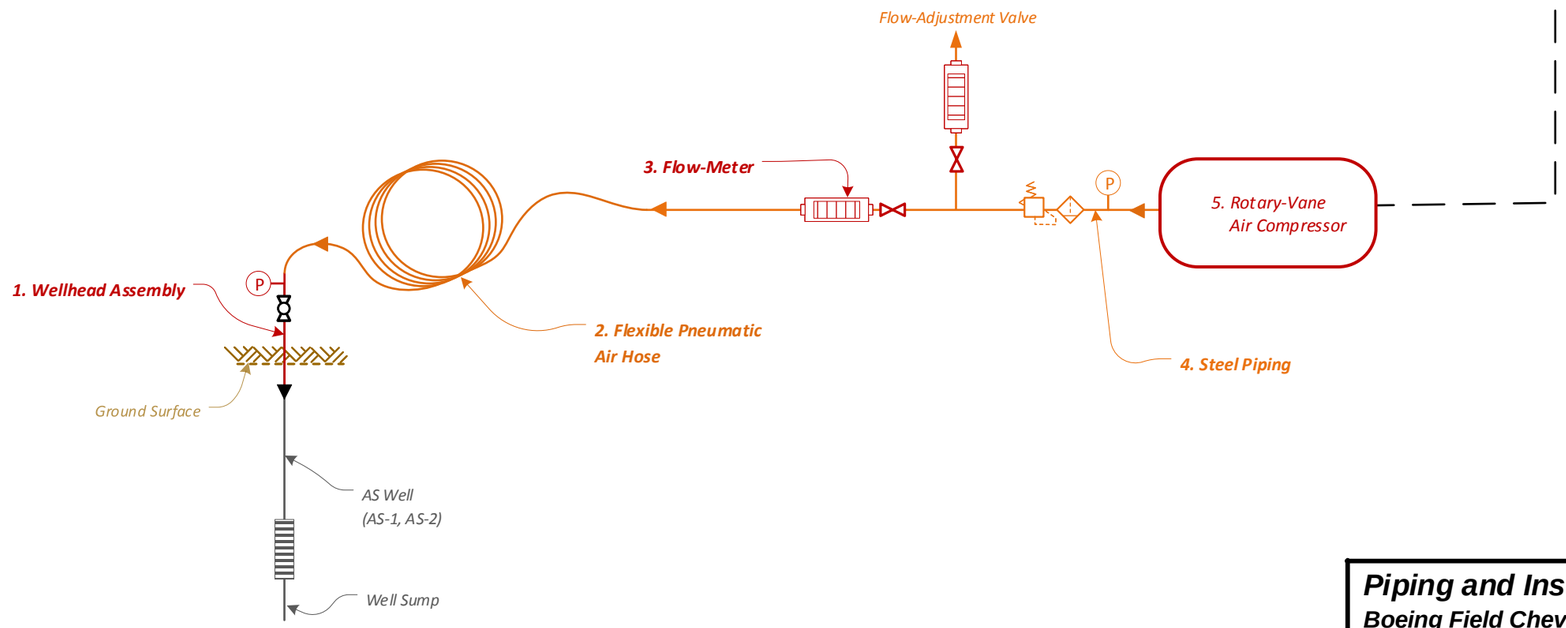
Project File: 01-0410-O F3 cross section.vsd

Mapping References: PLS Survey 2016, G-Logics Field Measurements, Previous Site Report Figures.

Soil-Vapor Extraction (SVE) System



Air-Sparge (AS) System



Legend

- Pressure Gauge
- Vacuum Gauge
- Differential-Pressure Gauge
- Temperature Gauge
- Hot Wire Anemometer Port
- Pressure Regulator
- Air Filter
- Rotameter
- Gate Valve
- Ball Valve
- Sample Port
- Power Wiring
- Air-Flow Direction

Note: Figure Not Drawn To Scale, See Text Section 4.1 for Equipment Description

Piping and Instrumentation Diagram
Boeing Field Chevron
10805 East Marginal Way South
Tukwila, Washington

Figure 4

Project File: 01-0410-O F4 P&ID.vsd

Project File: 01-0410-O F5 AS-2 Soil Profile.vsdx.vsd

g-logics

Note: This figure contains information in color. Black & white photocopies may not be suitable for review.

Boring AS-2 Soil Profile

Boeing Field Chevron
10805 Pacific Hwy S
Tukwila, Washington

Figure 5

East Marginal Way South

Tukwila International Boulevard

Car Wash

Current Station Store

MW-26S
MW-26D
TW-2
TW-1
IP-7
SVE-1
IP-4
AS-2
AS-1
IP-3
IP-5
TW-3
MW-28D
MW-28S
1%

Legend

- AS/SVE Well
- Observation Well
- Approximate Vacuum Radius of Influence*

*Radius of Influence defined as lateral distance at which 1% of the applied test-well vacuum can be measured in the subsurface. Inferred from measurements collected at Observation Wells, Day 2, SVE Step 3, 35 in H2O applied at SVE-1 (see text for discussion).

Project File: 01-0410-O F6 ROI.vsd

g-logics

Approximate Drawing Scale: 1" = 20'

0 ft. 12 ft. 20 ft. 40 ft.

Note: This figure contains information in color. Black & white photocopies may not be suitable for review.

Observed Vacuum Radius of Influence
Boeing Field Chevron
10805 East Marginal Way South
Tukwila, WA

Figure 6

Mapping Reference: PLS Survey, G-Logics Field Observations

TABLES

TABLE 1
Soil Sample Analyses
Boeing Field Chevron
Tukwila, Washington

Exploration Location	Sample Date	Sample Number	Sample Depth (ft)	PID Reading (ppmv) (1)	Gasoline Range Organics	Diesel Range Organics	Heavy Oil Range Organics	Benzene	Toluene	Ethylbenzene	Xylenes	Methyl Tert Butyl Ether (MTBE)	1,2-Dichloroethane (EDC)	1,2-Dibromoethane (EDB)	Lead
MTCA Method A Cleanup Level				*	100(a)/30(b)	2,000	2,000	0.03	7	6	9	0.100	11	0.005	250
(units in mg/kg)															
AS-1	4/10/19	AS-1-5	5	---	---	---	---	---	---	---	---	---	---	---	---
AS-2	4/10/19	AS-2-5	5	0.00	<4.07	<21.1	<52.6	<0.0163	<0.0163	<0.0203	<0.0407	---	---	---	---
	4/10/19	AS-2-10	10	45.0	<5.16	<23.4	<58.6	<0.0207	<0.0207	<0.0258	<0.0516	---	---	---	---
	4/10/19	AS-2-15	15	90.0	**12.9**	<25.8	<64.4	**0.0440**	**0.186**	<0.0332	<0.0664	---	---	---	---
	4/10/19	AS-2-19	19	75.0	**928**	<22.3	<55.7	**10.2**	**73.6**	**15.1**	**83.2**	<1.13	<0.450	<0.113	**1.36**
	4/10/19	AS-2-25	25	90.0	**24.1**	<24.3	<60.9	<0.0296	<0.0296	**1.26**	**0.419**	---	---	---	---
	4/10/19	AS-2-30	30	100	<5.44	<23.2	<58.0	<0.0218	**0.0230**	<0.0272	<0.0544	---	---	---	---
	4/10/19	AS-2-35	35	100	---	---	---	---	---	---	---	---	---	---	---
SVE-1	4/10/19	SVE-1-5	5	0.00	<5.44	<19.6	**106**	<0.0218	<0.0218	<0.0272	<0.0544	---	---	---	---
	4/10/19	SVE-1-9	9	88.0	**3,560**	<21.7	<54.2	<0.458	**16.8**	**62.2**	**407**	<1.14	<0.458	<0.114	**4.51**
TW-1	4/10/19	TW-1-5	5	0.00	<4.61	<19.4	**113**	<0.0184	**0.0307**	<0.0231	<0.0461	---	---	---	---
	4/11/19	TW-1-9	9	0.00	<5.48	<18.6	<46.5	<0.0219	<0.0219	<0.0274	<0.0548	---	---	---	---
TW-2	4/11/19	TW-2-5	5	0.00	<5.56	<19.6	<49.0	<0.0222	<0.0222	<0.0278	<0.0556	---	---	---	---
TW-3	4/11/19	TW-3-5	5	2.10	**9.09**	<18.6	<46.5	**0.0938**	**0.241**	**0.299**	**1.09**	---	---	---	---
	4/11/19	TW-3-9	9	151	**153**	<19.7	<49.2	**5.35**	**0.867**	**7.43**	**17.5**	<0.0455	<0.0182	<0.00455	**11.3**
	4/11/19	DUP	9	151	**29.4**	<20.8	<52.0	**0.798**	**1.67**	**0.864**	**2.83**	<0.0558	<0.0223	<0.00558	**6.89**

Notes: Refer to site diagram(s) for sampling locations. Refer to laboratory reports for analytical methods.

(1) Soil samples were field screened using a PID to measure VOCs. Headspace VOC concentrations were measured after placing the soil in a sealed plastic bag and allowing soil and air inside the bag to equilibrate.

(a) Soil Cleanup Level for Gasoline with no detectable benzene in the soil.

(b) Soil Cleanup Level for Gasoline with detectable benzene in the soil.

* Not Applicable/ Cleanup/Screening Level Not Established.

DUP Blind Field Duplicate Sample for QA/QC.

--- Sample not analyzed.

nd Not Detected (data gathered from historical reports, lab analysis reporting limits not available).

<1.07 The analyte was not detected at a concentration above the indicated reporting limit.

12.0 Bold Number(s) indicates contaminant detected.

419 Bold Number(s) and Yellow Shading indicates concentration exceeds applicable cleanup level.

<4.25 Laboratory reporting limit is higher than referenced cleanup levels.

TABLE 2
Groundwater Sample Analyses, Pilot Test Monitoring Wells (1)
Boeing Field Chevron
Tukwila, Washington

Exploration Location	Sample Name	Sample Date	Water Depth (ft)	Gasoline Range Organics	Diesel Range Organics	Heavy Oils	Benzene	Toluene	Ethylbenzene	Xylenes	Methyl Tert-Butyl Ether (MTBE)	1,2-Dibromoethane (EDB)	1,2-Dichloroethane (EDC)	Hexane	Naphthalene	2-Methylnaphthalene	1-Methylnaphthalene	Lead (Total)	Lead (Dissolved)
MTCA Cleanup Level (2, 3)				800(a)/1,000(b)	500	500	1.6	130	31	1,000	20	0.01	5	**	1.4	32*	1.51*	15	15
(units in µg/L)																			
ACTIVE WELLS																			
AS-1	AS-1	4/17/2019	9.60	**4,150**	**270**	<101	**702**	**224**	**138**	**141.9**	<1.00	<0.0100	<1.00	---	---	---	---	<0.500	---
AS-2	AS-2	4/17/2019	15.03	**1,560**	<50.0	<100	**20.8**	**78.4**	**22.4**	**128.4**	<1.00	<0.00994	<1.00	---	---	---	---	**0.804**	<0.500
	DUP	4/17/2019	15.03	**1,500**	<50.0	<99.9	**19.6**	**85.3D**	**22.3**	**130.7D**	<1.00	<0.00989	<1.00	---	---	---	---	<0.500	<0.500
MW-26S	MW-26	11/30/2016	8.09	<50.0	<49.8	<99.6	<1.00	<1.00	<1.00	<1.00	<1.00	<0.00996	<1.00	<1.00	<0.0993	<0.0993	<0.0993	**2.15**	<0.500
	MW-26S-3242017	3/24/2017	6.92	<50.0	<49.9	<99.8	<1.00	<1.00	<1.00	<1.00	<1.00	<0.00989	<1.00	---	<0.0995	<0.0995	<0.0995	**1.48**	<0.500
	MW-26S-7262017	7/26/2017	8.98	<50.0	<50.2	<100	<1.00	<1.00	<1.00	<1.00	<1.00	<0.00976	<1.00	---	<0.0997	<0.0997	<0.0997	**0.800**	<0.500
	MW-26S-1042017	10/4/2017	9.57	<50.0	<49.6	<99.2	<1.00	<1.00	<1.00	<1.00	<1.00	<0.00971	<1.00	<1.00	<0.0999	<0.0999	<0.0999	<0.500	<0.500
	MW-26S	1/11/2018	7.27	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	MW-26S	8/24/2018	8.80	<50.0	<49.7	<99.4	<1.00	<1.00	<1.00	<1.00	---	---	---	---	<1.00 Q	---	---	---	---
	MW-26S	11//28/2018	7.85	<50.0	<50.1	<100	<1.00	<1.00	<1.00	<1.00	---	---	---	---	---	---	---	<0.500	---
MW-26D	MW-26D	11/30/2016	12.19	<50.0	<49.9	<99.8	<1.00	<1.00	<1.00	<1.00	<1.00	<0.00997	<1.00	<1.00	<0.0997	<0.0997	<0.0997	**0.0633**	<0.500
	MW-26D-3242017	3/24/2017	12.24	<50.0	<49.6	<99.1	<1.00	<1.00	<1.00	<1.00	<1.00	<0.00952	<1.00	---	<0.0998	<0.0998	<0.0998	**4.48**	<0.500
	MW-26D-7262017	7/26/2017	13.49	<50.0	<49.9	<99.8	<1.00	<1.00	<1.00	<1.00	<1.00	<0.00976	<1.00	---	<0.0997	<0.0997	<0.0997	**0.800**	<0.500
	MW-26D-1042017	10/4/2017	14.66	<50.0	<50.0	<100	<1.00	<1.00	<1.00	<1.00	<1.00	<0.0100	<1.00	<1.00	<0.0989	<0.0989	<0.0989	**0.729**	<0.500
	MW-26D	1/11/2018	11.46	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	MW-26D	8/24/2018	15.65	<50.0	<49.7	<99.5	<1.00	<1.00	<1.00	<1.00	---	---	---	---	<1.00 Q	---	---	---	---
	MW-26D	11//28/2018	12.07	<50.0	<49.8	<99.7	<1.00	<1.00	<1.00	<1.00	---	---	---	---	---	---	---	**0.785**	---
MW-28S	MW-28S	11/28/2016	8.14	<50.0	<49.9	<99.8	<1.00	<1.00	<1.00	<1.00	<1.00	<0.00978	<1.00	<1.00	<0.100	<0.100	<0.100	<0.500	<0.500
	MW-28S-3242017	3/24/2017	6.66	<50.0	<49.9	<99.9	<1.00	<1.00	<1.00	<1.00	<1.00	<0.0100	<1.00	---	<0.0999	<0.0999	<0.0999	<0.500	<0.500
	MW-28S-7262017	7/26/2017	8.54	<50.0	<50.3	<101	<1.00	<1.00	<1.00	<1.00	<1.00	<0.00925	<1.00	---	<0.0999	<0.0999	<0.0999	<0.500	<0.500
	MW-28S-1042017	10/4/2017	9.51	<50.0	<49.3	<98.6	<1.00	<1.00	<1.00	<1.00	<1.00	<0.00997	<1.00	<1.00	<0.0985	<0.0985	<0.0985	<0.500	<0.500
	MW-28S	1/11/2018	7.91	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	MW-28S	8/23/2018	9.03	<50.0	<49.8	<99.6	<1.00	<1.00	<1.00	<1.00	---	---	---	---	<1.00 Q	---	---	---	---
	MW-28S	11//27/2018	8.75	<50.0	<49.8	<99.6	<1.00	<1.00	<1.00	<1.00	---	---	---	---	<1.00 Q	---	---	---	---

TABLE 2
Groundwater Sample Analyses, Pilot Test Monitoring Wells (1)
Boeing Field Chevron
Tukwila, Washington

Exploration Location	Sample Name	Sample Date	Water Depth (ft)	Gasoline Range Organics	Diesel Range Organics	Heavy Oils	Benzene	Toluene	Ethylbenzene	Xylenes	Methyl Tert-Butyl Ether (MTBE)	1,2-Dibromoethane (EDB)	1,2-Dichloroethane (EDC)	Hexane	Naphthalene	2-Methylnaphthalene	1-Methylnaphthalene	Lead (Total)	Lead (Dissolved)
MTCA Cleanup Level (2, 3)				800(a)/1,000(b)	500	500	1.6	130	31	1,000	20	0.01	5	**	1.4	32*	1.51*	15	15
(units in µg/L)																			
MW-28D	MW-28D	11/28/2016	12.00	<50.0	<49.5	<99.1	<1.00	<1.00	<1.00	<1.00	<1.00	<0.00995	<1.00	<1.00	<0.100	<0.100	<0.100	<0.500	<0.500
	MW-28D-3242017	3/24/2017	11.93	<50.0	<49.7	<99.4	<1.00	<1.00	<1.00	<1.00	<1.00	<0.00989	<1.00	---	<0.0993	<0.0993	<0.0993	<0.500	<0.500
	FD-2 (MW-28D Dup)	3/24/2017	11.93	<50.0	<49.7	<99.5	<1.00	<1.00	<1.00	**2.19**	<1.00	<0.00984	<1.00	---	<0.0995	<0.0995	<0.0995	<0.500	<0.500
	MW-28D-7262017	7/26/2017	13.34	<50.0	<49.9	<99.8	<1.00	<1.00	<1.00	<1.00	<1.00	<0.00982	<1.00	---	<0.0998	<0.0998	<0.0998	<0.500	<0.500
	MW-28D-1042017	10/4/2017	15.44	<50.0	<49.6	<99.1	<1.00	<1.00	<1.00	<1.00	<1.00	<0.00993	<1.00	<1.00	<0.0996	<0.0996	<0.0996	**0.872**	<0.500
	MW-28D	1/11/2018	12.29	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	MW-28D	8/23/2018	15.65	<50.0	<49.8	<99.7	<1.00	<1.00	<1.00	<1.00	---	---	---	---	<1.00 Q	---	---	---	---
	MW-28D	11//27/2018	11.96	<50.0	<49.6	<99.1	<1.00	<1.00	<1.00	<1.00	---	---	---	---	---	---	---	<0.500	---
IP-3	IP-3	5/8/2006	NR**	**28**	---	---	**1,800**	**13,000**	**1,400**	**8,300**	---	---	---	---	---	---	---	---	---
	IP-3	3/27/2008	NR**	**62,900**	---	---	**6,120**	**8,850**	**968**	**4,420**	---	---	---	---	---	---	---	---	---
	IP-3 GW-L	7/17/2015	17.44	**4,200**	**460 X**	<250	**1,200**	**11**	**70**	**38.5**	**1.2**	**0.10**	<1	**38**	**28**	**13**	**8.7**	<1	<1
	IP-3 GW-H	7/23/2015	14.97	**4,700**	**510 X**	<250	**1,300**	**13**	**71**	**41.0**	<10	**0.04**	<5	**35**	**3.1**	**7.7**	**5.5**	<1	<1
	IP-3-3232017	3/23/2017	12.96	**4,840 D**	<49.9	<99.8	**783 D**	**105 D**	**127 D**	**139 D**	<1.00	<0.00976	<1.00	---	**2.52**	**6.09**	**3.30**	<0.500	<0.500
	IP-3-7272017	7/27/2017	14.16	**5,800 D**	<50.2	<100	**862 D**	**20.5**	**136 D**	**61.6 D**	<1.00	<0.00952	<1.00		**0.789**	**6.10**	**3.56**	<0.500	<0.500
	IP-3-1042017	10/4/2017	15.32	**3,740 D**	<50.3	<101	**1,270 D**	**80.7**	**214 D**	**458.3 D**	<1.00	<0.0100	<1.00	**72.7 D**	**1.37**	**6.5**	**4.13**	<0.500	<0.500
	DUP	1/12/2018	12.01	**4,980 D**	**77.7**	<99.9	**950 D**	**45.7 D**	**100 D**	**91.62 D**	<1.00	<0.250	<1.00	---	**8.77**	---	---	---	<0.500
	IP-3	1/12/2018	12.01	**4,610 D**	**74.3**	<99.6	**895 D**	**42.9 D**	**94.3 D**	**88.93 D**	<1.00	<0.250	<1.00	---	**15.7**	---	---	---	---
	MW-B (dup)	5/29/2018	14.55	**4,520 D**	<49.8	<99.6	**832 D**	**31.4 D**	**101 D**	**114.21 D**	---	<0.00981	---	---	**2.56**	**9.79**	**5.38**	---	---
	IP-3	5/29/2018	14.55	**4,870 D**	<49.9	<99.8	**971 D**	**34.5 D**	**106 D**	**107.29 D**	---	<0.00984	---	---	**2.37**	**9.85 D**	**5.57**	---	---
	IP-3	8/24/2018	16.23	**6,160 D**	**111**	**101**	**1,390 D**	**27.1**	**125 D**	**141.33 D**	---	<0.00987	---	---	**8.19 Q**	---	---	<0.500	---
	MW-A	8/24/2018	16.23	**5,750 D**	**113**	<99.9	**1,300 D**	**29.4**	**129 D**	**154.98 D**	---	<0.00979	---	---	**6.70**	---	---	**0.551**	---
	IP-3	11/28/2018	12.53	**3,710 D**	**63.9**	<99.7	**865 D**	**18.8**	**53.0 D**	**52.4**	---	<0.00997	---	---	**1.95**	---	---	**1.92**	---
IP-4	IP-4	5/8/2006	NR**	**110**	---	---	**15,000**	**48,000**	**3,700**	**23,000**	---	---	---	---	---	---	---	---	---
	IP-4	3/27/2008	NR**	**84,400**	---	---	**14,600**	**22,100**	**4,920**	**17,600**	---	---	---	---	---	---	---	---	---
	IP-4 GW-L	7/17/2015	11.41	**170,000**	**6,800 X**	<250	**4,100**	**29,000**	**4,800**	**26,900**	**1.4**	**0.12**	<1	**87**	**550**	**96**	**56**	<1	<1
	IP-4 GW-H	7/24/2015	11.46	**150,000**	**8,700 X**	<250	**4,200**	**27,000**	**4,300**	**24,400**	<10	**0.04**	<5	**64**	**440**	**82**	**47**	<1	<1
	IP-4	11/30/2016	10.10	**93,400D**	**1,410**	<99.6	**1,070 D**	**15,600 D**	**3,300 D**	**19,950 D**	<1.00	<0.00986	<1.00	**127 EQ**	**504 D**	**85.2 D**	**47.3 D**	**0.974**	<0.500
	IP-4-3232017	3/23/2017	8.01	**209,000 D**	**1,570**	<99.6	**1,360 D**	**16,200 D**	**5,090 D**	**30,440 D**	<1.00	<0.00953	<1.00	---	**757 D**	**119 D**	**66.6 D**	<0.500	<0.500
	IP-4-7272017	7/27/2017	9.96	**213,000 D**	**1,180**	<99.4	**1,170 D**	**19,600 D**	**5,500 D**	**19,200 D**	<1.00	<0.00971	<1.00	---	**447 D**	**80.8 D**	**37.6 D**	<0.500	<0.500
	IP-4-1042017	10/4/2017	10.75	**212,000 D**	**1,110**	<101	**2,030 D**	**18,400 D**	**5,320 D**	**25,190 D**	<1.00	<0.00960	<1.00	**48.0**	**604 D**	**89.9 D**	**71.3 D**	**0.546**	<0.500
	IP-4	1/12/2018	9.23	**162,000 D**	**1,250**	<99.9	**939 D**	**18,600 D**	**5,180 D**	**27,980 D**	<1.00	<0.250	<1.00	---	**1,150 D**	---	---	---	---
	IP-4	5/29/2018	9.67	**199,000 D**	**1,250**	**138**	**687 D**	**17,200 D**	**6,090 D**	**32,200 D**	---	<0.00998	---	---	**661 D**	**101 D**	<0.0999	---	---
	IP-4	8/24/2018	9.98	**131,000 D**	**584**	<99.9	**421 D**	**11,400 D**	**5,550 D**	**29,340 D**	---	---	---	---	**748 D**	---	---	---	---
	IP-4	11/28/2018	10.00	**123,000 D**	**471**	<99.9	**246 D**	**7,380 D**	**5,170 D**	**27,120 D**	---	<0.00962	---	---	**867 D**	---	---	<0.500	---

TABLE 2
Groundwater Sample Analyses, Pilot Test Monitoring Wells (1)
Boeing Field Chevron
Tukwila, Washington

Exploration Location	Sample Name	Sample Date	Water Depth (ft)	Gasoline Range Organics	Diesel Range Organics	Heavy Oils	Benzene	Toluene	Ethylbenzene	Xylenes	Methyl Tert-Butyl Ether (MTBE)	1,2-Dibromoethane (EDB)	1,2-Dichloroethane (EDC)	Hexane	Naphthalene	2-Methylnaphthalene	1-Methylnaphthalene	Lead (Total)	Lead (Dissolved)
MTCA Cleanup Level (2, 3)				800(a)/1,000(b)	500	500	1.6	130	31	1,000	20	0.01	5	**	1.4	32*	1.51*	15	15
(units in µg/L)																			
IP-5	IP-5	5/9/2006	NR**	**48**	---	---	**2,100**	**18,000**	**3,500**	**20,000**	---	---	---	---	---	---	---	---	---
	IP-5	3/27/2008	NR**	**13,300**	---	---	**711**	**1,260**	**363**	**1,370**	---	---	---	---	---	---	---	---	---
	IP-5 GW-L	7/20/2015	16.58	**35,000**	**3,900 X**	<250	**5,200**	**1,400**	**2,400**	**2,800**	<10	**0.32**	<5	**160**	**90**	**15**	**15.0**	**1.02**	<1
	IP-5 GW-H	7/24/2015	15.50	**27,000**	**2,700 X**	<250	**4,500**	**1,100**	**2,200**	**2,580**	<10	**0.24**	<5	**170**	**86**	**18**	**13.0**	<1	<1
	IP-5	11/30/2016	13.00	**15,200 D**	**321**	<99.1	**3,450 DE**	**212 D**	**774 D**	**1,789 D**	<1.00	<0.00987	<1.00	**57.1 DQ**	**108 D**	**33.7 D**	**19.5 D**	<0.500	<0.500
	MW-B (IP-5 Dup)	11/30/2016	13.00	**15,400 D**	**313**	<99.1	**3,440 DE**	**256 D**	**795 D**	**1,824 D**	<1.00	<0.00996	<1.00	**63.1 DQ**	**104 D**	**31.6 D**	**18.4 D**	<0.500	<0.500
	IP-5-3232017	3/23/2017	13.80	**18,400 D**	**209**	<99.2	**1,740 D**	**141 D**	**665 D**	**1,637 D**	<1.00	<0.00980	<1.00	---	**60.4 D**	**25.1 D**	**15.1 D**	<0.500	<0.500
	FD-1 (IP-5 Dup)	3/23/2017	13.80	**15,700 D**	**273**	<99.9	**1,420 D**	**136 D**	**670 D**	**1,634 D**	<1.00	<0.00981	<1.00	---	**73.4 D**	**27.6 D**	**18.4 D**	**0.785**	<0.500
	IP5-7262017	7/27/2017	13.76	**15,800 D**	**102**	<99.9	**1,660 D**	**164 D**	**491 D**	**936 D**	<1.00	<0.00993	<1.00	---	**38.0 D**	**28.4 D**	**12.0 D**	<0.500	<0.500
	IP-5-1042017	10/4/2017	16.17	**30,700 D**	**175**	<100	**4,360 D**	**583 D**	**1,060 D**	**2,792 D**	<1.00	<0.00971	<1.00	**137**	**81.4 D**	**20.7 D**	**31.2 D**	<0.500	<0.500
	IP-5	1/12/2018	13.42	**13,000 D**	**222**	<100	**1,500 D**	**240 D**	**462 D**	**1,195 D**	<1.00	<0.250	<1.00	---	**61.1 D**	---	---	---	---
	IP-5	5/29/2018	16.82	**10,900 D**	**161**	<100	**1,270 D**	**149 D**	**415 D**	**806.6 D**	---	<0.00981	---	---	**31.6 D**	**20.3 D**	**4.57**	---	---
	IP-5	8/24/2018	17.08	**36,200 D**	**471**	<99.9	**5,670 D**	**2,200 D**	**1,190 D**	**2,773 D**	---	---	---	---	**74.4 DQ**	---	---	---	---
	IP-5	11/28/2018	13.29	**16,500 D**	**251**	<101	**2,590 D**	**490 D**	**633 D**	**1,105 D**	---	<0.00994	---	---	**48.1 JD**	---	---	<0.500	---

Notes:

(1)	Refer to site diagram(s) for sampling locations. Refer to laboratory reports for analytical methods.	D	The Sample was diluted. Detection Limits were raised nad surrogate recoveries my not be meaningful.
(2)	Method A groundwater cleanup levels used as surface water cleanup levels per WAC 173-340-730(3)(b)(iii)(C).	J	Analyte detected below reporting limit.
(3)	Gasoline Analyses by Method NWTPH-Gx, Diesel and Heavy Oil by NWTPH-Dx/Dx Ext., Lead by EPA 200.8, EDB by EPA 8011, PAH by 8270 (SIM), VOCs by 8260C.	Q	Analyte with an initial calibration that does not meet established acceptance criteria.
a	Benzene present in groundwater/site.	X	The sample chromatographic pattern does not resemble the fuel standard used for quantification.
b	Benzene not present in groundwater/site.	<50.0	Sample concentration below laboratory reporting limit.
*	Method B Cleanup Level.	**27**	Bold number(s) indicates contaminant detected, below cleanup level.
**	Not researched, no available data.	**160**	Bold number(s) and yellow shading indicates concentration exceeds MTCA Cleanup Level.
---	Sample not analyzed.	<250	Reporting limits exceeds cleanup level.
nd	Not Detected (Data gathered from historical reports, lab analysis reporting limits not available).		Peach shading indicates most recent sampling event data.
NS	Sample not collected (Undefined datum from Terracon's 2015 report).		
NA	Not Applicable (Undefined datum from Terracon's 2015 report).		
NR**	Water Level not reported, no available data.		
Dup	Duplicate Sample for QA/QC.		

TABLE 3
Soil Vapor Extraction Test
Field Observations
Boeing Field Chevron
Tukwila, Washington

Date	5/2/2019	5/3/2019
SVE System Initiation	9:50	10:23
SVE System Shutdown	13:50	15:00

		Extraction Well	Observation Well					SVE-System Parameters								
		SVE-1	TW-1	IP-4	TW-2	MW-26S	TW-3	Dilution Valve	KO Tank	Blower Inlet	Blower Inlet			Blower Exhaust		Mass Recovery (lbs/day)
		Distance from SVE-1	*10' N*	*10' S*	*20' N*	*50' N*	*50' S*									
Test Phase	**Time**	**Vacuum (in H_2O)**	**Vacuum (in H_2O)**	**Vacuum (in H_2O)**	**Vacuum (in H_2O)**	**Vacuum (in H_2O)**	**Vacuum (in H_2O)**	**% Open**	**Vacuum (in H_2O)**	**Vacuum (in H_2O)**	**Flow (SCFM)[1]**	**Temp (°F)**	**PID (ppmv)**	**Flow (SCFM)[1]**	**Temp (°F)**	
Day 1 (5/1/2019)																
Baseline	9:00	---	-0.005	0.01	0.00	0.00	0.00	---	---	---	---	---	300	---	---	---
Step 1	10:10	-10.0	-0.63	-0.30	-0.12	-0.020	-0.012	100	-60.0	---	22.0	55	430	---	---	---
	10:20	-10.0	-0.63	-0.38	-0.12	-0.025	-0.010	100	-60.0	---	22.0	57	430	---	---	0.7
Step 2	10:55	-19.5	-1.40	-0.30	-0.26	-0.030	-0.025	0	-42.0	-46.0	37.0	57	---	---	---	---
	11:00	-19.5	-1.25	-0.36	-0.27	-0.060	-0.020	0	-42.0	-46.0	37.0	57	450	---	---	---
	11:05	-19.5	-1.25	-0.35	-0.27	-0.060	-0.020	0	-42.0	-46.0	37.0	57	---	---	---	---
	11:10	-19.5	-1.25	-0.37	-0.27	-0.070	-0.020	0	-42.0	-46.0	37.0	57	---	---	---	---
	11:15	-19.5	-1.25	-0.37	-0.27	-0.070	-0.020	0	-42.0	-46.0	37.0	57	424	---	---	1.5
Step 3	11:40	-22.0	-1.45	-0.43	-0.33	-0.080	-0.020	0	-38.0	-42.0	43.0	57	428	---	---	---
	11:50	-22.0	-1.50	-0.47	-0.34	-0.080	-0.025	0	-38.0	-42.0	43.0	57	---	---	---	---
	11:57	-22.0	-1.50	-0.47	-0.34	-0.080	-0.020	0	-38.0	-42.0	43.0	57	---	---	---	---
	12:15	-22.0	-1.50	-0.40	-0.35	-0.090	-0.025	0	-38.0	-42.0	43.0	57	428	---	---	1.5
Step 4	12:47	-27.0	-1.80	-0.30	-0.44	-0.11	-0.025	0	-38.0	-42.0	60.0	70	388	---	---	---
	12:52	-27.0	-1.80	-0.42	-0.43	-0.10	-0.040	0	-38.0	-42.0	60.0	70	---	---	---	---
	13:03	-27.0	-1.80	-0.45	-0.43	-0.10	-0.030	0	-38.0	-42.0	60.0	70	---	---	---	---
	13:15	-27.0	-1.80	-0.25*	-0.48	-0.12	-0.050	0	-38.0	-42.0	60.0	70	---	---	---	---
	13:30	-27.0	-1.70	-0.14*	-0.45	-0.10	-0.040	0	-38.0	-42.0	60.0	70	---	---	---	---
	13:45	-27.0	-1.70	-0.06*	-0.43	-0.10	-0.025	0	-38.0	-42.0	60.0	70	400	---	---	1.6
Day 2 (5/2/2019)																
Step 1	10:33	-13.0	-0.76	-0.56	-0.16	-0.040	-0.020	100	-50.0	-55.0	28.0	60	470	72.0	61	---
	10:50	-13.0	-0.75	-0.53	-0.16	-0.040	-0.020	100	-50.0	-55.0	28.0	60	---	72.0	61	---
Step 2	11:20	-24.0	-1.40	-0.97	-0.33	-0.08	-0.020	0	---	---	65.0	60	400	61.0	85	
Step 2	11:50	-35.0	-2.00	-1.35	-0.50	-0.11	-0.030	0	-42.0	-46.0	89.0	64	400	84.0	70	---
	12:02	-35.0	-2.10	-1.35	-0.50	-0.11	-0.040	0	-42.0	-46.0	89.0	62	---	84.0	70	---
	12:10	-35.0	-2.10	-1.35	-0.50	-0.11	-0.040	0	-43.0	-47.0	89.0	62	400	84.0	70	3.2

Notes: Refer to site diagram(s) for testing locations.

1 Standard Cubic Feet Per Minute. Air flow was measured on Day 1 using a manifold of Dwyer ® rotameters. Air flow was measured on Day 2 using a hot-wire anemometer.

TABLE 4
Upper Saturated Zone Air Sparge / Soil Vapor Extraction Test
Field Observations
Boeing Field Chevron
Tukwila, Washington

Date	5/2/2019
SVE System Initiation	10:23
AS System Initiation	12:50
AS/SVE Shutdown	15:00

Time		**10:00**	**12:10**	**12:50**	**13:09**	**13:38**	**14:00**	**14:37**
AS-System Parameters								
AS-1 Wellhead	**Pressure (in H_2O)**	---	---	<1	2	3	3	3
Regulator	**Pressure(in H_2O)**	---	---	5	18	18	18	18
Manifold	**Pressure(in H_2O)**	---	---	5	18	18	18	18
	Temp (°F)	---	---	68	70	---	---	---
	Flowrate (SCFM)[1]	---	---	8	10	10	10	10
SVE-System Parameters								
SVE-1 Wellhead	**Vacuum (in H_2O)**	---	37.0	37.0	37.0	37.0	37.5	37.5
Blower Inlet	**Flowrate (SCFM)[1]**	---	92	92	92	97	90	101
	PID (ppmv)	---	300	400	400	400	400	400
Blower Exhaust	**Flowrate (SCFM)[1]**	---	84	93	96	---	93	89
	PID (ppmv)	---	0.0	---	---	0.0	---	0.0
Mass Removal Rate	**(lbs/day)**	---	3.2	---	---	2.7	---	2.6
Observation Well Parameters								
TW-1 (10' N of AS-1)	**Pressure (in H_2O)**	---	-2.1	---	-1.90	-1.90	-1.25	-1.90
	PID (ppmv)	1.6	---	---	0.90	2.0	1.0	1.0
	Water Elevation (ft)	10.85	---	---	10.79	---	---	10.81
	Dissolved Oxygen (%)	1.55	1.55	---	---	---	---	0.55
	Bubbling Observed (Y/N)	N	N	---	N	---	---	N
IP-4 (10' S of AS-1)	**Pressure (in H_2O)**	---	-1.25	---	-0.52	0.13	-0.36	-2.90
	PID (ppmv)	250	---	---	160	230	230	230
	Water Elevation (ft)	10.69	---	---	10.51	---	---	10.76
	Dissolved Oxygen (%)	0.85	---	---	---	---	---	0.68
	Bubbling Observed (Y/N)	N	---	---	N	---	---	N
TW-2 (20' N of AS-1)	**Pressure (in H_2O)**	---	-0.51	---	-0.51	-0.43	-0.27	-0.53
	PID (ppmv)	0.80	---	---	1.4	1.0	1.4	1.3
	Water Elevation (ft)	10.9	---	---	10.88	---	---	10.88
	Dissolved Oxygen (%)	2.75	---	---	---	---	---	1.49
	Bubbling Observed (Y/N)	N	---	---	N	---	---	N
MW-26S (50' N of AS-1)	**Pressure (in H_2O)**	---	-0.110	---	-0.130	-0.110	-0.060	-0.110
	PID (ppmv)	14	---	---	14	24	14	35
	Water Elevation (ft)	10.82	---	---	10.73	---	---	10.83
	Dissolved Oxygen (%)	5.6	---	---	---	---	---	1.00
	Bubbling Observed (Y/N)	N	---	---	N	---	---	N
TW-3 (50' S of AS-1)	**Pressure (in H_2O)**	---	-0.04	---	-0.12	---	-0.050	-0.060
	PID (ppmv)	205	---	---	86	24	23	35
	Water Elevation (ft)	11.12	---	---	11.10	---	---	11.69
	Dissolved Oxygen (%)	1.1	---	---	---	---	---	0.68
	Bubbling Observed (Y/N)	N	---	---	N	---	---	N

Notes: Refer to site diagram(s) for testing locations.

1 Standard Cubic Feet Per Minute. SVE air flow was measured using a hot-wire anemometer. AS air flow was measured using a Dwyer® rotameter.

TABLE 5
Lower Saturated Zone Air Sparge / Soil Vapor Extraction Test
Field Observations
Boeing Field Chevron
Tukwila, Washington

Date	5/3/2019
SVE System Initiation	11:26
AS System Initiation	12:25
AS System Shutdown	14:30

			Time[1]	10:00-11:00	11:26	11:35-12:00	12:05-12:20	12:25	12:45-13:45	14:15-15:00
System Parameters	**AS-System Parameters**									
	AS-2 Wellhead	**Pressure (in H_2O)**		---	---	---	---	6	8	8
	Regulator	**Pressure(in H_2O)**		---	---	---	---	18	18	18
	Manifold	**Pressure(in H_2O)**		---	---	---	---	6	20	20
		Temp (°F)		---	---	---	---	70	82	78
		Flowrate (SCFM)[3]		---	---	---	---	1	10	9
	SVE-System Parameters									
	SVE-1 Wellhead	**Vacuum (in H_2O)**		---	37.0	37.0	37.0	36.0	37.5	37.5
	Blower Inlet	**Flowrate (SCFM)[3]**		---	109	---	---	212	123	212
		PID (ppmv)		---	527	---	---	320	523	400
	Blower Exhaust	**Flowrate (SCFM)[3]**		---	96	---	---	89	87	89
		PID (ppmv)			0.0			0.0		0.0
	Mass Removal Rate	**(lbs/day)**			4.7	---	2.9	3.2	2.9	3.2
Upper Saturated Zone Wells	**Observation Well Parameters**									
	AS-1 (4' S of AS-2)	**Pressure (in H_2O)**		0.00	---	-0.13	-0.090	---	29.0	3.00
		PID (ppmv)		39	---	44	45	---	40	120
		Water Elevation (ft)		10.22	---	---	---	---	11.80	10.12
		Dissolved Oxygen (%)		6	---	---	---	---	4.50	---
		Bubbling Observed (Y/N)		N	---	---	---	---	Y	Y
	TW-1 (10' N of AS-2)	**Pressure (in H_2O)**		-0.01	---	-2.20	-2.10	---	-2.40	-2.35
		PID (ppmv)		4.0	---	140	16	---	87	80
		Water Elevation (ft)		9.22	---	---	---	---	9.30	9.31
		Dissolved Oxygen (%)		0.38	---	---	---	---	---	0.46
		Bubbling Observed (Y/N)		N	---	---	---	---	N	N
	IP-4 (10' S of AS-2)	**Pressure (in H_2O)**		-0.090	---	-0.50	-0.060	---	0.050	-0.020
		PID (ppmv)		100		100	115	---	115	195
		Water Elevation (ft)		9.70	---	---	---	---	10.00	9.90
		Dissolved Oxygen (%)		0.45	---	---	---	---	---	---
		Bubbling Observed (Y/N)		N	---	---	---	---	Y	Y
	TW-2 (20' N of AS-2)	**Pressure (in H_2O)**		-0.010	---	-0.50	-0.50	---	-0.55	-0.65
		PID (ppmv)		3.0	---	48	8.3	---	80	6.3
		Water Elevation (ft)		9.15	---	---	---	---	9.16	9.16
		Dissolved Oxygen (%)		0.91	---	---	---	---	---	0.92
		Bubbling Observed (Y/N)		N	---	---	---	---	N	N
	MW-26S (50' N of AS-2)	**Pressure (in H_2O)**		0.00	---	-0.150	-0.120	---	-0.10	-0.180
		PID (ppmv)		4.0	---	5.0	9.6	---	3.0	18
		Water Elevation (ft)		8.68	---	---	---	---	8.68	8.68
		Dissolved Oxygen (%)		0.68	---	---	---	---	---	1.60
		Bubbling Observed (Y/N)		N	---	---	---	---	N	N
	TW-3 (50' S of AS-2)	**Pressure (in H_2O)**		0.00	---	-0.040	-0.040	---	-0.060	-0.10
		PID (ppmv)		75	---	92	52	---	22	10
		Water Elevation (ft)		8.68	---	---	---	---	8.70	8.69
		Dissolved Oxygen (%)		0.48	---	---	---	---	---	0.83
		Bubbling Observed (Y/N)		N	---	---	---	---		N
	MW-28S (100' S of AS-2)	**Pressure (in H_2O)**		-0.010	---	0.00	0.00	---	-0.020	-0.020
		PID (ppmv)		6.0	---	5.0	11	---	14	6.0
		Water Elevation (ft)		8.55	---	---	---	---	8.54	8.55
		Dissolved Oxygen (%)		3.68	---	---	---	---	---	3.80
		Bubbling Observed (Y/N)		N	---	---	---	---	N	N

TABLE 5
Lower Saturated Zone Air Sparge / Soil Vapor Extraction Test
Field Observations
Boeing Field Chevron
Tukwila, Washington

Date	5/3/2019
SVE System Initiation	11:26
AS System Initiation	12:25
AS System Shutdown	14:30

Lower Saturated Zone Wells	**IP-5** (12' S of AS-2)	**Pressure (in H_2O)**	0.00	---	14.0	17.5	---	50	50
		PID (ppmv)	75	---	157	139	---	106	376
		Water Elevation (ft)	16.23	---	---	---	---	12.10	10.90
		Dissolved Oxygen (%)	0.31	---	---	---	---	6.13	---
		Bubbling Observed (Y/N)	N	---	---	---	---	Y	Y
	IP-3 (25' S of AS-2)	**Pressure (in H_2O)**	0.020	---	-3.45	-4.30	---	12.50	50
		PID (ppmv)	14	---	151	85	---	69	193
		Water Elevation (ft)	15.23	---	---	---	---	13.77	12.25
		Dissolved Oxygen (%)	0.46	---	---	---	---	0.60	1.19
		Bubbling Observed (Y/N)	N	---	---	---	---	Y	Y
	IP-7 (35' N of AS-2)	**Pressure (in H_2O)**	2.50	---	14.5	16.5	---	50	50
		PID (ppmv)	P	---	P	P	---	P	P
		Water Elevation (ft)	17.25	---	---	---	---	---	10.90
		Dissolved Oxygen (%)	---	---	---	---	---	---	---
		Bubbling Observed (Y/N)	N	---	---	---	---	Y[2]	Y
	MW-26D (50' N of AS-2)	**Pressure (in H_2O)**	0.290	---	3.25	-3.10	---	11.5	1.40
		PID (ppmv)	1.0	---	178	201	---	380	5.0
		Water Elevation (ft)	14.70	---	---	---	---	13.42	13.08
		Dissolved Oxygen (%)	0.54	---	---	---	---	---	0.44
		Bubbling Observed (Y/N)	N	---	---	---	---	N	N
	MW-28D (100' S of AS-2)	**Pressure (in H_2O)**	-0.380	---	-2.20	8.00	---	8.00	3.00
		PID (ppmv)	76	---	131	177	---	313	13
		Water Elevation (ft)	14.38	---	---	---	---	13.54	13.21
		Dissolved Oxygen (%)	0.53	---	---	---	---	---	0.55
		Bubbling Observed (Y/N)	N	---	---	---	---	N	N

Notes:
Refer to site diagram(s) for testing locations.

1 Measurements collected over the stated interval.

2 Test concluded after boiling observed in well containing NAPL

3 Standard Cubic Feet Per Minute. SVE air flow was measured using a hot-wire anemometer. AS air flow was measured using a Dwyer® rotameter.

P LNAPL present in well, headspace VOCs not measured

TABLE 6
Pilot Test Air Sample Analyses
Boeing Field Chevron
Tukwila, Washington

Test Interval	Sample Date	Sample Time	Sample Number	Gasoline Range Organics	Benzene	Toluene	Ethylbenzene	Total Xylenes
(units in ug/m^3)								
SVE Test Start (09:50)								
Full Dilution[1]	5/1/2019	9:50	VS-1	3,230	9.26	138	61.6	264.9
SVE Step 1	5/1/2019	10:35	VS-2	355,000	598	4,010	4,330	23,120
SVE Step 2	5/1/2019	11:30	VS-3	438,000	807	5,010	5,780	27,820
SVE Step 3	5/1/2019	12:20	VS-4	383,000	732	4,880	5,480	25,470
SVE Step 4	5/1/2019	13:45	VS-5	304,000	646	4,690	4,770	21,490
Day 2 SVE Start (10:23)								
Pre-Sparge	5/2/2019	12:15	VS-6	401,000	954	5,610	5,600	24,720
Upper Sparge Start (12:50)								
Sparge	5/2/2019	13:45	VS-7	332,000	777	5,330	5,110	22,160
Sparge	5/2/2019	14:15	VS-8	321,000	759	5,300	5,030	21,660
Day 3 SVE Start (11:26)								
Pre-Sparge	5/3/2019	11:30	VS-9	586,000	1,310	6,750	6,290	31,100
Pre-Sparge	5/3/2019	12:20	VS-10	365,000	900	5,620	5,320	23,260
Lower Sparge Start (12:25)								
Sparge	5/3/2019	12:55	VS-11	396,000	1,020	6,010	5,660	24,050
Sparge	5/3/2019	13:25	VS-12	359,000	1,260	5,760	5,300	22,430
Sparge	5/3/2019	14:05	VS-13	366,000	1,570	5,790	5,270	22,340
Lower Sparge End (14:30)								
Post-Sparge	5/3/2019	14:35	VS-14	404,000	2,780	6,100	5,450	23,120

Notes: Refer to site diagram(s) for testing locations. Refer to laboratory reports for analytical methods.

* See laboratory report for full analyte list.

[1] Sample collected from port located downstream of dilution valve immediately after stystem initiation.

--- Sample not analyzed.

nd Not detected.

12.0 Bold Number(s) indicates contaminant detected.

TABLE 7
Pilot Test Mass-Recovery Rates
Boeing Field Chevron
Tukwila, Washington

	SVE Step 1	SVE Step 2	SVE Step 3	SVE Step 4	Pre-Sparge	Sparge	Sparge	Pre-Sparge	Pre-Sparge	Sparge	Sparge	Sparge	Post-Sparge
Date	**5/1/2019**				**5/2/2019**			**5/3/2019**					
Time	10:35	11:30	12:20	13:45	12:15	13:45	14:15	11:30	12:20	12:55	13:25	14:05	14:35
Applied SVE Vacuum	10.0	19.5	22.0	27.0	35.0	37.0	37.0	37.0	37.0	37.0	36.0	37.5	37.5
SVE Flow	22.0	37.0	43.0	60.0	89.0	89.0	89.0	96.0	89.0	89.0	89.0	89.0	89.0
AS Flow	---	---	---	---	---	10.0	10.0	---	---	10.0	10.0	10.0	10.0
Sample Name	VS-2	VS-3	VS-4	VS-5	VS-6	VS-7	VS-8	VS-9	VS-10	VS-11	VS-12	VS-13	VS-14
Gasoline Range Organics (µg/m³)	355,000	438,000	383,000	304,000	401,000	332,000	321,000	586,000	365,000	396,000	359,000	366,000	404,000
Gasoline Range Organics (ppmv)	86.8	107	93.6	74.3	98.0	81.3	78.4	143	89.3	96.8	87.8	89.6	98.7
Estimated Mass-Removal Rate (pounds/day)	**0.701**	**1.45**	**1.48**	**1.64**	**3.20**	**2.65**	**2.56**	**5.05**	**2.91**	**3.16**	**2.87**	**2.92**	**3.23**

Notes: Refer to site diagram(s) for testing locations.

Flows measured using rotameter located upstream of blower inlet on first day.

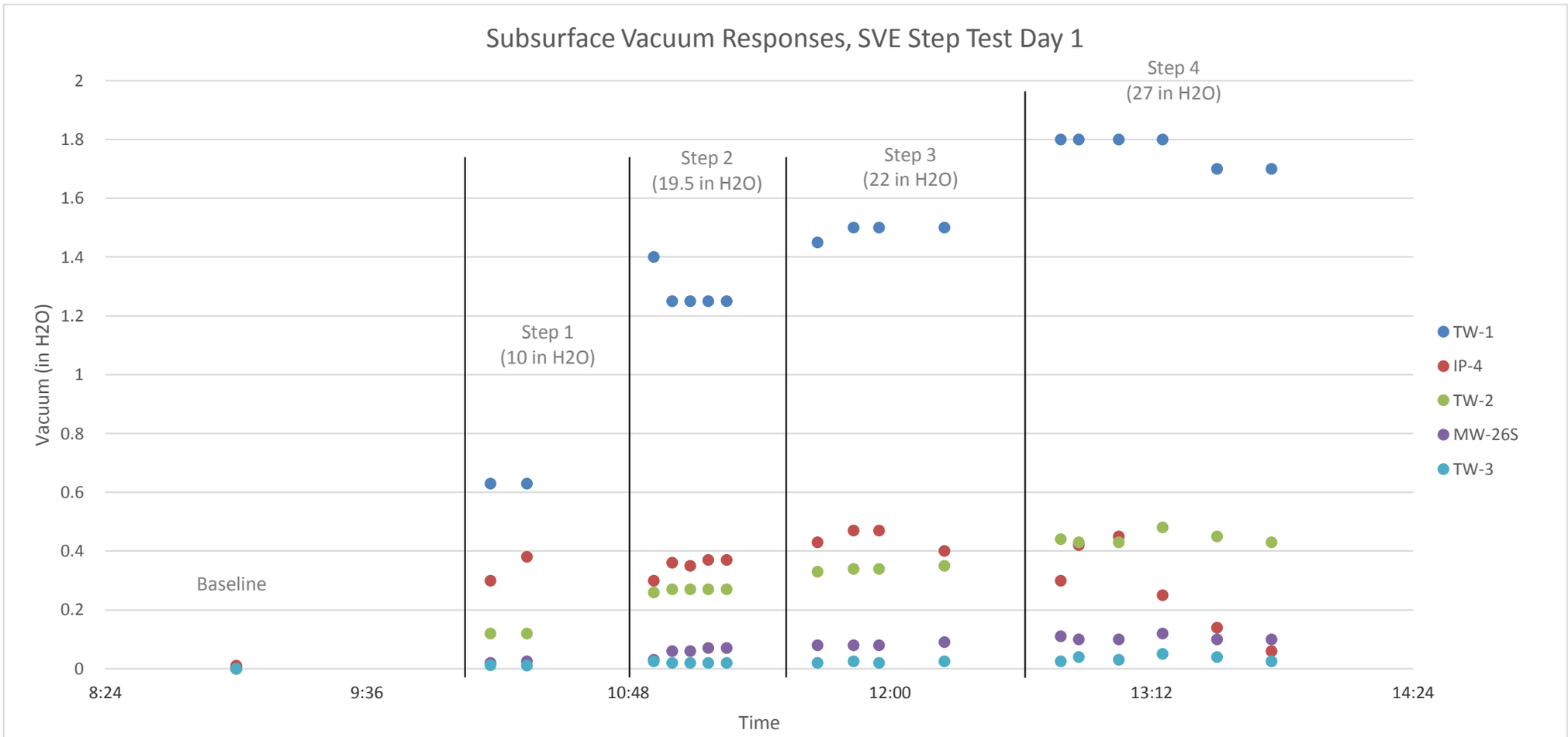
Days 2 and 3 flowrate measured using hot-wire anemometer downstream of blower exhaust.

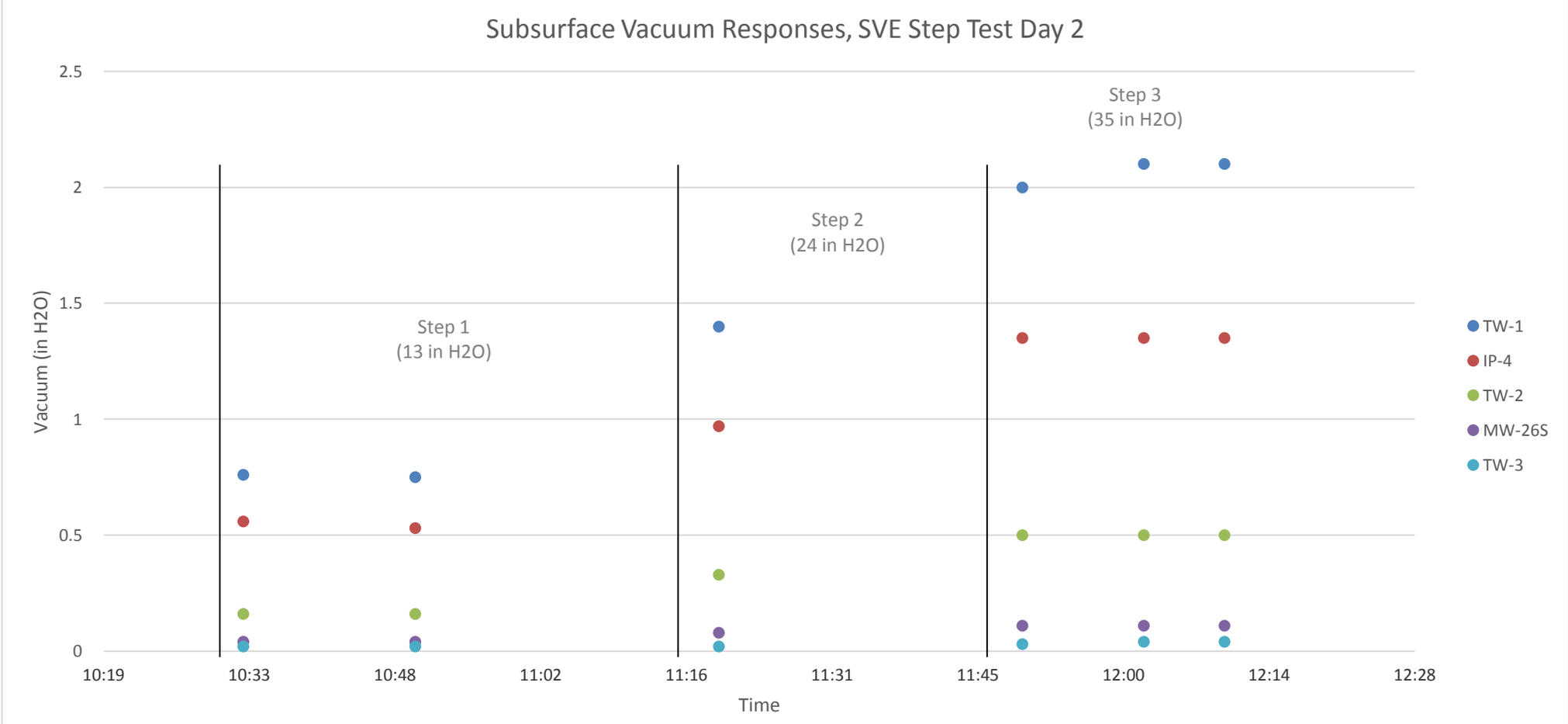
See laboratory analytical reports and Table 6 for more information regarding sample analytical results.

Mass-recovery rate estimate based on GRO concentration (µg/m³) and the measured flowrate presented.

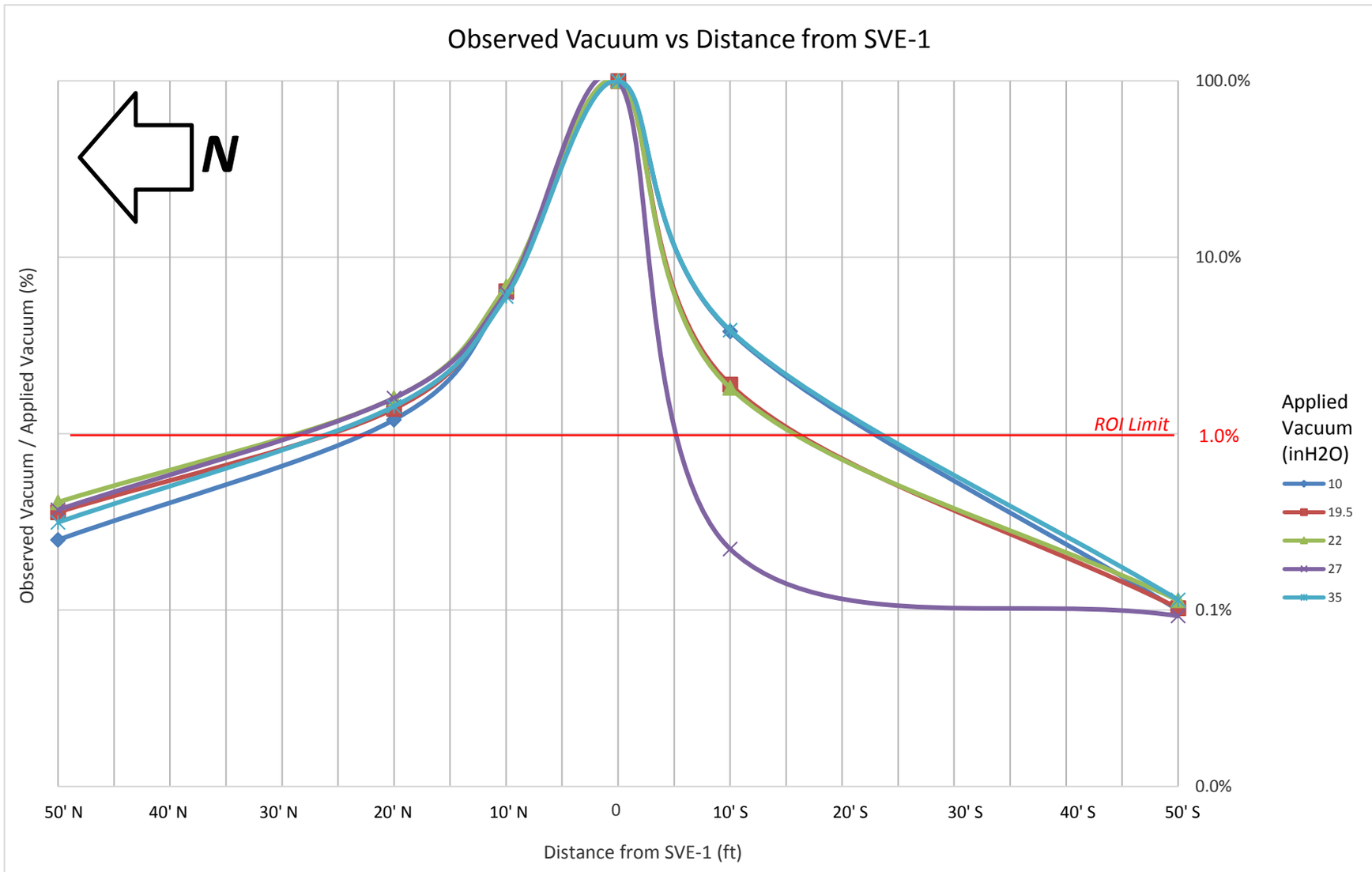
GRAPHS

Graph 1
Subsurface Vacuum Responses, SVE Step Tests
Boeing Field Chevron
Tukwila, Washington

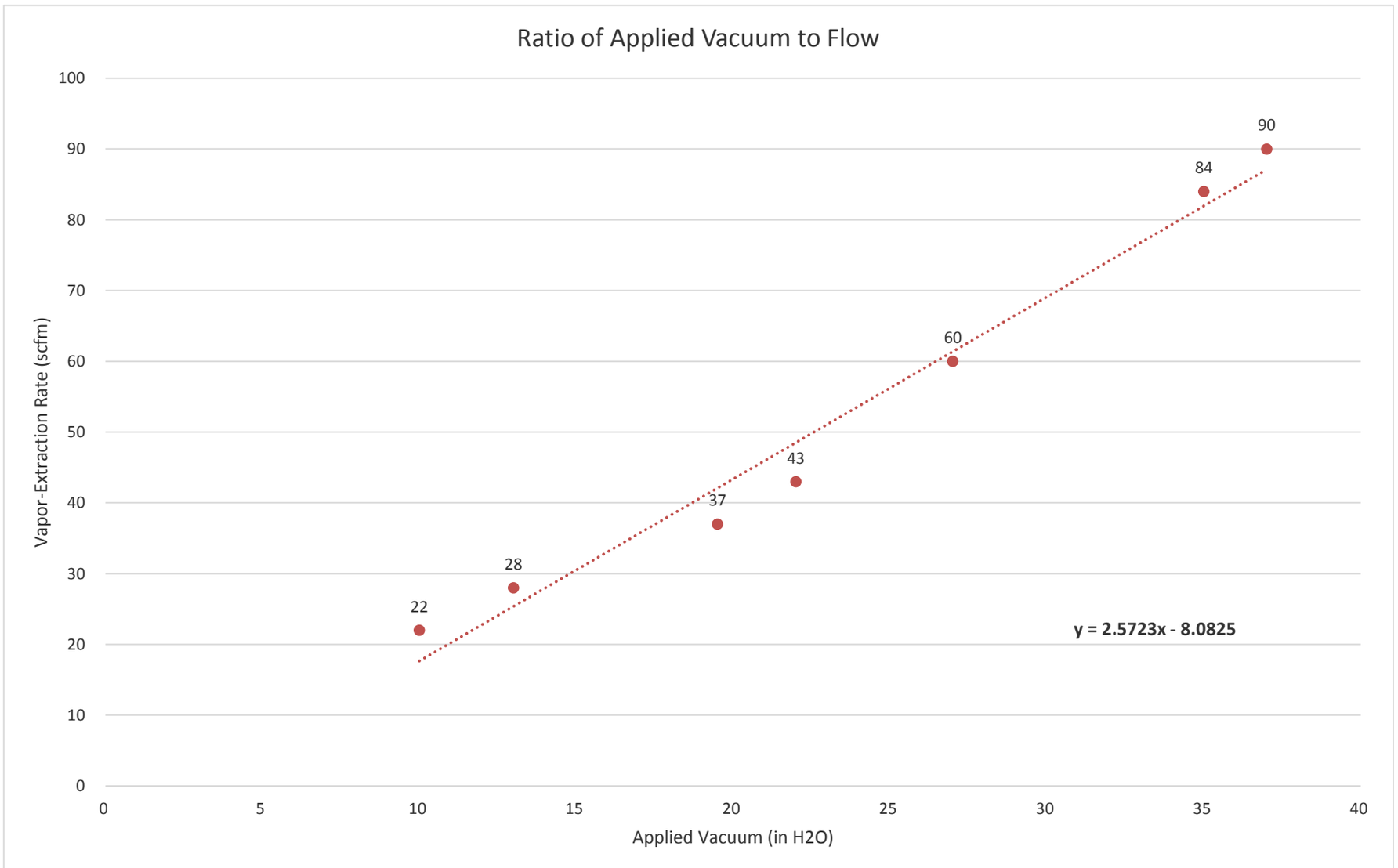




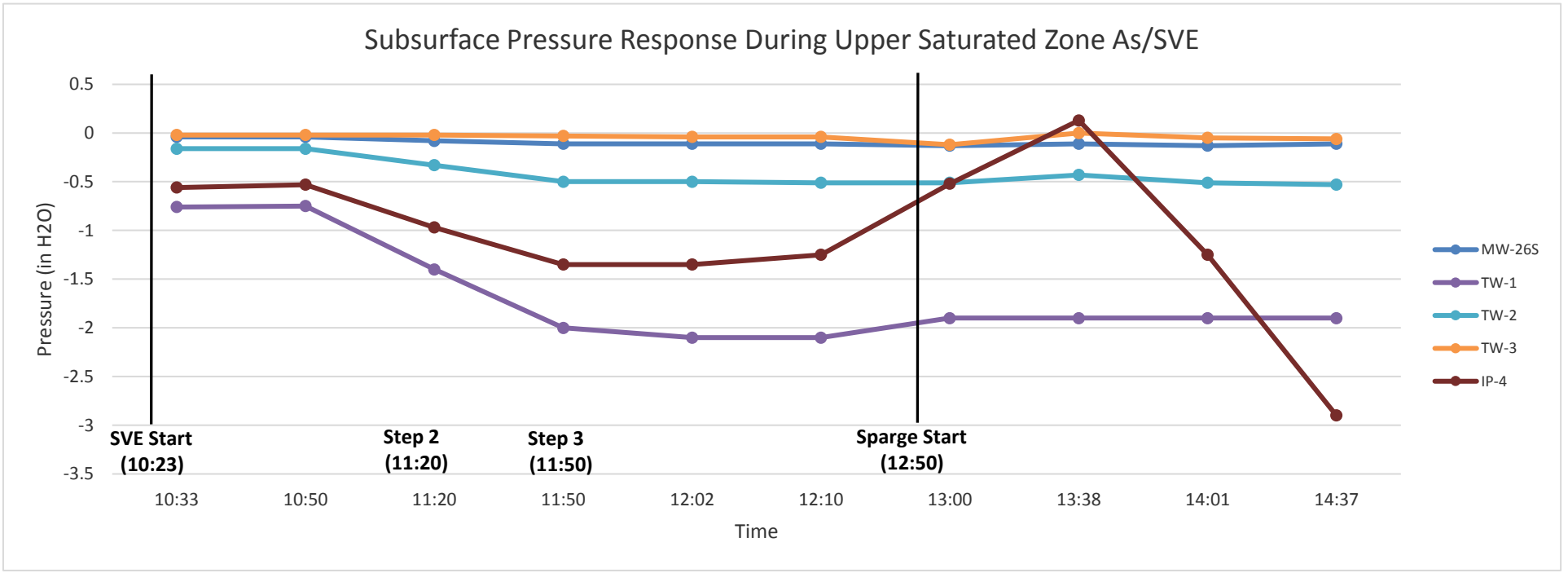
Graph 2
Vacuum Radius of Influence
Boeing Field Chevron
Tukwila, Washington



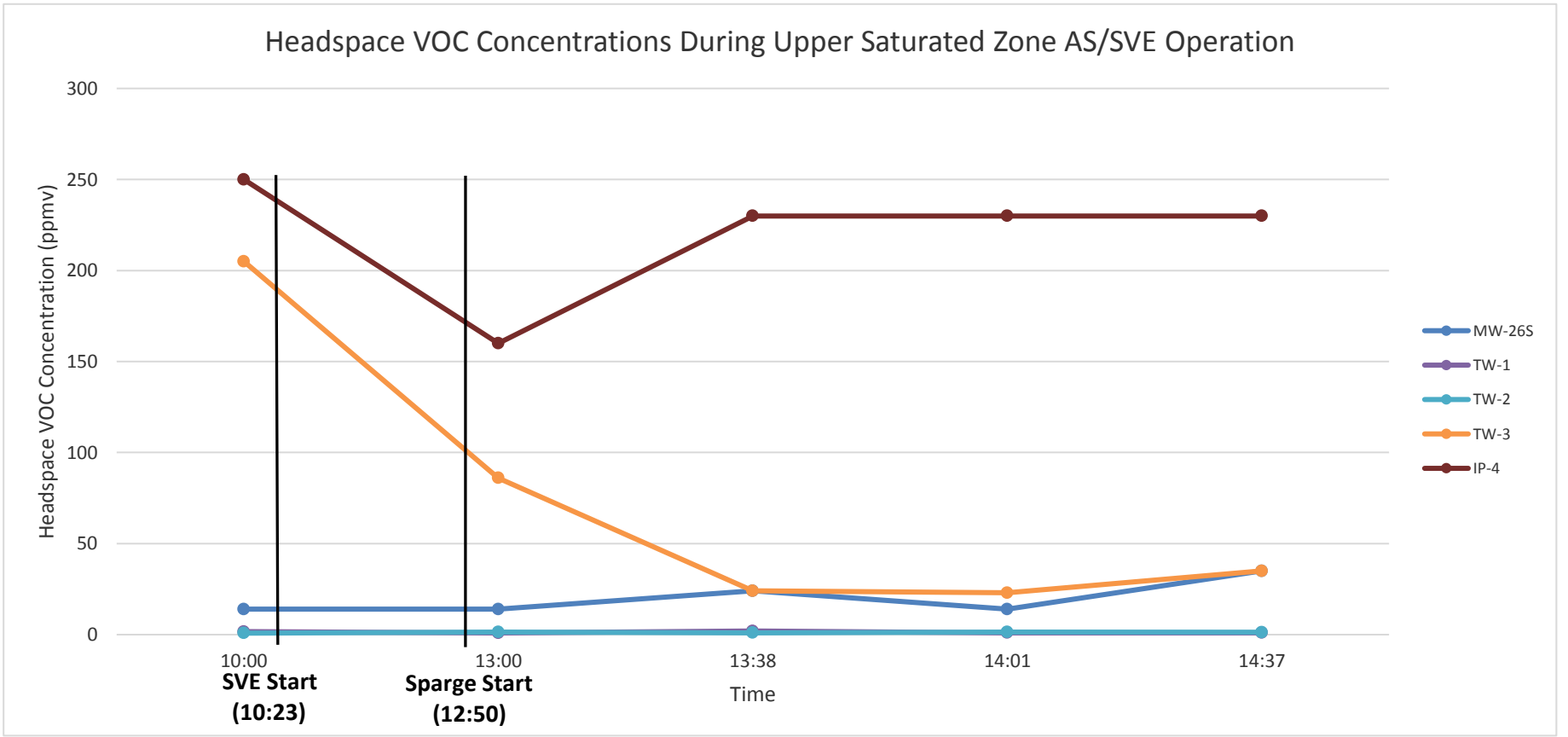
Graph 3
Ratio of Applied Vacuum to Flow
Boeing Field Chevron
Tukwila, Washington



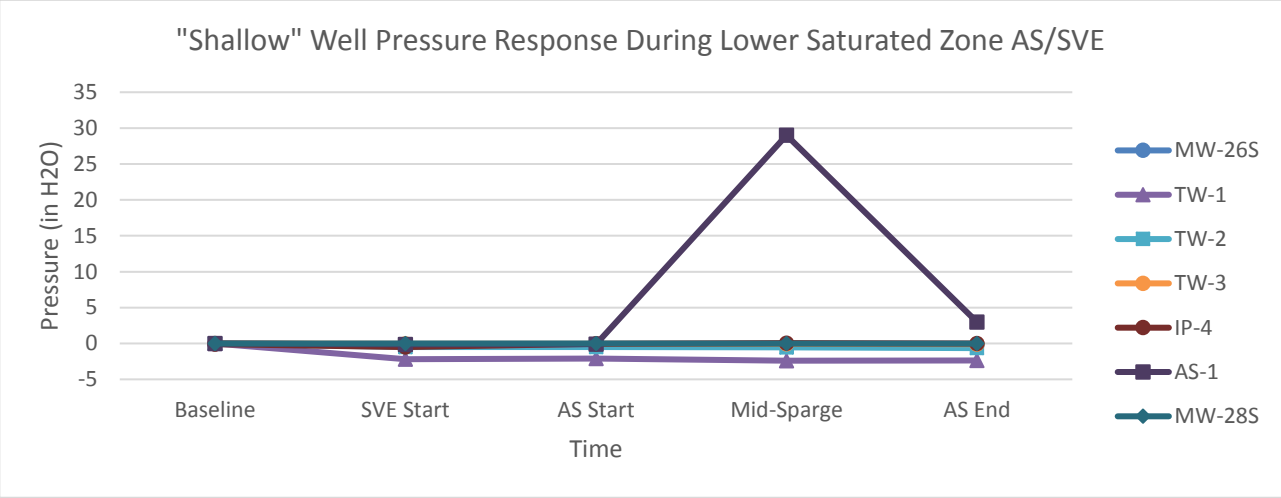
Graph 4
Subsurface Pressure Responses, Upper Saturated Zone AS/SVE
Boeing Field Chevron
Tukwila, Washington

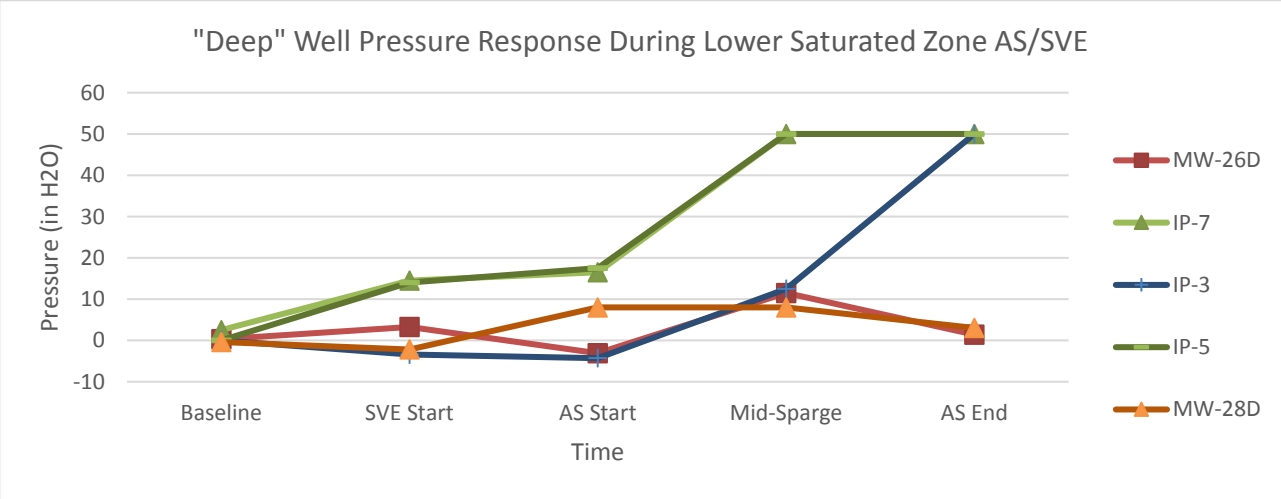


Graph 5
Headspace VOC Concentrations, Upper Saturated Zone AS/SVE
Boeing Field Chevron
Tukwila, Washington

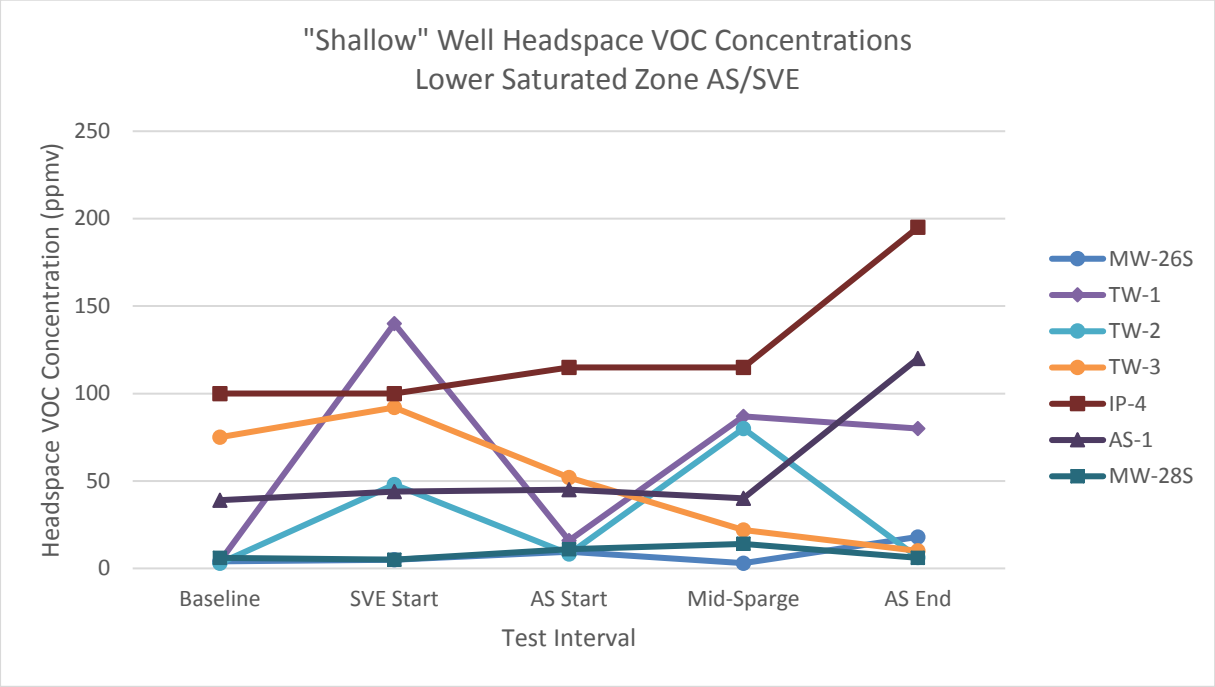


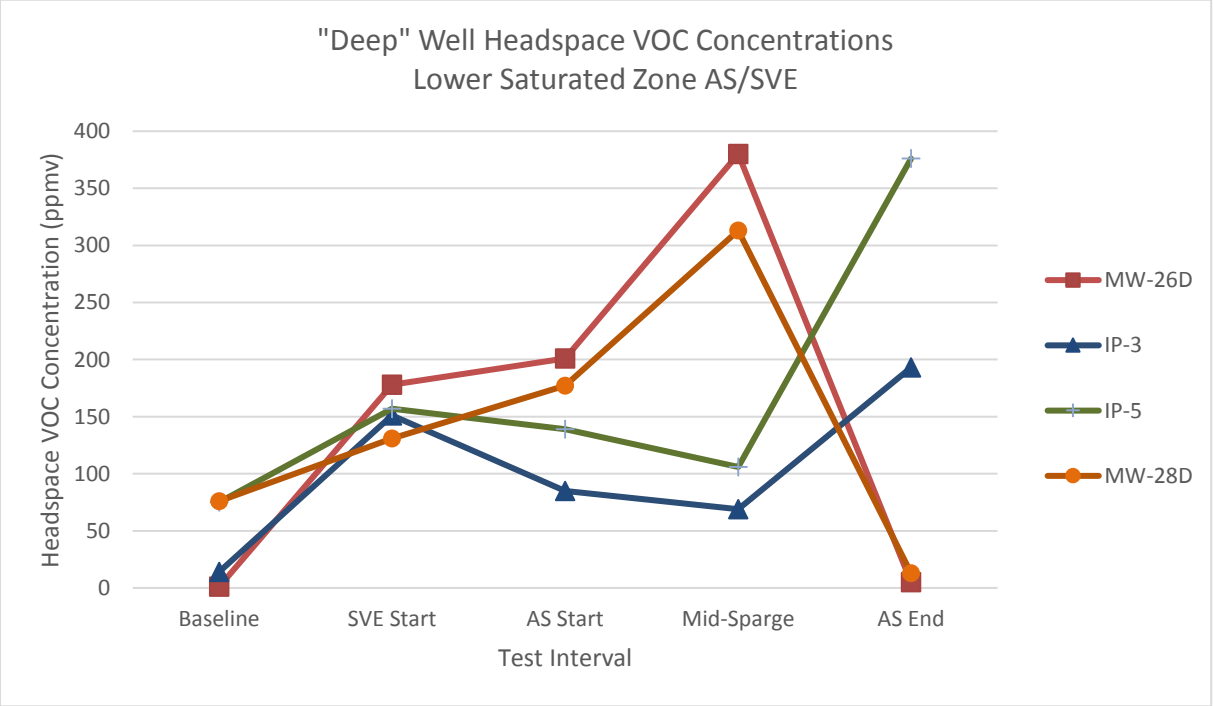
Graph 6
Subsurface Pressure Responses, Lower Saturated Zone AS/SVE
Boeing Field Chevron
Tukwila, Washington



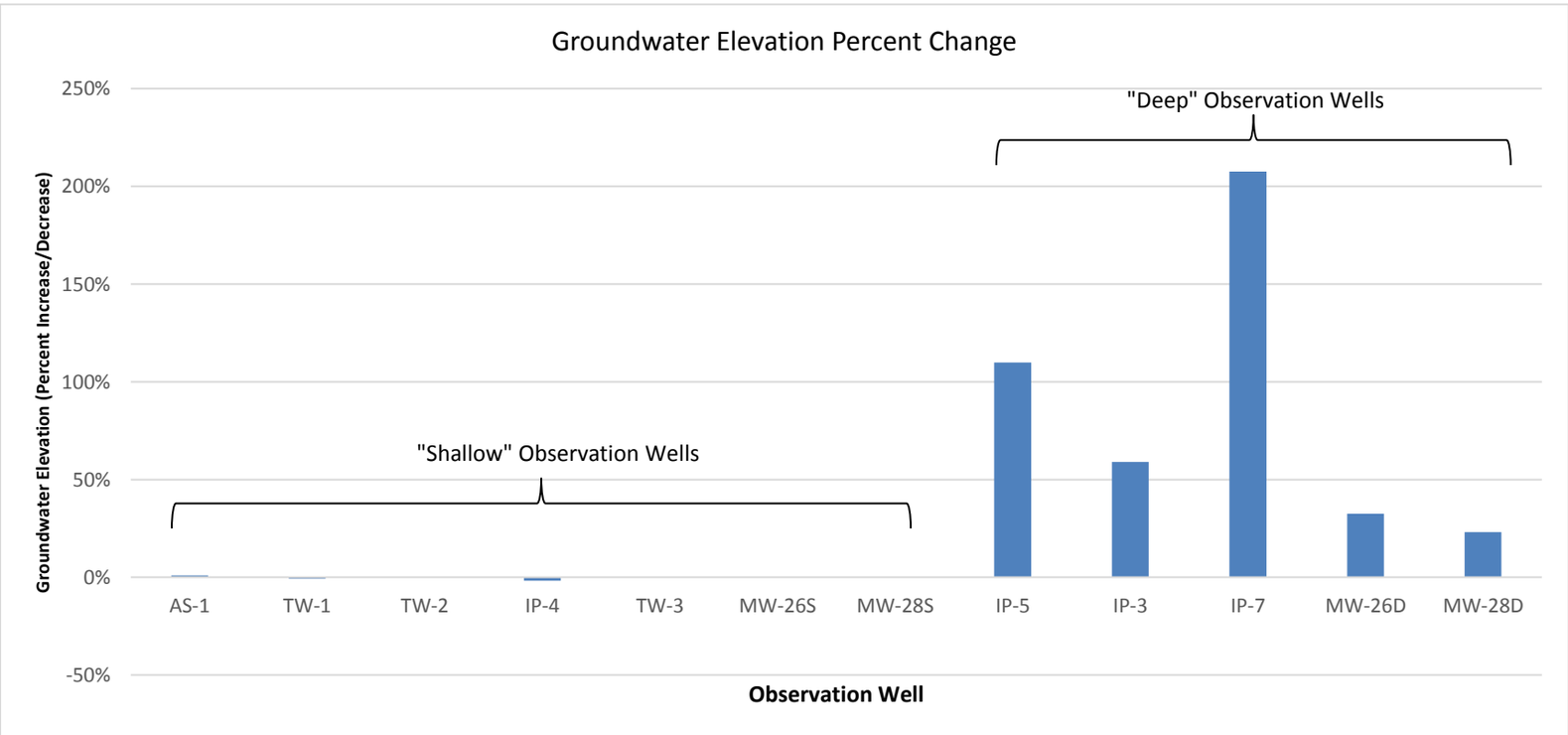


Graph 7
Headspace VOC Concentrations, Lower Saturated Zone AS/SVE
Boeing Field Chevron
Tukwila, Washington





Graph 8
Groundwater Elevation Responses, Lower Saturated Zone AS/SVE
Boeing Field Chevron
Tukwila, Washington



The net increase/decrease in groundwater elevation was calculated based on measurements collected during lower saturated zone AS/SVE test, 5/3/2019.

SITE PHOTOGRAPHS

Photo 1

Description: Boeing Field Chevron pilot test area, looking south.

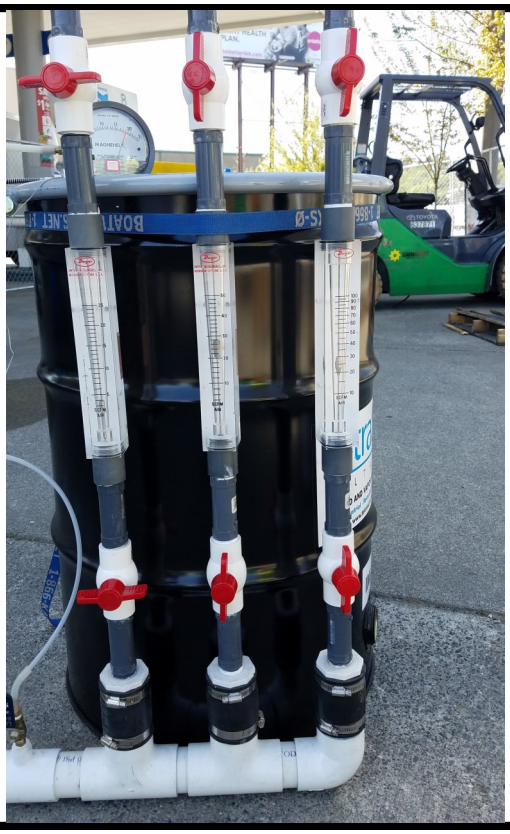
Comments: Test area was located on the western side of the property, in the area of greatest contaminant impacts.

Photo 2

Description: SVE Test Assembly.

Comments: SVE-1 wellhead is indicated by red pin. The green pin indicates AS-1. The test assembly is described further in the report text.

Photo 3



Description: SVE flow-meter manifold Day 1 (left photo) and Day 2 (right photo).

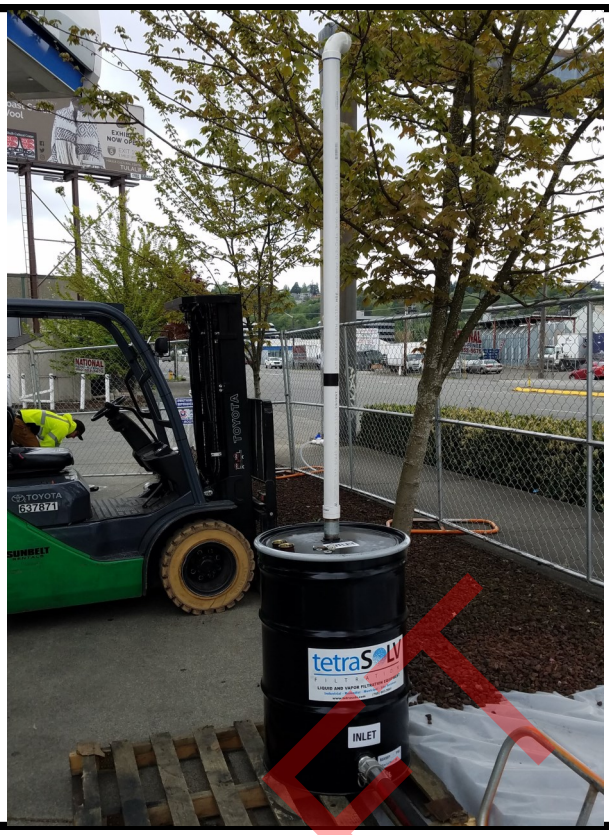
Comments: The rotameters were replaced with a straight section of 2" PVC pipe in order to achieve a higher applied vacuum/flow rate.

Photo 4

Description: 10-gallon moisture-reduction tank with vacuum-relief valve (red pin).

Comments: Photo looking north.

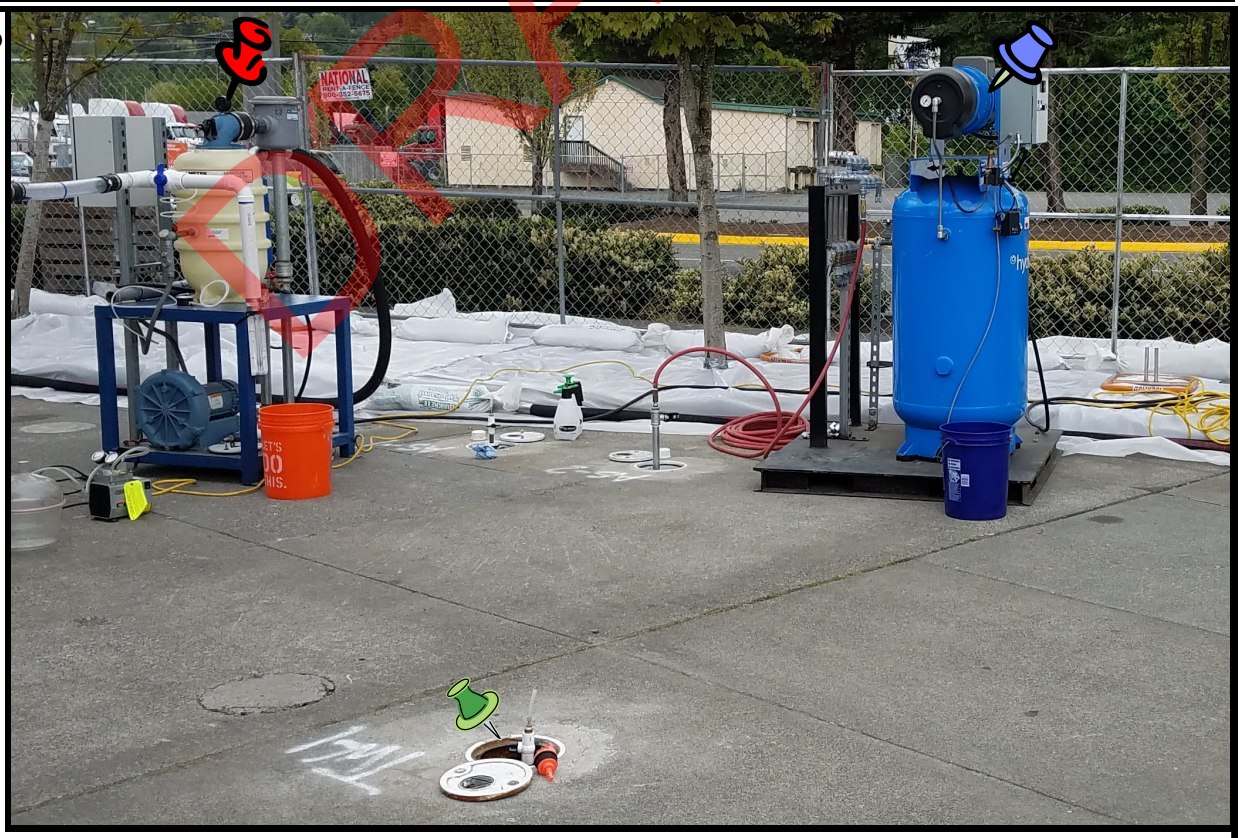
Photo 5



Description: Effluent-exhaust system. Looking south.

Comments: Vapors passed through a 55-gallon activated-carbon vessel before being discharged.

Photo 6



Description: AS (blue pin) and SVE (red pin) test equipment. Observation well TW-1 in foreground (green pin). Looking west.

Comments: Well AS-2 (center) was connected to the compressor assembly via a steel wellhead adapter and red flexible pneumatic hose.

Photo 7

Description: 6 mil plastic sheeting applied to landscaping adjacent to pilot test area.

Comments: Photograph looking north.

Photo 8

Description: Bubbling observed during sparging within the lower saturated zone.

Comments: Well IP-3 (screened in lower saturated zone).

APPENDIX A

Unified Soil Classification System (USCS)

PRIMARY DIVISIONS			SYMBOL	DESCRIPTIONS
COARSE GRAINED SOILS Sands & Gravels, Over 50% retained on #200 sieve	**GRAVELS** Over 50% of coarse material retained on #4 sieve	**CLEAN GRAVEL** Less than 5% passing #200 sieve	GW	Well graded gravel, many different particle sizes, little or no fines
			GP	Poorly graded, few different particle sizes, little or no fines
		GRAVEL WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	SAND Over 50% of coarse material passed #4 sieve	**CLEAN SANDS** Less than 5% passing #200 sieve	SW	Well graded gravel, many different particle sizes, little or no fines
			SP	Poorly graded, few different particle sizes, little or no fines
		SAND WITH FINES	SM	Silty gravels, gravel-sand-silt mixtures
			SC	Clayey gravels, gravel-sand-clay mixtures
FINE GRAINED SOILS Silts & Clays, Over 50% passing the #200 sieve	**SILTS AND CLAYS** Liquid limit is less than 50 %		ML	Inorganic silts, slight to no plasticity
			CL	Inorganic clays, low to moderate plasticity
			OL	Organic silts and clays of low plasticity
	SILTS AND CLAYS Liquid limit is more than 50 %		MH	Inorganic silts, moderate to high plasticity
			CH	Inorganic clays, high plasticity, fat clays
			OH	Organic silts and clays of high plasticity
Highly Organic Soils			PT	Peat and other highly organic soils

Soil Samples

- Disturbed, bag, bulk, or grab sample
- Standard penetration split spoon sample
- Cuttings
- Continuous-Core Sample

Field Measurements

- Water Level Observed During Drilling
- PID — Photoionization Detector
- ppmv — Parts Per Million by Volume
- End of Boring (E.O.B)

Note: Blows per foot is the number of blows used to drive a split-spoon (2" OD) sampler through the last 12 inches of an 18-inch sampling attempt. One blow is a 30-inch fall of a 140-pound hammer.

Note: The line separating strata on the logs represents approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of the strata between exploration locations. Logs represent the soil section observed at the exploration location on the date of exploration only.

ExplorationLogLegend.pub

g-logics

Exploration Log Legend

01-0410-o as-1.vsd

INTERVAL	SAMPLE NUMBER	SOIL DESCRIPTION	Recovery %	USCS	PID (ppmv in headspace)	WELL CONSTRUCTION
0		8" Concrete Surface 0-5': Advanced with air knife. See boring log for AS-2 for soil information.				4" Boring Well Box Well Cap Concrete Seal 2" PVC Blank Bentonite Seal 10/20 Sand 2" PVC Screen 2' Sump
5						
10		Groundwater at 11'	▽			
15		E.O.B. at 16 feet		▽		
20						
25						
30		Depth in feet				

Drilling Method: Direct-Push	**Date:** 4/10/2019	**Other Information:**
Drilling Company: ESN	**Weather:** Cool, Overcast, Windy	
Boring Diameter: Four Inches	**Page** 1 **of** 1	
Logged By: Zak Wall		

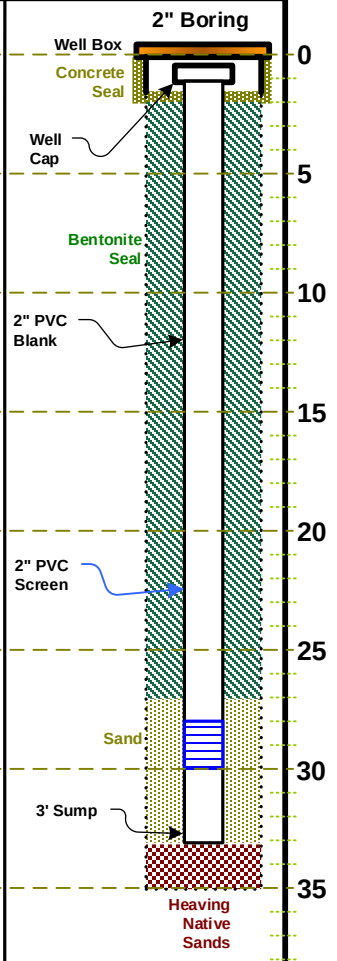
g-logics

Boring/Well Log
Boeing Field Chevron
10805 Pacific Hwy S
Tukwila, WA

AS-1
DRAFT

01-0410-o as-2.vsd

Depth in feet	INTERVAL	SAMPLE NUMBER	SOIL DESCRIPTION	Recovery %	USCS	PID (ppmv in headspace)
0			8" Concrete 0-5': Advanced with air knife. Brown, gravelly, silty sand. Asphalt, brick, and wood debris observed.			
5		AS-2-5	5'-9.5': As above, slightly moist.	45	SM (FILL)	0
10		AS-2-10	9.5'-11': Gray-brown silt with fine-grained sand. Moist. 11'-13': Gray, fine-grained silty sand, saturated. 13'-19': Gray-brown silt with fine-grained sand, moist to slightly moist. Reedy-grassy vegetation observed 16.5-19'.	90	SM SP	0.5
15		AS-2-15		75	SM	37
20		AS-2-19	19'-35': Black/dark gray fine to very coarse-grained sand, saturated.	90		500
25		AS-2-25		100	SW	2.0
30		AS-2-30		100		1.7
35		AS-2-35	EOB at 35'			0
40						
45						
50						



Drilling Method:	Direct Push	**Date:**	4/10/2019
Drilling Company:	ESN	**Weather:**	Overcast, Cool
Boring Diameter:	Two Inches	**Page**	1 of 1
Logged By:	Zak Wall		

Other Information:
Due to heaving sand, well was set at a depth of 33 feet below the ground surface.
Boring advanced with 2" direct push, then over-drilled with 5" auger.

g-logics

Boring/Well Log
Boeing Field Chevron
10805 Pacific Hwy S
Tukwila, WA

AS-2
DRAFT

01-0410-o sve-1.vsd

INTERVAL	SAMPLE NUMBER	SOIL DESCRIPTION	Recovery %	USCS	PID (ppmv in headspace)	WELL CONSTRUCTION
0		8" Concrete Surface Boring advanced with air knife. 0-3': Brown, silty sand with rounded gravel and cobbles, slightly moist.			0	8" Boring Well Box Well Cap Concrete Seal 4" PVC Blank Bentonite Seal 10/20 Sand 4" PVC Screen
		3'-8.5': Brown silty sand with gravel, slightly moist.				
5	SVE-1-5			SM		
		8.5'-9': As above, gray discoloration and strong petroleum odor.			88	
	SVE-1-9	E.O.B. at 9 feet				
10						
15						
20						
25						
30						

Depth in feet

Drilling Method: Air Knife	**Date:** 4/11/2019	**Other Information:**
Drilling Company: ESN	**Weather:** Cool, Overcast, Windy	4"-diameter soil-vapor extraction well.
Boring Diameter: Eight Inches	**Page** 1 **of** 1	
Logged By: Zak Wall		

g-logics

Boring/Well Log
Boeing Field Chevron
10805 Pacific Hwy S
Tukwila, WA

SVE-1
DRAFT

01-0410-o tw-1.vsd

INTERVAL	SAMPLE NUMBER	SOIL DESCRIPTION	Recovery %	USCS	PID (ppmv in headspace)	WELL CONSTRUCTION
0		8" Concrete Surface				2" Boring
		0-5': Advanced with air knife. Brown, silty sand with rounded gravel, slightly moist.			0	Well Box, Well Cap, Concrete Seal, 2" PVC Blank
	TW-1-5			SM		Bentonite Seal
5		5'-9': Brown, medium to coarse-grained silty sand with trace rounded gravel, moist.	40		0	10/20 Sand
	TW-1-9	Wet at 9' E.O.B. at 9 feet				2" PVC Screen
10						
15						
20						
25						
30						

Depth in feet

Drilling Method: Direct-Push	Date: 4/11/2019	Other Information:
Drilling Company: ESN	Weather: Cool, Overcast, Windy	
Boring Diameter: Two Inches	Page 1 of 1	
Logged By: Zak Wall		

g-logics

Boring/Well Log
Boeing Field Chevron
10805 Pacific Hwy S
Tukwila, WA

TW-1
DRAFT

01-0410-o tw-2.vsd

INTERVAL	SAMPLE NUMBER	SOIL DESCRIPTION	Recovery %	USCS	PID (ppmv in headspace)	WELL CONSTRUCTION
0		8" Concrete Surface				2" Boring
		0-5': Advanced with air knife. Brown, silty sand with rounded gravel, slightly moist. Angular concrete debris throughout.				Well Box, Well Cap, Concrete Seal, 2" PVC Blank, Bentonite Seal, 10/20 Sand, 2" PVC Screen
		8" PVC pipe obstructing hole at 4 feet. Moved 2				
	TW-2-5	feet north.		SM	0	
5		5'-9': As above, poor recovery.	<5		0	
		E.O.B. at 9 feet				
10						
15						
20						
25						
30						

Depth in feet

Drilling Method: Direct-Push	Date: 4/11/2019	Other Information:
Drilling Company: ESN	Weather: Cool, Overcast, Windy	
Boring Diameter: Two Inches	Page 1 of 1	
Logged By: Zak Wall		

g-logics

Boring/Well Log
Boeing Field Chevron
10805 Pacific Hwy S
Tukwila, WA

TW-2
DRAFT

01-0410-o tw-3.vsd

INTERVAL	SAMPLE NUMBER	SOIL DESCRIPTION	Recovery %	USCS	PID (ppmv in headspace)	WELL CONSTRUCTION
0		8" Concrete Surface				2" Boring
		0-5': Advanced with air knife. Brown, silty sand with rounded gravel, slightly moist.			2.1	Well Box, Well Cap, Concrete Seal, 2" PVC Blank
		8"-thick layer of weak concrete encountered at 2.5'				
	TW-3-5			SM		Bentonite Seal
5		5'-9': Gravelly, very silty, medium-grained sand, very moist.	50		151	10/20 Sand
	TW-3-9	E.O.B. at 9 feet				2" PVC Screen
10						
15						
20						
25						
30						

Depth in feet

Drilling Method: Direct-Push	Date: 4/11/2019	Other Information:
Drilling Company: ESN	Weather: Cool, Overcast, Windy	
Boring Diameter: Two Inches	Page 1 of 1	
Logged By: Zak Wall		

g-logics

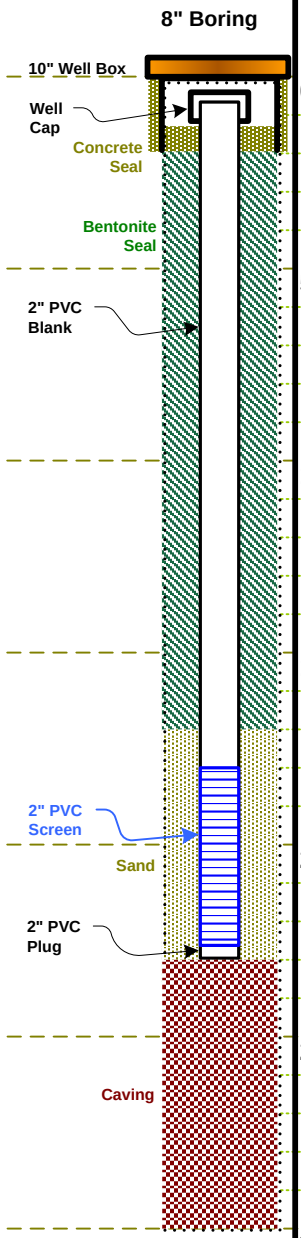
Boring/Well Log
Boeing Field Chevron
10805 Pacific Hwy S
Tukwila, WA

TW-3
DRAFT

mw-26d.vsd

INTERVAL	SAMPLE NUMBER	SOIL DESCRIPTION	Recovery %	USCS	PID (ppmv in headspace)
0		Surface: Concrete; 4"			
		Air Knife to 6'			
5	MW-26D-5	5-10': SILTY SAND with gravel; fine-coarse grain; gray, no odor, moist to wet @ 8'.	75	SM	0.0
10	MW-26D-10	10-11': SILTY SAND; fine grain; gray, slight odor, wet.	80	ML	0.0
		11-15': SILT with clay and sand; brown-gray, no odor, moist, some organics.			
		15-16.5': SILTY SAND; medium-coarse grain; gray, slight odor, wet.		SM	
15	MW-Z-16 MW-26D-16.5	16.5-30': Well-graded SAND; fine to medium grain turning medium to coarse grain with depth; dark-gray, no odor, wet.	45		0.0
20	MW-26D-20		80	SW	0.0
25	MW-26D-25		100		0.0
30	MW-26D-30	E.O.B. at 30 feet			0.0

Depth in feet



Drilling Method: Direct-Push/HSA	**Date:** 11/17/2016	**Other Information:**
Drilling Company: ESN Northwest	**Weather:** Cloudy, Cool	DOE Tag BJR-938
Boring Diameter: Eight Inches	**Page** 1 **of** 1	Sch. 40, 10 slot screen
Logged By: Karis Vandehey		11/21/16: H2O @ 12' prior to development.

g-logics

Boring
Boeing Field Chevron
10805 East Marginal Way South
Seattle, Washington

MW-26D

mw-26s.vsd

INTERVAL	SAMPLE NUMBER	SOIL DESCRIPTION	Recovery %	USCS	PID (ppmv in headspace)	WELL CONSTRUCTION
0		Surface: Concrete; 4"				4.5" Boring
		Air Knife to 6'				10" Well Box, Well Cap, Concrete Seal
5		No samples collected.				Bentonite Seal
		See MW-26D for soil information.				2" PVC Blank
			▽			2" PVC Screen, Sand
10		E.O.B. at 12 feet		▽		2" PVC Plug
15						
20						
25						
30		Depth in feet				

Drilling Method: Direct Push	**Date:** 11/21/2016	**Other Information:**
Drilling Company: ESN Northwest	**Weather:** Cloudy, Cool	DOE Tag BJR-906
Boring Diameter: 4.5 Inches	**Page** 1 **of** 1	Sch. 40, 10 slot screen
Logged By: Karis Vandehey		11/21/16: H2O @ 9' prior to development.

g-logics

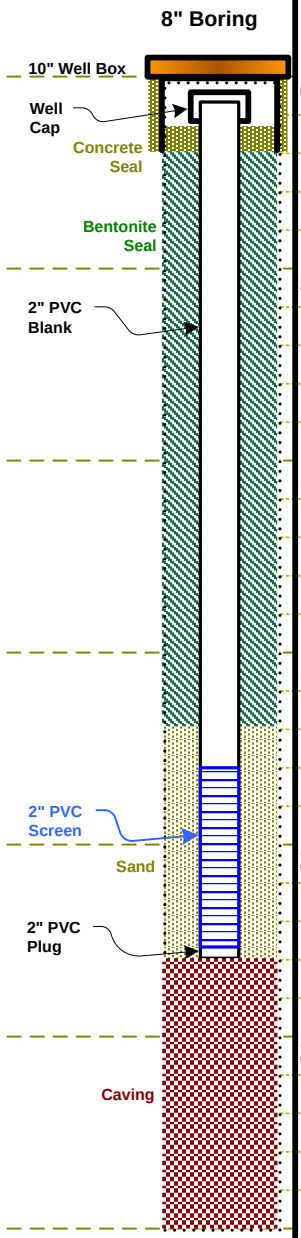
Boring
Boeing Field Chevron
10805 East Marginal Way South
Seattle, Washington

MW-26S

mw-28d.vsd

INTERVAL	SAMPLE NUMBER	SOIL DESCRIPTION	Recovery %	USCS	PID (ppmv in headspace)
0		Surface: Concrete; 4"			
		Air Knife to 6'			0.7
		4"-7': SILTY SAND; fine grain; brown, no odor, moist.	25	SM	
5	MW-28D-5				0.7
		Wet 6-6.5', oxidized lens (1" thick) at approx. 6.5'	35	?	
		7-10': No recovery.		ML/CL	
10	MW-278-10	10-11': Laminated SILT with clay and CLAY with silt; gray, no odor, moist to wet.			3.9
		@ 11': SILTY SAND; fine grain; dark-gray (oxidized).	25	SM ?	
		11-15': No recovery.			
15	MW-28D-15			CL	2.9
		15-15.5': CLAY with silt; gray-brown, no odor, moist, some organics.	40		
20	MW-28D-20 MW-Y	15.5-30': Well-graded SAND; fine to medium grain turning medium to coarse grain with depth; dark-gray, no odor, wet.	100	SW	7.5
25			100		
30	MW-28D-30	E.O.B. at 30 feet			3.7

Depth in feet



Drilling Method: Direct-Push/HSA	**Date:** 11/18/2016	**Other Information:**
Drilling Company: ESN Northwest	**Weather:** Cloudy, Cool	DOE Tag BJR-937
Boring Diameter: Eight Inches	**Page** 1 **of** 1	Sch. 40, 10 slot screen
Logged By: Karis Vandehey		11/18/16: H2O @ 13'.

g-logics

Boring
Boeing Field Chevron
10805 East Marginal Way South
Seattle, Washington

MW-28D

mw-28s.vsd

INTERVAL	SAMPLE NUMBER	SOIL DESCRIPTION	Recovery %	USCS	PID (ppmv in headspace)	WELL CONSTRUCTION
0		Surface: Concrete; 4"				4.5" Boring
		Air Knife to 6'				10" Well Box, Well Cap, Concrete Seal, Bentonite Seal, 2" PVC Blank
5		No samples collected.				
		See MW-28D for soil information.				Sand, 2" PVC Screen
10		E.O.B. at 12 feet				2" PVC Plug
15						
20						
25						
30						

Depth in feet

Drilling Method: Direct Push	**Date:** 11/18/2016	**Other Information:**
Drilling Company: ESN Northwest	**Weather:** Cloudy, Cool	DOE Tag BJR-935
Boring Diameter: 4.5 Inches	**Page** 1 **of** 1	Sch. 40, 10 slot screen
Logged By: Karis Vandehey		11/18/16: H2O @ 9'.

g-logics

Boring
Boeing Field Chevron
10805 East Marginal Way South
Seattle, Washington

MW-28S

01-0410-e-ip-3.vsd

BLOWS/6 inches	INTERVAL	SAMPLE NUMBER	SOIL DESCRIPTION	Recovery %	USCS	PID (ppmv in headspace)	WELL CONSTRUCTION
							8" Dia. Seal 2" Dia. Boring
					SM		Well Box Locking Well Cap
			Silty Sand				Bentonite Seal
			Moderate Odor, Wet				2" SS Blank
			Silt with organics		ML		10/20 Sand
			Coarse wet black sand Strong Odor	100	SP		2" 0.020 Slot SS Well Screen
			Coarse black sand				
			End of Boring at 26 feet No Odor				

0 5 10 15 20 25 30

Depth in feet

Drilling Method: HSA	**Date:** 4/19/06	**Other Information:** Soils logged by Urban Redevelopment
Drilling Company: NW Probe	**Weather:** Overcast, Rain	
Boring Diameter: 8-inches	**Page** 1 **of** 1	
Logged By: J. Funderburk		

g-logics

Boring/Well Log
Boeing Field Chevron
10805 East Marginal Way South
Tukwila, WA

IP-3

01-0410-e-ip-4.vsd

BLOWS/6 inches	INTERVAL	SAMPLE NUMBER	SOIL DESCRIPTION	Recovery %	USCS	PID (ppmv in headspace)	WELL CONSTRUCTION
					SM		8" Dia. Seal 2" Dia. Boring Well Box Locking Well Cap
			Silty Sand Strong Odor, Wet				Bentonite Seal 3" SS Blank 10/20 Sand 3" 0.020 Slot SS Well Screen
			Silt with organics		ML		
			Coarse wet black sand Strong Odor	100	SP	3480	Backfilled Bentonite Seal
			Coarse black sand			530	
			End of Boring at 24 feet No Odor				

0 5 10 15 20 25 30

Depth in feet

Drilling Method:	HSA	**Date:**	4/19/06
Drilling Company:	NW Probe	**Weather:**	Overcast, Rain
Boring Diameter:	8-inches	**Page**	1 of 1
Logged By:	J. Funderburk		

Other Information:
Soils logged by Urban Redevelopment

g-logics

Boring/Well Log
Boeing Field Chevron
10805 East Marginal Way South
Tukwila, WA

IP-4

01-0410-e-ip-5.vsd

BLOWS/6 inches	INTERVAL	SAMPLE NUMBER	SOIL DESCRIPTION	Recovery %	USCS	PID (ppmv in headspace)	WELL CONSTRUCTION
							8" Dia. Seal 2" Dia. Boring
					SM		Well Box Locking Well Cap
			Silty Sand				Bentonite Seal
			Moderate Odor, Wet				2" SS Blank
			Silt with organics		ML		10/20 Sand
				100	SP	5000	2" 0.020 Slot SS Well Screen
			Strong Odor 19-22 feet Coarse wet black sand			286	
			End of Boring at 26 feet No Odor				

0 5 10 15 20 25 30

Depth in feet

Drilling Method: HSA	**Date:** 4/26/06	**Other Information:** Soils logged by Urban Redevelopment
Drilling Company: NW Probe	**Weather:** Overcast, Rain	
Boring Diameter: 8-inches	**Page** 1 **of** 1	
Logged By: J. Funderburk		

g-logics

Boring/Well Log
Boeing Field Chevron
10805 East Marginal Way South
Tukwila, WA

IP-5

01-0410-e-ip-6.vsd

BLOWS/6 inches	INTERVAL	SAMPLE NUMBER	SOIL DESCRIPTION	Recovery %	USCS	PID (ppmv in headspace)	WELL CONSTRUCTION
					SM		8" Dia. Seal 2" Dia. Boring Well Box Locking Well Cap
			Gravelly Fill				Bentonite Seal
							2" SS Blank
							10/20 Sand
			Silt with organics		ML		
				100	SP		2" 0.020 Slot SS Well Screen
			Strong Odor 19-22 feet Coarse wet black sand				
			End of Boring at 24 feet No Odor				

0 5 10 15 20 25 30

Depth in feet

Drilling Method: HSA	**Date:** 8/4/06	**Other Information:** Soils logged by Urban Redevelopment
Drilling Company: Cascade	**Weather:** Overcast, Rain	
Boring Diameter: 8-inches	**Page** 1 **of** 1	
Logged By: J. Funderburk		

g-logics

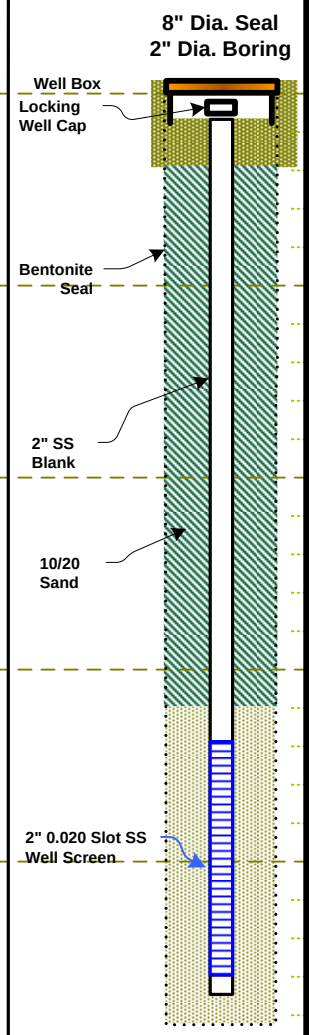
Boring/Well Log
Boeing Field Chevron
10805 East Marginal Way South
Tukwila, WA

IP-6

01-0410-e-ip-7.vsd

BLOWS/6 inches	INTERVAL	SAMPLE NUMBER	SOIL DESCRIPTION	Recovery %	USCS	PID (ppmv in headspace)
6 7 6			Black Sand with Gravel		SM	7.5
2 2 2			Peaty Clay Silt		CL	4.1
					ML	
6 13 13			Strong Odor 18 to 19 feet	100	SP	1500 3000 390
			Coarse wet black sand			300 5
		IP7-22				
			End of Boring at 24.5 feet			

WELL CONSTRUCTION



0 5 10 15 20 25 30

Depth in feet

Drilling Method:	HSA	**Date:**	8/4/06
Drilling Company:	Cascade	**Weather:**	Overcast, Rain
Boring Diameter:	8-inches	**Page**	1 of 1
Logged By:	R. Roberts		

Other Information:

g-logics

Boring/Well Log
Boeing Field Chevron
10805 East Marginal Way South
Tukwila, WA

IP-7

APPENDIX B

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

G-Logics
Zackary Wall
40 Second Ave. SE
Issaquah, WA 98027

RE: BFC
Work Order Number: 1904212

April 18, 2019

Attention Zackary Wall:

Fremont Analytical, Inc. received 16 sample(s) on 4/11/2019 for the analyses presented in the following report.

Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.
Gasoline by NWTPH-Gx
Sample Moisture (Percent Moisture)
Total Metals by EPA Method 6020
Volatile Organic Compounds by EPA Method 8260C

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: *04/18/2019*

CLIENT: G-Logics
Project: BFC
Work Order: 1904212

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1904212-001	AS-2-5	04/10/2019 9:20 AM	04/11/2019 12:00 PM
1904212-002	AS-1-5	04/10/2019 10:00 AM	04/11/2019 12:00 PM
1904212-003	AS-2-10	04/10/2019 11:10 AM	04/11/2019 12:00 PM
1904212-004	AS-2-15	04/10/2019 11:15 AM	04/11/2019 12:00 PM
1904212-005	AS-2-19	04/10/2019 11:20 AM	04/11/2019 12:00 PM
1904212-006	AS-2-25	04/10/2019 11:25 AM	04/11/2019 12:00 PM
1904212-007	AS-2-30	04/10/2019 11:30 AM	04/11/2019 12:00 PM
1904212-008	AS-2-35	04/10/2019 11:35 AM	04/11/2019 12:00 PM
1904212-009	TW-1-5	04/10/2019 2:30 PM	04/11/2019 12:00 PM
1904212-010	SVE-1-5	04/10/2019 3:15 PM	04/11/2019 12:00 PM
1904212-011	SVE-1-9	04/10/2019 4:15 PM	04/11/2019 12:00 PM
1904212-012	TW-2-5	04/11/2019 9:00 AM	04/11/2019 12:00 PM
1904212-013	TW-3-5	04/11/2019 9:30 AM	04/11/2019 12:00 PM
1904212-014	TW-1-9	04/11/2019 10:00 AM	04/11/2019 12:00 PM
1904212-015	TW-3-9	04/11/2019 10:30 AM	04/11/2019 12:00 PM
1904212-016	DUP	04/11/2019 11:00 AM	04/11/2019 12:00 PM

Case Narrative

WO#: **1904212**
Date: **4/18/2019**

CLIENT: G-Logics
Project: BFC

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

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

Matrix Spike (MS) and MS Duplicate (MSD) samples are tested from an analytical batch of "like" matrix to check for possible matrix effect. The MS and MSD will provide site specific matrix data only for those samples which are spiked by the laboratory. The sample chosen for spike purposes may or may not have been a sample submitted in this sample delivery group. 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 and the MS/MSD 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.

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

Analytical Report

Work Order: **1904212**
Date Reported: **4/18/2019**

Client: G-Logics
Collection Date: 4/10/2019 9:20:00 AM
Project: BFC
Lab ID: 1904212-001
Matrix: Soil
Client Sample ID: **AS-2-5**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.				Batch ID: 24162		Analyst: DW
Diesel (Fuel Oil)	ND	21.1		mg/Kg-dry	1	4/13/2019 8:53:42 AM
Heavy Oil	ND	52.6		mg/Kg-dry	1	4/13/2019 8:53:42 AM
Surr: 2-Fluorobiphenyl	90.1	50 - 150		%Rec	1	4/13/2019 8:53:42 AM
Surr: o-Terphenyl	89.8	50 - 150		%Rec	1	4/13/2019 8:53:42 AM
Gasoline by NWTPH-Gx				Batch ID: 24206		Analyst: KT
Gasoline	ND	4.07		mg/Kg-dry	1	4/18/2019 7:28:58 AM
Surr: 4-Bromofluorobenzene	90.2	65 - 135		%Rec	1	4/18/2019 7:28:58 AM
Surr: Toluene-d8	97.3	65 - 135		%Rec	1	4/18/2019 7:28:58 AM
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 24206		Analyst: KT
Benzene	ND	0.0163		mg/Kg-dry	1	4/18/2019 7:28:58 AM
Toluene	ND	0.0163		mg/Kg-dry	1	4/18/2019 7:28:58 AM
Ethylbenzene	ND	0.0203		mg/Kg-dry	1	4/18/2019 7:28:58 AM
m,p-Xylene	ND	0.0407		mg/Kg-dry	1	4/18/2019 7:28:58 AM
o-Xylene	ND	0.0203		mg/Kg-dry	1	4/18/2019 7:28:58 AM
Surr: Dibromofluoromethane	95.8	56.5 - 129		%Rec	1	4/18/2019 7:28:58 AM
Surr: Toluene-d8	97.7	64.5 - 151		%Rec	1	4/18/2019 7:28:58 AM
Surr: 1-Bromo-4-fluorobenzene	95.4	54.8 - 168		%Rec	1	4/18/2019 7:28:58 AM
Sample Moisture (Percent Moisture)				Batch ID: R50731		Analyst: CJ
Percent Moisture	8.65	0.500		wt%	1	4/15/2019 11:26:17 AM

Analytical Report

Work Order: **1904212**
Date Reported: **4/18/2019**

Client: G-Logics
Project: BFC
Lab ID: 1904212-003
Client Sample ID: **AS-2-10**

Collection Date: 4/10/2019 11:10:00 AM
Matrix: Soil

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.				Batch ID: 24162		Analyst: DW
Diesel (Fuel Oil)	ND	23.4		mg/Kg-dry	1	4/13/2019 9:53:06 AM
Heavy Oil	ND	58.6		mg/Kg-dry	1	4/13/2019 9:53:06 AM
Surr: 2-Fluorobiphenyl	103	50 - 150		%Rec	1	4/13/2019 9:53:06 AM
Surr: o-Terphenyl	105	50 - 150		%Rec	1	4/13/2019 9:53:06 AM
Gasoline by NWTPH-Gx				Batch ID: 24206		Analyst: KT
Gasoline	ND	5.16		mg/Kg-dry	1	4/18/2019 7:59:08 AM
Surr: 4-Bromofluorobenzene	89.8	65 - 135		%Rec	1	4/18/2019 7:59:08 AM
Surr: Toluene-d8	96.9	65 - 135		%Rec	1	4/18/2019 7:59:08 AM
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 24206		Analyst: KT
Benzene	ND	0.0207		mg/Kg-dry	1	4/18/2019 7:59:08 AM
Toluene	ND	0.0207		mg/Kg-dry	1	4/18/2019 7:59:08 AM
Ethylbenzene	ND	0.0258		mg/Kg-dry	1	4/18/2019 7:59:08 AM
m,p-Xylene	ND	0.0516		mg/Kg-dry	1	4/18/2019 7:59:08 AM
o-Xylene	ND	0.0258		mg/Kg-dry	1	4/18/2019 7:59:08 AM
Surr: Dibromofluoromethane	96.1	56.5 - 129		%Rec	1	4/18/2019 7:59:08 AM
Surr: Toluene-d8	97.6	64.5 - 151		%Rec	1	4/18/2019 7:59:08 AM
Surr: 1-Bromo-4-fluorobenzene	94.9	54.8 - 168		%Rec	1	4/18/2019 7:59:08 AM
Sample Moisture (Percent Moisture)				Batch ID: R50731		Analyst: CJ
Percent Moisture	20.7	0.500		wt%	1	4/15/2019 11:26:17 AM

Analytical Report

Work Order: **1904212**
Date Reported: **4/18/2019**

Client: G-Logics
Collection Date: 4/10/2019 11:15:00 AM
Project: BFC
Lab ID: 1904212-004
Matrix: Soil
Client Sample ID: **AS-2-15**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.				Batch ID: 24162		Analyst: DW
Diesel (Fuel Oil)	ND	25.8		mg/Kg-dry	1	4/13/2019 10:23:05 AM
Heavy Oil	ND	64.4		mg/Kg-dry	1	4/13/2019 10:23:05 AM
Surr: 2-Fluorobiphenyl	77.9	50 - 150		%Rec	1	4/13/2019 10:23:05 AM
Surr: o-Terphenyl	80.5	50 - 150		%Rec	1	4/13/2019 10:23:05 AM
Gasoline by NWTPH-Gx				Batch ID: 24206		Analyst: KT
Gasoline	12.9	6.64		mg/Kg-dry	1	4/18/2019 8:29:14 AM
Surr: 4-Bromofluorobenzene	94.0	65 - 135		%Rec	1	4/18/2019 8:29:14 AM
Surr: Toluene-d8	97.1	65 - 135		%Rec	1	4/18/2019 8:29:14 AM
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 24206		Analyst: KT
Benzene	0.0440	0.0265		mg/Kg-dry	1	4/18/2019 8:29:14 AM
Toluene	0.186	0.0265		mg/Kg-dry	1	4/18/2019 8:29:14 AM
Ethylbenzene	ND	0.0332		mg/Kg-dry	1	4/18/2019 8:29:14 AM
m,p-Xylene	ND	0.0664		mg/Kg-dry	1	4/18/2019 8:29:14 AM
o-Xylene	ND	0.0332		mg/Kg-dry	1	4/18/2019 8:29:14 AM
Surr: Dibromofluoromethane	99.9	56.5 - 129		%Rec	1	4/18/2019 8:29:14 AM
Surr: Toluene-d8	98.9	64.5 - 151		%Rec	1	4/18/2019 8:29:14 AM
Surr: 1-Bromo-4-fluorobenzene	98.5	54.8 - 168		%Rec	1	4/18/2019 8:29:14 AM
Sample Moisture (Percent Moisture)				Batch ID: R50731		Analyst: CJ
Percent Moisture	30.0	0.500		wt%	1	4/15/2019 11:26:17 AM

Client: G-Logics **Collection Date:** 4/10/2019 11:20:00 AM
Project: BFC
Lab ID: 1904212-005 **Matrix:** Soil
Client Sample ID: AS-2-19

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.				Batch ID: 24162		Analyst: DW
Diesel (Fuel Oil)	ND	22.3		mg/Kg-dry	1	4/13/2019 10:52:46 AM
Heavy Oil	ND	55.7		mg/Kg-dry	1	4/13/2019 10:52:46 AM
Surr: 2-Fluorobiphenyl	95.2	50 - 150		%Rec	1	4/13/2019 10:52:46 AM
Surr: o-Terphenyl	93.9	50 - 150		%Rec	1	4/13/2019 10:52:46 AM
Gasoline by NWTPH-Gx				Batch ID: 24200		Analyst: KT
Gasoline	928	113	D	mg/Kg-dry	20	4/17/2019 12:31:01 PM
Surr: 4-Bromofluorobenzene	99.0	65 - 135	D	%Rec	20	4/17/2019 12:31:01 PM
Surr: Toluene-d8	101	65 - 135	D	%Rec	20	4/17/2019 12:31:01 PM
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 24200		Analyst: KT
Methyl tert-butyl ether (MTBE)	ND	1.13	D	mg/Kg-dry	20	4/17/2019 12:31:01 PM
1,2-Dichloroethane (EDC)	ND	0.450	D	mg/Kg-dry	20	4/17/2019 12:31:01 PM
Benzene	10.2	0.450	D	mg/Kg-dry	20	4/17/2019 12:31:01 PM
Toluene	73.6	1.13	D	mg/Kg-dry	50	4/17/2019 2:58:51 PM
1,2-Dibromoethane (EDB)	ND	0.113	D	mg/Kg-dry	20	4/17/2019 12:31:01 PM
Ethylbenzene	15.1	0.563	D	mg/Kg-dry	20	4/17/2019 12:31:01 PM
m,p-Xylene	60.6	1.13	D	mg/Kg-dry	20	4/17/2019 12:31:01 PM
o-Xylene	22.6	0.563	D	mg/Kg-dry	20	4/17/2019 12:31:01 PM
Hexane	14.6	1.13	D	mg/Kg-dry	20	4/17/2019 12:31:01 PM
Surr: Dibromofluoromethane	89.9	56.5 - 129	D	%Rec	20	4/17/2019 12:31:01 PM
Surr: Toluene-d8	94.3	64.5 - 151	D	%Rec	20	4/17/2019 12:31:01 PM
Surr: 1-Bromo-4-fluorobenzene	102	54.8 - 168	D	%Rec	20	4/17/2019 12:31:01 PM
NOTES: Diluted due to matrix.						
Total Metals by EPA Method 6020				Batch ID: 24183		Analyst: WC
Lead	1.38	0.206		mg/Kg-dry	1	4/17/2019 2:57:46 AM
Sample Moisture (Percent Moisture)				Batch ID: R50748		Analyst: CJ
Percent Moisture	23.6	0.500		wt%	1	4/16/2019 8:17:26 AM

Analytical Report

Work Order: **1904212**
Date Reported: **4/18/2019**

Client: G-Logics
Collection Date: 4/10/2019 11:25:00 AM
Project: BFC
Lab ID: 1904212-006
Matrix: Soil
Client Sample ID: **AS-2-25**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.				Batch ID: 24162		Analyst: DW
Diesel (Fuel Oil)	ND	24.3		mg/Kg-dry	1	4/13/2019 11:22:27 AM
Heavy Oil	ND	60.9		mg/Kg-dry	1	4/13/2019 11:22:27 AM
Surr: 2-Fluorobiphenyl	91.7	50 - 150		%Rec	1	4/13/2019 11:22:27 AM
Surr: o-Terphenyl	93.6	50 - 150		%Rec	1	4/13/2019 11:22:27 AM
Gasoline by NWTPH-Gx				Batch ID: 24206		Analyst: KT
Gasoline	24.1	7.40		mg/Kg-dry	1	4/18/2019 9:29:31 AM
Surr: 4-Bromofluorobenzene	97.0	65 - 135		%Rec	1	4/18/2019 9:29:31 AM
Surr: Toluene-d8	98.9	65 - 135		%Rec	1	4/18/2019 9:29:31 AM
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 24206		Analyst: KT
Benzene	ND	0.0296		mg/Kg-dry	1	4/18/2019 9:29:31 AM
Toluene	0.0625	0.0296		mg/Kg-dry	1	4/18/2019 9:29:31 AM
Ethylbenzene	1.28	0.0370		mg/Kg-dry	1	4/18/2019 9:29:31 AM
m,p-Xylene	0.419	0.0740		mg/Kg-dry	1	4/18/2019 9:29:31 AM
o-Xylene	ND	0.0370		mg/Kg-dry	1	4/18/2019 9:29:31 AM
Surr: Dibromofluoromethane	97.5	56.5 - 129		%Rec	1	4/18/2019 9:29:31 AM
Surr: Toluene-d8	97.4	64.5 - 151		%Rec	1	4/18/2019 9:29:31 AM
Surr: 1-Bromo-4-fluorobenzene	102	54.8 - 168		%Rec	1	4/18/2019 9:29:31 AM
Sample Moisture (Percent Moisture)				Batch ID: R50748		Analyst: CJ
Percent Moisture	23.9	0.500		wt%	1	4/16/2019 8:17:26 AM

Analytical Report

Work Order: **1904212**
Date Reported: **4/18/2019**

Client: G-Logics
Collection Date: 4/10/2019 11:30:00 AM
Project: BFC
Lab ID: 1904212-007
Matrix: Soil
Client Sample ID: **AS-2-30**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.				Batch ID: 24162		Analyst: DW
Diesel (Fuel Oil)	ND	23.2		mg/Kg-dry	1	4/13/2019 11:52:15 AM
Heavy Oil	ND	58.0		mg/Kg-dry	1	4/13/2019 11:52:15 AM
Surr: 2-Fluorobiphenyl	90.9	50 - 150		%Rec	1	4/13/2019 11:52:15 AM
Surr: o-Terphenyl	93.5	50 - 150		%Rec	1	4/13/2019 11:52:15 AM
Gasoline by NWTPH-Gx				Batch ID: 24206		Analyst: KT
Gasoline	ND	5.44		mg/Kg-dry	1	4/18/2019 9:59:41 AM
Surr: 4-Bromofluorobenzene	90.6	65 - 135		%Rec	1	4/18/2019 9:59:41 AM
Surr: Toluene-d8	98.1	65 - 135		%Rec	1	4/18/2019 9:59:41 AM
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 24206		Analyst: KT
Benzene	ND	0.0218		mg/Kg-dry	1	4/18/2019 9:59:41 AM
Toluene	0.0230	0.0218		mg/Kg-dry	1	4/18/2019 9:59:41 AM
Ethylbenzene	ND	0.0272		mg/Kg-dry	1	4/18/2019 9:59:41 AM
m,p-Xylene	ND	0.0544		mg/Kg-dry	1	4/18/2019 9:59:41 AM
o-Xylene	ND	0.0272		mg/Kg-dry	1	4/18/2019 9:59:41 AM
Surr: Dibromofluoromethane	94.2	56.5 - 129		%Rec	1	4/18/2019 9:59:41 AM
Surr: Toluene-d8	97.3	64.5 - 151		%Rec	1	4/18/2019 9:59:41 AM
Surr: 1-Bromo-4-fluorobenzene	96.1	54.8 - 168		%Rec	1	4/18/2019 9:59:41 AM
Sample Moisture (Percent Moisture)				Batch ID: R50748		Analyst: CJ
Percent Moisture	19.6	0.500		wt%	1	4/16/2019 8:17:26 AM

Analytical Report

Work Order: **1904212**
Date Reported: **4/18/2019**

Client: G-Logics
Collection Date: 4/10/2019 2:30:00 PM
Project: BFC
Lab ID: 1904212-009
Matrix: Soil
Client Sample ID: **TW-1-5**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.				Batch ID: 24162		Analyst: DW
Diesel (Fuel Oil)	ND	19.4		mg/Kg-dry	1	4/13/2019 12:21:54 PM
Heavy Oil	113	48.5		mg/Kg-dry	1	4/13/2019 12:21:54 PM
Surr: 2-Fluorobiphenyl	90.3	50 - 150		%Rec	1	4/13/2019 12:21:54 PM
Surr: o-Terphenyl	89.2	50 - 150		%Rec	1	4/13/2019 12:21:54 PM
Gasoline by NWTPH-Gx				Batch ID: 24206		Analyst: KT
Gasoline	ND	4.61		mg/Kg-dry	1	4/18/2019 10:29:49 AM
Surr: 4-Bromofluorobenzene	90.3	65 - 135		%Rec	1	4/18/2019 10:29:49 AM
Surr: Toluene-d8	98.0	65 - 135		%Rec	1	4/18/2019 10:29:49 AM
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 24206		Analyst: KT
Benzene	ND	0.0184		mg/Kg-dry	1	4/18/2019 10:29:49 AM
Toluene	0.0307	0.0184		mg/Kg-dry	1	4/18/2019 10:29:49 AM
Ethylbenzene	ND	0.0231		mg/Kg-dry	1	4/18/2019 10:29:49 AM
m,p-Xylene	ND	0.0461		mg/Kg-dry	1	4/18/2019 10:29:49 AM
o-Xylene	ND	0.0231		mg/Kg-dry	1	4/18/2019 10:29:49 AM
Surr: Dibromofluoromethane	95.3	56.5 - 129		%Rec	1	4/18/2019 10:29:49 AM
Surr: Toluene-d8	97.9	64.5 - 151		%Rec	1	4/18/2019 10:29:49 AM
Surr: 1-Bromo-4-fluorobenzene	95.4	54.8 - 168		%Rec	1	4/18/2019 10:29:49 AM
Sample Moisture (Percent Moisture)				Batch ID: R50748		Analyst: CJ
Percent Moisture	8.12	0.500		wt%	1	4/16/2019 8:17:26 AM

Client: G-Logics **Collection Date:** 4/10/2019 3:15:00 PM
Project: BFC
Lab ID: 1904212-010 **Matrix:** Soil
Client Sample ID: SVE-1-5

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.				Batch ID: 24162		Analyst: DW
Diesel (Fuel Oil)	ND	19.6		mg/Kg-dry	1	4/13/2019 12:51:40 PM
Heavy Oil	106	49.0		mg/Kg-dry	1	4/13/2019 12:51:40 PM
Surr: 2-Fluorobiphenyl	92.7	50 - 150		%Rec	1	4/13/2019 12:51:40 PM
Surr: o-Terphenyl	93.3	50 - 150		%Rec	1	4/13/2019 12:51:40 PM
Gasoline by NWTPH-Gx				Batch ID: 24206		Analyst: KT
Gasoline	ND	5.44		mg/Kg-dry	1	4/18/2019 10:59:57 AM
Surr: 4-Bromofluorobenzene	88.8	65 - 135		%Rec	1	4/18/2019 10:59:57 AM
Surr: Toluene-d8	97.6	65 - 135		%Rec	1	4/18/2019 10:59:57 AM
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 24206		Analyst: KT
Benzene	ND	0.0218		mg/Kg-dry	1	4/18/2019 10:59:57 AM
Toluene	ND	0.0218		mg/Kg-dry	1	4/18/2019 10:59:57 AM
Ethylbenzene	ND	0.0272		mg/Kg-dry	1	4/18/2019 10:59:57 AM
m,p-Xylene	ND	0.0544		mg/Kg-dry	1	4/18/2019 10:59:57 AM
o-Xylene	ND	0.0272		mg/Kg-dry	1	4/18/2019 10:59:57 AM
Surr: Dibromofluoromethane	94.5	56.5 - 129		%Rec	1	4/18/2019 10:59:57 AM
Surr: Toluene-d8	100	64.5 - 151		%Rec	1	4/18/2019 10:59:57 AM
Surr: 1-Bromo-4-fluorobenzene	93.9	54.8 - 168		%Rec	1	4/18/2019 10:59:57 AM
Sample Moisture (Percent Moisture)				Batch ID: R50748		Analyst: CJ
Percent Moisture	8.28	0.500		wt%	1	4/16/2019 8:17:26 AM

Client: G-Logics
Collection Date: 4/10/2019 4:15:00 PM
Project: BFC
Lab ID: 1904212-011
Matrix: Soil
Client Sample ID: **SVE-1-9**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.				Batch ID: 24162		Analyst: DW
Diesel (Fuel Oil)	ND	21.7		mg/Kg-dry	1	4/13/2019 2:20:50 PM
Heavy Oil	ND	54.2		mg/Kg-dry	1	4/13/2019 2:20:50 PM
Surr: 2-Fluorobiphenyl	117	50 - 150		%Rec	1	4/13/2019 2:20:50 PM
Surr: o-Terphenyl	116	50 - 150		%Rec	1	4/13/2019 2:20:50 PM
Gasoline by NWTPH-Gx				Batch ID: 24200		Analyst: KT
Gasoline	3,560	572	D	mg/Kg-dry	100	4/17/2019 3:59:06 PM
Surr: 4-Bromofluorobenzene	103	65 - 135	D	%Rec	100	4/17/2019 3:59:06 PM
Surr: Toluene-d8	95.9	65 - 135	D	%Rec	100	4/17/2019 3:59:06 PM
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 24200		Analyst: KT
Methyl tert-butyl ether (MTBE)	ND	1.14	D	mg/Kg-dry	20	4/17/2019 2:00:03 PM
1,2-Dichloroethane (EDC)	ND	0.458	D	mg/Kg-dry	20	4/17/2019 2:00:03 PM
Benzene	ND	0.458	D	mg/Kg-dry	20	4/17/2019 2:00:03 PM
Toluene	16.8	0.458	D	mg/Kg-dry	20	4/17/2019 2:00:03 PM
1,2-Dibromoethane (EDB)	ND	0.114	D	mg/Kg-dry	20	4/17/2019 2:00:03 PM
Ethylbenzene	62.2	2.86	D	mg/Kg-dry	100	4/17/2019 3:59:06 PM
m,p-Xylene	286	5.72	D	mg/Kg-dry	100	4/17/2019 3:59:06 PM
o-Xylene	121	2.86	D	mg/Kg-dry	100	4/17/2019 3:59:06 PM
Hexane	ND	1.14	D	mg/Kg-dry	20	4/17/2019 2:00:03 PM
Surr: Dibromofluoromethane	95.3	56.5 - 129	D	%Rec	20	4/17/2019 2:00:03 PM
Surr: Toluene-d8	104	64.5 - 151	D	%Rec	20	4/17/2019 2:00:03 PM
Surr: 1-Bromo-4-fluorobenzene	103	54.8 - 168	D	%Rec	20	4/17/2019 2:00:03 PM
Total Metals by EPA Method 6020				Batch ID: 24183		Analyst: WC
Lead	4.51	0.184		mg/Kg-dry	1	4/17/2019 3:03:17 AM
Sample Moisture (Percent Moisture)				Batch ID: R50748		Analyst: CJ
Percent Moisture	16.4	0.500		wt%	1	4/16/2019 8:17:26 AM

NOTES:
Diluted due to matrix.

Analytical Report

Work Order: **1904212**
Date Reported: **4/18/2019**

Client: G-Logics
Collection Date: 4/11/2019 9:00:00 AM
Project: BFC
Lab ID: 1904212-012
Matrix: Soil
Client Sample ID: **TW-2-5**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.				Batch ID: 24162		Analyst: DW
Diesel (Fuel Oil)	ND	19.6		mg/Kg-dry	1	4/13/2019 2:50:36 PM
Heavy Oil	ND	49.0		mg/Kg-dry	1	4/13/2019 2:50:36 PM
Surr: 2-Fluorobiphenyl	98.0	50 - 150		%Rec	1	4/13/2019 2:50:36 PM
Surr: o-Terphenyl	98.6	50 - 150		%Rec	1	4/13/2019 2:50:36 PM
Gasoline by NWTPH-Gx				Batch ID: 24206		Analyst: KT
Gasoline	ND	5.56		mg/Kg-dry	1	4/18/2019 2:58:59 AM
Surr: 4-Bromofluorobenzene	89.1	65 - 135		%Rec	1	4/18/2019 2:58:59 AM
Surr: Toluene-d8	97.5	65 - 135		%Rec	1	4/18/2019 2:58:59 AM
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 24206		Analyst: KT
Benzene	ND	0.0222		mg/Kg-dry	1	4/18/2019 2:58:59 AM
Toluene	ND	0.0222		mg/Kg-dry	1	4/18/2019 2:58:59 AM
Ethylbenzene	ND	0.0278		mg/Kg-dry	1	4/18/2019 2:58:59 AM
m,p-Xylene	ND	0.0556		mg/Kg-dry	1	4/18/2019 2:58:59 AM
o-Xylene	ND	0.0278		mg/Kg-dry	1	4/18/2019 2:58:59 AM
Surr: Dibromofluoromethane	95.9	56.5 - 129		%Rec	1	4/18/2019 2:58:59 AM
Surr: Toluene-d8	98.7	64.5 - 151		%Rec	1	4/18/2019 2:58:59 AM
Surr: 1-Bromo-4-fluorobenzene	94.3	54.8 - 168		%Rec	1	4/18/2019 2:58:59 AM
Sample Moisture (Percent Moisture)				Batch ID: R50748		Analyst: CJ
Percent Moisture	5.69	0.500		wt%	1	4/16/2019 8:17:26 AM

Analytical Report

Work Order: **1904212**
Date Reported: **4/18/2019**

Client: G-Logics
Project: BFC
Lab ID: 1904212-013
Client Sample ID: **TW-3-5**

Collection Date: 4/11/2019 9:30:00 AM
Matrix: Soil

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.				Batch ID: 24162		Analyst: DW
Diesel (Fuel Oil)	ND	18.6		mg/Kg-dry	1	4/13/2019 3:20:18 PM
Heavy Oil	ND	46.5		mg/Kg-dry	1	4/13/2019 3:20:18 PM
Surr: 2-Fluorobiphenyl	92.1	50 - 150		%Rec	1	4/13/2019 3:20:18 PM
Surr: o-Terphenyl	92.8	50 - 150		%Rec	1	4/13/2019 3:20:18 PM
Gasoline by NWTPH-Gx				Batch ID: 24206		Analyst: KT
Gasoline	9.09	5.37		mg/Kg-dry	1	4/18/2019 11:30:05 AM
Surr: 4-Bromofluorobenzene	96.1	65 - 135		%Rec	1	4/18/2019 11:30:05 AM
Surr: Toluene-d8	98.6	65 - 135		%Rec	1	4/18/2019 11:30:05 AM
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 24206		Analyst: KT
Benzene	0.0938	0.0215		mg/Kg-dry	1	4/18/2019 11:30:05 AM
Toluene	0.241	0.0215		mg/Kg-dry	1	4/18/2019 11:30:05 AM
Ethylbenzene	0.299	0.0269		mg/Kg-dry	1	4/18/2019 11:30:05 AM
m,p-Xylene	0.848	0.0537		mg/Kg-dry	1	4/18/2019 11:30:05 AM
o-Xylene	0.244	0.0269		mg/Kg-dry	1	4/18/2019 11:30:05 AM
Surr: Dibromofluoromethane	97.4	56.5 - 129		%Rec	1	4/18/2019 11:30:05 AM
Surr: Toluene-d8	102	64.5 - 151		%Rec	1	4/18/2019 11:30:05 AM
Surr: 1-Bromo-4-fluorobenzene	101	54.8 - 168		%Rec	1	4/18/2019 11:30:05 AM
Sample Moisture (Percent Moisture)				Batch ID: R50748		Analyst: CJ
Percent Moisture	8.82	0.500		wt%	1	4/16/2019 8:17:26 AM

Analytical Report

Work Order: **1904212**
Date Reported: **4/18/2019**

Client: G-Logics
Project: BFC
Lab ID: 1904212-014
Client Sample ID: **TW-1-9**

Collection Date: 4/11/2019 10:00:00 AM
Matrix: Soil

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.				Batch ID: 24162		Analyst: DW
Diesel (Fuel Oil)	ND	18.6		mg/Kg-dry	1	4/13/2019 3:50:01 PM
Heavy Oil	ND	46.5		mg/Kg-dry	1	4/13/2019 3:50:01 PM
Surr: 2-Fluorobiphenyl	108	50 - 150		%Rec	1	4/13/2019 3:50:01 PM
Surr: o-Terphenyl	110	50 - 150		%Rec	1	4/13/2019 3:50:01 PM
Gasoline by NWTPH-Gx				Batch ID: 24206		Analyst: KT
Gasoline	ND	5.48		mg/Kg-dry	1	4/18/2019 12:00:13 PM
Surr: 4-Bromofluorobenzene	89.5	65 - 135		%Rec	1	4/18/2019 12:00:13 PM
Surr: Toluene-d8	97.6	65 - 135		%Rec	1	4/18/2019 12:00:13 PM
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 24206		Analyst: KT
Benzene	ND	0.0219		mg/Kg-dry	1	4/18/2019 12:00:13 PM
Toluene	ND	0.0219		mg/Kg-dry	1	4/18/2019 12:00:13 PM
Ethylbenzene	ND	0.0274		mg/Kg-dry	1	4/18/2019 12:00:13 PM
m,p-Xylene	ND	0.0548		mg/Kg-dry	1	4/18/2019 12:00:13 PM
o-Xylene	ND	0.0274		mg/Kg-dry	1	4/18/2019 12:00:13 PM
Surr: Dibromofluoromethane	93.7	56.5 - 129		%Rec	1	4/18/2019 12:00:13 PM
Surr: Toluene-d8	96.8	64.5 - 151		%Rec	1	4/18/2019 12:00:13 PM
Surr: 1-Bromo-4-fluorobenzene	94.6	54.8 - 168		%Rec	1	4/18/2019 12:00:13 PM
Sample Moisture (Percent Moisture)				Batch ID: R50748		Analyst: CJ
Percent Moisture	6.69	0.500		wt%	1	4/16/2019 8:17:26 AM

Client: G-Logics **Collection Date:** 4/11/2019 10:30:00 AM
Project: BFC
Lab ID: 1904212-015 **Matrix:** Soil
Client Sample ID: TW-3-9

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.				Batch ID: 24162		Analyst: DW
Diesel (Fuel Oil)	ND	19.7		mg/Kg-dry	1	4/13/2019 4:19:45 PM
Heavy Oil	ND	49.2		mg/Kg-dry	1	4/13/2019 4:19:45 PM
Surr: 2-Fluorobiphenyl	91.2	50 - 150		%Rec	1	4/13/2019 4:19:45 PM
Surr: o-Terphenyl	90.6	50 - 150		%Rec	1	4/13/2019 4:19:45 PM
Gasoline by NWTPH-Gx				Batch ID: 24200		Analyst: KT
Gasoline	153	90.9	D	mg/Kg-dry	20	4/17/2019 3:28:59 PM
Surr: 4-Bromofluorobenzene	97.5	65 - 135	D	%Rec	20	4/17/2019 3:28:59 PM
Surr: Toluene-d8	97.0	65 - 135	D	%Rec	20	4/17/2019 3:28:59 PM
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 24200		Analyst: KT
Methyl tert-butyl ether (MTBE)	ND	0.0455		mg/Kg-dry	1	4/17/2019 11:30:42 AM
1,2-Dichloroethane (EDC)	ND	0.0182		mg/Kg-dry	1	4/17/2019 11:30:42 AM
Benzene	5.35	0.364	D	mg/Kg-dry	20	4/17/2019 3:28:59 PM
Toluene	0.867	0.0182		mg/Kg-dry	1	4/17/2019 11:30:42 AM
1,2-Dibromoethane (EDB)	ND	0.00455		mg/Kg-dry	1	4/17/2019 11:30:42 AM
Ethylbenzene	7.43	0.455	D	mg/Kg-dry	20	4/17/2019 3:28:59 PM
m,p-Xylene	13.4	0.909	D	mg/Kg-dry	20	4/17/2019 3:28:59 PM
o-Xylene	4.12	0.455	D	mg/Kg-dry	20	4/17/2019 3:28:59 PM
Hexane	2.52	0.909	D	mg/Kg-dry	20	4/17/2019 3:28:59 PM
Surr: Dibromofluoromethane	92.5	56.5 - 129		%Rec	1	4/17/2019 11:30:42 AM
Surr: Toluene-d8	94.3	64.5 - 151		%Rec	1	4/17/2019 11:30:42 AM
Surr: 1-Bromo-4-fluorobenzene	101	54.8 - 168		%Rec	1	4/17/2019 11:30:42 AM
Total Metals by EPA Method 6020				Batch ID: 24183		Analyst: WC
Lead	11.3	0.167		mg/Kg-dry	1	4/17/2019 3:08:49 AM
Sample Moisture (Percent Moisture)				Batch ID: R50748		Analyst: CJ
Percent Moisture	10.6	0.500		wt%	1	4/16/2019 8:17:26 AM

Client: G-Logics **Collection Date:** 4/11/2019 11:00:00 AM
Project: BFC
Lab ID: 1904212-016 **Matrix:** Soil
Client Sample ID: DUP

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.				Batch ID: 24162		Analyst: DW
Diesel (Fuel Oil)	ND	20.8		mg/Kg-dry	1	4/13/2019 4:49:30 PM
Heavy Oil	ND	52.0		mg/Kg-dry	1	4/13/2019 4:49:30 PM
Surr: 2-Fluorobiphenyl	102	50 - 150		%Rec	1	4/13/2019 4:49:30 PM
Surr: o-Terphenyl	102	50 - 150		%Rec	1	4/13/2019 4:49:30 PM
Gasoline by NWTPH-Gx				Batch ID: 24200		Analyst: KT
Gasoline	29.4	5.58		mg/Kg-dry	1	4/17/2019 4:29:11 PM
Surr: 4-Bromofluorobenzene	100	65 - 135		%Rec	1	4/17/2019 4:29:11 PM
Surr: Toluene-d8	98.8	65 - 135		%Rec	1	4/17/2019 4:29:11 PM
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 24200		Analyst: KT
Methyl tert-butyl ether (MTBE)	ND	0.0558		mg/Kg-dry	1	4/17/2019 4:29:11 PM
1,2-Dichloroethane (EDC)	ND	0.0223		mg/Kg-dry	1	4/17/2019 4:29:11 PM
Benzene	0.798	0.0223		mg/Kg-dry	1	4/17/2019 4:29:11 PM
Toluene	1.67	0.0223		mg/Kg-dry	1	4/17/2019 4:29:11 PM
1,2-Dibromoethane (EDB)	ND	0.00558		mg/Kg-dry	1	4/17/2019 4:29:11 PM
Ethylbenzene	0.864	0.0279		mg/Kg-dry	1	4/17/2019 4:29:11 PM
m,p-Xylene	1.54	0.0558		mg/Kg-dry	1	4/17/2019 4:29:11 PM
o-Xylene	1.29	0.0279		mg/Kg-dry	1	4/17/2019 4:29:11 PM
Hexane	0.536	0.0558		mg/Kg-dry	1	4/17/2019 4:29:11 PM
Surr: Dibromofluoromethane	96.3	56.5 - 129		%Rec	1	4/17/2019 4:29:11 PM
Surr: Toluene-d8	98.5	64.5 - 151		%Rec	1	4/17/2019 4:29:11 PM
Surr: 1-Bromo-4-fluorobenzene	105	54.8 - 168		%Rec	1	4/17/2019 4:29:11 PM
Total Metals by EPA Method 6020				Batch ID: 24183		Analyst: WC
Lead	6.89	0.164		mg/Kg-dry	1	4/17/2019 3:14:20 AM
Sample Moisture (Percent Moisture)				Batch ID: R50748		Analyst: CJ
Percent Moisture	10.5	0.500		wt%	1	4/16/2019 8:17:26 AM

Work Order: 1904212
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Total Metals by EPA Method 6020

Sample ID: **MB-24183**	SampType: **MBLK**			Units: **mg/Kg**		Prep Date: **4/16/2019**		RunNo: **50792**		
Client ID: **MBLKS**	Batch ID: **24183**					Analysis Date: **4/17/2019**		SeqNo: **998179**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	ND	0.155									

Sample ID: **LCS-24183**	SampType: **LCS**			Units: **mg/Kg**		Prep Date: **4/16/2019**		RunNo: **50792**		
Client ID: **LCSS**	Batch ID: **24183**					Analysis Date: **4/17/2019**		SeqNo: **998182**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	17.3	0.153	19.08	0	90.8	80	120				

Sample ID: **1904200-001ADUP**	SampType: **DUP**			Units: **mg/Kg-dry**		Prep Date: **4/16/2019**		RunNo: **50792**		
Client ID: **BATCH**	Batch ID: **24183**					Analysis Date: **4/17/2019**		SeqNo: **998184**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	9.04	0.189						8.887	1.67	20	

Sample ID: **1904200-001AMS**	SampType: **MS**			Units: **mg/Kg-dry**		Prep Date: **4/16/2019**		RunNo: **50792**		
Client ID: **BATCH**	Batch ID: **24183**					Analysis Date: **4/17/2019**		SeqNo: **998186**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	28.2	0.190	23.74	8.887	81.4	75	125				

Sample ID: **1904200-001AMSD**	SampType: **MSD**			Units: **mg/Kg-dry**		Prep Date: **4/16/2019**		RunNo: **50792**		
Client ID: **BATCH**	Batch ID: **24183**					Analysis Date: **4/17/2019**		SeqNo: **998187**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	30.1	0.193	24.08	8.887	88.0	75	125	28.22	6.41	20	

Work Order: 1904212
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.

Sample ID: **MB-24162**	SampType: **MBLK**	Units: **mg/Kg**	Prep Date: **4/12/2019**	RunNo: **50735**
Client ID: **MBLKS**	Batch ID: **24162**		Analysis Date: **4/13/2019**	SeqNo: **996679**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel (Fuel Oil)	ND	20.0									
Heavy Oil	ND	50.0									
Surr: 2-Fluorobiphenyl	18.7		20.00		93.6	50	150				
Surr: o-Terphenyl	18.8		20.00		94.0	50	150				

Sample ID: **LCS-24162**	SampType: **LCS**	Units: **mg/Kg**	Prep Date: **4/12/2019**	RunNo: **50735**
Client ID: **LCSS**	Batch ID: **24162**		Analysis Date: **4/13/2019**	SeqNo: **996680**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel (Fuel Oil)	579	20.0	500.0	0	116	65	135				
Surr: 2-Fluorobiphenyl	19.8		20.00		99.0	50	150				
Surr: o-Terphenyl	19.0		20.00		94.9	50	150				

Sample ID: **1904171-001ADUP**	SampType: **DUP**	Units: **mg/Kg-dry**	Prep Date: **4/12/2019**	RunNo: **50735**
Client ID: **BATCH**	Batch ID: **24162**		Analysis Date: **4/13/2019**	SeqNo: **996682**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel (Fuel Oil)	902	23.5						866.8	4.03	30	
Heavy Oil	ND	58.8						0		30	
Surr: 2-Fluorobiphenyl	23.8		23.50		101	50	150		0		
Surr: o-Terphenyl	23.7		23.50		101	50	150		0		

Sample ID: **1904171-001AMS**	SampType: **MS**	Units: **mg/Kg-dry**	Prep Date: **4/12/2019**	RunNo: **50735**
Client ID: **BATCH**	Batch ID: **24162**		Analysis Date: **4/13/2019**	SeqNo: **996683**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel (Fuel Oil)	1,230	21.9	548.7	866.8	66.2	65	135				
Surr: 2-Fluorobiphenyl	21.8		21.95		99.5	50	150				
Surr: o-Terphenyl	20.8		21.95		94.6	50	150				

Work Order: 1904212
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.

Sample ID: **1904171-001AMS** SampType: **MS** Units: **mg/Kg-dry** Prep Date: **4/12/2019** RunNo: **50735**
Client ID: **BATCH** Batch ID: **24162** Analysis Date: **4/13/2019** SeqNo: **996683**

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

Sample ID: **1904171-001AMSD** SampType: **MSD** Units: **mg/Kg-dry** Prep Date: **4/12/2019** RunNo: **50735**
Client ID: **BATCH** Batch ID: **24162** Analysis Date: **4/13/2019** SeqNo: **996684**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel (Fuel Oil)	1,560	23.6	590.9	866.8	117	65	135	1,230	23.7	30	
Surr: 2-Fluorobiphenyl	23.0		23.64		97.2	50	150		0		
Surr: o-Terphenyl	23.1		23.64		97.8	50	150		0		

Sample ID: **1904212-001ADUP** SampType: **DUP** Units: **mg/Kg-dry** Prep Date: **4/12/2019** RunNo: **50735**
Client ID: **AS-2-5** Batch ID: **24162** Analysis Date: **4/13/2019** SeqNo: **996692**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel (Fuel Oil)	ND	21.6						0		30	
Heavy Oil	ND	53.9						0		30	
Surr: 2-Fluorobiphenyl	20.9		21.57		96.8	50	150		0		
Surr: o-Terphenyl	21.1		21.57		98.0	50	150		0		

Work Order: 1904212
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID: **LCS-24200** SampType: **LCS** Units: **mg/Kg** Prep Date: **4/17/2019** RunNo: **50804**
Client ID: **LCSS** Batch ID: **24200** Analysis Date: **4/17/2019** SeqNo: **998463**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	27.5	5.00	25.00	0	110	65	135				
Surr: Toluene-d8	1.26		1.250		101	65	135				
Surr: 4-Bromofluorobenzene	1.26		1.250		101	65	135				

Sample ID: **MB-24200** SampType: **MBLK** Units: **mg/Kg** Prep Date: **4/17/2019** RunNo: **50804**
Client ID: **MBLKS** Batch ID: **24200** Analysis Date: **4/17/2019** SeqNo: **998465**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00									
Surr: Toluene-d8	1.20		1.250		95.8	65	135				
Surr: 4-Bromofluorobenzene	1.12		1.250		89.4	65	135				

Sample ID: **1904212-005BDUP** SampType: **DUP** Units: **mg/Kg-dry** Prep Date: **4/17/2019** RunNo: **50804**
Client ID: **AS-2-19** Batch ID: **24200** Analysis Date: **4/17/2019** SeqNo: **998454**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	901	113						928.4	2.95	30	D
Surr: Toluene-d8	28.0		28.15		99.3	65	135		0		D
Surr: 4-Bromofluorobenzene	28.7		28.15		102	65	135		0		D

Sample ID: **LCSD-24200** SampType: **LCSD** Units: **mg/Kg** Prep Date: **4/17/2019** RunNo: **50804**
Client ID: **LCSS02** Batch ID: **24200** Analysis Date: **4/17/2019** SeqNo: **998464**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	27.3	5.00	25.00	0	109	65	135	27.51	0.679	20	
Surr: Toluene-d8	1.25		1.250		100	65	135		0		
Surr: 4-Bromofluorobenzene	1.26		1.250		101	65	135		0		

Work Order: 1904212
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID: **LCS-24206** SampType: **LCS** Units: **mg/Kg** Prep Date: **4/17/2019** RunNo: **50807**
Client ID: **LCSS** Batch ID: **24206** Analysis Date: **4/17/2019** SeqNo: **998506**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	27.6	5.00	25.00	0	110	65	135				
Surr: Toluene-d8	1.25		1.250		100	65	135				
Surr: 4-Bromofluorobenzene	1.27		1.250		102	65	135				

Sample ID: **MB-24206** SampType: **MBLK** Units: **mg/Kg** Prep Date: **4/17/2019** RunNo: **50807**
Client ID: **MBLKS** Batch ID: **24206** Analysis Date: **4/17/2019** SeqNo: **998507**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00									
Surr: Toluene-d8	1.23		1.250		98.4	65	135				
Surr: 4-Bromofluorobenzene	1.11		1.250		88.7	65	135				

Sample ID: **1904278-005BDUP** SampType: **DUP** Units: **mg/Kg-dry** Prep Date: **4/17/2019** RunNo: **50807**
Client ID: **BATCH** Batch ID: **24206** Analysis Date: **4/17/2019** SeqNo: **998498**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	3.60						0		30	
Surr: Toluene-d8	0.863		0.9001		95.8	65	135		0		
Surr: 4-Bromofluorobenzene	0.797		0.9001		88.6	65	135		0		

Sample ID: **1904212-012BMS** SampType: **MS** Units: **mg/Kg-dry** Prep Date: **4/17/2019** RunNo: **50807**
Client ID: **TW-2-5** Batch ID: **24206** Analysis Date: **4/18/2019** SeqNo: **998490**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	32.2	5.56	27.81	0	116	65	135				
Surr: Toluene-d8	1.39		1.390		100	65	135				
Surr: 4-Bromofluorobenzene	1.39		1.390		99.9	65	135				

Work Order: 1904212
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID: **1904212-012BMSD**	SampType: **MSD**			Units: **mg/Kg-dry**		Prep Date: **4/17/2019**			RunNo: **50807**		
Client ID: **TW-2-5**	Batch ID: **24206**					Analysis Date: **4/18/2019**			SeqNo: **998491**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	30.8	5.56	27.81	0	111	65	135	32.17	4.34	30	
Surr: Toluene-d8	1.39		1.390		99.9	65	135		0		
Surr: 4-Bromofluorobenzene	1.39		1.390		99.9	65	135		0		

Sample ID: **1904212-004BDUP**	SampType: **DUP**			Units: **mg/Kg-dry**		Prep Date: **4/17/2019**			RunNo: **50807**		
Client ID: **AS-2-15**	Batch ID: **24206**					Analysis Date: **4/18/2019**			SeqNo: **998805**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	12.8	6.64						12.91	0.632	30	
Surr: Toluene-d8	1.61		1.659		97.1	65	135		0		
Surr: 4-Bromofluorobenzene	1.56		1.659		94.2	65	135		0		

Work Order: 1904212
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID: **LCS-24200** SampType: **LCS** Units: **mg/Kg** Prep Date: **4/17/2019** RunNo: **50803**
Client ID: **LCSS** Batch ID: **24200** Analysis Date: **4/17/2019** SeqNo: **998448**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Methyl tert-butyl ether (MTBE)	1.15	0.0500	1.000	0	115	44.1	152				
1,2-Dichloroethane (EDC)	1.09	0.0200	1.000	0	109	50.9	162				
Benzene	1.08	0.0200	1.000	0	108	64.3	133				
Toluene	1.10	0.0200	1.000	0	110	67	144				
1,2-Dibromoethane (EDB)	1.12	0.00500	1.000	0	112	50.5	154				
Ethylbenzene	1.17	0.0250	1.000	0	117	74	129				
m,p-Xylene	2.32	0.0500	2.000	0	116	70	124				
o-Xylene	1.14	0.0250	1.000	0	114	68.1	139				
Hexane	1.16	0.0500	1.000	0	116	48.5	159				
Surr: Dibromofluoromethane	1.26		1.250		101	56.5	129				
Surr: Toluene-d8	1.23		1.250		98.4	64.5	151				
Surr: 1-Bromo-4-fluorobenzene	1.33		1.250		106	54.8	168				

Sample ID: **MB-24200** SampType: **MBLK** Units: **mg/Kg** Prep Date: **4/17/2019** RunNo: **50803**
Client ID: **MBLKS** Batch ID: **24200** Analysis Date: **4/17/2019** SeqNo: **998450**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Methyl tert-butyl ether (MTBE)	ND	0.0500									
1,2-Dichloroethane (EDC)	ND	0.0200									
Benzene	ND	0.0200									
Toluene	ND	0.0200									
1,2-Dibromoethane (EDB)	ND	0.00500									
Ethylbenzene	ND	0.0250									
m,p-Xylene	ND	0.0500									
o-Xylene	ND	0.0250									
Hexane	ND	0.0500									
Surr: Dibromofluoromethane	1.15		1.250		92.4	56.5	129				
Surr: Toluene-d8	1.19		1.250		95.4	64.5	151				
Surr: 1-Bromo-4-fluorobenzene	1.18		1.250		94.6	54.8	168				

Work Order: 1904212
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID: **1904212-005BDUP** SampType: **DUP** Units: **mg/Kg-dry** Prep Date: **4/17/2019** RunNo: **50803**
Client ID: **AS-2-19** Batch ID: **24200** Analysis Date: **4/17/2019** SeqNo: **998439**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Methyl tert-butyl ether (MTBE)	ND	1.13						0		30	D
1,2-Dichloroethane (EDC)	ND	0.450						0		30	D
Benzene	10.6	0.450						10.18	4.44	30	D
Toluene	74.9	0.450						69.46	7.56	30	DE
1,2-Dibromoethane (EDB)	ND	0.113						0		30	D
Ethylbenzene	15.9	0.563						15.14	5.13	30	D
m,p-Xylene	64.6	1.13						60.64	6.37	30	D
o-Xylene	24.4	0.563						22.62	7.52	30	D
Hexane	14.8	1.13						14.60	1.50	30	D
Surr: Dibromofluoromethane	25.5		28.15		90.6	56.5	129		0		D
Surr: Toluene-d8	27.0		28.15		95.8	64.5	151		0		D
Surr: 1-Bromo-4-fluorobenzene	29.5		28.15		105	54.8	168		0		D

NOTES:
E - Estimated value. The amount exceeds the linear working range of the instrument.
Diluted due to matrix.

Sample ID: **LCSD-24200** SampType: **LCSD** Units: **mg/Kg** Prep Date: **4/17/2019** RunNo: **50803**
Client ID: **LCSS02** Batch ID: **24200** Analysis Date: **4/17/2019** SeqNo: **998449**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Methyl tert-butyl ether (MTBE)	1.02	0.0500	1.000	0	102	44.1	152	1.147	12.0	20	
1,2-Dichloroethane (EDC)	1.09	0.0200	1.000	0	109	50.9	162	1.088	0.609	20	
Benzene	1.09	0.0200	1.000	0	109	74.6	124	1.081	1.16	20	
Toluene	1.13	0.0200	1.000	0	113	67	144	1.101	2.39	20	
1,2-Dibromoethane (EDB)	1.05	0.00500	1.000	0	105	50.5	154	1.119	6.42	20	
Ethylbenzene	1.20	0.0250	1.000	0	120	74	129	1.168	2.86	20	
m,p-Xylene	2.41	0.0500	2.000	0	121	70	124	2.321	3.91	20	
o-Xylene	1.19	0.0250	1.000	0	119	68.1	139	1.141	4.29	20	
Hexane	1.17	0.0500	1.000	0	117	48.5	159	1.162	0.800	20	
Surr: Dibromofluoromethane	1.33		1.250		106	56.5	129		0		
Surr: Toluene-d8	1.26		1.250		101	64.5	151		0		

Work Order: 1904212
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID: **LCSD-24200**	SampType: **LCSD**			Units: **mg/Kg**		Prep Date: **4/17/2019**		RunNo: **50803**		
Client ID: **LCSS02**	Batch ID: **24200**					Analysis Date: **4/17/2019**		SeqNo: **998449**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Surr: 1-Bromo-4-fluorobenzene	1.30		1.250		104	54.8	168		0		

Sample ID: **LCS-24206**	SampType: **LCS**			Units: **mg/Kg**		Prep Date: **4/17/2019**		RunNo: **50806**		
Client ID: **LCSS**	Batch ID: **24206**					Analysis Date: **4/17/2019**		SeqNo: **998486**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	1.11	0.0200	1.000	0	111	64.3	133				
Toluene	1.13	0.0200	1.000	0	113	67	144				
Ethylbenzene	1.15	0.0250	1.000	0	115	74	129				
m,p-Xylene	2.30	0.0500	2.000	0	115	70	124				
o-Xylene	1.14	0.0250	1.000	0	114	68.1	139				
Surr: Dibromofluoromethane	1.27		1.250		102	56.5	129				
Surr: Toluene-d8	1.26		1.250		101	64.5	151				
Surr: 1-Bromo-4-fluorobenzene	1.32		1.250		106	54.8	168				

Sample ID: **MB-24206**	SampType: **MBLK**			Units: **mg/Kg**		Prep Date: **4/17/2019**		RunNo: **50806**		
Client ID: **MBLKS**	Batch ID: **24206**					Analysis Date: **4/17/2019**		SeqNo: **998487**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.0200									
Toluene	ND	0.0200									
Ethylbenzene	ND	0.0250									
m,p-Xylene	ND	0.0500									
o-Xylene	ND	0.0250									
Surr: Dibromofluoromethane	1.16		1.250		93.0	56.5	129				
Surr: Toluene-d8	1.19		1.250		95.3	64.5	151				
Surr: 1-Bromo-4-fluorobenzene	1.17		1.250		93.8	54.8	168				

Work Order: 1904212
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID: **1904278-005BDUP** SampType: **DUP** Units: **mg/Kg-dry** Prep Date: **4/17/2019** RunNo: **50806**
Client ID: **BATCH** Batch ID: **24206** Analysis Date: **4/17/2019** SeqNo: **998476**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.0144						0		30	
Toluene	ND	0.0144						0		30	
Ethylbenzene	ND	0.0180						0		30	
m,p-Xylene	ND	0.0360						0		30	
o-Xylene	ND	0.0180						0		30	
Surr: Dibromofluoromethane	0.853		0.9001		94.7	56.5	129		0		
Surr: Toluene-d8	0.880		0.9001		97.7	64.5	151		0		
Surr: 1-Bromo-4-fluorobenzene	0.845		0.9001		93.9	54.8	168		0		

Sample ID: **1904278-009BMS** SampType: **MS** Units: **mg/Kg-dry** Prep Date: **4/17/2019** RunNo: **50806**
Client ID: **BATCH** Batch ID: **24206** Analysis Date: **4/18/2019** SeqNo: **998481**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	0.683	0.0129	0.6427	0	106	63.5	133				
Toluene	0.710	0.0129	0.6427	0	111	63.4	132				
Ethylbenzene	0.745	0.0161	0.6427	0	116	54.5	134				
m,p-Xylene	1.49	0.0321	1.285	0	116	53.1	132				
o-Xylene	0.732	0.0161	0.6427	0	114	53.3	139				
Surr: Dibromofluoromethane	0.852		0.8034		106	56.5	129				
Surr: Toluene-d8	0.801		0.8034		99.7	64.5	151				
Surr: 1-Bromo-4-fluorobenzene	0.834		0.8034		104	54.8	168				

Sample ID: **1904278-009BMSD** SampType: **MSD** Units: **mg/Kg-dry** Prep Date: **4/17/2019** RunNo: **50806**
Client ID: **BATCH** Batch ID: **24206** Analysis Date: **4/18/2019** SeqNo: **998482**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	0.700	0.0129	0.6427	0	109	63.5	133	0.6835	2.33	30	
Toluene	0.716	0.0129	0.6427	0	111	63.4	132	0.7102	0.798	30	
Ethylbenzene	0.730	0.0161	0.6427	0	114	54.5	134	0.7454	2.15	30	
m,p-Xylene	1.46	0.0321	1.285	0	114	53.1	132	1.487	1.60	30	

Work Order: 1904212
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID: **1904278-009BMSD** SampType: **MSD** Units: **mg/Kg-dry** Prep Date: **4/17/2019** RunNo: **50806**
Client ID: **BATCH** Batch ID: **24206** Analysis Date: **4/18/2019** SeqNo: **998482**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
o-Xylene	0.722	0.0161	0.6427	0	112	53.3	139	0.7318	1.37	30	
Surr: Dibromofluoromethane	0.860		0.8034		107	56.5	129		0		
Surr: Toluene-d8	0.813		0.8034		101	64.5	151		0		
Surr: 1-Bromo-4-fluorobenzene	0.837		0.8034		104	54.8	168		0		

Sample ID: **1904212-004BDUP** SampType: **DUP** Units: **mg/Kg-dry** Prep Date: **4/17/2019** RunNo: **50806**
Client ID: **AS-2-15** Batch ID: **24206** Analysis Date: **4/18/2019** SeqNo: **998766**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	0.0448	0.0265						0.04402	1.81	30	
Toluene	0.182	0.0265						0.1865	2.54	30	
Ethylbenzene	ND	0.0332						0		30	
m,p-Xylene	ND	0.0664						0		30	
o-Xylene	ND	0.0332						0		30	
Surr: Dibromofluoromethane	1.63		1.659		98.4	56.5	129		0		
Surr: Toluene-d8	1.62		1.659		97.8	64.5	151		0		
Surr: 1-Bromo-4-fluorobenzene	1.64		1.659		98.7	54.8	168		0		

Work Order: 1904212
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Sample Moisture (Percent Moisture)

Sample ID: **1904200-003ADUP**	SampType: **DUP**			Units: **wt%**		Prep Date: **4/15/2019**		RunNo: **50731**		
Client ID: **BATCH**	Batch ID: **R50731**					Analysis Date: **4/15/2019**		SeqNo: **996638**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Percent Moisture	28.5	0.500						30.98	8.51	20	

Sample ID: **1904205-007ADUP**	SampType: **DUP**			Units: **wt%**		Prep Date: **4/15/2019**		RunNo: **50731**		
Client ID: **BATCH**	Batch ID: **R50731**					Analysis Date: **4/15/2019**		SeqNo: **996648**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Percent Moisture	21.0	0.500						22.87	8.45	20	

Sample ID: **1904212-007ADUP**	SampType: **DUP**			Units: **wt%**		Prep Date: **4/16/2019**		RunNo: **50748**		
Client ID: **AS-2-30**	Batch ID: **R50748**					Analysis Date: **4/16/2019**		SeqNo: **996995**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Percent Moisture	19.7	0.500						19.60	0.637	20	

Sample ID: **1904232-004ADUP**	SampType: **DUP**			Units: **wt%**		Prep Date: **4/16/2019**		RunNo: **50748**		
Client ID: **BATCH**	Batch ID: **R50748**					Analysis Date: **4/16/2019**		SeqNo: **997010**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Percent Moisture	37.5	0.500						37.50	0.130	20	

Sample Log-In Check List

Client Name:	**GL**	Work Order Number:	**1904212**
Logged by:	**Clare Griggs**	Date Received:	**4/11/2019 12:00:00 PM**

Chain of Custody

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

Log In

3.	Coolers are present?	Yes	☑	No ☐	NA	☐
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:	Zak Wall	Date:	4/12/2019
By Whom:	Brianna Barnes	Via:	☐ eMail ☐ Phone ☐ Fax ☑ In Person
Regarding:	EDB in soil method confirmation.		
Client Instructions:			

19. Additional remarks:

Item Information

Item #	Temp ºC
Cooler	5.6
Sample	5.1

* 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

Chain of Custody Record & Laboratory Services Agreement

Date: 4/11/19 Page: 1 of: 2

Project Name: BFC

Project No: 01-0410-6

Collected by: ZW/JS

Location:

Report To (PM): Zak Wall

PM Email: Zackary W@g-logics.com

Laboratory Project No (internal): 1904212

Special Remarks:

Sample Disposal: ☐ Return to client ☐ Disposal by lab (after 30 days)

Client: G-Logics

Address:

City, State, Zip:

Telephone:

Fax:

	Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	VOCs (EPA 8260 / 624)	GX/BTEX	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T) | Dissolved (D)	Anions (IC)***	EDB (8011)	MTBE + EDC	n-Hexane			Comments
1	AS-2-5	4/10	920	S		X				X												$
2	AS-1-5		1000																			Hold
3	AS-2-10		1110			X				X												
4	AS-2-15		1115			X				X												
5	AS-2-19		1120			X				X			X			X		X	X			
6	AS-2-25		1125			X				X												
7	AS-2-30		1130			X				X												
8	AS-2-35		1135																			Hold
9	TW-1-5		1430			X				X												
10	SVE-1-5	↓	1515	↓		X				X												

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual:* Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl U V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

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]	4-11/1200	x [signature]	4/11/19 1400
Relinquished	Date/Time	Received	Date/Time
x		x	

Turn-around Time:

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

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

Chain of Custody Record & Laboratory Services Agreement

Date: 4/11/19 Page: 2 of: 2

Project Name: BFC

Project No: 01-0410-0

Collected by: ZW

Location:

Report To (PM): Zak Wall

PM Email: zackaryw@g-logics.com

Laboratory Project No (internal): 1904212

Special Remarks:

Sample Disposal: ☐ Return to client ☐ Disposal by lab (after 30 days)

Client: G-Logics

Address:

City, State, Zip:

Telephone:

Fax:

	Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	VOCs (EPA 8260 / 624)	GX/BTEX	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T) / Dissolved (D)	Anions (IC)***	EDB (8011)	MTBE + EDC + n-Hexane			Comments
1	SVE-1-9	4/10	1615	S		X				X				X			X	X				
2	TW-2-5	4/11	900			X				X												
3	TW-3-5	4/11	930			X				X												
4	TW-1-9	4/11	1000			X				X												
5	TW-3-9	4/11	1030			X				X				X			X	X				
6	DUP	4/11	1100			X				X				X			X	X				
7																						
8																						
9																						
10																						

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual:* Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl U V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

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Relinquished	Date/Time	Received	Date/Time
x [signature]	4-11 / 1200	x [signature]	4/11/19 1200
Relinquished	Date/Time	Received	Date/Time
x		x	

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

G-Logics
Zackary Wall
40 Second Ave. SE
Issaquah, WA 98027

RE: BFC
Work Order Number: 1904294

April 24, 2019

Attention Zackary Wall:

Fremont Analytical, Inc. received 3 sample(s) on 4/17/2019 for the analyses presented in the following report.

1,2-Dibromoethane (EDB) by EPA Method 8011
Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.
Dissolved Metals by EPA Method 200.8
Gasoline by NWTPH-Gx
Total Metals by EPA Method 200.8
Volatile Organic Compounds by EPA Method 8260C

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: *04/24/2019*

CLIENT: G-Logics
Project: BFC
Work Order: 1904294

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1904294-001	AS-2	04/17/2019 1:15 PM	04/17/2019 3:43 PM
1904294-002	AS-1	04/17/2019 2:15 PM	04/17/2019 3:43 PM
1904294-003	DUP	04/17/2019 12:00 AM	04/17/2019 3:43 PM

Case Narrative

WO#: **1904294**
Date: **4/24/2019**

CLIENT: G-Logics
Project: BFC

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

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

Matrix Spike (MS) and MS Duplicate (MSD) samples are tested from an analytical batch of "like" matrix to check for possible matrix effect. The MS and MSD will provide site specific matrix data only for those samples which are spiked by the laboratory. The sample chosen for spike purposes may or may not have been a sample submitted in this sample delivery group. 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 and the MS/MSD 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.

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

Analytical Report

Work Order: **1904294**
Date Reported: **4/24/2019**

Client: G-Logics
Project: BFC
Lab ID: 1904294-001
Client Sample ID: **AS-2**

Collection Date: 4/17/2019 1:15:00 PM
Matrix: Groundwater

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
1,2-Dibromoethane (EDB) by EPA Method 8011				Batch ID: 24271		Analyst: DW
1,2-Dibromoethane (EDB)	ND	0.00994		µg/L	1	4/23/2019 3:41:15 PM
Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.				Batch ID: 24224		Analyst: SB
Diesel (Fuel Oil)	ND	50.0		µg/L	1	4/19/2019 3:17:25 PM
Heavy Oil	ND	100		µg/L	1	4/19/2019 3:17:25 PM
Surr: 2-Fluorobiphenyl	111	50 - 150		%Rec	1	4/19/2019 3:17:25 PM
Surr: o-Terphenyl	111	50 - 150		%Rec	1	4/19/2019 3:17:25 PM
Gasoline by NWTPH-Gx				Batch ID: 24250		Analyst: KT
Gasoline	1,560	50.0		µg/L	1	4/22/2019 9:52:17 PM
Surr: Toluene-d8	95.9	65 - 135		%Rec	1	4/22/2019 9:52:17 PM
Surr: 4-Bromofluorobenzene	103	65 - 135		%Rec	1	4/22/2019 9:52:17 PM
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 24250		Analyst: KT
Methyl tert-butyl ether (MTBE)	ND	1.00		µg/L	1	4/22/2019 9:52:17 PM
1,2-Dichloroethane (EDC)	ND	1.00		µg/L	1	4/22/2019 9:52:17 PM
Benzene	20.8	1.00		µg/L	1	4/22/2019 9:52:17 PM
Toluene	78.4	10.0	D	µg/L	10	4/23/2019 8:08:00 AM
Ethylbenzene	22.4	1.00		µg/L	1	4/22/2019 9:52:17 PM
m,p-Xylene	89.4	10.0	D	µg/L	10	4/23/2019 8:08:00 AM
o-Xylene	39.0	1.00		µg/L	1	4/22/2019 9:52:17 PM
Surr: Dibromofluoromethane	96.2	45.4 - 152		%Rec	1	4/22/2019 9:52:17 PM
Surr: Toluene-d8	97.8	40.1 - 139		%Rec	1	4/22/2019 9:52:17 PM
Surr: 1-Bromo-4-fluorobenzene	101	64.2 - 128		%Rec	1	4/22/2019 9:52:17 PM
Dissolved Metals by EPA Method 200.8				Batch ID: 24260		Analyst: WC
Lead	ND	0.500		µg/L	1	4/23/2019 3:18:28 PM
Total Metals by EPA Method 200.8				Batch ID: 24227		Analyst: WC
Lead	0.804	0.500		µg/L	1	4/19/2019 12:28:03 PM

Analytical Report

Work Order: **1904294**
Date Reported: **4/24/2019**

Client: G-Logics
Project: BFC
Lab ID: 1904294-002
Client Sample ID: **AS-1**

Collection Date: 4/17/2019 2:15:00 PM
Matrix: Groundwater

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
1,2-Dibromoethane (EDB) by EPA Method 8011				Batch ID: 24271		Analyst: DW
1,2-Dibromoethane (EDB)	ND	0.0100		µg/L	1	4/23/2019 3:57:27 PM
Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.				Batch ID: 24224		Analyst: SB
Diesel (Fuel Oil)	ND	50.3		µg/L	1	4/19/2019 4:17:18 PM
Diesel Range Organics (C12-C24)	270	50.3		µg/L	1	4/19/2019 4:17:18 PM
Heavy Oil	ND	101		µg/L	1	4/19/2019 4:17:18 PM
Surr: 2-Fluorobiphenyl	98.7	50 - 150		%Rec	1	4/19/2019 4:17:18 PM
Surr: o-Terphenyl	73.5	50 - 150		%Rec	1	4/19/2019 4:17:18 PM
NOTES:						
DRO - Indicates the presence of unresolved compounds eluting from dodecane through tetracosane (~C12-C24).						
Gasoline by NWTPH-Gx				Batch ID: 24250		Analyst: KT
Gasoline	4,150	1,000	D	µg/L	20	4/23/2019 8:38:52 AM
Surr: Toluene-d8	96.3	65 - 135	D	%Rec	20	4/23/2019 8:38:52 AM
Surr: 4-Bromofluorobenzene	98.5	65 - 135	D	%Rec	20	4/23/2019 8:38:52 AM
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 24250		Analyst: KT
Methyl tert-butyl ether (MTBE)	ND	1.00		µg/L	1	4/23/2019 4:32:00 AM
1,2-Dichloroethane (EDC)	ND	1.00		µg/L	1	4/23/2019 4:32:00 AM
Benzene	702	20.0	D	µg/L	20	4/23/2019 8:38:52 AM
Toluene	224	20.0	D	µg/L	20	4/23/2019 8:38:52 AM
Ethylbenzene	138	20.0	D	µg/L	20	4/23/2019 8:38:52 AM
m,p-Xylene	112	20.0	D	µg/L	20	4/23/2019 8:38:52 AM
o-Xylene	29.9	1.00		µg/L	1	4/23/2019 4:32:00 AM
Surr: Dibromofluoromethane	96.5	45.4 - 152		%Rec	1	4/23/2019 4:32:00 AM
Surr: Toluene-d8	99.3	40.1 - 139		%Rec	1	4/23/2019 4:32:00 AM
Surr: 1-Bromo-4-fluorobenzene	100	64.2 - 128		%Rec	1	4/23/2019 4:32:00 AM

Analytical Report

Work Order: **1904294**
Date Reported: **4/24/2019**

Client: G-Logics
Project: BFC
Lab ID: 1904294-003
Client Sample ID: **DUP**

Collection Date: 4/17/2019
Matrix: Groundwater

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
1,2-Dibromoethane (EDB) by EPA Method 8011				Batch ID: 24271		Analyst: DW
1,2-Dibromoethane (EDB)	ND	0.00989		µg/L	1	4/23/2019 4:05:32 PM
Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.				Batch ID: 24224		Analyst: SB
Diesel (Fuel Oil)	ND	50.0		µg/L	1	4/19/2019 4:47:15 PM
Heavy Oil	ND	99.9		µg/L	1	4/19/2019 4:47:15 PM
Surr: 2-Fluorobiphenyl	97.4	50 - 150		%Rec	1	4/19/2019 4:47:15 PM
Surr: o-Terphenyl	105	50 - 150		%Rec	1	4/19/2019 4:47:15 PM
Gasoline by NWTPH-Gx				Batch ID: 24250		Analyst: KT
Gasoline	1,500	50.0		µg/L	1	4/22/2019 10:23:02 PM
Surr: Toluene-d8	96.4	65 - 135		%Rec	1	4/22/2019 10:23:02 PM
Surr: 4-Bromofluorobenzene	103	65 - 135		%Rec	1	4/22/2019 10:23:02 PM
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 24250		Analyst: KT
Methyl tert-butyl ether (MTBE)	ND	1.00		µg/L	1	4/22/2019 10:23:02 PM
1,2-Dichloroethane (EDC)	ND	1.00		µg/L	1	4/22/2019 10:23:02 PM
Benzene	19.6	1.00		µg/L	1	4/22/2019 10:23:02 PM
Toluene	85.3	10.0	D	µg/L	10	4/23/2019 9:09:37 AM
Ethylbenzene	22.3	1.00		µg/L	1	4/22/2019 10:23:02 PM
m,p-Xylene	93.4	10.0	D	µg/L	10	4/23/2019 9:09:37 AM
o-Xylene	37.3	1.00		µg/L	1	4/22/2019 10:23:02 PM
Surr: Dibromofluoromethane	96.2	45.4 - 152		%Rec	1	4/22/2019 10:23:02 PM
Surr: Toluene-d8	97.6	40.1 - 139		%Rec	1	4/22/2019 10:23:02 PM
Surr: 1-Bromo-4-fluorobenzene	102	64.2 - 128		%Rec	1	4/22/2019 10:23:02 PM
Dissolved Metals by EPA Method 200.8				Batch ID: 24260		Analyst: WC
Lead	ND	0.500		µg/L	1	4/23/2019 3:51:40 PM
Total Metals by EPA Method 200.8				Batch ID: 24227		Analyst: WC
Lead	ND	0.500		µg/L	1	4/19/2019 12:33:36 PM

Work Order: 1904294
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Dissolved Metals by EPA Method 200.8

Sample ID	MB-24260	SampType:	MBLK			Units:	µg/L		Prep Date:	4/23/2019		RunNo:	50928	
Client ID:	MBLKW	Batch ID:	24260						Analysis Date:	4/23/2019		SeqNo:	1000810	
Analyte		Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual		
Lead		ND	0.500											

Sample ID	LCS-24260	SampType:	LCS			Units:	µg/L		Prep Date:	4/23/2019		RunNo:	50928	
Client ID:	LCSW	Batch ID:	24260						Analysis Date:	4/23/2019		SeqNo:	1000811	
Analyte		Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual		
Lead		42.9	0.500	50.00	0	85.8	85	115						

Sample ID	1904294-001EDUP	SampType:	DUP			Units:	µg/L		Prep Date:	4/23/2019		RunNo:	50928	
Client ID:	AS-2	Batch ID:	24260						Analysis Date:	4/23/2019		SeqNo:	1000813	
Analyte		Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual		
Lead		ND	0.500						0		30			

Sample ID	1904294-001EMS	SampType:	MS			Units:	µg/L		Prep Date:	4/23/2019		RunNo:	50928	
Client ID:	AS-2	Batch ID:	24260						Analysis Date:	4/23/2019		SeqNo:	1000814	
Analyte		Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual		
Lead		229	0.500	250.0	0	91.5	70	130						

Sample ID	1904294-001EMSD	SampType:	MSD			Units:	µg/L		Prep Date:	4/23/2019		RunNo:	50928	
Client ID:	AS-2	Batch ID:	24260						Analysis Date:	4/23/2019		SeqNo:	1000817	
Analyte		Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual		
Lead		243	0.500	250.0	0	97.2	70	130	228.9	6.01	30			

Work Order: 1904294
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Dissolved Metals by EPA Method 200.8

Sample ID **MB-24245FB**	SampType: **MBLK**		Units: **µg/L**	Prep Date: **4/23/2019**		RunNo: **50928**			
Client ID: **MBLKW**	Batch ID: **24260**			Analysis Date: **4/23/2019**		SeqNo: **1000819**			
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	ND	0.500									

NOTES:
Filter Blank

Work Order: 1904294
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Total Metals by EPA Method 200.8

Sample ID	MB-24227	SampType:	MBLK			Units:	µg/L	Prep Date:	4/19/2019	RunNo:	50864	
Client ID:	MBLKW	Batch ID:	24227					Analysis Date:	4/19/2019	SeqNo:	999567	
Analyte		Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead		ND	0.500									

Sample ID	LCS-24227	SampType:	LCS			Units:	µg/L	Prep Date:	4/19/2019	RunNo:	50864	
Client ID:	LCSW	Batch ID:	24227					Analysis Date:	4/19/2019	SeqNo:	999568	
Analyte		Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead		45.7	0.500	50.00	0	91.4	85	115				

Sample ID	1904313-001EDUP	SampType:	DUP			Units:	µg/L	Prep Date:	4/19/2019	RunNo:	50864	
Client ID:	BATCH	Batch ID:	24227					Analysis Date:	4/19/2019	SeqNo:	999570	
Analyte		Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead		ND	0.500						0		30	

Sample ID	1904313-001EMS	SampType:	MS			Units:	µg/L	Prep Date:	4/19/2019	RunNo:	50864	
Client ID:	BATCH	Batch ID:	24227					Analysis Date:	4/19/2019	SeqNo:	999571	
Analyte		Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead		217	0.500	250.0	0.2015	86.5	70	130				

Sample ID	1904313-001EMSD	SampType:	MSD			Units:	µg/L	Prep Date:	4/19/2019	RunNo:	50864	
Client ID:	BATCH	Batch ID:	24227					Analysis Date:	4/19/2019	SeqNo:	999572	
Analyte		Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead		229	0.500	250.0	0.2015	91.6	70	130	216.5	5.66	30	

Work Order: 1904294
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

1,2-Dibromoethane (EDB) by EPA Method 8011

Sample ID	**MB-24271**	SampType:	**MBLK**			Units:	**µg/L**	Prep Date:	**4/23/2019**		RunNo:	**50926**	
Client ID:	**MBLKW**	Batch ID:	**24271**					Analysis Date:	**4/23/2019**		SeqNo:	**1000751**	
Analyte		Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	
1,2-Dibromoethane (EDB)		ND	0.00987										

Sample ID	**LCS-24271**	SampType:	**LCS**			Units:	**µg/L**	Prep Date:	**4/23/2019**		RunNo:	**50926**	
Client ID:	**LCSW**	Batch ID:	**24271**					Analysis Date:	**4/23/2019**		SeqNo:	**1000752**	
Analyte		Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	
1,2-Dibromoethane (EDB)		0.292	0.0101	0.2528	0	116	60	140					

Sample ID	**LCSD-24271**	SampType:	**LCSD**			Units:	**µg/L**	Prep Date:	**4/23/2019**		RunNo:	**50926**	
Client ID:	**LCSW02**	Batch ID:	**24271**					Analysis Date:	**4/23/2019**		SeqNo:	**1000753**	
Analyte		Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	
1,2-Dibromoethane (EDB)		0.276	0.0100	0.2505	0	110	60	140	0.2921	5.84	20		

Sample ID	**1904294-001BDUP**	SampType:	**DUP**			Units:	**µg/L**	Prep Date:	**4/23/2019**		RunNo:	**50926**	
Client ID:	**AS-2**	Batch ID:	**24271**					Analysis Date:	**4/23/2019**		SeqNo:	**1000755**	
Analyte		Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual	
1,2-Dibromoethane (EDB)		ND	0.00992						0		30		

Work Order: 1904294
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.

Sample ID **MB-24224**	SampType: **MBLK**	Units: **µg/L**	Prep Date: **4/18/2019**	RunNo: **50861**
Client ID: **MBLKW**	Batch ID: **24224**		Analysis Date: **4/19/2019**	SeqNo: **999760**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel (Fuel Oil)	ND	50.3									
Heavy Oil	ND	101									
Surr: 2-Fluorobiphenyl	77.5		80.42		96.4	50	150				
Surr: o-Terphenyl	86.6		80.42		108	50	150				

Sample ID **LCS-24224**	SampType: **LCS**	Units: **µg/L**	Prep Date: **4/18/2019**	RunNo: **50861**
Client ID: **LCSW**	Batch ID: **24224**		Analysis Date: **4/19/2019**	SeqNo: **999761**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel (Fuel Oil)	725	50.1	1,002	0	72.4	65	135				
Surr: 2-Fluorobiphenyl	88.6		80.12		111	50	150				
Surr: o-Terphenyl	85.0		80.12		106	50	150				

Sample ID **1904294-001CDUP**	SampType: **DUP**	Units: **µg/L**	Prep Date: **4/18/2019**	RunNo: **50861**
Client ID: **AS-2**	Batch ID: **24224**		Analysis Date: **4/19/2019**	SeqNo: **999877**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel (Fuel Oil)	ND	52.2						0		30	
Heavy Oil	ND	104						0		30	
Surr: 2-Fluorobiphenyl	90.3		83.52		108	50	150		0		
Surr: o-Terphenyl	93.6		83.52		112	50	150		0		

Sample ID **1904302-001BDUP**	SampType: **DUP**	Units: **µg/L**	Prep Date: **4/18/2019**	RunNo: **50861**
Client ID: **BATCH**	Batch ID: **24224**		Analysis Date: **4/19/2019**	SeqNo: **999890**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel (Fuel Oil)	ND	62.3						0		30	
Heavy Oil	ND	125						0		30	
Surr: 2-Fluorobiphenyl	109		99.72		109	50	150		0		

Work Order: 1904294
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Diesel and Heavy Oil by NWTPH-Dx/Dx Ext.

Sample ID **1904302-001BDUP**	SampType: **DUP**			Units: **µg/L**		Prep Date: **4/18/2019**		RunNo: **50861**		
Client ID: **BATCH**	Batch ID: **24224**					Analysis Date: **4/19/2019**		SeqNo: **999890**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Surr: o-Terphenyl	119		99.72		119	50	150		0		

Sample ID **1904294-001CMS**	SampType: **MS**			Units: **µg/L**		Prep Date: **4/18/2019**		RunNo: **50861**		
Client ID: **AS-2**	Batch ID: **24224**					Analysis Date: **4/20/2019**		SeqNo: **999897**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel (Fuel Oil)	631	49.5	989.0	24.18	61.4	65	135				S
Surr: 2-Fluorobiphenyl	84.1		79.12		106	50	150				
Surr: o-Terphenyl	76.9		79.12		97.2	50	150				

NOTES:
S - Outlying spike recovery(ies) observed. A duplicate analysis was performed and recovered within range.

Sample ID **1904294-001CMSD**	SampType: **MSD**			Units: **µg/L**		Prep Date: **4/18/2019**		RunNo: **50861**		
Client ID: **AS-2**	Batch ID: **24224**					Analysis Date: **4/20/2019**		SeqNo: **999898**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel (Fuel Oil)	713	51.3	1,026	24.18	67.1	65	135	631.5	12.1	30	
Surr: 2-Fluorobiphenyl	85.1		82.11		104	50	150		0		
Surr: o-Terphenyl	82.4		82.11		100	50	150		0		

Work Order: 1904294
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID **LCS-24250**	SampType: **LCS**	Units: **µg/L**	Prep Date: **4/22/2019**	RunNo: **50905**
Client ID: **LCSW**	Batch ID: **24250**		Analysis Date: **4/22/2019**	SeqNo: **1000280**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	513	50.0	500.0	0	103	65	135				
Surr: Toluene-d8	25.1		25.00		100	65	135				
Surr: 4-Bromofluorobenzene	25.3		25.00		101	65	135				

Sample ID **LCSD-24250**	SampType: **LCSD**	Units: **µg/L**	Prep Date: **4/22/2019**	RunNo: **50905**
Client ID: **LCSW02**	Batch ID: **24250**		Analysis Date: **4/22/2019**	SeqNo: **1000281**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	515	50.0	500.0	0	103	65	135	513.4	0.297	20	
Surr: Toluene-d8	24.0		25.00		96.1	65	135		0		
Surr: 4-Bromofluorobenzene	25.0		25.00		100	65	135		0		

Sample ID **MB-24250**	SampType: **MBLK**	Units: **µg/L**	Prep Date: **4/22/2019**	RunNo: **50905**
Client ID: **MBLKW**	Batch ID: **24250**		Analysis Date: **4/22/2019**	SeqNo: **1000282**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	50.0									
Surr: Toluene-d8	24.1		25.00		96.5	65	135				
Surr: 4-Bromofluorobenzene	23.0		25.00		92.0	65	135				

Sample ID **1904323-001ADUP**	SampType: **DUP**	Units: **µg/L**	Prep Date: **4/22/2019**	RunNo: **50905**
Client ID: **BATCH**	Batch ID: **24250**		Analysis Date: **4/22/2019**	SeqNo: **1000275**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	50.0						0		30	
Gasoline Range Organics (C6-C12)	245	50.0						262.3	6.98	30	
Surr: Toluene-d8	24.1		25.00		96.5	65	135		0		
Surr: 4-Bromofluorobenzene	26.6		25.00		107	65	135		0		

Work Order: 1904294
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID **1904323-001ADUP**	SampType: **DUP**			Units: **µg/L**		Prep Date: **4/22/2019**		RunNo: **50905**			
Client ID: **BATCH**	Batch ID: **24250**					Analysis Date: **4/22/2019**		SeqNo: **1000275**			
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

NOTES:
GRO - Indicates the presence of unresolved compounds eluting from hexane to dodecane (~C6-C12).

Sample ID **1904306-001ADUP**	SampType: **DUP**			Units: **µg/L**		Prep Date: **4/22/2019**		RunNo: **50905**			
Client ID: **BATCH**	Batch ID: **24250**					Analysis Date: **4/23/2019**		SeqNo: **1000272**			
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	50.0						0		30	
Gasoline Range Organics (C6-C12)	116	50.0						108.1	7.20	30	
Surr: Toluene-d8	25.6		25.00		102	65	135		0		
Surr: 4-Bromofluorobenzene	25.0		25.00		100	65	135		0		

NOTES:
GRO - Indicates the presence of unresolved compounds eluting from hexane to dodecane (~C6-C12).

Work Order: 1904294
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **LCS-24250** SampType: **LCS** Units: **µg/L** Prep Date: **4/22/2019** RunNo: **50901**
Client ID: **LCSW** Batch ID: **24250** Analysis Date: **4/22/2019** SeqNo: **1000206**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Methyl tert-butyl ether (MTBE)	19.7	1.00	20.00	0	98.7	58	138				
1,2-Dichloroethane (EDC)	19.9	1.00	20.00	0	99.4	67	126				
Benzene	20.1	1.00	20.00	0	101	69.3	132				
Toluene	20.4	1.00	20.00	0	102	61.3	145				
Ethylbenzene	20.3	1.00	20.00	0	102	72	130				
m,p-Xylene	41.0	1.00	40.00	0	103	70.3	134				
o-Xylene	20.6	1.00	20.00	0	103	72.1	131				
Surr: Dibromofluoromethane	24.8		25.00		99.0	45.4	152				
Surr: Toluene-d8	24.8		25.00		99.3	40.1	139				
Surr: 1-Bromo-4-fluorobenzene	25.4		25.00		102	64.2	128				

Sample ID **LCSD-24250** SampType: **LCSD** Units: **µg/L** Prep Date: **4/22/2019** RunNo: **50901**
Client ID: **LCSW02** Batch ID: **24250** Analysis Date: **4/22/2019** SeqNo: **1000207**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Methyl tert-butyl ether (MTBE)	19.0	1.00	20.00	0	94.9	58	138	19.74	3.99	20	
1,2-Dichloroethane (EDC)	18.8	1.00	20.00	0	93.9	68.8	123	19.87	5.60	20	
Benzene	18.7	1.00	20.00	0	93.6	69.3	132	20.10	7.09	20	
Toluene	18.9	1.00	20.00	0	94.7	61.3	145	20.43	7.63	20	
Ethylbenzene	19.1	1.00	20.00	0	95.4	72	130	20.33	6.39	20	
m,p-Xylene	38.3	1.00	40.00	0	95.7	70.3	134	41.01	6.92	20	
o-Xylene	18.6	1.00	20.00	0	92.8	72.1	131	20.62	10.5	20	
Surr: Dibromofluoromethane	24.8		25.00		99.3	45.4	152		0		
Surr: Toluene-d8	24.8		25.00		99.0	40.1	139		0		
Surr: 1-Bromo-4-fluorobenzene	25.1		25.00		100	64.2	128		0		

Work Order: 1904294
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **MB-24250** SampType: **MBLK** Units: **µg/L** Prep Date: **4/22/2019** RunNo: **50901**
Client ID: **MBLKW** Batch ID: **24250** Analysis Date: **4/22/2019** SeqNo: **1000208**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Methyl tert-butyl ether (MTBE)	ND	1.00									
1,2-Dichloroethane (EDC)	ND	1.00									
Benzene	ND	1.00									
Toluene	ND	1.00									
Ethylbenzene	ND	1.00									
m,p-Xylene	ND	1.00									
o-Xylene	ND	1.00									
Surr: Dibromofluoromethane	25.0		25.00		99.8	45.4	152				
Surr: Toluene-d8	24.9		25.00		99.6	40.1	139				
Surr: 1-Bromo-4-fluorobenzene	22.7		25.00		90.6	64.2	128				

Sample ID **1904323-001ADUP** SampType: **DUP** Units: **µg/L** Prep Date: **4/22/2019** RunNo: **50901**
Client ID: **BATCH** Batch ID: **24250** Analysis Date: **4/22/2019** SeqNo: **1000196**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Methyl tert-butyl ether (MTBE)	ND	1.00						0		30	
1,2-Dichloroethane (EDC)	ND	1.00						0		30	
Benzene	16.2	1.00						16.11	0.529	30	
Toluene	ND	1.00						0		30	
Ethylbenzene	ND	1.00						0		30	
m,p-Xylene	ND	1.00						0		30	
o-Xylene	ND	1.00						0		30	
Surr: Dibromofluoromethane	25.2		25.00		101	45.4	152		0		
Surr: Toluene-d8	24.0		25.00		95.9	40.1	139		0		
Surr: 1-Bromo-4-fluorobenzene	26.2		25.00		105	64.2	128		0		

Work Order: 1904294
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **1904306-001ADUP** SampType: **DUP** Units: **µg/L** Prep Date: **4/22/2019** RunNo: **50901**
Client ID: **BATCH** Batch ID: **24250** Analysis Date: **4/23/2019** SeqNo: **1000188**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Methyl tert-butyl ether (MTBE)	ND	1.00						0		30	
1,2-Dichloroethane (EDC)	ND	1.00						0		30	
Benzene	ND	1.00						0		30	
Toluene	1.43	1.00						1.369	4.14	30	
Ethylbenzene	ND	1.00						0		30	
m,p-Xylene	ND	1.00						0		30	
o-Xylene	ND	1.00						0		30	
Surr: Dibromofluoromethane	24.5		25.00		98.1	45.4	152		0		
Surr: Toluene-d8	24.5		25.00		98.0	40.1	139		0		
Surr: 1-Bromo-4-fluorobenzene	24.6		25.00		98.5	64.2	128		0		

Sample Log-In Check List

Client Name:	**GL**	Work Order Number:	**1904294**
Logged by:	**Brianna Barnes**	Date Received:	**4/17/2019 3:43:00 PM**

Chain of Custody

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

Log In

3.	Coolers are present?	Yes ☑	No ☐	NA ☐
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 ☐ HNO3 added to fraction E.	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

Item #	Temp ºC
Cooler	6.5
Sample	8.6

* 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

Chain of Custody Record & Laboratory Services Agreement

Date: 4/17/19 Page: 1 of: 1

Laboratory Project No (internal): 1904294

Project Name: BFC

Special Remarks:

Client: G-Logics

Project No: 01-0410-0

Address:

Collected by: ZW

City, State, Zip:

Location:

Telephone:

Report To (PM): Zackary Wall

Sample Disposal: ☐ Return to client ☐ Disposal by lab (after 30 days)

Fax:

PM Email: ZackaryW@G-Logics.com

	Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	VOCs (EPA 8260 / 624)	GX/BTEX	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T) / Dissolved (D)	Anions (IC)***	EDB (8011)	GX + MTBE			Comments
1	AS-2	4/17	1315	GW		X				X				X	X		X	X			
2	AS-1	4/17	1415	GW		X				X				X			X	X			
3	DUP	4/17	—	GW		X				X				X	X		X	X			
4																					
5																					
6																					
7																					
8																					
9																					
10																					

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual:* Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl U V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

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]	4-17 / 15:43	x [signature]	4/17/19 1543
Relinquished	Date/Time	Received	Date/Time
x		x	

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

G-Logics
Zackary Wall
40 Second Ave. SE
Issaquah, WA 98027

RE: BFC
Work Order Number: 1905068

May 10, 2019

Attention Zackary Wall:

Fremont Analytical, Inc. received 14 sample(s) on 5/3/2019 for the analyses presented in the following report.

Petroleum Fractionation by EPA Method TO-15
Sulfur Compounds by EPA Method TO-15
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: *05/10/2019*

CLIENT: G-Logics
Project: BFC
Work Order: 1905068

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1905068-001	VS-1	05/01/2019 9:50 AM	05/03/2019 4:31 PM
1905068-002	VS-2	05/01/2019 10:35 AM	05/03/2019 4:31 PM
1905068-003	VS-3	05/01/2019 11:30 AM	05/03/2019 4:31 PM
1905068-004	VS-4	05/01/2019 12:20 PM	05/03/2019 4:31 PM
1905068-005	VS-5	05/01/2019 1:45 PM	05/03/2019 4:31 PM
1905068-006	VS-6	05/02/2019 12:15 PM	05/03/2019 4:31 PM
1905068-007	VS-7	05/02/2019 1:45 PM	05/03/2019 4:31 PM
1905068-008	VS-8	05/02/2019 2:15 PM	05/03/2019 4:31 PM
1905068-009	VS-9	05/03/2019 11:30 AM	05/03/2019 4:31 PM
1905068-010	VS-10	05/03/2019 12:20 PM	05/03/2019 4:31 PM
1905068-011	VS-11	05/03/2019 12:55 PM	05/03/2019 4:31 PM
1905068-012	VS-12	05/03/2019 1:26 PM	05/03/2019 4:31 PM
1905068-013	VS-13	05/03/2019 2:05 PM	05/03/2019 4:31 PM
1905068-014	VS-14	05/03/2019 2:35 PM	05/03/2019 4:31 PM

Case Narrative

WO#: **1905068**
Date: **5/10/2019**

CLIENT: G-Logics
Project: BFC

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).

Note: Gasoline Range Organics reported in ug/m3 should be considered an estimate. The estimated molecular weight of gasoline used in the equation = 100

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: G-Logics
WorkOrder: 1905068
Project: BFC

Client Sample ID: VS-1
Lab ID: 1905068-001A
Sample Type: Tedlar Bag

Date Sampled: 5/1/2019
Date Received: 5/3/2019

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Volatile Organic Compounds by EPA Method TO-15								
	(ppbv)	(ug/m³)	(ppbv)	(ug/m³)				
Benzene	2.90	9.26	0.895	2.86	H	EPA-TO-15	05/06/2019	AD
Ethylbenzene	14.2	61.6	4.00	17.4	H	EPA-TO-15	05/06/2019	AD
Gasoline Range Organics	791	3,230	10.0	40.9	H	EPA-TO-15	05/06/2019	AD
m,p-Xylene	46.3	201	8.00	34.7	H	EPA-TO-15	05/06/2019	AD
o-Xylene	14.7	63.9	4.00	17.4	H	EPA-TO-15	05/06/2019	AD
Toluene	36.7	138	4.00	15.1	H	EPA-TO-15	05/06/2019	AD
Surr: 4-Bromofluorobenzene	97.2 %Rec	--	70-130	--	H	EPA-TO-15	05/06/2019	AD

Client: G-Logics
WorkOrder: 1905068
Project: BFC

Client Sample ID: VS-2
Lab ID: 1905068-002A
Sample Type: Tedlar Bag

Date Sampled: 5/1/2019
Date Received: 5/3/2019

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	
Benzene	187	598	0.895	2.86	H	EPA-TO-15	05/06/2019	AD
Ethylbenzene	998	4,330	4.00	17.4	EH	EPA-TO-15	05/06/2019	AD
Gasoline Range Organics	86,800	355,000	10.0	40.9	EH	EPA-TO-15	05/06/2019	AD
m,p-Xylene	3,490	15,100	8.00	34.7	EH	EPA-TO-15	05/06/2019	AD
o-Xylene	1,850	8,020	4.00	17.4	EH	EPA-TO-15	05/06/2019	AD
Toluene	1,060	4,010	4.00	15.1	EH	EPA-TO-15	05/06/2019	AD
Surr: 4-Bromofluorobenzene	153 %Rec	--	70-130	--	SH	EPA-TO-15	05/06/2019	AD

NOTES:
E - Estimated value. The amount exceeds the linear working range of the instrument.
S - Outlying surrogate recovery attributed to TPH interference. The method is in control as indicated by the Method Blank (MB) & Laboratory Control Sample (LCS).

Client: G-Logics
WorkOrder: 1905068
Project: BFC

Client Sample ID: VS-3
Lab ID: 1905068-003A
Sample Type: Tedlar Bag

Date Sampled: 5/1/2019
Date Received: 5/3/2019

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	
Benzene	253	807	0.895	2.86	EH	EPA-TO-15	05/06/2019	AD
Ethylbenzene	1,330	5,780	4.00	17.4	EH	EPA-TO-15	05/06/2019	AD
Gasoline Range Organics	107,000	438,000	10.0	40.9	EH	EPA-TO-15	05/06/2019	AD
m,p-Xylene	4,210	18,300	8.00	34.7	EH	EPA-TO-15	05/06/2019	AD
o-Xylene	2,190	9,520	4.00	17.4	EH	EPA-TO-15	05/06/2019	AD
Toluene	1,330	5,010	4.00	15.1	EH	EPA-TO-15	05/06/2019	AD
Surr: 4-Bromofluorobenzene	167 %Rec	--	70-130	--	SH	EPA-TO-15	05/06/2019	AD

NOTES:
E - Estimated value. The amount exceeds the linear working range of the instrument.
S - Outlying surrogate recovery attributed to TPH interference. The method is in control as indicated by the Method Blank (MB) & Laboratory Control Sample (LCS).

Client: G-Logics
WorkOrder: 1905068
Project: BFC

Client Sample ID: VS-4
Lab ID: 1905068-004A
Sample Type: Tedlar Bag

Date Sampled: 5/1/2019
Date Received: 5/3/2019

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	
Benzene	229	732	0.895	2.86	EH	EPA-TO-15	05/06/2019	AD
Ethylbenzene	1,260	5,480	4.00	17.4	EH	EPA-TO-15	05/06/2019	AD
Gasoline Range Organics	93,600	383,000	10.0	40.9	EH	EPA-TO-15	05/06/2019	AD
m,p-Xylene	3,850	16,700	8.00	34.7	EH	EPA-TO-15	05/06/2019	AD
o-Xylene	2,020	8,770	4.00	17.4	EH	EPA-TO-15	05/06/2019	AD
Toluene	1,300	4,880	4.00	15.1	EH	EPA-TO-15	05/06/2019	AD
Surr: 4-Bromofluorobenzene	153 %Rec	--	70-130	--	SH	EPA-TO-15	05/06/2019	AD

NOTES:
E - Estimated value. The amount exceeds the linear working range of the instrument.
S - Outlying surrogate recovery attributed to TPH interference. The method is in control as indicated by the Method Blank (MB) & Laboratory Control Sample (LCS).

Client: G-Logics
WorkOrder: 1905068
Project: BFC

Client Sample ID: VS-5
Lab ID: 1905068-005A
Sample Type: Tedlar Bag

Date Sampled: 5/1/2019
Date Received: 5/3/2019

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Volatile Organic Compounds by EPA Method TO-15								
	(ppbv)	(ug/m³)	(ppbv)	(ug/m³)				
Benzene	202	646	0.895	2.86	EH	EPA-TO-15	05/06/2019	AD
Ethylbenzene	1,100	4,770	4.00	17.4	EH	EPA-TO-15	05/06/2019	AD
Gasoline Range Organics	74,300	304,000	10.0	40.9	EH	EPA-TO-15	05/06/2019	AD
m,p-Xylene	3,240	14,100	8.00	34.7	EH	EPA-TO-15	05/06/2019	AD
o-Xylene	1,700	7,390	4.00	17.4	EH	EPA-TO-15	05/06/2019	AD
Toluene	1,240	4,690	4.00	15.1	EH	EPA-TO-15	05/06/2019	AD
Surr: 4-Bromofluorobenzene	134 %Rec	--	70-130	--	SH	EPA-TO-15	05/06/2019	AD

NOTES:
E - Estimated value. The amount exceeds the linear working range of the instrument.
S - Outlying surrogate recovery attributed to TPH interference. The method is in control as indicated by the Method Blank (MB) & Laboratory Control Sample (LCS).

Client: G-Logics
WorkOrder: 1905068
Project: BFC

Client Sample ID: VS-6
Lab ID: 1905068-006A
Sample Type: Tedlar Bag

Date Sampled: 5/2/2019
Date Received: 5/3/2019

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	
Benzene	299	954	0.895	2.86	EH	EPA-TO-15	05/06/2019	AD
Ethylbenzene	1,290	5,600	4.00	17.4	EH	EPA-TO-15	05/06/2019	AD
Gasoline Range Organics	98,000	401,000	10.0	40.9	EH	EPA-TO-15	05/06/2019	AD
m,p-Xylene	3,740	16,200	8.00	34.7	EH	EPA-TO-15	05/06/2019	AD
o-Xylene	1,960	8,520	4.00	17.4	EH	EPA-TO-15	05/06/2019	AD
Toluene	1,490	5,610	4.00	15.1	EH	EPA-TO-15	05/06/2019	AD
Surr: 4-Bromofluorobenzene	149 %Rec	--	70-130	--	SH	EPA-TO-15	05/06/2019	AD

NOTES:
E - Estimated value. The amount exceeds the linear working range of the instrument.
S - Outlying surrogate recovery attributed to TPH interference. The method is in control as indicated by the Method Blank (MB) & Laboratory Control Sample (LCS).

Client: G-Logics
WorkOrder: 1905068
Project: BFC

Client Sample ID: VS-7
Lab ID: 1905068-007A
Sample Type: Tedlar Bag

Date Sampled: 5/2/2019
Date Received: 5/3/2019

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	
Benzene	243	777	0.895	2.86	EH	EPA-TO-15	05/07/2019	AD
Ethylbenzene	1,180	5,110	4.00	17.4	EH	EPA-TO-15	05/07/2019	AD
Gasoline Range Organics	81,300	332,000	10.0	40.9	EH	EPA-TO-15	05/07/2019	AD
m,p-Xylene	3,360	14,600	8.00	34.7	EH	EPA-TO-15	05/07/2019	AD
o-Xylene	1,740	7,560	4.00	17.4	EH	EPA-TO-15	05/07/2019	AD
Toluene	1,410	5,330	4.00	15.1	EH	EPA-TO-15	05/07/2019	AD
Surr: 4-Bromofluorobenzene	135 %Rec	--	70-130	--	SH	EPA-TO-15	05/07/2019	AD

NOTES:
E - Estimated value. The amount exceeds the linear working range of the instrument.
S - Outlying surrogate recovery attributed to TPH interference. The method is in control as indicated by the Method Blank (MB) & Laboratory Control Sample (LCS).

Client: G-Logics
WorkOrder: 1905068
Project: BFC

Client Sample ID: VS-8
Lab ID: 1905068-008A
Sample Type: Tedlar Bag

Date Sampled: 5/2/2019
Date Received: 5/3/2019

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Volatile Organic Compounds by EPA Method TO-15								
	(ppbv)	(ug/m³)	(ppbv)	(ug/m³)				
Benzene	238	759	0.895	2.86	EH	EPA-TO-15	05/07/2019	AD
Ethylbenzene	1,160	5,030	4.00	17.4	EH	EPA-TO-15	05/07/2019	AD
Gasoline Range Organics	78,400	321,000	10.0	40.9	EH	EPA-TO-15	05/07/2019	AD
m,p-Xylene	3,290	14,300	8.00	34.7	EH	EPA-TO-15	05/07/2019	AD
o-Xylene	1,690	7,360	4.00	17.4	EH	EPA-TO-15	05/07/2019	AD
Toluene	1,410	5,300	4.00	15.1	EH	EPA-TO-15	05/07/2019	AD
Surr: 4-Bromofluorobenzene	131 %Rec	--	70-130	--	SH	EPA-TO-15	05/07/2019	AD

NOTES:
E - Estimated value. The amount exceeds the linear working range of the instrument.
S - Outlying surrogate recovery attributed to TPH interference. The method is in control as indicated by the Method Blank (MB) & Laboratory Control Sample (LCS).

Client: G-Logics
WorkOrder: 1905068
Project: BFC

Client Sample ID: VS-9
Lab ID: 1905068-009A
Sample Type: Tedlar Bag

Date Sampled: 5/3/2019
Date Received: 5/3/2019

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	
Benzene	411	1,310	0.895	2.86	EH	EPA-TO-15	05/07/2019	AD
Ethylbenzene	1,450	6,290	4.00	17.4	EH	EPA-TO-15	05/07/2019	AD
Gasoline Range Organics	143,000	586,000	10.0	40.9	EH	EPA-TO-15	05/07/2019	AD
m,p-Xylene	4,660	20,200	8.00	34.7	EH	EPA-TO-15	05/07/2019	AD
o-Xylene	2,510	10,900	4.00	17.4	EH	EPA-TO-15	05/07/2019	AD
Toluene	1,790	6,750	4.00	15.1	EH	EPA-TO-15	05/07/2019	AD
Surr: 4-Bromofluorobenzene	180 %Rec	--	70-130	--	SH	EPA-TO-15	05/07/2019	AD

NOTES:
E - Estimated value. The amount exceeds the linear working range of the instrument.
S - Outlying surrogate recovery attributed to TPH interference. The method is in control as indicated by the Method Blank (MB) & Laboratory Control Sample (LCS).

Client: G-Logics
WorkOrder: 1905068
Project: BFC

Client Sample ID: VS-10
Lab ID: 1905068-010A
Sample Type: Tedlar Bag

Date Sampled: 5/3/2019
Date Received: 5/3/2019

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	
Benzene	282	900	0.895	2.86	EH	EPA-TO-15	05/07/2019	AD
Ethylbenzene	1,230	5,320	4.00	17.4	EH	EPA-TO-15	05/07/2019	AD
Gasoline Range Organics	89,300	365,000	10.0	40.9	EH	EPA-TO-15	05/07/2019	AD
m,p-Xylene	3,520	15,300	8.00	34.7	EH	EPA-TO-15	05/07/2019	AD
o-Xylene	1,830	7,960	4.00	17.4	EH	EPA-TO-15	05/07/2019	AD
Toluene	1,490	5,620	4.00	15.1	EH	EPA-TO-15	05/07/2019	AD
Surr: 4-Bromofluorobenzene	138 %Rec	--	70-130	--	SH	EPA-TO-15	05/07/2019	AD

NOTES:
E - Estimated value. The amount exceeds the linear working range of the instrument.
S - Outlying surrogate recovery attributed to TPH interference. The method is in control as indicated by the Method Blank (MB) & Laboratory Control Sample (LCS).

Client: G-Logics
WorkOrder: 1905068
Project: BFC

Client Sample ID: VS-11
Lab ID: 1905068-011A
Sample Type: Tedlar Bag

Date Sampled: 5/3/2019
Date Received: 5/3/2019

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Sulfur Compounds by EPA Method TO-15	**(ppbv)**	**(ug/m³)**	**(ppbv)**	**(ug/m³)**				
Carbon Disulfide	<10.0	<31.1	10.0	31.1	H	EPA-TO-15	05/06/2019	AD
Carbonyl Sulfide	<10.0	<24.6	10.0	24.6	H	EPA-TO-15	05/06/2019	AD
Dimethyl Disulfide	<10.0	<38.4	10.0	38.4	H	EPA-TO-15	05/06/2019	AD
Dimethyl Sulfide	<100	<254	100	254	H	EPA-TO-15	05/06/2019	AD
Ethyl Mercaptan	<10.0	<25.4	10.0	25.4	H	EPA-TO-15	05/06/2019	AD
Hydrogen Sulfide	<100	<139	100	139	H	EPA-TO-15	05/06/2019	AD
Isobutyl Mercaptan	<100	<368	100	368	H	EPA-TO-15	05/06/2019	AD
Isopropyl Mercaptan	<10.0	<31.1	10.0	31.1	H	EPA-TO-15	05/06/2019	AD
Methyl Mercaptan	<100	<196	100	196	H	EPA-TO-15	05/06/2019	AD
n-Butyl Mercaptan	<10.0	<36.9	10.0	36.9	H	EPA-TO-15	05/06/2019	AD
n-Propyl Mercaptan	<100	<311	100	311	H	EPA-TO-15	05/06/2019	AD
t-Butyl Mercaptan	<100	<368	100	368	H	EPA-TO-15	05/06/2019	AD
Surr: 4-Bromofluorobenzene	148 %Rec	--	70-130	--	SH	EPA-TO-15	05/06/2019	AD

NOTES:
S - Surrogate recovery indicates a possible matrix effect. The method is in control as indicated by the Laboratory Control Sample (LCS).

Volatile Organic Compounds by EPA Method TO-15	**(ppbv)**	**(ug/m³)**	**(ppbv)**	**(ug/m³)**				
Benzene	320	1,020	0.895	2.86	E	EPA-TO-15	05/06/2019	AD
Ethylbenzene	1,300	5,660	4.00	17.4	E	EPA-TO-15	05/06/2019	AD
Gasoline Range Organics	96,800	396,000	10.0	40.9	E	EPA-TO-15	05/06/2019	AD
m,p-Xylene	3,610	15,700	8.00	34.7	E	EPA-TO-15	05/06/2019	AD
o-Xylene	1,920	8,350	4.00	17.4	E	EPA-TO-15	05/06/2019	AD
Toluene	1,590	6,010	4.00	15.1	E	EPA-TO-15	05/06/2019	AD
Surr: 4-Bromofluorobenzene	138 %Rec	--	70-130	--	S	EPA-TO-15	05/06/2019	AD

NOTES:
E - Estimated value. The amount exceeds the linear working range of the instrument.
S - Outlying surrogate recovery attributed to TPH interference. The method is in control as indicated by the Method Blank (MB) & Laboratory Control Sample (LCS).

Client: G-Logics
WorkOrder: 1905068
Project: BFC

Client Sample ID: VS-12
Lab ID: 1905068-012A
Sample Type: Tedlar Bag

Date Sampled: 5/3/2019
Date Received: 5/3/2019

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Sulfur Compounds by EPA Method TO-15	**(ppbv)**	**(ug/m³)**	**(ppbv)**	**(ug/m³)**				
Carbon Disulfide	<10.0	<31.1	10.0	31.1	H	EPA-TO-15	05/06/2019	AD
Carbonyl Sulfide	<10.0	<24.6	10.0	24.6	H	EPA-TO-15	05/06/2019	AD
Dimethyl Disulfide	<10.0	<38.4	10.0	38.4	H	EPA-TO-15	05/06/2019	AD
Dimethyl Sulfide	<100	<254	100	254	H	EPA-TO-15	05/06/2019	AD
Ethyl Mercaptan	<10.0	<25.4	10.0	25.4	H	EPA-TO-15	05/06/2019	AD
Hydrogen Sulfide	<100	<139	100	139	H	EPA-TO-15	05/06/2019	AD
Isobutyl Mercaptan	<100	<368	100	368	H	EPA-TO-15	05/06/2019	AD
Isopropyl Mercaptan	<10.0	<31.1	10.0	31.1	H	EPA-TO-15	05/06/2019	AD
Methyl Mercaptan	<100	<196	100	196	H	EPA-TO-15	05/06/2019	AD
n-Butyl Mercaptan	<10.0	<36.9	10.0	36.9	H	EPA-TO-15	05/06/2019	AD
n-Propyl Mercaptan	<100	<311	100	311	H	EPA-TO-15	05/06/2019	AD
t-Butyl Mercaptan	<100	<368	100	368	H	EPA-TO-15	05/06/2019	AD
Surr: 4-Bromofluorobenzene	144 %Rec	--	70-130	--	SH	EPA-TO-15	05/06/2019	AD

NOTES:
S - Surrogate recovery indicates a possible matrix effect. The method is in control as indicated by the Laboratory Control Sample (LCS).

Volatile Organic Compounds by EPA Method TO-15	**(ppbv)**	**(ug/m³)**	**(ppbv)**	**(ug/m³)**				
Benzene	396	1,260	0.895	2.86	E	EPA-TO-15	05/06/2019	AD
Ethylbenzene	1,220	5,300	4.00	17.4	E	EPA-TO-15	05/06/2019	AD
Gasoline Range Organics	87,800	359,000	10.0	40.9	E	EPA-TO-15	05/06/2019	AD
m,p-Xylene	3,400	14,700	8.00	34.7	E	EPA-TO-15	05/06/2019	AD
o-Xylene	1,780	7,730	4.00	17.4	E	EPA-TO-15	05/06/2019	AD
Toluene	1,530	5,760	4.00	15.1	E	EPA-TO-15	05/06/2019	AD
Surr: 4-Bromofluorobenzene	134 %Rec	--	70-130	--	S	EPA-TO-15	05/06/2019	AD

NOTES:
E - Estimated value. The amount exceeds the linear working range of the instrument.
S - Outlying surrogate recovery attributed to TPH interference. The method is in control as indicated by the Method Blank (MB) & Laboratory Control Sample (LCS).

Client: G-Logics
WorkOrder: 1905068
Project: BFC

Client Sample ID: VS-13
Lab ID: 1905068-013A
Sample Type: Tedlar Bag

Date Sampled: 5/3/2019
Date Received: 5/3/2019

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Sulfur Compounds by EPA Method TO-15								
	(ppbv)	**(ug/m³)**	**(ppbv)**	**(ug/m³)**				
Carbon Disulfide	<10.0	<31.1	10.0	31.1	H	EPA-TO-15	05/06/2019	AD
Carbonyl Sulfide	<10.0	<24.6	10.0	24.6	H	EPA-TO-15	05/06/2019	AD
Dimethyl Disulfide	<10.0	<38.4	10.0	38.4	H	EPA-TO-15	05/06/2019	AD
Dimethyl Sulfide	<100	<254	100	254	H	EPA-TO-15	05/06/2019	AD
Ethyl Mercaptan	<10.0	<25.4	10.0	25.4	H	EPA-TO-15	05/06/2019	AD
Hydrogen Sulfide	<100	<139	100	139	H	EPA-TO-15	05/06/2019	AD
Isobutyl Mercaptan	<100	<368	100	368	H	EPA-TO-15	05/06/2019	AD
Isopropyl Mercaptan	<10.0	<31.1	10.0	31.1	H	EPA-TO-15	05/06/2019	AD
Methyl Mercaptan	<100	<196	100	196	H	EPA-TO-15	05/06/2019	AD
n-Butyl Mercaptan	<10.0	<36.9	10.0	36.9	H	EPA-TO-15	05/06/2019	AD
n-Propyl Mercaptan	<100	<311	100	311	H	EPA-TO-15	05/06/2019	AD
t-Butyl Mercaptan	<100	<368	100	368	H	EPA-TO-15	05/06/2019	AD
Surr: 4-Bromofluorobenzene	142 %Rec	--	70-130	--	SH	EPA-TO-15	05/06/2019	AD

NOTES:
S - Surrogate recovery indicates a possible matrix effect. The method is in control as indicated by the Laboratory Control Sample (LCS).

Volatile Organic Compounds by EPA Method TO-15								
	(ppbv)	**(ug/m³)**	**(ppbv)**	**(ug/m³)**				
Benzene	492	1,570	0.895	2.86	E	EPA-TO-15	05/06/2019	AD
Ethylbenzene	1,210	5,270	4.00	17.4	E	EPA-TO-15	05/06/2019	AD
Gasoline Range Organics	89,600	366,000	10.0	40.9	E	EPA-TO-15	05/06/2019	AD
m,p-Xylene	3,380	14,700	8.00	34.7	E	EPA-TO-15	05/06/2019	AD
o-Xylene	1,760	7,640	4.00	17.4	E	EPA-TO-15	05/06/2019	AD
Toluene	1,540	5,790	4.00	15.1	E	EPA-TO-15	05/06/2019	AD
Surr: 4-Bromofluorobenzene	132 %Rec	--	70-130	--	S	EPA-TO-15	05/06/2019	AD

NOTES:
E - Estimated value. The amount exceeds the linear working range of the instrument.
S - Outlying surrogate recovery attributed to TPH interference. The method is in control as indicated by the Method Blank (MB) & Laboratory Control Sample (LCS).

Client: G-Logics
WorkOrder: 1905068
Project: BFC

Client Sample ID: VS-14
Lab ID: 1905068-014A
Sample Type: Tedlar Bag

Date Sampled: 5/3/2019
Date Received: 5/3/2019

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Petroleum Fractionation by EPA Method TO-15	**(ppbv)**	**(ug/m³)**	**(ppbv)**	**(ug/m³)**				
Decane	30.1	175	0.416	2.42	EH	EPA-TO-15	05/08/2019	AD
Heptane	409	1,640	0.580	2.33	EH	EPA-TO-15	05/08/2019	AD
Dodecane	7.81	54.4	1.10	7.65	*H	EPA-TO-15	05/08/2019	AD
n-Hexane	358	1,260	0.318	1.12	EH	EPA-TO-15	05/08/2019	AD
Nonane	52.5	275	0.487	2.55	EH	EPA-TO-15	05/08/2019	AD
Undecane	5.74	40.0	0.724	5.04	EH	EPA-TO-15	05/08/2019	AD
Octane	128	596	0.503	2.35	EH	EPA-TO-15	05/08/2019	AD
Surr: 4-Bromofluorobenzene	148 %Rec	--	70-130	--	SH	EPA-TO-15	05/08/2019	AD

NOTES:
* - Flagged value is not within established control limits.
E - Estimated value. The amount exceeds the linear working range of the instrument.
S - Surrogate recovery indicates a possible matrix effect. The method is in control as indicated by the Laboratory Control Sample (LCS).

Sulfur Compounds by EPA Method TO-15	**(ppbv)**	**(ug/m³)**	**(ppbv)**	**(ug/m³)**				
Carbon Disulfide	<10.0	<31.1	10.0	31.1	H	EPA-TO-15	05/06/2019	AD
Carbonyl Sulfide	<10.0	<24.6	10.0	24.6	H	EPA-TO-15	05/06/2019	AD
Dimethyl Disulfide	<10.0	<38.4	10.0	38.4	H	EPA-TO-15	05/06/2019	AD
Dimethyl Sulfide	<100	<254	100	254	H	EPA-TO-15	05/06/2019	AD
Ethyl Mercaptan	<10.0	<25.4	10.0	25.4	H	EPA-TO-15	05/06/2019	AD
Hydrogen Sulfide	<100	<139	100	139	H	EPA-TO-15	05/06/2019	AD
Isobutyl Mercaptan	<100	<368	100	368	H	EPA-TO-15	05/06/2019	AD
Isopropyl Mercaptan	<10.0	<31.1	10.0	31.1	H	EPA-TO-15	05/06/2019	AD
Methyl Mercaptan	<100	<196	100	196	H	EPA-TO-15	05/06/2019	AD
n-Butyl Mercaptan	<10.0	<36.9	10.0	36.9	H	EPA-TO-15	05/06/2019	AD
n-Propyl Mercaptan	<100	<311	100	311	H	EPA-TO-15	05/06/2019	AD
t-Butyl Mercaptan	<100	<368	100	368	H	EPA-TO-15	05/06/2019	AD
Surr: 4-Bromofluorobenzene	144 %Rec	--	70-130	--	SH	EPA-TO-15	05/06/2019	AD

NOTES:
S - Surrogate recovery indicates a possible matrix effect. The method is in control as indicated by the Laboratory Control Sample (LCS).

Volatile Organic Compounds by EPA Method TO-15	**(ppbv)**	**(ug/m³)**	**(ppbv)**	**(ug/m³)**

Client: G-Logics
WorkOrder: 1905068
Project: BFC

Client Sample ID: VS-14
Lab ID: 1905068-014A
Sample Type: Tedlar Bag

Date Sampled: 5/3/2019
Date Received: 5/3/2019

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	
Benzene	869	2,780	0.895	2.86	E	EPA-TO-15	05/06/2019	AD
Ethylbenzene	1,260	5,450	4.00	17.4	E	EPA-TO-15	05/06/2019	AD
Gasoline Range Organics	98,700	404,000	10.0	40.9	E	EPA-TO-15	05/06/2019	AD
m,p-Xylene	3,500	15,200	8.00	34.7	E	EPA-TO-15	05/06/2019	AD
o-Xylene	1,820	7,920	4.00	17.4	E	EPA-TO-15	05/06/2019	AD
Toluene	1,620	6,100	4.00	15.1	E	EPA-TO-15	05/06/2019	AD
Surr: 4-Bromofluorobenzene	134 %Rec	--	70-130	--	S	EPA-TO-15	05/06/2019	AD

NOTES:
E - Estimated value. The amount exceeds the linear working range of the instrument.
S - Outlying surrogate recovery attributed to TPH interference. The method is in control as indicated by the Method Blank (MB) & Laboratory Control Sample (LCS).

Work Order: 1905068
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Petroleum Fractionation by EPA Method TO-15

Sample ID **LCS-R51314** SampType: **LCS** Units: **ppbv** Prep Date: **5/8/2019** RunNo: **51314**
Client ID: **LCSW** Batch ID: **R51314** Analysis Date: **5/8/2019** SeqNo: **1010068**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Decane	1.57	0.416	2.000	0	78.4	70	130				
Dodecane	3.26	1.10	2.000	0	163	70	130				S
Heptane	1.72	0.580	2.000	0	86.2	70	130				
n-Hexane	1.77	0.318	2.000	0	88.7	70	130				
Nonane	1.68	0.487	2.000	0	84.0	70	130				
Octane	1.73	0.503	2.000	0	86.6	70	130				
Undecane	2.13	0.724	2.000	0	106	70	130				
Surr: 4-Bromofluorobenzene	4.03		4.000		101	70	130				

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

Sample ID **MB-R51314** SampType: **MBLK** Units: **ppbv** Prep Date: **5/8/2019** RunNo: **51314**
Client ID: **MBLKW** Batch ID: **R51314** Analysis Date: **5/8/2019** SeqNo: **1010069**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Decane	ND	0.416									
Dodecane	ND	1.10									
Heptane	ND	0.580									
n-Hexane	ND	0.318									
Nonane	ND	0.487									
Octane	ND	0.503									
Undecane	ND	0.724									
Surr: 4-Bromofluorobenzene	3.65		4.000		91.1	70	130				

Sample ID **1905068-014AREP** SampType: **REP** Units: **ppbv** Prep Date: **5/8/2019** RunNo: **51314**
Client ID: **VS-14** Batch ID: **R51314** Analysis Date: **5/8/2019** SeqNo: **1010071**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Decane	30.1	0.416						30.07	0.0342	30	EH
Dodecane	7.94	1.10						7.808	1.71	30	*H
Heptane	457	0.580						409.3	11.0	30	EH

Work Order: 1905068
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Petroleum Fractionation by EPA Method TO-15

Sample ID **1905068-014AREP** SampType: **REP** Units: **ppbv** Prep Date: **5/8/2019** RunNo: **51314**
Client ID: **VS-14** Batch ID: **R51314** Analysis Date: **5/8/2019** SeqNo: **1010071**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
n-Hexane	393	0.318						357.5	9.45	30	EH
Nonane	53.3	0.487						52.50	1.56	30	EH
Octane	131	0.503						127.7	2.85	30	EH
Undecane	5.82	0.724						5.743	1.29	30	EH
Surr: 4-Bromofluorobenzene	5.96		4.000		149	70	130		0		SH

NOTES:
S - Surrogate recovery indicates a possible matrix effect. The method is in control as indicated by the Laboratory Control Sample (LCS).
E - Estimated value. The amount exceeds the linear working range of the instrument.
* - Flagged value is not within established control limits.

Work Order: 1905068
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Sulfur Compounds by EPA Method TO-15

Sample ID **LCS-R51029** SampType: **LCS** Units: **ppbv** Prep Date: **4/27/2019** RunNo: **51029**
Client ID: **LCSW** Batch ID: **R51029** Analysis Date: **4/27/2019** SeqNo: **1002972**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Hydrogen Sulfide	118	10.0	110.0	0	107	70	130				
Methyl Mercaptan	102	10.0	103.0	0	99.4	70	130				
Dimethyl Sulfide	144	10.0	144.0	0	99.9	70	130				
t-Butyl Mercaptan	99.7	10.0	95.00	0	105	70	130				
n-Propyl Mercaptan	102	10.0	97.00	0	105	70	130				
Isobutyl Mercaptan	87.9	10.0	92.00	0	95.6	70	130				
Surr: 4-Bromofluorobenzene	4.70		4.000		118	70	130				

Sample ID **MB-R51029** SampType: **MBLK** Units: **ppbv** Prep Date: **4/27/2019** RunNo: **51029**
Client ID: **MBLKW** Batch ID: **R51029** Analysis Date: **4/27/2019** SeqNo: **1002973**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Hydrogen Sulfide	ND	10.0									
Methyl Mercaptan	ND	10.0									
Dimethyl Sulfide	ND	10.0									
t-Butyl Mercaptan	ND	10.0									
n-Propyl Mercaptan	ND	10.0									
Isobutyl Mercaptan	ND	10.0									
Surr: 4-Bromofluorobenzene	4.20		4.000		105	70	130				

Sample ID **LCS-R51030** SampType: **LCS** Units: **ppbv** Prep Date: **4/27/2019** RunNo: **51030**
Client ID: **LCSW** Batch ID: **R51030** Analysis Date: **4/27/2019** SeqNo: **1003013**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Carbon Disulfide	98.5	10.0	103.0	0	95.7	70	130				
Ethyl Mercaptan	59.9	10.0	63.00	0	95.1	70	130				
Carbonyl Sulfide	108	10.0	112.0	0	96.2	70	130				
Isopropyl Mercaptan	58.9	10.0	62.00	0	95.0	70	130				
n-Butyl Mercaptan	76.5	10.0	78.00	0	98.1	70	130				
Dimethyl Disulfide	25.9	10.0	26.00	0	99.5	70	130				

Work Order: 1905068
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Sulfur Compounds by EPA Method TO-15

Sample ID **LCS-R51030**	SampType: **LCS**	Units: **ppbv**	Prep Date: **4/27/2019**	RunNo: **51030**
Client ID: **LCSW**	Batch ID: **R51030**		Analysis Date: **4/27/2019**	SeqNo: **1003013**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Surr: 4-Bromofluorobenzene	4.34		4.000		108	70	130				

Sample ID **MB-R51030**	SampType: **MBLK**	Units: **ppbv**	Prep Date: **4/27/2019**	RunNo: **51030**
Client ID: **MBLKW**	Batch ID: **R51030**		Analysis Date: **4/27/2019**	SeqNo: **1003014**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Carbon Disulfide	ND	10.0									
Ethyl Mercaptan	ND	10.0									
Carbonyl Sulfide	ND	10.0									
Isopropyl Mercaptan	ND	10.0									
n-Butyl Mercaptan	ND	10.0									
Dimethyl Disulfide	ND	10.0									
Surr: 4-Bromofluorobenzene	3.80		4.000		94.9	70	130				

Sample ID **1904386-001AREP**	SampType: **REP**	Units: **ppbv**	Prep Date: **4/27/2019**	RunNo: **51029**
Client ID: **BATCH**	Batch ID: **R51029**		Analysis Date: **4/27/2019**	SeqNo: **1002976**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Hydrogen Sulfide	280,000	2,000						273,100	2.38	30	DEH
Methyl Mercaptan	2,400	2,000						2,324	3.03	30	DH
Dimethyl Sulfide	ND	2,000						0		30	DH
t-Butyl Mercaptan	ND	2,000						0		30	DH
n-Propyl Mercaptan	ND	2,000						0		30	DH
Isobutyl Mercaptan	ND	2,000						0		30	DH
Surr: 4-Bromofluorobenzene	786		4.000		19,700	70	130		0		DSH

NOTES:
S - Outlying surrogate recovery(ies) observed. A duplicate analysis was performed with similar results indicating a possible matrix effect.
E - Estimated value. The amount exceeds the linear working range of the instrument.

Work Order: 1905068
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Sulfur Compounds by EPA Method TO-15

Sample ID **1904386-001AREP** SampType: **REP** Units: **ppbv** Prep Date: **4/27/2019** RunNo: **51030**
Client ID: **BATCH** Batch ID: **R51030** Analysis Date: **4/27/2019** SeqNo: **1003017**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Carbon Disulfide	ND	2,000						0		30	DH
Ethyl Mercaptan	ND	2,000						0		30	DH
Carbonyl Sulfide	ND	2,000						0		30	DH
Isopropyl Mercaptan	ND	2,000						0		30	DH
n-Butyl Mercaptan	ND	2,000						0		30	DH
Dimethyl Disulfide	ND	2,000						0		30	DH
Surr: 4-Bromofluorobenzene	767		4.000		19,200	70	130		0		DSH

NOTES:
S - Outlying surrogate recovery(ies) observed. A duplicate analysis was performed with similar results indicating a possible matrix effect.
Diluted due to matrix.

Sample ID **LCS-R51029B** SampType: **LCS** Units: **ppbv** Prep Date: **5/6/2019** RunNo: **51029**
Client ID: **LCSW** Batch ID: **R51029** Analysis Date: **5/6/2019** SeqNo: **1008174**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Hydrogen Sulfide	141	10.0	110.0	0	128	70	130				
Methyl Mercaptan	132	10.0	103.0	0	128	70	130				
Dimethyl Sulfide	149	10.0	144.0	0	104	70	130				
t-Butyl Mercaptan	122	10.0	95.00	0	129	70	130				
n-Propyl Mercaptan	137	10.0	97.00	0	142	70	130				S
Isobutyl Mercaptan	113	10.0	92.00	0	122	70	130				
Surr: 4-Bromofluorobenzene	4.12		4.000		103	70	130				

NOTES:
S - Outlying spike recovery observed (high bias). Samples are non-detect for this analyte; no further action required.

Sample ID **LCS-R51030** SampType: **LCS** Units: **ppbv** Prep Date: **5/6/2019** RunNo: **51030**
Client ID: **LCSW** Batch ID: **R51030** Analysis Date: **5/6/2019** SeqNo: **1008221**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Carbon Disulfide	108	10.0	103.0	0	105	70	130				
Ethyl Mercaptan	67.0	10.0	63.00	0	106	70	130				
Carbonyl Sulfide	111	10.0	112.0	0	99.2	70	130				

Work Order: 1905068
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Sulfur Compounds by EPA Method TO-15

Sample ID **LCS-R51030** SampType: **LCS** Units: **ppbv** Prep Date: **5/6/2019** RunNo: **51030**
Client ID: **LCSW** Batch ID: **R51030** Analysis Date: **5/6/2019** SeqNo: **1008221**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Isopropyl Mercaptan	65.1	10.0	62.00	0	105	70	130				
n-Butyl Mercaptan	89.0	10.0	78.00	0	114	70	130				
Dimethyl Disulfide	33.1	10.0	26.00	0	127	70	130				
Surr: 4-Bromofluorobenzene	4.07		4.000		102	70	130				

Sample ID **MB-R51029B** SampType: **MBLK** Units: **ppbv** Prep Date: **5/6/2019** RunNo: **51029**
Client ID: **MBLKW** Batch ID: **R51029** Analysis Date: **5/6/2019** SeqNo: **1008175**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Hydrogen Sulfide	ND	10.0									
Methyl Mercaptan	ND	10.0									
Dimethyl Sulfide	ND	10.0									
t-Butyl Mercaptan	ND	10.0									
n-Propyl Mercaptan	ND	10.0									
Isobutyl Mercaptan	ND	10.0									
Surr: 4-Bromofluorobenzene	3.81		4.000		95.2	70	130				

Sample ID **MB-R51030** SampType: **MBLK** Units: **ppbv** Prep Date: **5/6/2019** RunNo: **51030**
Client ID: **MBLKW** Batch ID: **R51030** Analysis Date: **5/6/2019** SeqNo: **1008222**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Carbon Disulfide	ND	10.0									
Ethyl Mercaptan	ND	10.0									
Carbonyl Sulfide	ND	10.0									
Isopropyl Mercaptan	ND	10.0									
n-Butyl Mercaptan	ND	10.0									
Dimethyl Disulfide	ND	10.0									
Surr: 4-Bromofluorobenzene	3.71		4.000		92.8	70	130				

Work Order: 1905068
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Sulfur Compounds by EPA Method TO-15

Sample ID **1905068-011AREP** SampType: **REP** Units: **ppbv** Prep Date: **5/6/2019** RunNo: **51029**
Client ID: **VS-11** Batch ID: **R51029** Analysis Date: **5/6/2019** SeqNo: **1008177**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Hydrogen Sulfide	ND	100						0		30	H
Methyl Mercaptan	ND	100						0		30	H
Dimethyl Sulfide	ND	100						0		30	H
t-Butyl Mercaptan	ND	100						0		30	H
n-Propyl Mercaptan	ND	100						0		30	H
Isobutyl Mercaptan	ND	100						0		30	H
Surr: 4-Bromofluorobenzene	58.8		40.00		147	70	130		0		SH

NOTES:
S - Surrogate recovery indicates a possible matrix effect. The method is in control as indicated by the Laboratory Control Sample (LCS).

Sample ID **1905068-011AREP** SampType: **REP** Units: **ppbv** Prep Date: **5/6/2019** RunNo: **51030**
Client ID: **VS-11** Batch ID: **R51030** Analysis Date: **5/6/2019** SeqNo: **1008224**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Carbon Disulfide	ND	10.0						0		30	H
Ethyl Mercaptan	ND	10.0						0		30	H
Carbonyl Sulfide	ND	10.0						0		30	H
Isopropyl Mercaptan	ND	10.0						0		30	H
n-Butyl Mercaptan	ND	10.0						0		30	H
Dimethyl Disulfide	ND	10.0						0		30	H
Surr: 4-Bromofluorobenzene	5.73		4.000		143	70	130		0		SH

NOTES:
S - Outlying surrogate recovery(ies) observed. A duplicate analysis was performed with similar results indicating a possible matrix effect.

Work Order: 1905068
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method TO-15

Sample ID **LCS-R51276** SampType: **LCS** Units: **ppbv** Prep Date: **5/6/2019** RunNo: **51276**
Client ID: **LCSW** Batch ID: **R51276** Analysis Date: **5/6/2019** SeqNo: **1008949**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline Range Organics	68.2	1.00	72.00	0	94.8	70	130				
Benzene	1.82	0.0895	2.000	0	91.0	70	130				
Toluene	2.07	0.400	2.000	0	103	70	130				
Ethylbenzene	1.94	0.400	2.000	0	97.2	70	130				
m,p-Xylene	3.81	0.800	4.000	0	95.2	70	130				
o-Xylene	1.85	0.400	2.000	0	92.3	70	130				
Surr: 4-Bromofluorobenzene	4.12		4.000		103	70	130				

Sample ID **MB-R51276** SampType: **MBLK** Units: **ppbv** Prep Date: **5/6/2019** RunNo: **51276**
Client ID: **MBLKW** Batch ID: **R51276** Analysis Date: **5/6/2019** SeqNo: **1008950**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline Range Organics	ND	1.00									
Benzene	ND	0.0895									
Toluene	ND	0.400									
Ethylbenzene	ND	0.400									
m,p-Xylene	ND	0.800									
o-Xylene	ND	0.400									
Surr: 4-Bromofluorobenzene	3.55		4.000		88.7	70	130				

Sample ID **1905068-011AREP** SampType: **REP** Units: **ppbv** Prep Date: **5/6/2019** RunNo: **51276**
Client ID: **VS-11** Batch ID: **R51276** Analysis Date: **5/6/2019** SeqNo: **1008952**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline Range Organics	92,000	10.0						96,790	0	30	E
Benzene	300	0.895						319.8	6.52	30	E
Toluene	1,550	4.00						1,594	2.52	30	E
Ethylbenzene	1,270	4.00						1,304	2.67	30	E
m,p-Xylene	3,540	8.00						3,609	1.84	30	E
o-Xylene	1,870	4.00						1,922	2.68	30	E

Work Order: 1905068
CLIENT: G-Logics
Project: BFC

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method TO-15

Sample ID **1905068-011AREP** SampType: **REP** Units: **ppbv** Prep Date: **5/6/2019** RunNo: **51276**
Client ID: **VS-11** Batch ID: **R51276** Analysis Date: **5/6/2019** SeqNo: **1008952**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Surr: 4-Bromofluorobenzene	54.7		40.00		137	70	130		0		S

NOTES:
S - Outlying surrogate recovery attributed to TPH interference. The method is in control as indicated by the Method Blank (MB) & Laboratory Control Sample (LCS).
E - Estimated value. The amount exceeds the linear working range of the instrument.

Sample Log-In Check List

Client Name:	**GL**	Work Order Number:	**1905068**
Logged by:	**Clare Griggs**	Date Received:	**5/3/2019 4:31:00 PM**

Chain of Custody

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

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: 5/3/2019 Page: 1 of: 3

Laboratory Project No (Internal): 1905068

Special Remarks:

Project Name: BFC

Project No: 01-0410-0

Client: G-Logics

Address:

Location:

City, State, Zip:

Collected by: ZW

Telephone:

Reports to (PM): ZackaryW@g-logics.com

Air samples are disposed of one week after report is submitted to client unless otherwise requested. ☐ OK to Dispose ☐ Hold (fees may apply)

Fax:

Email (PM):

	Sample Name	Canister / Flow Reg Serial #	Sample Date & Time	Sample Type (Matrix) *	Container Type **	Fill Time / Flow Rate	Internal: Initial Evacuation Pressure (" Hg)	Field Initial Sample Pressure (" Hg)	Field Final Sample Pressure (" Hg)	Analysis: VOCs TO15 SCAN	VOCs TO15 SCAN LL	VOCs TO15 SIM	Siloxanes TO15	Sulfur TO15	Sulfur Ext. TO15	APH TO15	Helium	Major Gases 3C	Comments	Internal: Final Pressure ("Hg)
1	VS-1	Canister / Flow Reg	5/1 Date / 950 Time	S	TB	10s	Pressure / Date	Pressure / Date	Pressure / Date										GX, BTEX ONLY	
2	VS-2	Canister / Flow Reg	5/1 Date / 1035 Time	S	~~TB~~	10s	Pressure / Date	Pressure / Date	Pressure / Date											
3	VS-3	Canister / Flow Reg	5/1 Date / 1130 Time	S	TB	10s	Pressure / Date	Pressure / Date	Pressure / Date											
4	VS-4	Canister / Flow Reg	5/1 Date / 1220 Time	S	TB	10s	Pressure / Date	Pressure / Date	Pressure / Date											
5	VS-5	Canister / Flow Reg	5/1 Date / 1345 Time	S	TB	10s	Pressure / Date	Pressure / Date	Pressure / Date											

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

** Container Codes: BV = 1 Liter Bottle Vac 6L = 6L Canister 1L = 1L 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, 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]	5-3/1641	x [signature]	5/3/19 1631
Relinquished	Date/Time	Received	Date/Time
x		x	

Turn-Around Time:

- ☒ 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: 5/3/2019 Page: 2 of: 3

Project Name: BFC

Project No: 01-0410-0

Location:

Collected by:

Reports to (PM):

Email (PM):

Client: G-Logics

Address:

City, State, Zip:

Telephone:

Fax:

Laboratory Project No (Internal): 1905068

Special Remarks:

Air samples are disposed of one week after report is submitted to client unless otherwise requested. ☐ OK to Dispose ☐ Hold (fees may apply)

	Sample Name	Canister / Flow Reg Serial #	Sample Date & Time	Sample Type (Matrix) *	Container Type **	Fill Time / Flow Rate	Internal: Initial Evacuation Pressure (" Hg)	Field Initial Sample Pressure (" Hg)	Field Final Sample Pressure (" Hg)	Analysis: VOCs TO15 SCAN	VOCs TO15 SCAN LL	VOCs TO15 SIM	Siloxanes TO15	Sulfur TO15	Sulfur Ext. TO15	APH TO15	Helium	Major Gases 3C		Comments	Internal: Final Pressure ("Hg)
1	VS-6	Canister / Flow Reg	5/2 Date / 1215 Time	S	TB	105	Pressure / Date	Pressure / Date	Pressure / Date											6X BTEX ONLY	
2	VS-7	Canister / Flow Reg	5/2 Date / 1345 Time	S			Pressure / Date	Pressure / Date	Pressure / Date												
3	VS-8	Canister / Flow Reg	5/2 Date / 1415 Time	S			Pressure / Date	Pressure / Date	Pressure / Date												
4	VS-9	Canister / Flow Reg	5/3 Date / 1130 Time	S			Pressure / Date	Pressure / Date	Pressure / Date												
5	VS-10	Canister / Flow Reg	5/3 Date / 1220 Time	S			Pressure / Date	Pressure / Date	Pressure / Date												

HIGH CONCENTRATION

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

** Container Codes: BV = 1 Liter Bottle Vac 6L = 6L Canister 1L = 1L 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, 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]	5/3 1642	x [signature]	5/3/19 1642
Relinquished	Date/Time	Received	Date/Time
x		x	

Turn-Around Time:

- ☒ 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: 5/3/19 Page: 3 of: 3

Laboratory Project No (Internal): 1905008

Special Remarks:

Client: G-Logics

Address:

City, State, Zip:

Telephone:

Fax:

Project Name: BFC

Project No: 01-0410-0

Location:

Collected by:

Reports to (PM):

Email (PM):

Air samples are disposed of one week after report is submitted to client unless otherwise requested. ☐ OK to Dispose ☐ Hold (fees may apply)

	Sample Name	Canister / Flow Reg Serial #	Sample Date & Time	Sample Type (Matrix) *	Container Type **	Fill Time / Flow Rate	Internal: Initial Evacuation Pressure (" Hg)	Field Initial Sample Pressure (" Hg)	Field Final Sample Pressure (" Hg)	Analysis: VOCs TO15 SCAN	VOCs TO15 SCAN LL	VOCs TO15 SIM	Siloxanes TO15	Sulfur TO15	Sulfur Ext. TO15	APH TO15	Helium	Major Gases 3C		Comments	Internal: Final Pressure ("Hg)
1	VS-11	Canister / Flow Reg	5/3 Date / 1255 Time	S	TB	10s	Pressure / Date	Pressure / Date	Pressure / Date											HIGH Concentrations GX, BTEX ONLY + sulfur MC 5/3/19	
2	VS-12	Canister / Flow Reg	5/3 Date / 1326 Time				Pressure / Date	Pressure / Date	Pressure / Date												
3	VS-13	Canister / Flow Reg	5/3 Date / 1405 Time				Pressure / Date	Pressure / Date	Pressure / Date												
4	VS-14	Canister / Flow Reg	5/3 Date / 1435 Time				Pressure / Date	Pressure / Date	Pressure / Date											+ APH MC 5/13/19	
5		Canister / Flow Reg	Date / Time				Pressure / Date	Pressure / Date	Pressure / Date												

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

** Container Codes: BV = 1 Liter Bottle Vac 6L = 6L Canister 1L = 1L 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, 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	5-3/1642	x	5/3/19 1642
Relinquished	Date/Time	Received	Date/Time
x		x	

Turn-Around Time:

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

APPENDIX C

Kennedy Jenks

23 May 2019

Technical Memorandum

To: Dale Myers, Washington State Department of Ecology

From: Julia Schwarz, Ty Schreiner

Subject: Boeing Field Chevron Pilot Study
K/J 1896033.00

This technical memorandum provides a summary of field oversight conducted by Kennedy Jenks on behalf of the Washington State Department of Ecology (Ecology). On 1 through 3 May 2019, G-Logics conducted an air sparge/soil vapor extraction (AS/SVE) pilot test at the Boeing Field Chevron site located at 10805 East Marginal Way South in Tukwila, WA. G-Logics personnel onsite for the pilot test included Zak Wall and Jon Stordahl. Adam Morine (EPI) was also onsite to help run the pilot test as a subcontractor to G-Logics. Russell Shropshire (Leidos) was onsite on behalf of Chevron on 1 and 2 May 2019. Julia Schwarz of Kennedy Jenks was onsite on 1 through 3 May 2019 to observe the pilot test on behalf of Ecology.

On 1 May 2019, the SVE system was tested in the upper saturated zone to evaluate the efficacy of SVE at the site. A blower step test was conducted extracting air from well SVE-1 at three different flow rates/pressures. A photo log is provided in Attachment A. At each step, flow rates and pressures were measured at SVE-1, a photoionization detector was used to measure volatiles extracted from well SVE-1, and pressures were measured at nearby wells screened in the upper saturated zone. Vacuum was observed in nearby wells. The maximum vacuum achieved at well SVE-1 was approximately 28 in H_20. PID measurements in outflow from SVE-1 were generally around 350 ppm regardless of the vacuum or air flow.

On 2 May 2019, the SVE system was operated at maximum pressure/flow while sparging into the upper saturated zone at AS-1. A photo log from 2 May 2019 is provided in Attachment B. Wells in the upper saturated zone were monitored for pressure, headspace gases with the PID, and bubbles. Observation frequency for these parameters was modified slightly from the work plan given field constraints including time to open wells to observe bubbles, and negative pressures observed in wells (unlikely to be bubbles). Sparging into well AS-1 at a rate of approximately 8 scfm with approximately 8 inches H_20 pressure at the well. PID measurements from well SVE-1 did not significantly increase from the step test day. Following system shutdown, DO measurements in some wells were lower than prior to the start of the test.

On 3 May 2019, the SVE system was operated at maximum pressure/flow while sparging into the lower saturated zone at AS-2. A photo log from 3 May 2019 is provided in Attachment C. Wells in the upper and lower saturated zone were monitored for pressure, headspace gases with a PID, and bubbles, and for DO prior to and following the test. Positive pressure was noted

in lower zone wells prior to starting the test. Pressure fluctuations in the lower zone may be influenced by tidal cycles. Observation frequency for parameters to be collected during the test was again modified from the work plan due to field constraints (e.g. time to collect measurements from all wells). Approximately 9 scfm was injected into AS-2 with a steady pressure of approximately 8 psi. Large amounts of bubbles were observed in some lower saturated zone wells, including IP-5 and IP-7. Limited, intermittent, and small bubbles were noted in some upper saturated zone wells located nearby to AS-2; however, most of the air appeared to still be within the lower saturated zone. During the AS test into the lower saturated zone, PID readings from SVE-1 remained relatively similar to concentrations from the SVE test.

Some questions raised during this pilot test that may need to be answered to accurately assess the efficacy of an AS/SVE system at the site and may be important for design and implementation. These include, but are not limited to:

- How do tidal fluctuations influence the ability to inject air into the lower saturated zone?
- Where is air in the lower saturated zone going? What is the ROI in the lower saturated zone vs. the ROI in the upper saturated zone from sparging in the lower saturated zone? During sparging into the lower saturated zone, bubbles were observed in wells screened in the lower saturated zone, approximately 35 feet away from the sparge well. Small bubbles, but not of the same volume, were observed in closer wells screened in the upper saturated zone.
- Is air within the lower saturated zone traveling along preferential pathways, e.g. the utility corridor?
- Is air traveling along the bottom of the semi-confining layer rather than being released to the upper saturated zone? If so, what are the expected directions of travel and ROI of this air based on the elevation of the confining layer?

Enclosure(s) (3)

Attachment A: Photo log from 1 May 2019
Attachment B: Photo log from 2 May 2019
Attachment C: Photo log from 3 May 2019

***Photo #1**:* Soil Vapor Extraction (SVE) system set up at well SVE-1. SVE system set up to extract from SVE-1 with manifold with several flow meters in order to conduct a step test. Extracted vapor will be run through GAC canister (drum in background).

***Photo #2**:* Measuring vacuum at wells prior to startup of the SVE system.

***Photo #3**:*

System startup of the SVE system. Opening the valves on part of the manifold. Operating at 100% dilution.

***Photo #4**:*

Collecting SVE system sample in a tedlar bag. Sample collected from the SVE system prior to going through the manifold. Sample being drawn through the vacuum pump.

Photo #5:

Measuring concentrations in air leaving the GAC canister using a photoionization detector (PID) measuring in ppm. Low concentrations in air after going through GAC.

Photo #6:

Measuring vacuum in shallow wells during operation of the SVE system. Vacuum observed in nearby shallow wells.

***Photo #7**:*

Measuring vacuum in shallow well MW-26S during operation of the SVE system. Traffic control set up direct traffic around the well.

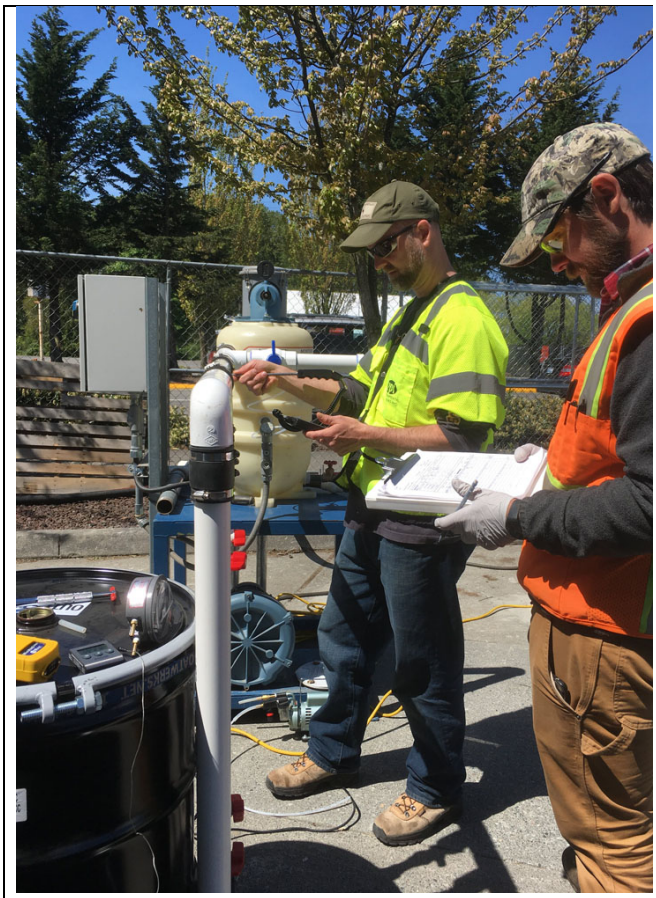

***Photo #8**:*

Measuring airflow between well SVE-1 and the moisture separator with a hot wire anemometer. Flow within the manifold was limited by the flow meters, so one section was changed out for blank PVC with no flow meter (closest upright in picture), and the airflow was measured by hot wire anemometer instead.

Photo #1: Setting up visqueen on gravel area adjacent to AS-1 prior to operation of the air sparge (AS) system.

Photo #2:

Completed setup of visqueen on gravel area adjacent to AS-1. Edge secured with sandbags, and duct taped around trees and visqueen seams.

***Photo #3**:*

SVE setup at well SVE-1, measuring pressure in SVE-1 prior to startup of AS system.

***Photo #4**:*

Collecting an air sample for PID testing from SVE-1. Using a vacuum chamber so that the sample does not go through the vacuum pump. Sample collected prior to going through the manifold.

***Photo #5**:*

Measuring flow in the GAC outflow pipe to compare to flow near SVE-1.

***Photo #6**:*

Setting up for injection into the shallow zone at well AS-1. SVE in operation.

Photo #7:

Using a well camera paired with a phone to inspect shallow well MW-26S for bubbles prior to startup of the AS system.

Photo #8: Initiating startup of the AS system, to blow into shallow well AS-1. AS-1 is located beneath the yellow jacket; concerns were raised about pressurizing PVC so a jacket was placed over the well attachment to protect personnel from PVC pieces in the event that the PVC

***Photo #9**:*

Ground near AS-1 and AS-2 wetted to inspect the surface for bubbles. No bubbles were observed.

***Photo #10**:*

Measuring well head space with a PID while AS (shallow) and SVE systems operating.

***Photo #11**:*

AS system gauges. Injecting into AS-1 at highest measurable flow rate (right gauge at 10 SCFM).

***Photo #12**:* Well attachment at AS-1 with two pressure gauges attached.

Photo #13: Measuring airspace beneath the visqueen near AS-1 with a PID. Readings beneath the visqueen were similar to ambient.

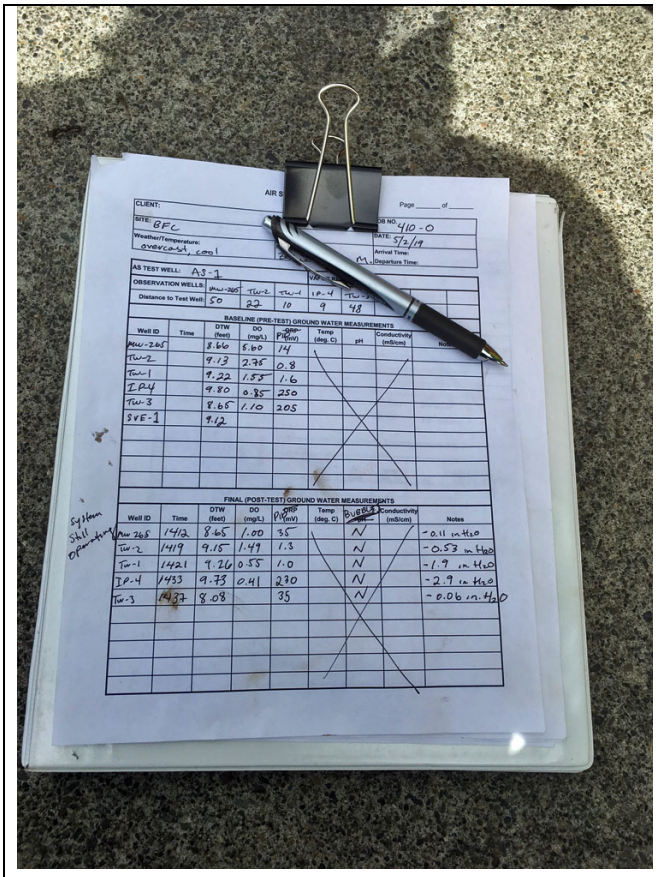

Photo #14:

Data collection sheets for baseline (pre-test) and final (near the end of test) groundwater readings in monitoring wells. Vacuum measured in most shallow wells; DO after operation of AS and SVE systems lower than initial. PID readings generally a similar order of magnitude.

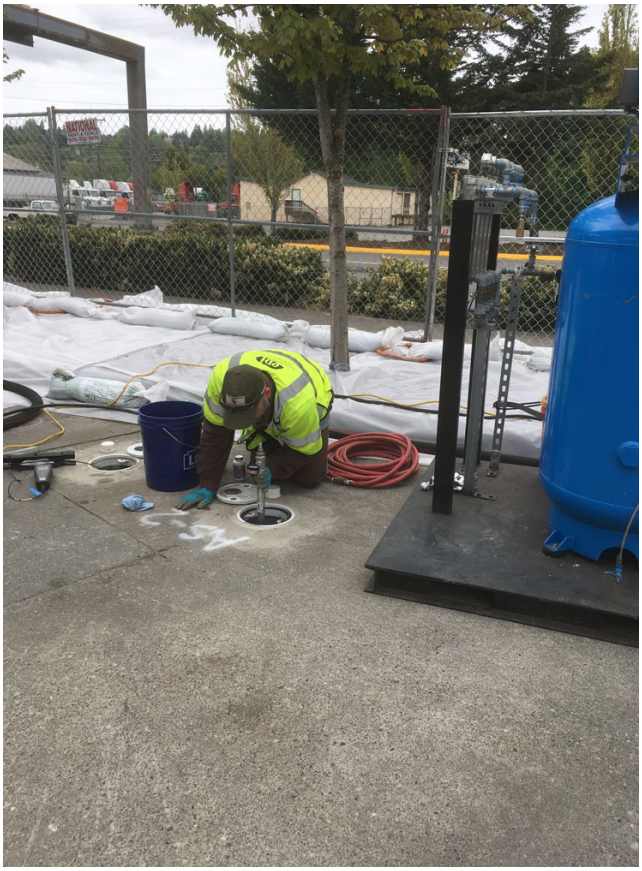

***Photo #1**:*

Setting up steel well attachments for sparging at deep well AS-2.

***Photo #2**:*

Measuring headspace in well IP-4 using a PID.

***Photo #3**:*

Collecting a vapor sample from SVE-1 using a vacuum chamber prior to startup of sparging into AS-2.

***Photo #4**:*

Field screening air extracted from well SVE-1 using a PID and tedlar bag. Concentrations measured with a PID did not change significantly while sparging compared to just soil vapor extraction.

***Photo #5**:*

Measuring pressure/vacuum in each well prior to startup of the AS system in the deep zone.

***Photo #6**:*

Measuring well headspace with a PID at deep well IP-5.

Photo #7:

System startup, sparging into deep well AS-2.

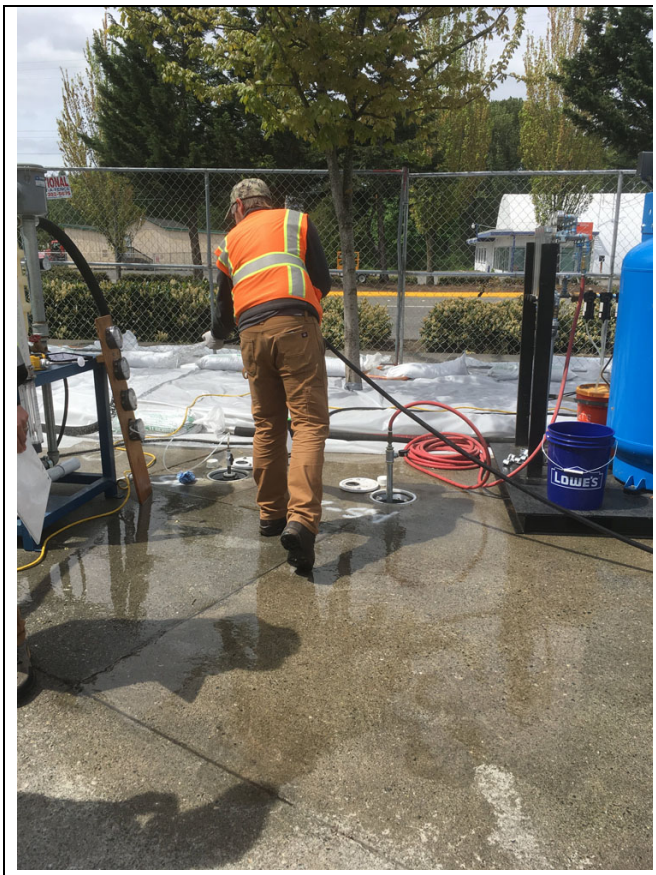

Photo #8:

Wetting down pavement near AS-1 and AS-2 to check for bubbles in the pavement.

***Photo #9**:* Inspecting wet ground for bubbles near IP-5 and SVE-1.

Photo #10:

Using a well camera paired with a phone to inspect well MW-28D for bubbles while sparging into the lower zone and extracting from the upper zone.

Photo #11:

Measuring well headspace in well MW-26D while sparging into the lower zone and extracting from the upper zone.

ATTACHMENTS

Permission and Conditions for Use and Copying Form

Feasibility Study Pilot Test Report, Air Sparge/Soil Vapor Extraction
Boeing Field Chevron, 10805 East Marginal Way South
Tukwila, WA 98168

G-Logics Project 01-0410-O
August 14, 2019

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- I recognize that G-Logics has prepared this Document only for their Client and/or other user(s), only for the purposes stated in the Document and subject to any identified and contractual limitations.
- My intended use of the Document is for general informational purposes only.
- I understand and accept that there may be limitations to the reliability of the Document's findings due to circumstances beyond the control of G-Logics, the limited scope of funding, and/or limitations inherent in the nature of the performed services.
- I agree not to rely on the Document as being comprehensive or inclusive of all possible site hazards and agree to defend, indemnify, and hold G-Logics harmless from and against any and all claims, damages, or liability which arise from or which are alleged to arise from my use of the Document. I also will compensate G-Logics for any time spent or expenses incurred by G-Logics in defense of any such claim.
- I agree not to provide the Document to any other person or organizations without prior authorization from G-Logics and their Client.

I, the Requestor, have reviewed the above-identified conditions for copying/use of the Document, am familiar with the presented limitations of the provided services, and acknowledge my understanding and concurrence, as indicated by my signature below.

Requestor's Company _____

Mailing Address _____

City, State, Zip Code _____

Contact Name & Title _____

Signature & Date _____

Telephone & Fax Numbers _____

Planned Use of Document _____

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With your information and signature above, please fax to G-Logics (425-313-3074) for approval review. G-Logics will share your request with our Client for their approval.

Client Review and Acknowledgment of Use and Copying Request

Per the notification of G-Logics, I, the Client, have reviewed this request for copying/use of this Document, have discussed the request with G-Logics, and grant my consent as indicated by my signature below.

Client Company _____

Client Contact Name & Title _____

Signature & Date _____

Telephone & Fax Numbers _____

G-Logics review and Acknowledgment of Use and Copying Request

Based on your concurrence with the above-presented conditions, approval of our Client, and our review of the information, G-Logics allows the Requestor to copy/use the above referenced Document for purposes stated. Additional fees may apply.

G-Logics Signature _____

Title _____

Date _____