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Jason Goodwin, P.G. Alaska HSE Area Manager
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Via email: jason.goodwin@bakerhughes.com

Subject: Data Gap Review and Site Characterization Work Plan, Baker Hughes Nikiski Completions Facility (Baker Oil Tools – Delores Drive); ADEC File No. 2323.38.055

Dear Mr. Goodwin:

DNA Environmental Consultants, LLC (DNA) has prepared this data gap review and work plan for Baker Hughes Oilfield Operations, Inc. (Baker Hughes) for the Nikiski Completions Facility located in Nikiski, Alaska. The objectives of this document are:

- Identify data gaps preventing the site from being closed by the Alaska Department of Environmental Conservation (ADEC);
- Come to an agreement with ADEC regarding what new site data needs to be collected to fill data gaps;
- Come to an agreement with ADEC regarding what site conditions are needed to acquire a "cleanup complete without institutional controls" and a "cleanup complete with institutional controls" determination; and
- Acquire ADEC approval for a work plan describing the collection of the required soil and groundwater samples needed to fill the identified data gaps.

Previously, the ADEC had planned on providing closure of this site after the completion of a second phase of site characterization work in 2015 and follow-up groundwater monitoring of the well network in 2016. As recent as May 2019, the ADEC had indicated that the site would be closed. In February 2020, ADEC stated that the site could not be closed (ADEC 2020).

1.0 SITE LOCATION AND BACKGROUND CONDITIONS

The Baker Hughes Nikiski Completions Facility is located at 51950 Dolores Drive (a.k.a. Sand Dollar Drive; formerly Old Nikishika Beach Road), in Nikiski, Alaska (see Attachment 1, Figure 1). The 5-acre Baker Hughes Nikiski Completions facility is located within United States Public Land Survey Section 1, Township 7 North (N), Range 12 West (W), Seward Meridian; 60°43'57.75"N latitude and 151°18'2.36"W longitude. Baker Hughes acquired the site from Tri-State Oil Tool Industries, Inc. (Tri-State) in October 1987. Tri-State acquired the property in 1971 from Oil Well Services Company, Inc.

The site is on the Kenai lowland, 55 miles southwest of Anchorage and 12 miles north of Kenai. Cook Inlet lies about 0.6 miles to the north and numerous lakes dot the area. The topography includes gently to steeply sloping low hills that are generally less than 200 feet above sea level. The site surficial soils include ice contract, glacio-fluvial sands and gravels with intermittent layers of poorly graded sand, overlying till, glacio-lacustrine and glacio-marine sediments, and bedrock. The existing boring logs indicate the site soils are relatively uniform. The water table is approximately 40 feet below ground surface (bgs) over most of the developed portion of the site. Previous drilling activities in the area indicated that a confining layer of interbedded sand and silty clay, thin bedded to laminated, exists at approximately 90 feet bgs.

2.0 PREVIOUS INVESTIGATIONS AND REVIEW OF EXISTING DATA

Multiple environmental investigations have been conducted at the Baker Hughes site over the last eight years. A summary of the investigations is presented below, and a compilation of the laboratory results are presented in Attachment 2, Tables 1 through 4. The ADEC updated the contaminated site regulations several times since 2016, and the updates have significantly changed soil and groundwater cleanup levels. This letter and attached data tables screen the past laboratory data against current cleanup levels. (The tables list the pre-2016 cleanup levels for reference). In the attached laboratory data tables, soil and water detections are indicated by a bold font. For soils, individual compound detections exceeding ADEC default cleanup levels, which are typically migration to groundwater cleanup levels, are indicated by gray shading, and detections exceeding 10% of the risk based cleanup level are indicated by underlines (analytes exceeding 10% of the risk based cleanup level are included in the cumulative risk calculations). For the gasoline-range organics (GRO), diesel-range organics (DRO), and residual-range organics (RRO) fractions in soils, the samples with concentrations indicating the presence of non-aqueous phase liquids (NAPL) are highlighted in light yellow (note that the NAPL encountered to date at the Nikiski site is present as immobile residual). Water sample detections exceeding ADEC default cleanup levels are indicated by gray shading, and detections exceeding 10% of the risk based cleanup level are indicated by underlines. The location's site features, soil borings, and monitoring wells are shown on site maps in Attachment 1, Figures 1 and 2.

The following summarizes the findings of the major characterization and cleanup events conducted at the site.

2.1 2012 ADEC Drinking Water Well Sampling

In August 2012, the ADEC, with the permission of Baker Hughes, collected two water samples from the water system that served the Nikiski Completions Building at that time. In 2012, the facility derived water from an onsite well screened in the water table aquifer at the site. The ADEC analyzed the water for a suite of volatile organic compounds (VOCs) and found that the water contained trichloroethylene (TCE) and 1,1,1-tricholoroethane (1,1,1-TCA), with TCE being present at concentrations close to the ADEC cleanup level in effect at the time (5 ug/L). The detection of the TCE and 1,1,1-TCA in the August 2012 samples caused ADEC to conduct confirmation resampling of the Baker Hughes drinking water well in September 2012. The September laboratory results again documented the presence in groundwater of TCE and 1,1,1-TCA, with TCE being present at concentrations slightly greater than the ADEC cleanup level in effect at the time (Attachment 2, Table 1).

The water samples collected in 2012 were part of an area-wide study of groundwater contamination that was prompted by the discovery in 1989 of tetrachloroethylene (PCE) in a community water production well (McGahan Well) located about 300 feet southwest of the Baker Hughes site. The source of the PCE detected in the community water production well was attributed to a former dry-cleaning business located about 700 feet southwest of the Baker Hughes site. Note that PCE was not detected in the Baker Hughes drinking water well samples. As part of the 1989 investigation, three soil borings were installed at the Baker Hughes Nikiski Completions Facility by ADEC (Figure 2, identified as TH-3, P-7, and P-8). Borings TH-3 and P-7 were located in an area where waste (scrap metal) generated during operations by Baker's predecessor Tri-State was allegedly buried. Boring P-8 was located in the approximate alleged vicinity of a Tri-State leach field. Laboratory analytical results for subsurface soil samples collected on Baker Hughes property at TH-3, P-7, and P-8 were all reported as non-detect. Soil screening and sampling in these borings extended to 15 feet bgs.

2.2 2013 Drinking Water Well Sampling

Baker Hughes contracted with Weston Solutions, Inc. to resample the Nikiski Completions Building drinking water well in January, February, and March 2013. During the January sampling event, a water sample was collected from a spigot at the paint shop sink, and during the February and March events, samples were collected from both the paint shop spigot and an upstairs bathroom spigot. Weston had the samples analyzed for the United States Environmental Protection Agency (USEPA) SW-846 list of VOCs. Two VOCs, TCE and 1,1,1TCA, were detected in each sampling event, and TCE was detected close to, but did not exceed, the ADEC cleanup level in effect at that time. The 2013 drinking water well results do exceed the current TCE groundwater cleanup levels (Attachment 2, Table 1). The drinking water well was abandoned, and the Completions Building was connected to a community production well in response to the discovery of TCE in the groundwater at the site.

2.3 2014 Initial Site Investigation

Baker Hughes contracted with Ahtna Engineering Services (Ahtna) to conduct an initial site investigation in May 2014. The objective of the investigation was to assess if the TCE groundwater contamination was attributable to site activities or to an unknown source area. The investigation focused on two potential source areas: the facility wastewater septic leach field, and the sumps and floor drain system in the tool shop building. The investigation included drilling six soil borings (soil borings SB-01 through SB-06); installing monitoring wells in three of these borings (MW-01 through MW-03); and analyzing soil and groundwater samples for the target analytes TCE, PCE, and 1,1,1-TCA (Attachment 2, Tables 2 and 3).

Three of the six soil borings (SB-01 through SB-03) were drilled inside the tool shop building to investigate the shop sumps and drain system, and three were drilled outside the building. Each boring was advanced to approximately 45 feet bgs. Soil cores were collected using direct-push drilling and continuous MacroCore® soil coring tubes. Three primary soil samples were collected for laboratory analyses in each boring, from depths characterized as shallow, moderate, and deep (e.g. 0 to 10, 15 to 30, and 30 to 45 feet bgs). The monitoring wells were installed in the borings outside of the building, with one being installed in the septic system leach field to the north of the building, one installed on the east side of the building, and one installed on the south side of the building. The screened intervals in the wells were between approximately 35 to 45 feet bgs, intercepting the groundwater table.

The laboratory results show that TCE was present in the deep soil samples in each boring, and in the deep soil samples three of the six borings had TCE concentrations exceeding migration to groundwater criteria (Attachment B, Table 3). TCE was detected in a few soil samples at depths shallower than 35 feet, and the concentrations of these shallower detections were lower than the detections in the 35- to 45-foot depth range. PCE and 1,1,1-TCA were not detected in soils in the six borings in the initial site investigation.

TCE and 1,1,1-TCA were detected in groundwater samples from each of the three monitoring wells, and TCE exceeded the ADEC cleanup level in MW-01, which was located in the septic system leach field area, and in monitoring well MW-02, which was located near the east end of the Completions Building (Attachment 2, Table 2). Note that MW-02 met the cleanup level in effect in 2014, but the cleanup level changed such that the May 2014 concentration in MW-02 exceeded the risk-based level. PCE was not detected in the water samples from the three monitoring wells.

A visual assessment of the Completions Building sumps and drain system showed that a pair of concrete sumps were located in the paint shop booth and a pair of concrete sumps were located in a waste storage area. The sumps had multiple pipe openings, but the plumbing layout and integrity could not be visually confirmed. Therefore, hydrostatic testing of the sumps and drain system was conducted. The hydrostatic test consisted of partially filling each sump with water, limiting evaporation, and then monitoring the decrease in water level in the sump to assess the loss of water from the sumps. The tests showed that each sump lost substantial water during the 48-hour test, which indicates that fluids may have been lost from the sumps previously.

2.4 2014 Removal

In July 2014, Baker Hughes determined that the floor drain piping in the tool shop portion of the building terminates in the paint shop sump; that a cleanout outside the Completions Building leads to a tank north of the Completions Building; and that the current septic system leach field does not appear to connect to the floor drains or sumps. In August 2014, the building sumps and drain system were further investigated and a removal action was undertaken. The work was described as occurring in two phases. The Phase 1 work, conducted in early August, included removing the pair of concrete sumps inside the waste water room, removing piping between the paint shop sump and the waste water sump, abandonment by grouting of all interior floor drains, and excavating soils outside the building to uncover three concrete "dry well" or "injection well" structures a few feet north of the tool shop building as well as an oil-water separator and a leach field about 50 to 100 feet north of the building. The Phase 2 work, conducted in late August, included the removal or in situ decommissioning of the dry wells, the removal of the oil-water separator and some piping, the excavation of impacted soils, and the collection of soil samples representative of soils remaining in situ.

The three dry wells consisted of sections of 4-foot diameter concrete pipe installed vertically, with an open bottom resting in drain rock. The three dry wells were plumbed such that a sump in the building discharged fluid to one well, the overflow from the first well entered a second well, and the overflow from the second well entered the third well. The third dry well was located partly under the wastewater room of the Completions Building. After exposing the dry wells, some initial soil samples were collected following USEPA guidance for Class Five injection wells. In Phase 2 of the removal action, two of the dry wells were excavated, and the third dry well (which was partially under the building) was abandoned in place by filling with concrete. Impacted soils around and under the dry wells were removed and stockpiled, and the in-situ soils at the limit of excavation were sampled. Note that the soils represented by the Phase 1 soil samples were excavated and included in the soil stockpiles, and that the soil stockpiles were sampled and then properly disposed of by Emerald Alaska. Soil sample analytical results from the removal action are compiled in Attachment 2, Tables 3 and 4, and in the table, there are notes indicating whether the soils represented by the sample were excavated or remain in situ.

The oil-water separator was a 1,800-gallon (5-foot diameter by 12-foot long) steel tank that appeared to have received fluids from sumps in the Completions Building and discharged fluids to a leach field north of the oil-water separator. In Phase 1 of the removal action, the soils overlying the tank were excavated, the tank contents were removed and disposed of by Emerald Alaska (now NRC), and some initial soil samples were collected following USEPA guidance for Class Five injection wells and ADEC guidance for underground storage tanks. In Phase 2 of the removal action, the oil-water separator tank, the piping between the building and the tank, and 30 feet of perforated leach field piping north of the tank were removed. Note that the perforated leach field drain pipe, 30 feet north of the oil-water separator tank, was left in place, and that the total length of the leach field was not investigated nor known. While removing the piping between the building and the tank, the soil at each pipe joint was screened for an indication of leaks; no leaks were discovered. Impacted soils around and under the oil-water separator tank and along the perforated leach field piping north of the tank were removed and stockpiled, and the in-situ soils at the limit of excavation were sampled. As described above, the perforated leach field line was not completely excavated; rather, an unknown length of the line remains in place. Note that the soils represented by the Phase 1 soil samples were excavated and included in the soil stockpiles, and the soil stockpiles were sampled and then properly disposed of by Emerald Alaska.

The soil samples collected during the removal action were analyzed for GRO, DRO, RRO, VOCs, semi-volatile organic compounds (SVOCs) including polycyclic aromatic hydrocarbon (PAHs), polychlorinated bi-phenols (PCBs), and eight Resource Conservation and Recovery Act (RCRA) metals (Attachment 2, Tables 3 and 4). The laboratory data indicate there are two soil source areas: one associated with the oil-water separator, and one associated with the cement dry wells.

The laboratory tests, representative of the in-situ soils associated with the oil-water separator following the removal action, show the following:

- The organic compounds benzo(g,h,i)perylene, pyrene, bis-2-ethylhexyladipate, butyl benzyl phthalate, and 4-Nitrophenol were detected at concentrations less than the Method Two cleanup levels and less than 10% of respective risk-based cleanup levels (no other VOCs were detected in the soil samples);
- No SVOCs were detected in the soil samples;
- The metals mercury, cadmium, nickel, and vanadium are present at concentrations less than the Method Two cleanup levels and less than 10% of associated risk-based cleanup levels;
- DRO and TCE were detected at concentrations greater than the ADEC Method Two migration to groundwater cleanup levels but less than the associated Method Two risk-based levels;
- Arsenic and lead were detected at concentrations greater than the risk-based cleanup levels;
- Chromium was detected at less than the total chromium cleanup levels but was not speciated to assess hexavalent chromium (chromium VI) concentrations, and the measured total chromium concentrations were greater than the chromium VI risk-based cleanup levels;
- Barium was detected at concentrations greater than the Method Two migration to groundwater cleanup level and greater than 10% of the risk-based cleanup level in one boring.

These laboratory data are interpreted to indicate that fuel hydrocarbons, chlorinated solvents, and paints were released to the oil-water separator and the associated leach field. The highest measured in-situ DRO and RRO concentrations were encountered in the oil-water separator leach field about 10 feet north of the oil-water separator tank. The metals detected at the site are interpreted to be due to both naturally occurring metals and site contaminants. The highest lead, barium, cadmium, and chromium concentrations appear to be associated with soils having high DRO and RRO concentrations as well as plasticizer detections (bis-2-ethylhexyladipate) and are interpreted to indicate soils impacted by paints. Note that the arsenic distribution is relatively uniform throughout the site soils and not higher in soils with high DRO, RRO, lead, or barium concentrations, and therefore it is interpreted to be present primarily as naturally occurring arsenic and not a site contaminant. Also note that the site arsenic and chromium concentrations are less than the average arsenic and chromium concentrations in a United States Geological Survey (USGS) geochemical data base for Southcentral Alaska (Bailey et.al. 2010). The USGS average arsenic concentration is 18.4 mg/kg, and the Nikiski site maximum arsenic concentration is 7.7 mg/kg. The USGS average chromium concentration is 140 mg/kg, and the Nikiski site maximum in-situ chromium concentration is 81 mg/kg (230 mg/kg maximum in excavated soil). The USGS database contains metals concentration data from approximately 368 stream soil samples that were interpreted to represent background or naturally occurring metals concentrations in Southcentral Alaska (i.e. the samples were not collected at known contaminated sites or at known mineralized locations).

The laboratory tests, representative of the in situ soils associated with the dry wells following the removal action, indicate that DRO is present at a concentration greater than the associated migration to groundwater cleanup level, but the concentrations are less than the risk-based concentration, and that all other analytes were less than both migration to groundwater and risk-based cleanup levels (with the exception of chromium if it is present as chromium VI and arsenic which is interpreted to be present as naturally occurring arsenic).

The laboratory data from the soils that were excavated and disposed of during the removal action are shown on the right side of Attachment 2, Table 4. The results are generally similar to the in-situ results, although they have higher concentration detections and indicate the release of fuel hydrocarbons, chlorinated solvents, and paints through the dry wells as well as the oil-water separator and its leach field.

2.5 2014 Groundwater Monitoring

In August 2014, while the removal action was occurring, groundwater samples were collected from the three monitoring wells existing at that time and analyzed for USEPA VOCs (Attachment 2, Table 1). The laboratory reported detections of TCE and 1,1,1-TCA in all three wells, and detected cis-1,2-dichlorothene (cis-1,2-DCE) and 1,1,2-trichloroethane (1,1,2-TCA) in monitoring well MW-01. TCE was detected at a concentration greater than the groundwater risk-based cleanup level in monitoring well MW-01. The 1,1,2-TCA detection was reported at a concentration less than the groundwater risk based cleanup level in effect before 2016, but the measured concentration in 2014 exceeds the current 1,1,2-TCA risk-based groundwater cleanup level. PCE was not detected in the three monitoring wells.

2.6 2015 Phase II Site Characterization

In May 2015, Baker Hughes contracted DNA to conduct a second phase of site characterization work. The objectives of the work were to 1) further delineate the extent of the TCE groundwater plume; and 2) assess the presence and extent of soil contamination at the location of the dry wells, the oil-water separator leach field, the septic system leach field, and at the east end of the Completions Building. The investigation included drilling 12 soil borings (SB-07 through SB-18) and installing monitoring wells in five of these borings (MW-04 through MW-08). Each boring was advanced to a total depth of approximately 45 feet bgs, except for the boring in the northeast corner of the site which extended to a depth of about 80 feet bgs due to a higher ground surface in this area (this boring was significantly upslope of the Completions Building and the equipment yard around the building). Soil cores were collected with continuous MacroCore® soil coring tubes and direct push drilling technology. Four primary soil samples were collected for laboratory analyses in most borings, from depths characterized as shallow, moderate, and deep (e.g. 0 to 10, 15 to 30, and 30 to 45 feet bgs). The borings encountered primarily glacio-fluvial sand and gravels. Five of the borings were used to install monitoring wells, including one at the location of the oil-water separator leach field (MW-04) and one at the location of the dry wells (MW-05). The screened intervals in the wells were 10 feet long and ranged from a top of screen of 37 feet bgs at MW-06 to a bottom of screen of nearly 57 feet bgs at MW-07.

The soil samples collected at the oil-water separator leach field location (SB-08) and dry well location (SB-09) were analyzed for DRO, RRO, VOCs, SVOCs and RCRA metals (Attachment 2, Tables 3 and 4). Soil samples from the other borings and all groundwater samples were analyzed for the target analytes TCE, PCE, and 1,1,1-TCA. The soil laboratory results show the following:

- Boring SB-08 was drilled at the location of the oil-separator leach field sample that had the highest in situ DRO, RRO, barium, and lead concentrations. The laboratory results document DRO concentrations greater than the migration to groundwater cleanup levels, with elevated RRO and lead results reported in the shallow sample (6.9 feet bgs). The TCE concentration was greater than the migration to groundwater cleanup levels occured in the samples from 30 and 43 feet bgs. All other organic compounds and metals that are understood to be site contaminants were detected at concentrations less than the ADEC migration to groundwater and risk-based cleanup levels (except potentially chromium, if chromium is present as chromium VI). Monitoring well MW-04 was installed in this boring.
- Boring SB-09 was drilled at the location of the concrete dry wells, and the soil test results indicated that no organic compounds or metals that are understood to be site contaminants exceeded ADEC migration to groundwater or risk based cleanup levels (except potentially chromium if chromium is present as chromium VI). TCE was detected in the samples from 8.33 feet bgs and 41.5 feet bgs, but at concentrations significantly less than the migration to groundwater and risk based cleanup levels. In addition, arsenic and chromium were detected in the boring, but it is likely that the arsenic and the majority of the chromium is naturally occurring (the chromium has not been speciated to assess chromium VI concentrations). Monitoring well MW-05 was installed in this boring.
- Borings SB-10, SB-11, and SB-12 were drilled in the septic system leach field surrounding MW-01. The soil samples were analyzed for TCE, PCE, and 1,1,1-TCA only. TCE was detected in most of the soil samples, and concentrations in SB-11 and SB-12 were reported as greater than the migration to groundwater cleanup level at some depths. PCE was only detected in one sample from these borings,

and the detection did not exceed cleanup levels. Although 1,1,1-TCA was detected in several samples, the concentrations reported for 1,1,1-TCA did not exceed cleanup levels in any of the samples.

- Borings SB-13, SB-14, and SB-15 were drilled at the eastern end of the Completions Building surrounding MW-02. The soil samples were only analyzed for TCE, PCE, and 1,1,1-TCA. TCE was detected in most of the soil samples, and the reported concentrations in SB-13 were greater than the migration to groundwater cleanup level. PCE and 1,1,1-TCA were not detected in any of the samples.
- Borings SB-07, SB-16, SB-017, and SB-18 were distributed near the perimeter of the site. The soil samples were analyzed for TCE, PCE, and 1,1,1-TCA only. TCE was detected in a few of the soil samples, and concentrations in SB-17 were above the migration to groundwater cleanup level at shallow and medium depths. PCE was not detected, and 1,1,1-TCA was detected in SB-18 at concentrations below cleanup levels. Monitoring wells MW-06, MW-07, and MW-08 were installed in these borings.
- All of the monitoring wells at the site were sampled and analyzed for TCE, PCE, and 1,1,1-TCA. The laboratory reported detections of TCE and 1,1,1-TCA at MW-01, MW-02, MW-03, MW-04, MW-05, and MW-08. In addition, 1,1,1-TCA was detected at MW-07 and PCE was detected at MW-04. TCE was the only analyte detected at a concentration that exceeded a groundwater risk-based level, with the only location of the exceedance being at MW-01.

2.7 2015 Groundwater Monitoring (August and December)

DNA conducted groundwater monitoring at the Nikiski site in August and December 2015. Groundwater samples were collected from the eight monitoring wells in August and from seven monitoring wells in December (one well had frozen sampling lines). The samples were analyzed for TCE, PCE, and 1,1,1-TCA, and the laboratory results were similar to the previous results. TCE and 1,1,1-TCA were detected at monitoring wells MW-01, MW-02, MW-03, MW-04, MW-05, and MW-08. In addition, 1,1,1-TCA was detected at MW-07, and PCE was detected at MW-04.

TCE was the only analyte which exceeded its groundwater risk-based level, and the risk-based level was only exceeded at MW-01.

2.8 2016 Additional Delineation and Groundwater Monitoring (February and May)

DNA installed two additional monitoring wells and conducted groundwater monitoring at the Nikiski site in February 2016. The monitoring wells were installed to the north, northwest, and west of the Completions Building and were installed to assess potential off-site transport of groundwater contaminants. Four original soil samples were collected from each boring for the monitoring wells and analyzed for TCE, PCE, and 1,1,1-TCA (Attachment 2, Tables 2 and 3). The target analytes were not detected in any of the soil samples. Groundwater samples were collected from nine of the site monitoring wells in February (one well had frozen sampling lines), and the samples were analyzed for TCE, PCE, and 1,1,1-TCA. TCE was the only analyte which exceeded its groundwater risk-based level, and the risk-based level was only exceeded in MW-01.

DNA conducted another quarterly round of groundwater monitoring at the Nikiski site in May 2016. Groundwater samples were collected from all ten of the site monitoring wells, and the samples were analyzed for TCE, PCE, and 1,1,1-TCA. TCE was the only analyte which exceeded its groundwater risk-based level, and the risk-based level was only exceeded in MW-01.

DNA performed a Mann-Kendal trend analysis, and the results indicated that there was a significantly decreasing concentration trend for TCE in monitoring wells MW-01 and MW-02, and that there was an apparent dissolved phase half-life on the order of two years.

3.0 CONCEPTUAL SITE MODEL

Releases of hydrocarbons, chlorinated solvents, and paints appear to have occurred at two locations at this site:

- Dry wells formerly located a few feet north of the Completions Building; and
- An oil-water separator and its perforated pipe leach field located about 50 to 100 feet north of the Completions Building.

At both locations, DRO and RRO hydrocarbon NAPLs, chlorinated solvents, and metals likely associated with paint were detected in soil samples that remain in situ. In addition, chlorinated solvents appear to have been released through the septic system leach field due to the fact that the dissolved phase TCE concentrations are highest in monitoring well MW-01 in the septic system leach field area.

A human health Conceptual Site Model (CSM) was developed for this site in accordance with ADEC guidance (ADEC 2017). The CSM includes a graphical depiction of site conditions and identifies source and release mechanisms, impacted media, transport mechanisms, exposure pathways, and current and future receptors. The completed ADEC Human Health CSM Scoping Form, Graphic, and Ecoscoping Form are included in Attachment 3.

3.1 Source and Release Mechanisms, Impacted Media, and Transport Mechanisms

The primary release mechanisms of contaminants at the Nikiski site are interpreted to include petroleum NAPL, dissolved phase solvents and paint releases to the dry wells and the oil-water separator leach field, and dissolved phase solvents to the septic system leach field. The left side of the CSM Human Health Conceptual Site Model Graphic Form (Graphic Form, Attachment 3) indicates the primary remaining contaminant sources are the subsurface soils at the dry well and oil-water separator leach field locations that have been impacted with hydrocarbon NAPLs and metals as well as low concentration, widely distributed soils near the water table that show TCE detections. Farther to the right on the Graphic Form, the transport mechanisms are identified. The remaining hydrocarbon NAPLs in the soil are interpreted to be immobile residual (i.e., they will not flow as a separate phase). Individual hydrocarbon and solvent constituents in the NAPL, however, will tend to partition into the vapor, dissolved, and adsorbed phases according to the phase-partitioning relationships. Vapors would tend to migrate toward the ground surface and atmosphere by the processes of diffusion (which is driven by concentration gradients) and advection (which is driven by pressure gradients). Dissolved constituents in the soil moisture in the vadose zone will tend to be carried to the water table by infiltrating precipitation, and dissolved-phase constituents reaching the saturated zone will be transported downgradient by the flowing groundwater. Natural attenuation processes will tend to reduce near-surface concentrations of organic compounds first and then the concentrations at depth (due to the processes of volatilization and dissolution into infiltrating precipitation). Both vapor and dissolved-phase constituents of the organic compounds will tend to be sorbed and biodegraded (albeit very slowly for the chlorinated compounds) during transport.

3.2 Exposure Media, Exposure Pathways, and Receptors

An exposure pathway evaluation identifies the means by which people, animals, and plants might come into contact with chemicals in environmental media (soil, water, and air). ADEC makes site closure decisions based on a land-use scenario that assumes the site is used for residential purposes and that the primary exposure pathways are complete. ADEC's primary exposure pathways include soil ingestion, dermal adsorption from soil, inhalation of fugitive dust, outdoor air inhalation, vapor intrusion, groundwater ingestion, dermal contact with groundwater, and volatilization from groundwater used as tap water.

The right side of the Graphic Form shows potential exposure media, exposure routes, and receptors. It also indicates whether complete exposure routes are for current or potential future receptors, or an insignificant exposure pathway. Exposure pathways at the Nikiski site are as follows:

- The soil exposure routes are checked as being potentially complete routes because hydrocarbon-solvent- and metals-impacted soil is present within 15 feet of the ground surface. There are currently no residential buildings at the Nikiski site, so soil exposure routes are identified as "future" exposure routes for residents (not current exposure routes). Site workers and site visitors may contact site soils, so the soil exposure routes are considered to be current routes for site workers and site visitors. Site construction workers, subsistence harvesters, and subsistence consumers may potentially contact site soils, but the routes are considered to be insignificant exposure routes due to the low duration and low frequency of exposure for these receptors. The sediment exposure routes are also considered to be incomplete for present and future receptors because there are not sediments at or near the site.
- The groundwater is recognized as a potential future source of tap water at the Nikiski site, so the groundwater exposure routes are all identified as complete future routes on the Graphic Form (Attachment 3). Surface water is not present at or close to the site, so it is interpreted to be an incomplete pathway for current or future tap water and incomplete for incidental ingestion and dermal contact with surface water.
- The outdoor air and inhalation of fugitive dust exposure routes are considered to be potentially complete routes. For site residents, the outdoor and indoor air routes are considered to be potential future routes because there are no current residential buildings on the property. For site workers and site visitors, the outdoor and indoor air routes are considered currently complete. For site construction workers, subsistence harvesters, and subsistence consumers, the air exposure routes are considered to be insignificant routes.
- For potential residents, site workers, site visitors, construction workers, subsistence users, and subsistence consumers, the ingestion of wild or farmed foods is considered incomplete or insignificant because plants tend to not accumulate hydrocarbons or chlorinated solvents, and the site does not provide significant habitat for subsistence use.

4.0 HYDROCARBON RISK CALCULATOR RESULTS

The Hydrocarbon Risk Calculator (HRC) tool was used to characterize risk, help assess compliance with the closure criteria in the regulations, and help identify data gaps. The HRC is a spreadsheet tool that can be used to calculate human health risk, alternative cleanup levels (ACLs), and to help support cleanup complete determinations with or without Institutional Controls (ICs). The HRC can also be used to help evaluate remedial action strategies. The HRC uses more representative (and commonly less conservative) calculations than are in used in the ADEC online calculator, and, therefore, it may show lower risk than the ADEC online calculator. The HRC has been peer reviewed and approved for use by ADEC (ADEC 2020). The HRC is typically used to calculate the risk associated with a NAPL–impacted soil. For the purposes of this project, the source area is the three-dimensional NAPL-impacted soil volume with GRO and/or DRO concentrations greater than the ADEC Method Two, under 40-inch zone, migration to groundwater cleanup levels of 300 and 250 mg/kg respectively, and RRO concentrations greater than 250 mg/kg (Geosphere Inc, et al. 2011). Co-located with the hydrocarbon contaminated soil is soil impacted by chlorinated solvents and organic chemicals and metals associated with paint. The groundwater underlying a portion of the site has detectable concentrations of chlorinated solvents. The risk associated with the metals is tabulated and displayed on a new page inserted into the HRC.

4.1 HRC Inputs

Input to the HRC includes soil and groundwater chemical concentration data as well as soil and groundwater physical condition data representative of the site. Exposure point concentrations are the concentrations used as input to the risk calculations. The soil exposure point concentrations used in these preliminary calculations are the maximum measured concentrations if there were detections, or the maximum reporting limit (for VOCs) or maximum level of detection (for PAHs) as there were no detections in 2015 for DRO, RRO, BTEX and chlorinated VOC, PAH, and metals data from the oil-water separator location. It would be more representative to use 95% upper confidence limit (UCL) values as inputs for the soil exposure point concentrations, but there was not enough data currently available from the oil-separator leach field area to calculate 95% UCLs. Also note that the maximum BTEX and PAH reporting limits and level of detection values appear to be elevated at the oil-water separator location because the sample had relatively high DRO and RRO concentrations. The water exposure point concentrations are the maximum May 2016 groundwater concentrations (most recent data available) for TCE; the maximum detected 1,1,2-TCA concentration from the 2014 data set (the most recent data available for this compound); and the groundwater concentrations modeled from soils data for the hydrocarbon compounds (the modeling uses the 4-phase partitioning with Raoult's Law calculations in the HRC). The modeled data was used because hydrocarbon concentrations in groundwater have not been measured at the oil-water separator location.

The maximum DRO and RRO concentrations from the oil-separator leach field source area are 2,600 and 6,200 mg/kg respectively. These values are less than the maximum allowable concentrations described in footnote 17 to ADEC Table B2, and no free product was observed in site monitoring wells. Therefore, the mobility concerns in Footnote 17 to ADEC Table B2 and 18 AAC 75.325(f) are met.

The soil properties and hydrogeologic conditions used as input to the HRC are estimates based on site data, literature values, and/or ADEC default values, as shown in Attachment 4, Table 1 and 2. The source area soil gas concentrations were modeled using the 4-phase partitioning with Raoult's Law equations in the HRC.

4.2 HRC Results

The HRC input and output calculations for the Nikiski site areas are provided in Attachment 4, Tables 1 through 4. The HRC assumes a residential land use scenario with all ADEC default exposure pathways complete when assessing risk and compliance with the regulations. The exposure pathways include soil ingestion, soil dermal contact, particulate inhalation, outdoor air inhalation, indoor air inhalation, groundwater ingestion, groundwater dermal contact, and inhalation of VOCs from tap water. Based on site-specific contaminant and non-contaminant input parameters, and assuming that all primary exposure pathways are complete, the HRC results for the Nikiski source area indicate that site conditions do not meet the ADEC human health risk standard established in 18 AAC 75.325. Details are as follows:

- The carcinogenic cumulative risk, posed by the individual indicator compounds, exceeds the risk standard, assuming a residential land-use scenario and assuming that all primary exposure pathways are complete. TCE is the primary risk driver, and it presents more than two times the allowable risk level with the majority of the risk associated with the use of the groundwater as tap water. The HRC results indicate that other carcinogenic risk contributors include benzene via the vapor intrusion and groundwater use route, even though benzene was not detected. This indicates that lower reporting limits and level of detection values are needed in subsequent site investigations (including the use of USEPA method 8260-SIM test methods).
- The non-carcinogenic cumulative risk, posed by the individual indicator compounds, exceeds the risk standard, assuming a residential land-use scenario and assuming that all primary exposure pathways are complete. TCE is the primary risk driver, and it presents more than four times the allowable risk level with the majority of the risk associated with the use of the groundwater as tap water. The HRC results indicate that other non-carcinogenic risk contributors include 1,1,2-TCA via the vapor intrusion and groundwater use routes (even though 1,1,2-TCA was not detected in the source area soil samples). This indicates that lower reporting limits and level of detection values are needed in subsequent site investigations (including the use of USEPA method 8260-SIM test methods).
- The risk posed by the DRO and RRO aromatic and aliphatic fractions meet the risk standard for the soil direct contact exposure pathway, assuming a residential land-use scenario.
    - DRO aliphatics are present at about 23% of the allowable risk level and DRO aromatics are present at about 14% of the allowable risk level. The DRO aromatic and aliphatic risk based cleanup levels are 4,056 mg/kg and 10,139 mg/kg respectively. The total DRO cleanup is approximately 12,517 mg/kg, given the DRO is 20% aromatics (this is the approximate average DRO aromatic percentage for diesel fuel from several hundred laboratory tests of Alaskan samples).
    - RRO aliphatics are present at about 2% of the allowable risk level and DRO aromatics are present at about 81% of the allowable risk level. The RRO aromatic and aliphatic risk based cleanup levels are 3,042 mg/kg and 202,778 mg/kg respectively.
- The migration to groundwater calculations indicate that the TCE soil concentrations may cause TCE to exceed groundwater cleanup levels (and TCE does exceed groundwater cleanup levels). All other organic compounds appear to meet migration to groundwater criteria.
- Metals are interpreted to be present in the site soils as naturally occurring metals and as contaminants likely associated with paint. Risk associated with metals and compliance with cumulative risk criteria are shown on Table 4 of Attachment 2. The 1000 mg/kg maximum lead detection in the oil-water separator leach field (which is at the same location as the highest DRO and RRO detections) is above the residential risk based cleanup level of 400 mg/kg and above the industrial site cleanup level of 800 mg/kg. Lead is not included in the cumulative risk calculation but is used as a separate or independent pass-fail criterion when assessing if a site is suitable for a “cleanup complete without ICs” determination.

Barium was detected above 10% of its risk based cleanup level and therefore is included in the cumulative risk calculations. The maximum barium concentration presents approximately 13% of the allowable risk. Cadmium was not detected in in situ soils at a concentration greater than 10% of the risk-based concentrations, so it was not included in the cumulative risk calculations. Arsenic is interpreted to be present as a naturally occurring metal and consequently was not included in the risk calculations. Total chromium was measured at the site, and provided chromium is present as chromium III, it does not contribute significantly to the site risk.

- As shown on Table 4 of Attachment 2, under a residential land use scenario, if the shallow aquifer groundwater is not used for drinking (i.e. an IC is placed on the site prohibiting shallow aquifer use), then the site still does not meet risk criteria due to the presence of lead above risk based levels and the limited characterization of lead at the site. The cumulative risk posed by organic compounds and carcinogenic and noncarcinogenic metals via the soil ingestion, soil dermal contact, particulate inhalation, outdoor air inhalation, and indoor air inhalation routes appear to meet the ADEC risk standard.
- Under an industrial land use scenario, which is how the property is used now and likely how the property will be used in the future, the risk posed by the site contaminants are much lower than those described above for the residential use scenario. However, if the shallow aquifer groundwater in not used for drinking, then the site still does not meet risk criteria due to the presence of lead above industrial site risk-based levels and the limited characterization of lead at the site. Given that water is obtained from a water utility, the outdoor worker cumulative carcinogenic and noncarcinogenic risks from the organic compounds and carcinogenic and noncarcinogenic metals are approximately 11% and 18% of the allowable risk levels respectively.

In summary, given the current knowledge of soil and groundwater concentrations, the Nikiski site conditions are not protective of human health under an unrestricted (residential) land-use scenario and are not protective under an industrial land use scenario and hence the site is not eligible for a “cleanup complete without ICs” determination. The site may be eligible for a “cleanup complete with ICs” determination given that the ICs prohibit use of the shallow aquifer groundwater as tap water and restrict excavation in the vicinity of the oil-water separator leach field where lead has been measured at concentrations above the lead soil cleanup level. The prohibition on use of the shallow aquifer may not be needed if additional monitoring documents that TCE and 1,1,2-TCA have attenuated to below risk-based levels. The restriction on excavation in the vicinity of the oil-water separator leach field may not be needed if further site characterization shows that lead meets risk criteria or if a removal action targeting lead (and potentially other chemicals) is undertaken. The site does not appear to contain mobile or migrating product.

5.0 ENVIRONMENTAL AND ECOLOGICAL CLOSURE CONSIDERATIONS

The contaminated site regulations (e.g. 18 AAC 75 sections 325, 340, and 380) require that levels of contaminants remaining at a site be protective of the environment and provide several criteria to be evaluated. Applicable environmental criteria are currently met when the following conditions are considered:

- No surface soil staining was present.
- No stunted vegetation was observed at the site during sampling activities, and plants tend to not accumulate significant levels of hydrocarbons or chlorinated VOCs in their tissues. Metals may

accumulate in plant tissue, but the oil-water separator leach field source area is in an equipment yard that is devoid of vegetation and below the root zone depth of most plants.

- There are likely no impacts to terrestrial animal populations based on the understanding that animals feeding on plants at the site are not impacted because there is little to no accumulation of petroleum hydrocarbons or chlorinated solvents in plant roots, wood, stems, leaves, or fruit (ITRC 2009); regional populations of small soil dwelling animals are not impacted because the source area is relatively small and not exposed at the ground surface, and the site soils are densely compacted and do not significantly support small soil dwelling animals; regional populations of large animals feeding on the small soil dwelling animals have large feeding ranges relative to the source area; and the source area is not productive habitat as it is in an operating equipment yard.
- The Nikiski site is in a developed area, and there are not sensitive environments, valued species, subsistence use, critical habitats, or fish at the site. The site is neither in, nor immediately adjacent to, parkland. Given these conditions, the site appears to qualify for the ADEC ecological scoping form off-ramp associated with Item 3, Habitat.
- The residual contamination at the site is currently considered to be protective of the environment because there is not surface water on the site and monitoring shows that dissolved phase contaminants are not migrating off site. The equipment yard surface soils are generally not contaminated, which limits or eliminates contaminated surface water runoff and/or contaminated sediment production and transport, and there is no visible sediment transport from the site to surface water bodies.

Risk to the environment has been evaluated using the ecological scoping process and the ecoscoping form described in the ADEC Ecoscoping Guidance (ADEC 2014). The ecoscoping form indicates that a more in-depth risk evaluation is not needed and that the Nikiski site conditions are protective of the environment. The completed ecoscoping form is presented in Attachment C.

6.0 SITE CONDITIONS, ASSUMPTIONS, AND IDENTIFICATION OF DATA GAPS

This section briefly reviews the site geologic and hydrogeologic conditions; site contaminants and contaminant concentrations relative to screening levels; and assumptions used to date and that are proposed to be used going forward for risk calculations. The objective of the section is to come to an agreement on what site conditions are, what data gaps exist, and what data needs to be collected to characterize risk for potential “cleanup complete without ICs” and “cleanup complete with ICs” determinations.

Site conditions and assumptions are as follows:

- The topography includes gently to steeply sloping low hills that are generally less than 200 feet above sea level. Cook Inlet lies about 0.6 miles to the north, and numerous lakes are scattered throughout the area (the nearest lake is approximately 1000 feet northwest of the site). There are no streams in the vicinity of the Nikiski site.
- The site soils include ice contract, glacio-fluvial outwash sands and gravels with intermittent layers of poorly graded sand, overlying till, glacio-lacustrine and glacio-marine sediments, and bedrock (Reger, DGGS, 2007). The existing boring logs indicate that the site soils are relatively uniform. Based on the reported soil textures and slug tests at a nearby property, the hydraulic conductivity of the water table aquifer is interpreted to be similar to the ADEC default hydraulic conductivity value to one or two orders

of magnitude higher than the ADEC default hydraulic conductivity value. The hydraulic gradient is on the order of the ADEC default value to approximately two to three times higher than the ADEC default value.

- The water table is at an approximately 40-foot depth over most of the developed portion of the site. Previous drilling activities in the area indicated that a confining layer of interbedded sand and silty clay strata exists at approximately 90 feet bgs, and drinking water wells in the Nikiski area have been described as being completed in the confined aquifer (presumably below the fine-grained soils at an approximately 90-foot depth).
- Three source areas have been identified at the site – the septic system leach field, the oil-water separator leach field, and the dry well infiltration source areas. Samples have been collected from soils representative of in situ soils as well as representative of excavated soils, sediment in the oil-water separator, dry wells, and the building sumps. The soil samples have been analyzed for GRO, DRO, RRO, VOCs, SVOCs, PCBs, and metals.
- The samples representative of excavated soils and the building sumps, dry wells, and oil-water separator have significantly higher concentrations that those representative of the remaining in situ soil samples and are useful in identifying what could be present in site soils as well as documenting near worst-case conditions. Laboratory detections in samples representative of the excavated soils and the contents of the building sumps, dry wells, and oil-water separator include GRO, DRO, RRO, BTEX compounds, several chlorinated VOCs, several additional hydrocarbon compounds (e.g. trimethylbenzenes and propylbenzene), several PAHs, several SVOCs (e.g. plasticizers interpreted to be associated with paints), and metals. Of the compounds detected in the samples representative of excavated soils and the contents of the building sumps, dry wells, and oil-water separator, only DRO, RRO, bis(2-ethylhexyl)phthalate, arsenic, barium, lead, and potentially chromium (if chromium is present as chromium VI) exceed risk based criteria.
- Metals detected at the site are interpreted to be due to both naturally occurring metals and site contaminants. The highest lead, barium, cadmium, and chromium concentrations appear to be associated with soils having high DRO and RRO concentrations as well as plasticizer detections and are interpreted to indicate soils impacted by paints.
- The soil samples representative of the remaining in situ soils detected similar compounds as were detected in the excavated soils, but at significantly lower concentrations:
    - Chemicals or compounds of potential concern (COPCs) are defined as a site contaminant exceeding the ADEC migration to groundwater cleanup levels or 10% of the risk-based concentration screening criteria. The chemicals that have been detected in samples representative of in situ soils at concentrations exceeding these screening levels include DRO, RRO, TCE, lead, barium, and potentially chromium, if chromium is present as chromium VI;
    - Additional compounds detected in in situ soils at concentrations below screening levels include TCE, benzo(g,h,i)perylene, pyrene, bis(2-ethylhexyl)phthalate, 4-Nitrophenol, PCBs (Araclor 1260), and cadmium;
    - Known COPCs in groundwater include only TCE and 1,1,2-TCA;
    - Additional compounds detected in groundwater at concentrations below screening levels include PCE, 1,1,1-TCA, and cis-1,2-Dichloroethene;

  - Groundwater has not been analyzed for GRO, DRO, RRO, PAHs, or SVOCs; however, these compounds are not expected to migrate to groundwater at concentrations exceeding risk based criteria given their effective solubilities as well as the dilution and attenuation assumed in both the ADEC default migration to groundwater calculation and the site-specific migration to groundwater calculation in the HRC. Therefore, analysis of groundwater samples for these fractions and compounds is not proposed, and dissolved phase concentrations will be assessed by the phase portioning calculations in the HRC.
  - Arsenic was detected above risk based cleanup levels in most soil samples, but it is assumed to be present as naturally occurring arsenic and not as a site contaminant. This interpretation is based on the observations that the arsenic concentration is relatively uniform throughout the site soils and not higher in soils with high DRO and RRO or high lead and barium, and that the site arsenic and chromium concentrations are below the average arsenic and chromium concentrations in a USGS geochemical data base for Southcentral Alaska (USGS, 2010).

Data Gaps at the Baker Hughes Nikiski facility include the following:

- At the oil-water separator leach field location there is not an adequate delineation of the horizontal and vertical extent of hydrocarbon, VOCs, and metals impacted soil given that only the southern 30 feet of the leach field was excavated, the perforated leach field piping extends an unknown distance further north, and soils at the limit of excavation and in a soil boring approximately 10 feet north of the oil-water separator exceed ADEC cleanup levels. The delineation of the horizontal and vertical extent of the contamination should include borings along and lateral to the leach field perforated pipe. The delineation should target the collection of at least ten source-area impacted soil samples to allow calculation of 95% UCL concentrations as well as samples outside the source area (to bound the source area). The source area is expected to be impacted by diesel and residual range hydrocarbons and paint related chemicals, so photoionization detector (PID) readings as well as visual and olfactory screening will likely be useful tools to assess the extent of contamination.
- The preliminary risk calculations used site specific total DRO and RRO concentration data and an average aromatic and aliphatic equivalent carbon distribution from a data base of HRC input values (Geosphere, 2016). This characterization of the aromatic and aliphatic equivalent carbon distribution or the ADEC default aromatic and aliphatic equivalent carbon distribution is proposed to be used for the site in future risk calculations in the HRC. If ADEC does not accept these characterizations, then site specific analysis of the DRO and RRO aromatic and aliphatic equivalent carbon distribution will be conducted by analyzing approximately five of the more heavily hydrocarbon impacted soil samples via the Washington extractable petroleum hydrocarbon (EPH) test.
- Chromium has been detected in every soil sample from the site, and the chromium concentrations appear to be elevated in the most heavily hydrocarbon impacted samples as well as the samples having the highest lead and barium concentrations. This leads to the interpretation that the chromium is present as both naturally occurring chromium and as a site contaminant associated with paint. If the chromium is present as chromium III, then all measured concentrations are far below risk based cleanup levels; however, if some of the chromium is present as chromium VI, then chromium VI may contribute significantly to risk. Therefore, soil samples will be analyzed to assess the chromium VI and total chromium concentrations;

- Groundwater samples have not been analyzed to assess dissolved phase concentrations of metals and VOCs using methods with low levels of quantitation, detection, or limits, and therefore the calculation of dissolved phase concentrations of metals from soil concentration data may not yield representative results. Consequently, groundwater samples from monitoring wells in the source areas will be analyzed for VOCs using USEPA solid waste (SW) method 8260-SIM; the metals barium, cadmium, and lead using USEPA method 200.8; and chromium VI using USEPA method 7199.
- Groundwater samples have not been analyzed to assess dissolved phase concentrations of GROs, DROs/RROs, PAHs, or SVOCs; however, these fractions and compounds are not expected to migrate to groundwater and therefore do not need to be measured in groundwater. Instead, concentrations in groundwater will be modeled in the HRC.
- The HRC calculations indicate that chlorinated solvents have the potential to contribute significant risk via the vapor intrusion pathway. The soil gas concentrations used in the HRC were based on phase partitioning from soils data which is generally not an accepted approach. Therefore, VOC soil gas concentrations will be measured in two locations in the oil-water separator leach field source area. The soil gas samples will be collected from soil gas probes installed at depths representative of a basement floor.

7.0 2020 WORK PLAN

This work plan describes the project scope and objectives, proposed soil boring locations, soil-gas monitoring locations, and sampling protocols. Attachment 1 to this work plan includes figures depicting the proposed soil borings (Figure 3) and soil gas sample locations (Figure 4).

7.1 Objectives and Scope

7.1.1 Objectives

The primary objectives of the environmental media sampling described in this work plan are gather the data needed to better assess the extent of contamination and risk under residential and industrial scenarios. The following objectives are identified based on the review of the site data:

- Identify the horizontal and vertical extent of the more heavily contaminated soils which are expected to be present in the immediate vicinity of the leach field line emanating from the former oil-water separator;
- Collect enough source area samples to allow development of 95% UCL values for the source area soils, so that the 95% UCLs can be used as exposure point concentrations in representative risk calculations. The 95% UCL calculations should be based on approximately 10 or more samples from the source area.
- Reassess groundwater concentration trends for TCE and 1,1,2-TCA using a Mann-Kendall analysis as well as reassess the rate of natural attenuation (if possible, depending the site data).
- Characterize groundwater for possible VOC and the dissolved metals lead, barium, cadmium, total chromium and chromium VI impact to groundwater in the vicinity of the septic system leach field, the oil-water separator leach field and dry well infiltration source areas respectively.
- Assess the potential vapor intrusion risks at the site. The preliminary HRC risk calculations indicate that vapor intrusion may be a significant risk contributor and could impact the use of the property and the

ICs placed on the site. The objective of the soil gas sampling work is to measure VOC concentrations in soil gas in the oil-water separator leach field at the Baker Hughes Nikiski site. The soil gas results will be utilized as input in the Johnson and Ettinger model which is incorporated in to the HRC to perform a multiple-lines-of-evidence vapor intrusion evaluation for the site. Vapor intrusion (VI) is the general term given to migration of vapors from a contaminant source in the subsurface into indoor air. The soil gas sampling is being conducted because preliminary risk calculations preformed in the HRC indicate that vapor intrusion may have the potential to contribute significantly to human health risk if a residence was constructed over the oil-water separator leach field in the future.

- Use the data to assess risk under residential and industrial scenarios.

If the site meets the risk standard, then apply for a “cleanup complete without ICs” determination. If the site does not meet the risk standard, then 1) identify what ICs would be required to qualify for a “cleanup complete with ICs” determination, and 2) what actions would be required to meet the risk standard and qualify for a “cleanup complete without ICs” determination.

7.1.2 Scope

To achieve the project objective, the following scope will be conducted:

- Collect soil samples from up to 14 soil borings (three samples per boring) at the leach field line emanating from the former oil-water separator to define the nature and delineate extent of soil contamination. Soil samples will be submitted for DRO, RRO, VOC, and PAH analysis as well as the metals lead, barium, cadmium, total chromium, and chromium VI. In addition, extractable petroleum hydrocarbons (EPH) may be measured to assess the aromatic and aliphatic equivalent carbon distribution of the DRO and RRO fractions (the EPH may not be required if ADEC allows the use of default ADEC assumptions or an average aromatic and aliphatic equivalent carbon distribution). If soil contamination is found to reach groundwater, then this scope item will be expanded to include the installation and sampling of a new groundwater monitoring well either this season or at a later date.
- Collect groundwater samples from three existing monitoring wells (MW-01, MW-04, and MW-05) located in the septic system leach field, oil-water separator leach field, and dry well infiltration source areas respectively. The groundwater samples will be analyzed for VOCs and the metals lead, barium, cadmium, total chromium, and chromium VI. If soil hydrocarbon contamination is discovered to extend to the zone of seasonal water table fluctuation in the oil-water separator leach field area, then water samples will be collected from MW-04 (and any new well or wells determined to be needed in the area) and be analyzed for DRO, RRO, EPH and PAHs.
- Collect soil gas samples by advancing two soil gas monitoring points in the vicinity of the oil-water separator leach field. Soil gas samples will be analyzed for VOCs.

7.2 Project Activities

7.2.1 Soil Characterization

The oil-water separator leach field is currently characterized by one excavation soil sample and four samples from a soil boring (SB-08/MW-04). Both the excavation sample and the boring are at about the same location, approximately ten feet north of the decommissioned oil-water separator tank. Both the excavation sample and boring show elevated DRO, RRO, lead, barium, cadmium, and chromium concentrations as well as TCE and PCE detections in the shallow soil near the perforated leach field pipe. At approximately ten feet below the leach field pipe, DRO and RRO were not detected, and metals appeared to be at background concentrations. This data is interpreted to indicate that the bulk hydrocarbons NAPL and metals associated with paint may be limited to the vicinity of the leach field line.

In order to further delineate the extent of soil contamination in the vicinity of the leach field line emanating from the former oil-water separator, approximately 14 soil borings will be drilled (see Figure 3). Six of the borings will be drilled along the axis of the leach field line from about 10 feet north of MW-04 and continuing northward in 10-foot increments. In addition, at 20-foot intervals, up to four borings will be drilled on a line 10 feet east of the line of boring along the leach field line, and up to four borings will be drilled on a line 10 feet west of the line of boring along the leach field line. The secondary lines will be off-site to the south 10 feet to delineate around the SB-08/MW-04 location. The borings will begin from the south and work north. If a series of three east-to-west borings indicate no impact as the rows of borings are advanced from the south to the north, then the delineation will be considered complete, and additional rows of three borings to the north will not be advanced; two rows of clean borings will be evidence that the northern boundary of the impacted area has been reached.

Vertically, the borings will have a minimum depth of 15 feet but will be extended deeper as needed to penetrate 5 feet into soils that are interpreted to not be contaminated based on visual, olfactory, and field screening using a PID. The 15-foot minimum depth is deeper than the depth of impact observed in the oil-water separator leach field and dry well locations (impact documented at 6 to 8 feet bgs at SB-08/IP-03 [sample numbers 15-BNT-SB08-01-SO and 14-BHI-IP-03-SO]) and deeper than the depth considered in the soil ingestion and dermal contact risk calculations. If the impacted soils appear to extend deeper than 25 feet, then the borings will be extended to the water table, and if impacted soils are interpreted to be present at the water table, then a monitoring well will be installed at the location. No new groundwater wells are currently identified because MW-04 is located within the source area and should provide representative dissolved phase data, provided the source zone soils do not extend to the zone of seasonal water table fluctuation. However, if DRO, RRO, or paint impacted soils are identified in the zone of seasonal water table fluctuation, then a new well will be installed to provide more representative groundwater data.

Subsurface soil samples will be retrieved from two intervals: two samples for off-site analysis will be collected from the impacted/source zone interval, expected from 6 to 12 feet bgs; and one sample will be collected form the lower unimpacted interval, expected from 12 to 15 feet bgs. The goal of collecting two samples within the source zone interval per boring is to generate enough analytical data to calculate 95% UCLs. The samples from below the source zone will help bound and define the source area.

To evaluate soils and aid in defining the source zone interval and bottom of impact in the field, DNA will use a combination of both open-air core screening and discrete heated headspace field screening using a PID. Field screening using ADEC's heated headspace method at 2.5-foot intervals will serve to define the locations/depths for the collection of samples for off-site analysis. Assuming a maximum boring depth of 15 feet, a total of six discrete heated headspace field screenings will be conducted per boring. Assuming a total of 14 soil borings advanced to 15 feet bgs are needed to delineate this area, then a total of 84 heated headspace field screenings will be conducted and 42 primary samples will be collected for off-site analysis.

7.2.2 Groundwater Characterization

The water table is present about 40 feet bgs in a high conductivity sand and gravel aquifer. The aquifer reportedly extends to 80 to 90 feet bgs, where fine grained soils overlie a deeper confined aquifer. The groundwater flow direction is not well defined, potentially because the site is located between several producing wells which may influence flow directions at different times. The gradient appears to be higher than the ADEC default value. The hydraulic conductivity of the aquifer will be characterized by conducting slug tests in two monitoring wells on the site. The hydraulic conductivity values will be used in the HRC to help assess the dilution-attenuation factor for the site.

Groundwater at the Nikiski site has been sampled and analyzed in approximately 12 monitoring events between 2012 and 2016. In the first five events only the facility drinking water well was sampled. In the next two events only monitoring wells MW-01, MW-02, and MW-03 were sampled. In the subsequent events 7 to 10 wells were monitored. The only analytes which have been documented to exceed ADEC groundwater cleanup levels are TCE and 1,1,2-TCA. TCE has exceeded the ADEC cleanup level in each monitoring event at the MW-01 location, and once in 2014, at the MW-02 location. 1,1,2-TCA exceeded its cleanup level in MW-01, in 2014. The groundwater monitoring results appear to show that contaminated groundwater does not migrate off site in a defined plume. In addition, the monitoring data indicate that TCE has a statistically significant downward concentration trend, with a half-life of about 2 years. If the TCE degradation rate observed in the 2014 to 2016 timeframe is occurring, then the Nikiski groundwater concentrations could be approaching, or are now less than, the currently applicable site cleanup levels.

Given that a groundwater plume is not migrating off site, the 2020 groundwater sampling program will be limited to sampling wells in each source area, primarily to support risk calculations. The program plans to sample existing monitoring wells MW-1, MW-04, and MW-05, which are installed in the septic system leach field, oil-water separator leach field, and dry well infiltration area respectively. The groundwater samples will be analyzed for VOCs and the metals lead, barium, cadmium, total chromium, and chromium VI. The data will be used in risk calculations, to assess dissolved phase concentration trends, and to characterize the rate of natural attenuation.

If hydrocarbon contamination is discovered to extend to the zone of seasonal water table fluctuation in the oil-water separator leach field area, then a new monitoring well will be installed and both the new well and MW-04 will be tested for DRO, RRO, and PAHs. If hydrocarbon is not observed to extend to the zone of seasonal water table fluctuation, then the DRO, RRO, and PAH groundwater analysis will not be conducted, and the HRC input for these analytes will be modeled from soils data (DRO, RRO, and PAHs from a vadose zone diesel, waste oil, or crude oil source will typically not cause a groundwater exceedance).

7.2.3 Soil Gas Characterization

The HRC risk calculations indicate that vapor intrusion may be a significant risk contributor and could impact the use of the property and the ICs placed on the site. To better characterize the soil gas concentrations and VI risks, DNA will install two soil gas monitoring points and collect soil gas samples (Figure 4). The samples will be analyzed for VOCs by method TO-15.

7.3 Field Methods

The following section outlines project methods in detail. Specific sampling methods and analytical protocols are discussed further in the Sampling and Analysis Plan section of this letter.

DNA will mobilize a two-person field team from Anchorage to conduct the site characterization activities.

7.3.1 Infrastructure Locates

DNA will perform utility locates prior to drilling activities. DNA will establish gas, electrical, telephone, fiber optic, and utilidor locates prior to any ground penetration work in the leach field area. The locate work will be conducted by making a locate request with Alaska Digline 811. Baker Hughes will coordinate and conduct utility locates for secondary lines that may exist on the north side of the shop building.

7.3.2 Soil Boring Installation

Drilling services will be provided by Discovery Drilling, Inc. using a Geoprobe® track-mounted direct-push drill rig with rotary auger capability.

At each soil boring location, soils will be cored and logged in 5-foot segments using continuous MacroCore® samplers. Each soil boring will be logged with details regarding soil horizons, soil type, odor, moisture, color, and in situ PID response. Sample locations/depths for heated headspace field screening and laboratory samples will be noted as well. The first soil borings will be identified as **SB-21** by the field team. The proposed soil boring locations are presented on Figure 3 (see Attachment 1 – Figures).

Soil boring logs will be recorded using the Soil Boring Log form found in Attachment 5 – Field Forms. The soil boring log will contain a description of the soil as classified under the Unified Soil Classification System (USCS).

7.3.3 Soil Field Screening

Field screening will identify the depth at which contamination is found as well as help determine the depth of clean limits and whether there is a potential for groundwater impact.

7.3.3.1 In Situ

The length of each MacroCore® will be field screened by placing a PID within 1/4-inch of the exposed soil core where a dedicated stainless-steel spoon will be used to split open the soils the length of the sample core. In situ screening will aid in determining the general depth of contamination.

7.3.3.2 Heated Headspace

DNA will collect soil samples for heated headspace field screening at 2.5-foot intervals in each boring. Heated headspace field screening will be conducted in general accordance with the ADEC Field Sampling Guidance dated October 2019 (ADEC 2019a). Field screening will be conducted as follows:

- Calibrate PID according to the manufacturer's specifications and requirements and document in the field notes.
- Partially fill (one-third to one-half) of a re-sealable quart size polyethylene bag with the sample to be analyzed.
- Collect the sample from freshly uncovered soil if it's collected from an excavation or soil stockpile.

- From the time of collection, allow headspace vapors to develop in the container for at least 10 minutes but no longer than one hour.
- Shake or agitate containers for 15 seconds at the beginning and end of the headspace development period to assist volatilization. Temperatures of the headspace must be warmed to at least 40˚F (approximately 5˚C).
- After headspace development, insert the instrument sampling probe to a point about one-half the headspace depth. The container opening must be minimized, and care must be taken to avoid uptake of water droplets and soil particulates.
- After probe insertion, record the highest meter reading. This normally will occur between two and five seconds after probe insertion.
- Complete headspace field screening within one hour from the time of sample collection.
- Document all field screening results in the field record or logbook.

7.3.4 Soil Sample Collection

Soil samples for off-site laboratory analysis will be collected at the two depths within a boring with the highest and second highest heated head space field screening PID responses. A third sample will be collected at the bottom of the boring, or a minimum of 5 feet deeper than the bottom of contamination if in the vadose zone. If contamination reaches to the saturated zone, the third sample will be collected at the soil/water interface. The impacted soils samples may be closely spaced if the impacted depth interval is relatively thin. Because heated headspace field screening is destructive, the soil samples collected for off-site laboratory analysis will be from borings re-advanced within about a 1-foot radius of the original field screening boring.

7.3.5 Soil Boring Abandonment

All soil borings will be abandoned by filling the boring annulus with soil cuttings from that boring.

7.3.6 Groundwater Monitoring Well Installation

Monitoring well installation is not planned, but if obviously contaminated soils are discovered in the zone of seasonal water table fluctuation, then one or more monitoring wells will be installed.

7.3.6.1 Well Construction

The potential new well or wells will be constructed of 2-inch diameter Schedule 40 polyvinyl chloride (PVC) casing with 10 feet of 0.010-inch slotted screen and threaded end caps. The 10-foot screen will be centered on the static water level found at the time of drilling. Total depth of each well is expected to extend to approximately 45 feet bgs. The first well installed will be identified as **BHI-MW-11** by the field team.

The groundwater monitoring wells will contain a filter pack of Colorado 10-20 sand around the screen. A bentonite seal will be placed above the sand (at least 6 inches thick), with a second bentonite seal (at least 24 inches thick) will be located within three feet of the ground surface. The bentonite material will be hydrated as part of the sealing process. All groundwater monitoring wells will be completed as a flush mount due to the proximity to roadways, parking lots, and plowing. The flush monuments will be set in concrete. Groundwater monitoring well completion details will be recorded on monitoring well installation forms found in Attachment 5 – Field Forms.

7.3.6.2 Well Development

If new monitoring wells are installed, the wells will be developed prior to sample collection. A total of 24 hours will elapse after development is complete and before sample collection activities. Well development purging will be accomplished using a positive displacement pump (Fultz® or similar). The goal of well development is to ensure proper hydraulic connection to the surrounding aquifer and to allow for free flow of formation water into the well for sampling.

Well development is the agitation of the adjacent formation and pulling of the fines into the well. Well development consists of repeatedly surging the well with a surge block followed by purging of groundwater. As purge water becomes visibly less turbid, the field team will initiate recording water quality parameters including turbidity, pH, dissolved oxygen (DO), temperature, and specific conductivity. Well development (surging and purging) will continue until the turbidity decreases and repeated water quality parameter measurements become consistent, or until ten well casing volumes have been removed.

Groundwater monitoring well development forms, found in Attachment 5 – Field Forms, will be completed as part of the groundwater monitoring well development process.

7.3.7 Groundwater Sampling

Groundwater will be sampled using the USEPA Region 4 low-flow/minimal drawdown technique. Dedicated bladder pumps (Solinst® Model 407; stainless steel) were installed in 2015. These pumps will be removed, and the wells will be purged and sampled using stainless steel positive pressure pumps for the organic sample fractions, and a foot valve tubing pump (Waterra tubing pump with a thermoplastic foot valve) for the inorganic fractions. The samples submitted for metals analysis will be filtered to ensure that dissolved metals are being measured and not solids suspended by the pump. A groundwater monitoring well sampling form, provided in Attachment 5 – Field Forms, will be completed as part of the groundwater monitoring well sampling process.

7.3.8 Soil Gas Sampling

Soil gas probe installation and soil gas sampling will be conducted at two locations. The scope of the sampling will include the collecting of two primary and one duplicate soil gas samples using soil gas probes installed in the 2020 drilling program.

Standard operating procedures (SOPs) that will be implemented while performing this task are presented as Attachment 6. Outdoor air samples will not be collected because DNA does not expect there to be significant outdoor VOC concentrations and because any results obtained from the outdoor air sample would not contribute to the understanding of the vapor intrusion issue.

7.3.8.1 Soil Gas Sample Train

At two of the advanced boring locations for the soil sampling work, the Geoprobe® will be used to advance temporary soil gas probes to 5 feet bgs with expendable drive points and post-run tubing (Attachment 6 – Soil Gas SOPs).

7.3.8.2 Soil Gas Sample Train Leak Testing

Leak testing of the sample train will be conducted by both tracer testing and shut-in testing (Attachment 6 – Soil Gas SOPs)

The tracer testing includes the use of helium as the tracer gas and a Dielectric® MGD-2002 helium detector. The surface completion is covered with a detection hood, and then the interior of the hood is flooded with helium. The MGD-2002 is then used to detect for the presence of helium inside the sample train. ADEC guidance recommends that the presence of helium detected within the sampling train not exceed 10% of the helium present in the leak detection hood.

The shut-in test will then be conducted and consist of evacuating the lines in the above-ground sample train to a measured vacuum (12-inches) and then shutting the vacuum in by closing the valves on opposite ends of the sample train. The vacuum gauge is then observed for at least one minute, and if there is any observable loss of vacuum, the fittings are tightened or adjusted as needed until the vacuum in the sample train does not noticeably dissipate.

7.3.9 Equipment Decontamination

Non-dedicated equipment will be decontaminated. Equipment to be decontaminated will include drill auger flights, soil core barrels and cutting shoes, the groundwater interface probe, and the positive displacement pump used for developing the newly installed groundwater monitoring wells.

Proper decontamination is essential to avoid cross-contamination. Drilling equipment will be decontaminated using the following steps:

1. Thoroughly and vigorously wash with potable water containing non-phosphate detergent such as Liquinox®, Alconox®, or equivalent using a dedicated wash bristle brush or similar brush.
2. Rinse with potable water.
3. Allow to air dry.

The groundwater interface probe and the positive displacement pump will be decontaminated using the following steps:

1. Place displacement pump into a potable water wash basin/reservoir (5-gallon bucket) containing non-phosphate detergent such as Liquinox®, Alconox®, or equivalent, making sure the pump intake is fully submerged and the pump outlet is allowed to flow directly back into the wash reservoir. Set the pump to a very low flow rate and turn on, allowing the wash water to recirculate through the pump mechanism for a minimum of 5 minutes. Thoroughly wash the exterior of the pump using a bristle brush while in the wash basin.
2. Rinse the pump by repeating Step 2 in a water basin/reservoir using potable water, a dedicated rinse bristle brush, and a rinse basin/reservoir containing only potable water (first rinse).
3. Give the pump a final rinse by duplicating Step 2 in a water basin/reservoir using ASTM Reagent Grade II water in a second rinse.
4. Allow to air dry at a location where dust or other fugitive contaminants may not contact the sample pump.

7.3.10 Groundwater Elevation Survey

If a new monitoring well is installed, DNA will contract with a professional surveyor to survey the measuring points for the newly installed groundwater monitoring well(s). If a new survey is conducted, the existing monitoring well measuring point elevations may be checked to assess if measuring point elevations have changed.

The professional land surveyor (PLS) will certify by signature that the survey loop is closed to within an accuracy of 0.2 feet for horizontal coordinates and 0.01 feet for elevation.

For accurate water level measurements, each well has been, and new wells will be, marked with a reference point (measuring point) on the PVC well casing. This mark will be a permanent marker or notch, preferably located on the north side of the well casing. Wellhead elevations will be used in conjunction with groundwater level measurements to calculate groundwater elevation and depict inferred elevation contours and therefore flow direction.

To ensure accuracy, the field team will gauge the depth to groundwater at each of the site wells within a 4-hour period between the first and last well gauging.

7.3.11 Investigation Derived Waste Management

Concentrations of contaminants of concern, reported for soil and water samples collected during site characterization, will be used to determine if investigation derived waste (IDW) is hazardous or non-hazardous for soil cuttings and well development and purge water. Additional samples will be collected to characterize water used for decontamination.

There are four IDW waste streams for activities planned at this site:

- Soil Cuttings: Soil cuttings from borehole/groundwater monitoring well installation may contain detectable concentrations of TCE, 1,1,1-TCA, PCE, and petroleum hydrocarbon constituents. The estimated volume of soil cutting IDW is less than 1 cubic yard (CY) if no wells are installed, and 1 CY per well installed. Cuttings will be placed into a 1 CY supersack and sampled at a rate of one field screening sample using the ADEC heated headspace method per supersack. Analytical samples will be collected at a rate of 1 sample per 10 CY, as a composite sample from the three highest field screening values and analyzed for all contaminants of concern to determine disposal options.
- Development and Purge Water: Groundwater monitoring well developing and sample stabilization purge water may contain detectable concentrations of TCE, 1,1,1-TCA, PCE, and petroleum hydrocarbon constituents. Up to 3 gallons of purge water are expected from each well sampled. Development and purge water will be filtered through a 5-gallon granular activated carbon (GAC) filter and surface discharged.
- Decontamination (decon) Water: Water used to wash and rinse drilling and sampling equipment may have detectable concentrations of TCE, 1,1,1-TCA, PCE, and petroleum hydrocarbon constituents. The estimated volume of decon IDW is 40 gallons. Decon water will be filtered through a 5-gallon granular activated carbon (GAC) filter and surface discharged.
- Other Solid Waste. Other solid waste that will be produced will include general personal protective equipment (PPE) such as nitrile gloves and paper towels. Other solid waste will be disposed of at the Kenai Peninsula Borough Kenai Transfer Facility.

7.4 SAMPLING AND ANALYSIS PLAN

Project samples will include soil samples, groundwater samples, water rinsate/equipment blank samples, field blank samples, and laboratory prepared sample container trip blanks. Additionally, each cooler shipped will contain a temperature indicator (a.k.a. temperature blank).

DNA will utilize Pace Analytical, located in Mt. Juliet, Tennessee, for soil and water analytical services, with the exception of chromium VI (hexavalent chromium) analysis. Water samples collected for Chromium VI analysis will be conducted by SGS Laboratory located in Anchorage, Alaska. For air samples, DNA will utilize Eurofins Air Toxics, Inc., located in Folsom, California.

The soils target analytes at this site include DRO, RRO, EPH aromatics and aliphatics, VOCs, PAHs, and the metals lead, barium, cadmium, total chromium, and chromium VI. The groundwater target analytes at this site include DRO, RRO, EPH aromatics and aliphatics, VOCs, and the metals lead, barium, cadmium, total chromium, and chromium VI. Air samples will be analyzed for VOCs.

7.4.1 Analytical Methods

7.4.1.1 Soil

All soil samples will be analyzed by the following laboratory methods:

- DRO and RRO by AK102 and AK103;
- EPH (yields the aromatic & aliphatic equivalent carbon distribution) by the Washington State Northwest Total Petroleum Hydrocarbon (TPH) EPH Method;
- VOCs by USEPA SW 8260C and SW 8260C-SIM;
- PAHs by USEPA SW 8270D-SIM;
- Barium, cadmium, total chromium, and lead by USEPA SW 6020; and,
- Hexavalent chromium by USEPA SW 7196A.

7.4.1.2 Groundwater

The groundwater samples will be submitted for the following analysis:

- VOCs by USEPA SW 8260C and SW 8260C-SIM;
- Barium, cadmium, total chromium, and lead by USEPA National Exposure Research Laboratory (NERL) method 200.8; and
- Hexavalent chromium by USEPA SW 7199.

If hydrocarbon contamination extends to the zone of seasonal water table fluctuation in the oil-water separator leach field area, then a new monitoring well will be installed (as described previously) and both the new well (MW-11) and existing well (MW-04) will be tested for DRO, RRO, and PAHs. If hydrocarbon is not observed to extend to the zone of seasonal water table fluctuation, then the DRO, RRO, and PAH groundwater analysis will not be conducted, and the HRC input for these analytes will be modeled from soils data (DRO, RRO, and PAHs from a vadose zone diesel, waste oil, or crude oil source will typically not cause a groundwater exceedance).

7.4.1.3 Air

Air samples will be analyzed by the following laboratory methods:

- VOCs by USEPA Toxic Organics (TO) Method 15.

7.4.2 Sampling Procedures

7.4.2.1 Soil Sample Collection

All soil samples collected for off-site laboratory analysis will be collected using dedicated stainless-steel spoons. Volatile sample fractions will not be homogenized but rather placed directly into one 4-ounce (oz) pre-tared, laboratory-provided jar. A minimum of 25 grams and a maximum of 50 grams of soil will be placed in the jar and immediately preserved in the field with 25 milliliters (ml) of methanol provided by the laboratory. A second 2-oz jar will also be filled (completely) with soil but remain unpreserved for percent solid analysis.

All samples will be immediately placed on ice after collection and chilled to 4 Degrees Celsius (°C) ± 2°C.

7.4.2.2 Groundwater Sample Collection

Prior to purging and sampling, all groundwater monitoring wells will be gauged for depth-to-groundwater (DTW) and total depth. Low-flow (minimal drawdown) purge and sampling techniques will then be used to purge and sample each well. A calibrated water quality meter with a flow-through cell will be used to measure field parameters.

The low-flow purge and sample collection technique involves purging the well at flow rates of 0.1 to 0.5 liters per minute to minimize drawdown. During purging, water quality parameters will be monitored until:

- pH is stable within 0.1 pH units;
- Temperature is stable within 0.2 °C;
- Conductivity is stable within 3%;
- Dissolved oxygen (DO) is within 10%; and,
- Turbidity is stable within 10%.

Measurements should be taken every three to five minutes. If stability of the above parameters cannot be achieved, then removal of three casing volumes will be performed at which time sampling will commence. The removal of three volumes is not necessary if stability is achieved sooner during the purge process, as evident from successive readings of the above parameters that are within the stated tolerances. For wells that purge dry, the field team will return to the well once it has recharged to 80% of the original pre-purge water level/volume and a sample will be collected without additional purging or water quality monitoring (generally allowing 12 to 24 hours for recharge).

During well purging, water quality parameters will be collected by the field team. Calibration of the water quality meter sensors will be verified prior to use with calibration standards obtained from a secondary source. Personnel operating the water quality meter will understand the working ranges and maximum saturation values for the various sensors and monitor results during purging and testing to ensure that they remain within these ranges or beneath maximum theoretical values. In the event the response for any individual sensor fails to meet precision and accuracy criteria specified by the equipment manufacturer, or actual project sample responses fall near or outside the theoretical working range for each sensor, the unit will be recalibrated or repaired as necessary before purging and sampling activities continue.

The normal pH range for groundwater is generally between 4 and 9 with a theoretical range from 0 to 14. The normal DO range for groundwater is between 0 and 12 milligrams per liter (mg/L), with a theoretical saturation point at approximately 12 mg/L. Oxidation-reduction potential (ORP), specific conductance, and alkalinity are all dependent upon the concentration of anions and cations in site groundwater, so ranges are not included here.

Once the parameters are stabilized, a final reading will be recorded for DO, ORP, pH, temperature, turbidity, and conductivity. All measurements, including DTW and the above parameters, will be recorded on a groundwater sample form (Attachment 5).

Prior to collecting the sample, the flow-through cell will be disconnected from the flow line. The flow rate during sample collection should remain the same as the purging flow rate. Water samples will be placed in 40 ml Volatile Organic Analysis (VOA) vials with zero headspace (no air bubbles) in the container directly from the sample tubing. Fill each container remaining for the non-volatile fractions to the top. All samples will be immediately placed on ice after collection and chilled to 4°C ± 2°C.

7.4.2.2 Air Sample Collection

The soil gas samples for VOC analysis will be collected using 1-liter Summa canisters equipped with flow controllers limiting flow to about 100 to 200 ml per minute. Soil gas canisters that show a positive pressure prior to laboratory analysis will not be analyzed.

7.5 SAMPLE HANDLING

7.5.1 Field Documentation

Field documentation will include sample identification labels, photographs, laboratory analysis requests, and permanently bound field logs. A field logbook will be maintained by the DNA field team lead to record a detailed description of all field activities and samples collected. Pages will not be removed from any data logbook for any reason. Any possible corrections will be made by drawing a single line through the original entry, so that the original entry can still be read. The corrections will be written alongside the crossed-out entry. The corrections will be initialed and dated.

7.5.2 Sample Labeling

Each sample container will be sealed and labeled immediately after collection. Sample labels will be completed using waterproof ink and will be affixed firmly to the sample containers. A sample code will be assigned to each sample as an identification number to track collected samples. The sample label will provide the following information: project name; date and time of collection; sample identification number; analysis required; and preservation method used. DNA will use an alpha-numeric code for sample identification numbers.

The sample code for each media (soil, groundwater, and air) are broken down in Tables 2 through 4.

TABLE 2: SOIL SAMPLE IDENTIFICATION SCHEME

Digits	Description	Code Examples
1-2	Year	20
3-5	Project Code	BNT
6-10	***Location/Type:***	***Symbol:***
	Soil Boring ID	SB-21
11-12	Sequential number at location (shallow to deep)	01

***Example**: 20-BNT-SB-07-01 (sample year 2020, Baker Nikiski Tools project, Soil Boring No.21, 1st sample from boring)*

TABLE 3: MONITORING WELL SAMPLE IDENTIFICATION SCHEME

Digits	Description	Code Examples
1-2	Date (MM-DD-YY)	09-20-20
3-5	Project Code	BNT
6-10	Well ID.	MW-01

***Example**: 09-20-20-BNT-MW-01 (Sample date of September 20, 2020, Baker Nikiski Tools project, at MW-01)*

TABLE 4: SOIL GAS SAMPLE IDENTIFICATION SCHEME

Digits	Description	Code Examples
1-2	Date (MM-DD-YY)	09-20-20
3-5	Project Code	BNT
6-10	Soil Boring	SB-21

***Example**: 09-20-20-BNT-SB-21 (Sample date of September 20, 2020, Baker Nikiski Tools project, at SB-21)*

After a sample is collected, pertinent information such as sample identification number, date and time of sample collection, location, sample collection method, description of sample, and any field screening measurements will be recorded in the field logbook

Duplicate samples will be numbered sequentially without any indication of the primary sample so the laboratory cannot identify the quality control purpose of the sample. Laboratory-provided trip blanks will not be numbered, but identified by the laboratory generated number and delivery cooler.

The sample code for QA/QC samples, including field duplicate samples, is outlined in Table 5.

TABLE 5: QA/QC SAMPLE IDENTIFICATION SCHEME

Description	Code Examples
Year (soil) or Date (water or air)	20 or 09-20-20
Project Code	BNT
Type:	***Symbol:***
Rinsate Blank	RB
Trip Blank	TB
Field Duplicate (Blind Duplicate)	FD
Sequential number for media	01
Sample Media/Type:	***Symbol:***
Water/Groundwater	WA
Soil	SO
Air	AI

Examples*: 20-BNT-FD-01-SO (2020, Baker Nikiski Tools project, Field Duplicate No.1, soil media)*
09-20-20-BNT-FD-01-WA (September 20, 2020, Baker Nikiski Tools project, Field Duplicate No.1, water media)
09-20-20-BNT-FD-01-AI (September 20, 2020, Baker Nikiski Tools project, Field Duplicate No.1, air media)

7.5.3 Chain of Custody, Sample Packaging

A chain-of-custody (CoC) record will be completed and shipped with the samples. Proper sample custody is maintained through adherence to the procedures listed below:

- Custody seals will be placed in two locations over the lid/cooler edge and secured with clear packing tape.
- A CoC record must accompany the coolers in which the samples are packed. When transferring samples, the individuals relinquishing and receiving the coolers must sign, date, and note the time on the CoC record. This record documents sample custody transfer.

Samples must be packaged carefully to avoid breakage or cross-contamination and must be shipped to the laboratory at proper temperatures. Adherence to the following sample package requirements is essential:

- Sample container lids must never be mixed. All lids must remain with their original container.
- Environmental samples must be cooled to 4 °C ± 2°C to preserve many chemical constituents. All coolers will contain a temperature blank that the laboratory will use to document sample temperatures.
- Any remaining space in the cooler should be filled with inert packing material such as bubble wrap, newspaper, etc. Under no circumstances should material such as sawdust, sand, or Styrofoam peanuts be used.

7.5.3 Sample Shipping

Environmental samples will be properly packaged and labeled inside an insulated cooler for transport via pre-paid FedEx® overnight delivery to out-of-state laboratories. Air samples will not be chilled during storage or shipment.

7.6 Quality Assurance and Quality Control

7.6.1 Data Quality Objectives

The data quality objective (DQO) for this project is to obtain analytical data of sufficient quality and quantity to satisfy the specific project objectives outlined in this work plan. To achieve this general objective, data of known and acceptable precision, accuracy, representativeness, completeness, and comparability must be generated in sufficient quantity and quality to ensure that the integrity of the results is legally defensible.

7.6.2 Quality Control Samples

Quality control samples will be collected to assess potential errors introduced during sample collection, handling, and analyses. As part of the field quality assurance/quality control (QA/QC) program, field duplicate samples, trip blanks, and rinsate blanks will be collected.

Quality control samples will be collected or prepared to assess potential errors introduced during sample collection, handling, and analyses. In summary, QC samples will include:

- One duplicate field sample for every 10 samples collected for laboratory analysis;
- One trip blank per cooler containing samples for volatiles analysis; and
- One rinsate blank per non-dedicated equipment item.

The relative percent differences (RPD) tolerances for duplicate samples are less than 30% for water media and less than 50% for soil media (ADEC, 2019). No RPD tolerance is established for air sample duplicates (ADEC, 2017)

7.6.2.1 Rinsate Sample Collection

One equipment rinsate will be collected from the positive pressure pump used to develop each groundwater monitoring well. The sample will be collected after decontaminating the pump following the procedure described in this work plan. The sample will be generated by pouring organic-free (ASTM Reagent Grade II) water over the pump and collecting the runoff water into sample containers.

7.6.3 Data Reduction, Validation, and Reporting

Validation and review of all analytical data will be performed by a qualified professional experienced in data validation and review procedures. All data will be validated and reviewed in accordance with appropriate USEPA procedural guidance documents and ADEC regulatory guidance documents. The reference documents include USEPA Functional Guidelines for Organic Data Review (USEPA 2017) and ADEC Minimum Quality Assurance Requirements for Sample Handling, Reports, and Laboratory Data, Technical Memorandum (ADEC 2019).

7.6.4 Calibration of Field Instruments – Water Quality Meter

Calibration date, time, and results for all instruments will be recorded. The instrument model and serial number will be recorded. Calibration for pH, DO, ORP, total dissolved solids, and turbidity will be conducted daily. Fresh calibration fluids will be used during each daily calibration, with the type and expiration date of the calibration used recorded in a calibration logbook for the instrument.

Calibration of Field Instruments – PID

The PID will be calibrated to 100 parts per million isobutylene at the beginning of each day. Calibration checks will be performed at the beginning of each day by the field team. Calibration date, time, and results for all instruments will be recorded in a logbook. The instrument model and serial number will be recorded.

7.6.5 Sample Containers, Hold Times, and Preservation

Table 6 summarizes sample analysis methods, containers, preservation, and holding times.

TABLE 6: ANALYTICAL METHOD, CONTAINER, HOLDING TIME, AND PRESERVATION

Analytical Parameter	Analytical Method	Holding Time	Containers	Preservation	
Soil Samples					
VOCs, full list + Low Level for 1,1,1- TCA; 1,1,2-TCA; PCE; TCE; BTEX; Naphthalene	USEPA SW 8260C/SIM	28 days	1 – 4 oz amber glass. TLS	MeOH	4°C ± 2°C
DRO/RRO	AK102/AK103	14 days to extraction, 40 days to analysis of extract	4 oz amber glass, TLC	4°C ± 2°C	
EPH*	NWTPH-Dx	14 days to extraction, 40 days to analysis of extract	4 oz amber glass, TLS	4°C ± 2°C	
PAHs	USEPA SW8270D/SIM	14 days	4 oz amber glass, TLS	4°C ± 2°C	
Inorganics (barium, cadmium, total chromium, and lead)	USEPA SW 6020A	6 months,	1 – 4 or 8 oz glass, TLC	4°C ± 2°C	
Hexavalent chromium	USEPA SW 7196A	30 days from collection to digestion and 7 days after digestion to analysis	1 – 4 oz glass, TLC	4°C ± 2°C	
Water Samples					
VOCs, full list + Low Level for 1,1,1- TCA; 1,1,2-TCA; PCE; TCE; BTEX; Naphthalene	USEPA SW 8260C/SIM	14 days	3 – 40 ml VOA vials, TLS	pH<2, HCl	4°C ± 2°C
DRO/RRO	AK102/AK103	14 days	2 – 250 ml amber glass, TLC	pH<2, HCl	4°C ± 2°C
EPH*	NWTPH-Dx	14 days	2 – 250 ml amber glass, TLC	pH<2, HCl	4°C ± 2°C
PAHs	USEPA SW8270D SIM	7 days	2 – 1 L amber glass, TLC	4°C ± 2°C	
Inorganics (barium, cadmium, total chromium, and lead)	USEPA NERL 200.8	6 months	1 – 250 mL HDPE	pH<2, HNO_3	4°C ± 2°C
Hexavalent chromium	USEPA SW 7199	24 hours	1 – 250 mL HDPE	4°C ± 2°C	
Air Samples					
VOCs	USEPA TO-15	30 days	1-liter stainless steel canister (SUMMA®)	none	

Notes:
*May be removed if ADEC allows use of averages

Key:
°C = Degrees Celsius
DRO = Diesel-Range Organics
EPH = Extractable Petroleum Hydrocarbon
RRO = Residual Range Organics
SIM = Selective Ion Monitoring
SW = Solid Waste

GRO = Gasoline-Range Organics
HCl = Hydrochloric Acid
HNO3 = Nitric Acid
MeOH = Methanol
ml = milliliter
oz = ounce
PAH = Polycyclic Aromatic Hydrocarbons
TLC = Teflon Lined Screw Caps
TLS = Teflon Lined Septa sonically bonded to screw caps
TO = Toxic Organics
USEPA = United States Environmental Protection Agency
VOA = Volatile Organic Analysis
VOCs = Volatile Organic Compounds

8.0 REGULATORY STANDARDS

Analytical results for the work reported herein will be compared to relevant State of Alaska cleanup criteria. Cleanup standards are defined in 18 AAC 75.30(c)(2), entitled Oil and Hazardous Substance Pollution Control Regulations, Discharge Reporting, Cleanup, and Disposal of Oil and Other Hazardous Substances. Groundwater results for samples will be compared to 18 AAC 75.345, Table C Groundwater Cleanup Levels. Soil sample analytical results will be compared to ADEC Method Two soil cleanup levels found in 18 AAC 75.341, Table B1

Soil gas sampling results will be assessed using ADEC Target Levels found in the VI Guidance for Contaminated Sites (ADEC 2017). Selected compound cleanup levels are listed below in Table 7.

Sampling activities detailed in this work plan will be conducted in accordance with 18 AAC 75 Oil and Other Hazardous Substances Pollution Control, as revised January 2019; Monitoring Well Guidance dated September 2013 (ADEC 2013), Vapor Intrusion Guidance (ADEC 2017), and Field Sampling Guidance for Contaminated Sites and Leaking Underground Storage Tank Sites (ADEC 2019).

TABLE 7: ADEC DEFAULT SOIL & GROUNDWATER CLEANUP LEVELS

Contaminant of Concern	ADEC Default Soil Cleanup Level(1) (mg/kg)	ADEC Groundwater Cleanup Level(2) (mg/L)
1,1,1-Trichloroethane (1,1,1-TCA)	32	8
1,1,2-Trichloroethane	0.0014	0.00041
Tetrachloroethene (PCE)	0.19	0.041
Trichloroethene (TCE)	0.011	0.002.8
Benzene	0.022	0.0046
Toluene	6.7	1.1
Ethylbenzene	0.13	0.015
Xylenes	1.5	0.19
Naphthalene	0.038	0.0017
bis(2-ethylhexyl)phthalate	88	0.056
Gasoline-range organics (GRO)	300	2.2
Diesel-range organics (DRO)	250	1.5
Residual-range organics (RRO)	10,000	1.1
Barium	2,100	3.8
Cadmium	9.1	9.2
Chromium, total	100,000	22
Chromium VI	0.089	0.00035
Lead	400	0.015

Notes:
(1) Alaska Administrative Code Title 18 Chapter 76. Table B1 and B2

(2) Alaska Administrative Code Title 18 Chapter 75, Table C
*May be removed if ADEC allows use of average
Key:
ADEC = Alaska Department of Environmental Conservation
mg/kg = Milligrams per kilogram
mg/L = Milligrams per liter
GRO = Gasoline-Range Organics

9.0 REPORTING

Upon receipt of analytical data, DNA will prepare a report summarizing analytical data on figures and in tables. The report will comply with 18 AAC 75.335.

10.0 SCHEDULE

The following table provides the estimated timeline for this project:

TABLE 8: PROPOSED PROJECT SCHEDULE

Task Description	Tentative Date
Anticipated ADEC Work Plan Approval	September 2020
Field Work	October 2020
Site Characterization Report (~90 days)	January 2021

Please do not hesitate to contact me at 907-350-4897 if you have any questions regarding this work plan.

Sincerely,
DNA Environmental Consultants, LLC

Daniel A. Frank

Daniel Frank
Principal

Attachments:

1. Site Maps
2. Data Tables
3. Conceptual Site Model (Human Health & Eco Screening)
4. HRC Calculations and Tables
5. Field Forms
6. Soil Gas SOPs

REFERENCES

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ATTACHMENT 1

Site Maps

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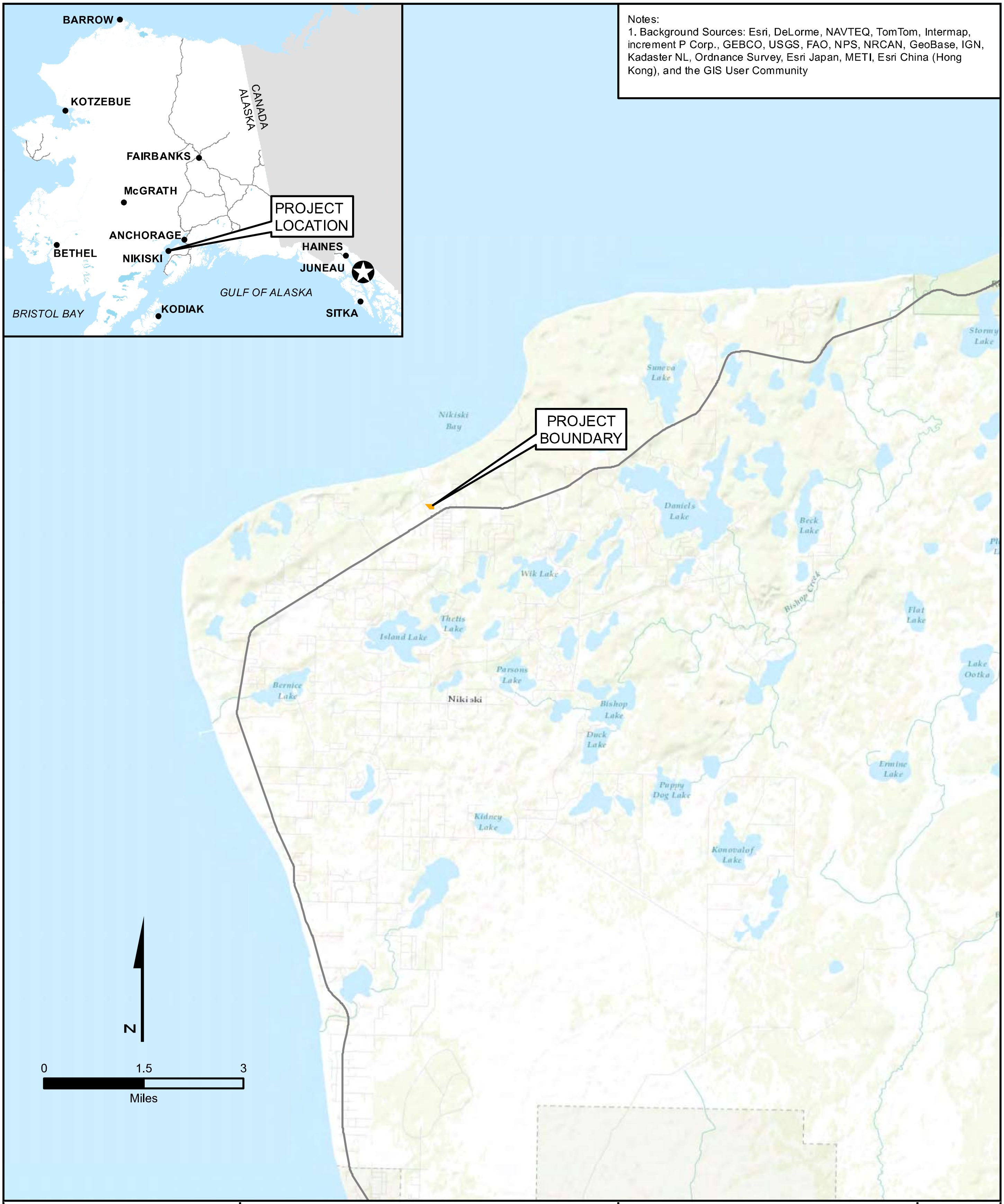

Notes:
1. Background Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), and the GIS User Community

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Site Characterization Work Plan
Baker Hughes Nikiski Completions Facility
Nikiski, Alaska

1 inch equals 2 miles

Site Vicinity Map

April 13, 2016
16.BHI.01
DRAWN: TDSL
CHKD: DJF

Figure
1

C:\GIS\CLIENTS\DNA\Nikiski\Nikiski BHI\2016_April\Fig 1 Site Vicinity Map.mxd Apr 13, 2016 3:49:49 PM User: Tri

dna
ENVIRONMENTAL

Quarterly Monitoring and Additional Site Characterization Report
Baker Hughes Nikiski Completions Facility
Nikiski, Alaska

1 inch = 125 feet

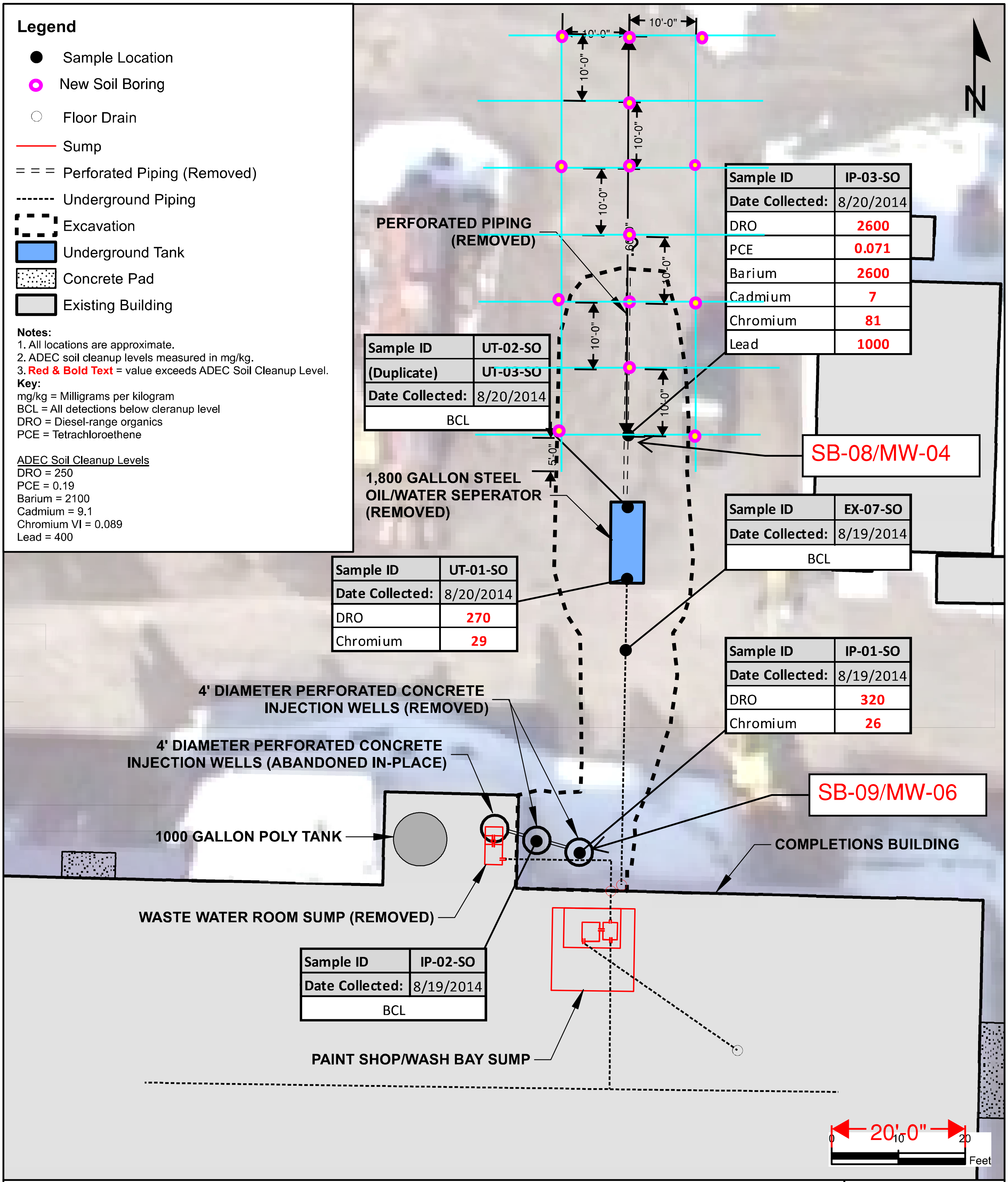
Site Detail Map

Figure

2

April 13, 2016	16.BHI.01
DRAWN: TDSL	CHKD: DJF

Fig 2 Site Detail Map.mxd Apr 13, 2016 3:38:57 PM User: Tricia



Legend

- ● Sample Location
- ○ New Soil Boring
- ○ Floor Drain
- — Sump
- = = = Perforated Piping (Removed)
- -------- Underground Piping
- ⬚ Excavation
- ▇ Underground Tank
- ▨ Concrete Pad
- ▢ Existing Building

Notes:
1. All locations are approximate.
2. ADEC soil cleanup levels measured in mg/kg.
3. **Red & Bold Text** = value exceeds ADEC Soil Cleanup Level.

Key:
mg/kg = Milligrams per kilogram
BCL = All detections below cleranup level
DRO = Diesel-range organics
PCE = Tetrachloroethene

ADEC Soil Cleanup Levels
DRO = 250
PCE = 0.19
Barium = 2100
Cadmium = 9.1
Chromium VI = 0.089
Lead = 400

Sample ID	IP-03-SO
Date Collected:	8/20/2014
DRO	**2600**
PCE	**0.071**
Barium	**2600**
Cadmium	**7**
Chromium	**81**
Lead	**1000**

Sample ID	UT-02-SO
(Duplicate)	UT-03-SO
Date Collected:	8/20/2014
BCL	

Sample ID	EX-07-SO
Date Collected:	8/19/2014
BCL	

Sample ID	UT-01-SO
Date Collected:	8/20/2014
DRO	**270**
Chromium	**29**

Sample ID	IP-01-SO
Date Collected:	8/19/2014
DRO	**320**
Chromium	**26**

Sample ID	IP-02-SO
Date Collected:	8/19/2014
BCL	

Baker Hughes Oilfield Operations, Inc.
Nikiski, Alaska

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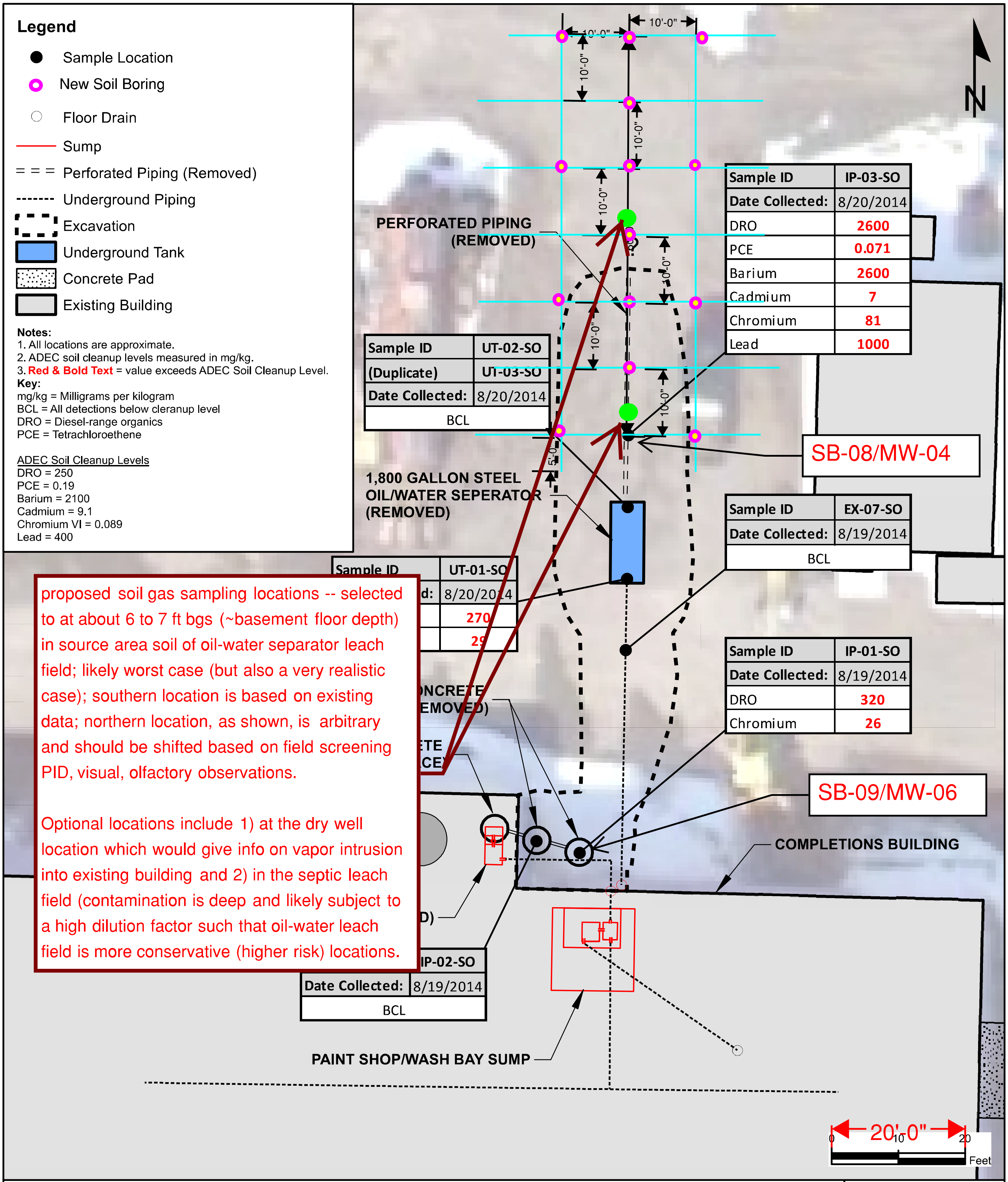
Proposed 2020 Boring Locations

Date: 8/5/2020
Drafted By: J.C.
Figure: 3

Prepared by jclous, 10/8/2014; Y:\Projects\AES\Nisiki_Tool_Shop\GIS\Report\Report3\Nikiski_Fig5_Report3xxxx.mxd



Legend

- ● Sample Location
- ○ New Soil Boring
- ○ Floor Drain
- — Sump
- = = = Perforated Piping (Removed)
- -------- Underground Piping
- ⬚ Excavation
- 🟦 Underground Tank
- ▨ Concrete Pad
- ⬜ Existing Building

Notes:

1. All locations are approximate.
2. ADEC soil cleanup levels measured in mg/kg.
3. **Red & Bold Text** = value exceeds ADEC Soil Cleanup Level.

Key:

mg/kg = Milligrams per kilogram
BCL = All detections below cleranup level
DRO = Diesel-range organics
PCE = Tetrachloroethene

ADEC Soil Cleanup Levels
DRO = 250
PCE = 0.19
Barium = 2100
Cadmium = 9.1
Chromium VI = 0.089
Lead = 400

Sample ID	**IP-03-SO**
Date Collected:	8/20/2014
DRO	**2600**
PCE	**0.071**
Barium	**2600**
Cadmium	**7**
Chromium	**81**
Lead	**1000**

Sample ID	**UT-02-SO**
(Duplicate)	**UT-03-SO**
Date Collected:	8/20/2014
BCL	

Sample ID	**EX-07-SO**
Date Collected:	8/19/2014
BCL	

Sample ID	**UT-01-SO**
d:	8/20/2014
	270
	29

Sample ID	**IP-01-SO**
Date Collected:	8/19/2014
DRO	**320**
Chromium	**26**

	IP-02-SO
Date Collected:	8/19/2014
BCL	

proposed soil gas sampling locations -- selected to at about 6 to 7 ft bgs (~basement floor depth) in source area soil of oil-water separator leach field; likely worst case (but also a very realistic case); southern location is based on existing data; northern location, as shown, is arbitrary and should be shifted based on field screening PID, visual, olfactory observations.

Optional locations include 1) at the dry well location which would give info on vapor intrusion into existing building and 2) in the septic leach field (contamination is deep and likely subject to a high dilution factor such that oil-water leach field is more conservative (higher risk) locations.

Baker Hughes Oilfield Operations, Inc.
Nikiski, Alaska

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Proposed 2020 Boring Locations - Soil Gas

Figure: 4

Date: 8/5/2020

Drafted By: J.C.

Prepared by jcbus, 10/8/2014; Y:\Projects\AES\Nikiski_Tool_Shop\GIS\Report\Report3\Nikiski_Fig5_Report3xxxx.mxd

ATTACHMENT 2

Data Tables

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TABLE 1: VOC ANALYTICAL RESULTS (FULL LIST) - GROUNDWATER

Phase III Site Characterization Work Plan
Baker Hughes Nikiski Completions Facility
Nikiski, Alaska

Sample Location:				**MW-01**		**MW-02**	**MW-03**	**Baker Hughes Drinking Water Well (ADEC samples)**			**Baker Hughes Drinking Water Well**				
Sample ID:				**14-BHI-202-GW**	**14-BHI-203-GW**	**14-BHI-201-GW**	**14-BHI-204-GW**	**NA-01-20**	**NA-01-21 (duplicate)**	**NA-01-20-01**	**13-BH1-101-GW**	**13-BH1-201-GW**	**13-BH1-202-GW (duplicate)**	**13-BH1-301-GW**	**13-BH1-302-GW (duplicate)**
Sample Date:				**8/5/14**	**8/5/14**	**8/5/14**	**8/6/14**	**8/6/12**	**8/6/12**	**9/19/12**	**1/11/13**	**2/20/13**	**2/20/13**	**3/20/13**	**3/20/13**
Analyte (Method EPA 8260B)	**CAS**	**2020 ADEC Groundwater Risk Based Cleanup Levels** (mg/L)	**2016 ADEC Groundwater Cleanup Levels** (mg/L)	**EPA Method 8260**	**EPA Method 8260**	**EPA Method 8260**	**EPA Method 8260**	**EPA Method 524.2**	**EPA Method 524.2**	**EPA Method 524.2**	**EPA Method 524.2**	**EPA Method 524.2**	**EPA Method 524.2**	**EPA Method 524.2**	**EPA Method 524.2**
1,1,1,2-Tetrachloroethane	630-20-6	0.0057	-	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
1,1,1-Trichloroethane	71-55-6	8.0120	0.2	**0.0015**	**0.0017**	**0.003**	**0.00049**	**0.00284**	**0.00284**	**0.00284**	**0.00145**	**0.00166**	**0.00127**	**0.0025**	**0.00226**
1,1,2,2-Tetrachloroethane	79-34-5	0.0008	0.0043	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
1,1,2-Trichloroethane	79-00-5	0.0004	0.005	**0.00043**	**0.00045**	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
1,1-Dichloroethane	75-34-3	0.0275	7.3	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
1,1-Dichloroethene	75-35-4	0.2848	-	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
1,1-Dichloropropene	563-58-6	-	-	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
1,2,3-Trichlorobenzene	87-61-6	0.0070	-	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
1,2,4-Trichlorobenzene	120-82-1	0.0040	0.07	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
1,2-Dibromo-3-chloropropane	96-12-8	3.34E-03 RSL	-	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.002)	ND (0.002)	ND (0.002)	-	-	-	-	-
1,2-Dibromoethane	106-93-4	0.0001	-	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
1,2-Dichlorobenzene	95-50-1	0.3036	0.6	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
1,2-Dichloroethane (EDC)	107-06-2	0.0017	7.3	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
1,2-Dichloropropane	78-87-5	0.0082	0.005	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
1,3,5-Trimethylbenzene	108-67-8	0.0603	1.8	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
1,3-Dichlorobenzene	541-73-1	0.2984	3.3	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
1,3-Dichloropropane	142-28-9	3.69E+02 RSL	-	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
1,4-Dichlorobenzene	106-46-7	0.0048	0.075	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
2,2-Dichloropropane	594-20-7	-	-	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
2-Butanone	78-93-3	5.5655	0.022	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	-	-	-	-	-	-	-	-
2-Chloroethyl Vinyl Ether	110-75-8	-	-	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	-	-	-	-	-	-	-	-
2-Chlorotoluene	95-49-8	2.37E+02 RSL	-	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
2-Hexanone	591-78-6	0.0380	-	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	-	-	-	-	-	-	-	-
4-Chlorotoluene	106-43-4	2.50E+02 RSL	-	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
Acetone	67-64-1	14.0534	33	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	-	-	-	-	-	-	-	-
Benzene	71-43-2	0.0046	0.005	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
Bromobenzene	108-86-1	0.0622	-	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
Bromochloromethane	74-97-5	8.34E+01 RSL	0.014	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
Bromodichloromethane	75-27-4	0.0013	0.11	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
Bromoform	75-25-2	0.0329	-	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
Bromomethane	74-83-9	0.0075	0.005	ND (0.0015)	ND (0.0015)	ND (0.0015)	ND (0.0015)	ND (0.002)	ND (0.002)	ND (0.002)	-	-	-	-	-
Carbon disulfide	75-15-0	0.8107	0.1	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	-	-	-	-	-	-	-	-
Carbon tetrachloride	56-23-5	0.0046	-	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
Chlorobenzene	108-90-7	0.0777	0.01	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
Chloroethane	75-00-3	20.8571	0.29	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	-	-	-	-	-
Chloroform	67-66-3	0.0022	0.14	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
Chloromethane	74-87-3	0.1877	-	ND (0.0016)	ND (0.0016)	ND (0.0016)	ND (0.0016)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
cis-1,2-Dichloroethene	156-59-2	0.0361	0.07	**0.00095**	**0.0011**	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
cis-1,3-Dichloropropene	542-75-6	0.0047	-	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
Dibromochloromethane	124-48-1	0.0087	-	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
Dibromomethane	74-95-3	0.0083	-	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
Dichlorodifluoromethane	75-71-8	0.1972	-	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
Ethylbenzene	100-41-4	0.0150	0.7	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)

TABLE 1: VOC ANALYTICAL RESULTS (FULL LIST) - GROUNDWATER

Phase III Site Characterization Work Plan
Baker Hughes Nikiski Completions Facility
Nikiski, Alaska

			Sample Location:	**MW-01**		**MW-02**	**MW-03**	**Baker Hughes Drinking Water Well (ADEC samples)**			**Baker Hughes Drinking Water Well**				
			Sample ID:	**14-BHI-202-GW**	**14-BHI-203-GW**	**14-BHI-201-GW**	**14-BHI-204-GW**	**NA-01-20**	**NA-01-21 (duplicate)**	**NA-01-20-01**	**13-BH1-101-GW**	**13-BH1-201-GW**	**13-BH1-202-GW (duplicate)**	**13-BH1-301-GW**	**13-BH1-302-GW (duplicate)**
			Sample Date:	**8/5/14**	**8/5/14**	**8/5/14**	**8/6/14**	**8/6/12**	**8/6/12**	**9/19/12**	**1/11/13**	**2/20/13**	**2/20/13**	**3/20/13**	**3/20/13**
Analyte (Method EPA 8260B)	**CAS**	**2020 ADEC Groundwater Risk Based Cleanup Levels** (mg/L)	**2016 ADEC Groundwater Cleanup Levels** (mg/L)	**EPA Method 8260**	**EPA Method 8260**	**EPA Method 8260**	**EPA Method 8260**	**EPA Method 524.2**	**EPA Method 524.2**	**EPA Method 524.2**	**EPA Method 524.2**	**EPA Method 524.2**	**EPA Method 524.2**	**EPA Method 524.2**	**EPA Method 524.2**
Hexachlorobutadiene	87-68-3	0.0014	0.0073	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
Iodomethane	74-88-4	-	-	ND (0.0048)	ND (0.0048)	ND (0.0048)	ND (0.0048)	-	-	-	-	-	-	-	-
Isopropylbenzene	98-82-8	0.4506	3.7	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
Xylenes (total)	1330-20-7	0.1932		ND (0.0006)	ND (0.0006)	ND (0.0006)	ND (0.0006)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
Methyl Isobutyl Ketone	108-10-1	6.2571	0.0029	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	-	-	-	-	-	-	-	-
Methyl tert-butyl ether	1634-04-4	0.1430	0.47	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.001)	ND (0.001)	ND (0.001)	-	-	-	-	-
Methylene chloride	75-09-2	0.1066	0.005	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
Naphthalene	91-20-3	0.0017	0.73	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
n-Butylbenzene	104-51-8	1.0027	0.37	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
n-Propylbenzene	103-65-1	0.6560	0.37	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
p-Isopropyltoluene	99-87-6	-	-	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	-	-	-	-	-	-	-	-
sec-Butylbenzene	135-98-8	2.0055	0.37	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
Styrene	100-42-5	1.2102	0.1	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
tert-Butylbenzene	98-06-6	0.6909	0.37	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
Tetrachloroethene	127-18-4	0.0406	0.005	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
Toluene	108-88-3	1.1015	1	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
trans-1,2-Dichloroethene	156-60-5	0.3612	0.1	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
trans-1,3-Dichloropropene	542-75-6	0.0047	-	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
Trichloroethene	79-01-6	0.0028	0.005	**0.031**	**0.034**	**0.0025**	**0.001**	**0.00432**	**0.00432**	**0.00432**	**0.00363**	**0.00462**	**0.0038**	**0.00482**	**0.00391**
Trichlorofluoromethane	75-69-4	5.1622	11	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.0005)	ND (0.0005)	-	-	-	-	-
Vinyl Acetate	108-05-4	0.4085	37	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	-	-	-	-	-	-	-	-
Vinyl chloride	75-01-4	0.0002	0.002	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0004)	ND (0.0004)	ND (0.0004)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)

Notes: bold font = detected Value
gray shaded cell = detection above ADEC cleanup level
underline = detection >10% of risk based level

[1] 18 AAC 75.345, Table C

Data Flags

B - Analyte was detected within 5 times of the detected concentration in a corresponding method blank sample.

J = Estimated concentration; analyte was detected between the method detection limit and the practical quantitation limit.

Key:

1,1,1-TCA = 1,1,1-Trichloroethane	MW = Monitoring well	ND = non-detect, Reported Detection Limit provided in parenthesis.
ADEC = Alaska Department of Environmental Conservation	GW = Groundwater	mg/L = milligrams per liter
BNT = Baker Nikiski Tool	NS = not sampled	SIM = Selective ion monitoring
EPA = United States Environmental Protection Agency	PCE = Tetrachloroethene	TCE = Trichloroethene

TABLE 2: VOC ANALYTICAL RESULTS (TARGET COMPOUNDS) - GROUNDWATER

Phase III Site Characterization Work Plan
Baker Hughes Nikiski Completions Facility
Nikiski, Alaska

Well ID	**Sample No.**	**Sample Date**	**Duplicate**	**Halogenated Volatiles (EPA 8260C;**		
				1,1,1-TCA	**TCE**	**PCE**
2020 ADEC Groundwater Cleanup Level(1):				*8.0120*	*0.0028*	*0.0406*
2016 ADEC Groundwater Cleanup Level (1):				*0.2*	*0.005*	*0.005*
BHI-MW-01	14-BHI-103-GW	5/16/14		**0.0017**	**0.043**	ND (0.00020)
	14-BHI-202-GW	8/5/14		**0.0015**	**0.031**	ND (0.00020)
	14-BHI-203-GW	8/5/14	✓	**0.0017**	**0.034**	ND (0.00020)
	15-BNT-103-GW	5/21/15		**0.0023**	**0.018**	ND (0.0002)
	15-BNT-FD101-GW	5/21/15	✓	**0.0024**	**0.019**	ND (0.0002)
	15-BNT-208-GW	8/29/15		**0.006**	**0.022**	ND (0.00020)
	15-BNT-209-GW	8/29/15	✓	**0.0059**	**0.023**	ND (0.00020)
	15-BNT-303-GW	12/11/15		ND (0.00020)	**0.016**	ND (0.00020)
	15-BNT-304-GW	12/11/15	✓	ND (0.00020)	**0.016**	ND (0.00020)
	16-BNT-107-GW	2/16/16		**0.00150**	**0.0216**	ND (0.0010)
	16-BNT-108-GW	2/16/16	✓	**0.00147**	**0.0211**	ND (0.0010)
	16-BNT-209-GW	5/19/16		**0.00160**	**0.0149**	ND (0.0010)
	16-BNT-210-GW	5/19/16	✓	**0.00182**	**0.0159**	ND (0.0010)
BHI-MW-02	14-BHI-106-GW	5/16/14		**0.00033**	**0.0029**	ND (0.00020)
	14-BHI-201-GW	8/5/14		**0.0003**	**0.0025**	ND (0.00020)
	15-BNT-104-GW	5/21/15		**0.00026**	**0.0024**	ND (0.0002)
	15-BNT-204-GW	8/28/15		**0.00031**	**0.0025**	ND (0.00020)
	15-BNT-306-GW	12/11/15		**0.00027**	**0.0025**	ND (0.00020)
	16-BNT-106-GW	2/16/16		ND (0.0010)	**0.00226**	ND (0.0010)
	16-BNT-211-GW	5/19/16		ND (0.0010)	**0.0017**	ND (0.0010)
BHI-MW-03(T	14-BHI-101-GW	5/16/14		**0.00029**	**0.00067**	ND (0.00020)
	14-BHI-102-GW	5/16/14	✓	**0.00029**	**0.00069**	ND (0.00020)
	14-BHI-204-GW	8/6/14		**0.00049**	**0.001**	ND (0.00020)
	15-BNT-105-GW	5/21/15		**0.00026**	**0.00088**	ND (0.0002)
	15-BNT-201-GW	8/28/15		**0.00025**	**0.0006**	ND (0.00020)
	15-BNT-301-GW	12/10/15		ND (0.00020)	**0.00075**	ND (0.00020)
	16-BNT-103-GW	2/15/16		ND (0.0010)	**0.00149 B**	ND (0.0010)
	16-BNT-206-GW	5/19/16		ND (0.0010)	**0.00101**	ND (0.0010)
BHI-MW-04	15-BNT-101-GW	5/20/15		**0.005**	**0.0018**	**0.00027**
	15-BNT-207-GW	8/29/15		**0.0075**	**0.0047**	**0.00059**
	NS	12/10/15		frozen pump lines, not sampled		
	16-BNT-101-GW	2/15/16		**0.00522**	**0.00295 B**	ND (0.0010)
	16-BNT-208-GW	5/19/16		**0.00569**	**0.00176**	ND (0.0010)
BHI-MW-05	15-BNT-102-GW	5/20/15		**0.0014**	**0.0019**	ND (0.0002)
	15-BNT-206-GW	8/28/15		**0.002**	**0.0021**	ND (0.00020)
	15-BNT-302-GW	12/10/15		ND (0.00020)	**0.0014**	ND (0.00020)
	NS	2/15/16	frozen surface access, not sampled			
	16-BNT-207-GW	5/19/16		**0.00127**	**0.00163**	ND (0.0010)
BHI-MW-06	15-BNT-107-GW	5/21/15		ND (0.0002)	ND (0.0002)	ND (0.0002)
	15-BNT-202-GW	8/28/15		ND (0.00020)	ND (0.00020)	ND (0.00020)
	15-BNT-308-GW	12/11/15		ND (0.00020)	ND (0.00020)	ND (0.00020)

TABLE 2: VOC ANALYTICAL RESULTS (TARGET COMPOUNDS) - GROUNDWATER

Phase III Site Characterization Work Plan
Baker Hughes Nikiski Completions Facility
Nikiski, Alaska

Well ID	**Sample No.**	**Sample Date**	**Duplicate**	**Halogenated Volatiles (EPA 8260C;**		
				1,1,1-TCA	**TCE**	**PCE**
2020 ADEC Groundwater Cleanup Level[(1)]:				*8.0120*	*0.0028*	*0.0406*
2016 ADEC Groundwater Cleanup Level [(1)]:				*0.2*	*0.005*	*0.005*
	16-BNT-105-GW	2/16/16		ND (0.0010)	ND (0.0010)	ND (0.0010)
	16-BNT-203-GW	5/18/16		ND (0.0010)	ND (0.0010)	ND (0.0010)
BHI-MW-07	15-BNT-106-GW	5/21/15		**0.00037**	ND (0.0002)	ND (0.0002)
	15-BNT-205-GW	8/28/15		**0.00043**	ND (0.00020)	ND (0.00020)
	15-BNT-307-GW	12/11/15		ND (0.00020)	ND (0.00020)	ND (0.00020)
	16-BNT-104-GW	2/15/16		**0.000361 J**	**0.000495 BJ**	ND (0.0010)
	16-BNT-205-GW	5/18/16		ND (0.0010)	ND (0.0010)	ND (0.0010)
BHI-MW-08(T	15-BNT-108-GW	5/21/15		**0.0073**	**0.00065**	ND (0.0002)
	15-BNT-203-GW	8/28/15		**0.013**	**0.00091**	ND (0.00020)
	15-BNT-305-GW	12/11/15		**0.012**	**0.00065**	ND (0.00020)
	16-BNT-102-GW	2/15/16		**0.00947**	**0.001 BJ**	ND (0.0010)
	16-BNT-201-GW	5/18/16		**0.00904**	**0.00061 J**	ND (0.0010)
BHI-MW-09	16-BNT-109-GW	2/16/16		ND (0.0010)	ND (0.0010)	ND (0.0010)
	16-BNT-204-GW	5/18/16		ND (0.0010)	ND (0.0010)	ND (0.0010)
BHI-MW-10	16-BNT-110-GW	2/16/16		**0.00458**	ND (0.0010)	ND (0.0010)
	16-BNT-202-GW	5/18/16		**0.00231**	ND (0.0010)	ND (0.0010)

Notes: bold font = detected Value

[(1)] 18 AAC 75.345, Table C

Key:

1,1,1-TCA = 1,1,1-Trichloroethane	MW = Monitoring well
ADEC = Alaska Department of Environmental Conservation	GW = Groundwater
BNT = Baker Nikiski Tool	NS = not sampled
EPA = United States Environmental Protection Agency	PCE = Tetrachloroethene
ND = non-detect, Reported Detection Limit provided in parenthesis.	SIM = Selective ion monitoring
mg/L = milligrams per liter	TCE = Trichloroethene

Data Flags

B - Analyte was detected within 5 times of the detected concentration in a corresponding method blank sample.

J = Estimated concentration; analyte was detected between the MDL and the PQL.

TABLE 3: VOC ANALYTICAL RESULTS (TARGET COMPOUNDS) - SOIL BORINGS

Phase III Site Characterization Work Plan
Baker Hughes Nikiski Completions Facility
Nikiski, Alaska

Location	Sample No. (14-BHI-)	Sample Depth (Feet bgs)	Duplicate	Sample Date	Target Halogenated Volatiles (EPA 8260C SIM) (mg/kg)		
					1,1,1-TCA	TCE	PCE
				2020 ADEC Health Based (mg/kg):	*11,000*	*4.9*	*95*
				2020 ADEC Migration to Groundwater:	*32*	*0.011*	*0.19*
SB-01	SB01-01-SO	0-5		5/12/14	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB01-04-SO	15-20		5/12/14	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB01-09-SO	40-45		5/12/14	ND (0.0025)	**0.0074**	ND (0.0025)
SB-02	SB02-01-SO	0-5		5/12/14	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB02-04-SO	15-20		5/12/14	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB02-09-SO	40-45		5/12/14	ND (0.0025)	**0.0098**	ND (0.0025)
SB-03	SB03-01-SO	0-5		5/13/14	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB03-04-SO	15-20		5/13/14	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB03-05-SO	15-20	✓	5/13/14	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB03-10-SO	40-45		5/13/14	ND (0.0025)	**0.058**	ND (0.0025)
SB-04/ BHI-MW-01	SB04-01-SO	0-5		5/13/14	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB04-04-SO	15-20		5/13/14	ND (0.0025)	**0.0045**	ND (0.0025)
	SB04-08-SO	35-40		5/13/14	ND (0.0025)	**0.093**	ND (0.0025)
SB-05/ BHI-MW-02	SB05-01-SO	0-5		5/13/14	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB05-04-SO	15-20		5/13/14	ND (0.0025)	**0.010**	ND (0.0025)
	SB05-05-SO	15-20	✓	5/13/14	ND (0.0025)	**0.0071**	ND (0.0025)
	SB05-10-SO	40-45		5/13/14	ND (0.0025)	**0.024**	ND (0.0025)
SB-06 BHI-MW-03	SB06-01-SO	0-5		5/14/14	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB06-04-SO	15-20		5/14/14	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB06-09-SO	40-45		5/14/14	ND (0.0025)	**0.0056**	ND (0.0025)
SB-7 (MW-06)	SB07-01-SO	13.5		5/15/15	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB07-02-SO	18.66		5/15/15	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB07-03-SO	28.17		5/15/15	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB07-04-SO	36.83		5/15/15	ND (0.0025)	ND (0.0025)	ND (0.0025)
SB-8 (MW-04)	SB08-01-SO	6.91		5/15/15	ND (0.0025)	ND (0.0025)	**0.0053 J**
	SB08-02-SO	17.25		5/15/15	ND (0.0025)	**0.0037 J**	**0.0052 J**
	SB08-03-SO	30		5/15/15	ND (0.0025)	**0.014 J**	**0.0039 J**
	SB08-04-SO	43		5/15/15	ND (0.0025)	**0.020 J**	ND (0.0025)
SB-9 (MW-05)	SB09-01-SO	8.33		5/16/15	ND (0.0025)	**0.0065 J**	**0.0035 J**
	SB09-02-SO	17.67		5/16/15	ND (0.0025)	**0.0043 J**	ND (0.0025)
	SB09-03-SO	28.67		5/16/15	ND (0.0025)	**0.0076 J**	ND (0.0025)
	FD01-SO	28.67	✓	5/16/15	ND (0.0025)	**0.0077 J**	ND (0.0025)
	SB09-04-SO	41.5		5/16/15	ND (0.0030)	**0.0068 J**	ND (0.0030)
SB-10	SB10-01-SO	7		5/16/15	ND (0.0032)	ND (0.0032)	**0.0062 J**
	SB10-02-SO	19.5		5/16/15	ND (0.0033)	ND (0.0033)	ND (0.0033)
	SB10-03-SO	28.58		5/16/15	ND (0.0028)	**0.008 J**	ND (0.0028)
	SB10-04-SO	38.5		5/16/15	ND (0.0025)	**0.0026 J**	ND (0.0025)
SB-11	SB11-01-SO	8.91		5/16/15	ND (0.0030)	**0.0018 J**	ND (0.0030)
	SB11-02-SO	17.91		5/16/15	**0.0026 J**	**0.130 J**	ND (0.0025)
	SB11-03-SO	27.67		5/16/15	**0.0031 J**	**0.180 J**	**0.0025 J**
	SB11-04-SO	37.67		5/16/15	**0.0032 J**	**0.110 J**	ND (0.0025)
	FD02-SO	37.67	✓	5/16/15	**0.003 J**	**0.120 J**	ND (0.0025)
SB-12	SB12-01-SO	8.33		5/17/15	ND (0.0044)	**0.0048 J**	ND (0.0044)
	SB12-02-SO	18.58		5/17/15	**0.0028 J**	**0.068 J**	ND (0.0027)
	SB12-03-SO	27.67		5/17/15	**0.004 J**	**0.070 J**	ND (0.0027)
	SB12-04-SO	36.67		5/17/15	**0.0055 J**	**0.120 J**	ND (0.0025)
SB-13	SB13-01-SO	6.58		5/17/15	ND (0.0030)	**0.012 J**	ND (0.0030)
	SB13-02-SO	17.83		5/17/15	ND (0.0025)	**0.013 J**	ND (0.0025)
	SB13-03-SO	28.75		5/17/15	ND (0.0032)	**0.033 J**	ND (0.0032)
	SB13-04-SO	38.42		5/17/15	ND (0.0034)	**0.022 J**	ND (0.0034)
SB-14	SB14-01-SO	9		5/17/15	ND (0.0025)	**0.0025 J**	ND (0.0025)
	SB14-02-SO	20		5/17/15	ND (0.0026)	**0.0028 J**	ND (0.0026)
	SB14-03-SO	29.67		5/17/15	ND (0.0025)	**0.0025 J**	ND (0.0025)

TABLE 3: VOC ANALYTICAL RESULTS (TARGET COMPOUNDS) - SOIL BORINGS

Phase III Site Characterization Work Plan
Baker Hughes Nikiski Completions Facility
Nikiski, Alaska

Location	Sample No. (14-BHI-)	Sample Depth (Feet bgs)	Duplicate	Sample Date	Target Halogenated Volatiles (EPA 8260C SIM) (mg/kg)		
					1,1,1-TCA	TCE	PCE
2020 ADEC Health Based (mg/kg):					*11,000*	*4.9*	*95*
2020 ADEC Migration to Groundwater:					*32*	*0.011*	*0.19*
	SB14-04-SO	39.5		5/17/15	ND (0.0025)	**0.0033 J**	ND (0.0025)
	FD03-SO	39.5	✓	5/17/15	ND (0.0025)	**0.0033 J**	ND (0.0025)
SB-15	SB15-01-SO	7.67		5/18/15	ND (0.0027)	ND (0.0027)	ND (0.0027)
	SB15-02-SO	18.67		5/18/15	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB15-03-SO	29		5/18/15	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB15-04-SO	39.16		5/18/15	ND (0.0025)	**0.0043 J**	ND (0.0025)
SB-16 (MW-07)	SB16-01-SO	9.67		5/18/15	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB16-02-SO	19.67		5/18/15	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB16-03-SO	29.5		5/18/15	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB16-04-SO	48.67		5/18/15	ND (0.0025)	ND (0.0025)	ND (0.0025)
	FD04-SO	48.67	✓	5/18/15	ND (0.0025)	ND (0.0025)	ND (0.0025)
SB-17	SB17-01-SO	8.25		5/19/15	ND (0.0025)	**0.030 J**	ND (0.0025)
	SB17-02-SO	17.41		5/19/15	ND (0.0025)	**0.027 J**	ND (0.0025)
	SB17-03-SO	29.5		5/19/15	ND (0.0025)	**0.011 J**	ND (0.0025)
	SB17-04-SO	39.67		5/19/15	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB17-05-SO	49.67		5/19/15	ND (0.0026)	ND (0.0026)	ND (0.0026)
	SB17-06-SO	58.75		5/19/15	ND (0.0025)	ND (0.0025)	ND (0.0025)
	SB17-07-SO	69.5		5/19/15	ND (0.0026)	ND (0.0026)	ND (0.0026)
	SB17-08-SO	79.83		5/19/15	ND (0.0025)	ND (0.0025)	ND (0.0025)
SB-18 (MW-08)	SB18-01-SO	8.92		5/19/15	ND (0.0025)	**0.0076**	ND (0.0025)
	SB18-02-SO	18.33		5/19/15	ND (0.0025)	**0.0038**	ND (0.0025)
	SB18-03-SO	29.08		5/19/15	**0.0059**	**0.0046**	ND (0.0025)
	SB18-04-SO	40.5		5/19/15	**0.0028**	ND (0.0025)	ND (0.0025)
	FD05-SO	40.5	✓	5/19/15	**0.004**	**0.0031**	ND (0.0025)
SB-19 (MW-09)	SB19-01-SO	5-10		2/15/16	ND (0.0526)	ND (0.0526) X	ND (0.0526) X
	SB19-02-SO	15-20		2/15/16	ND (0.0620)	ND (0.0620) X	ND (0.0620) X
	SB19-FD01-SO	15-20	✓	2/15/16	ND (0.0590) H	ND (0.0590) H, X	ND (0.0590) X
	SB19-03-SO	25-30		2/15/16	ND (0.0602)	ND (0.0602) X	ND (0.0602) X
	SB19-04-SO	35-40		2/15/16	ND (0.0598)	ND (0.0598) X	ND (0.0598) X
SB-20 (MW-10)	SB20-01-SO	5-10		2/15/16	ND (0.0631)	ND (0.0631) X	ND (0.0631) X
	SB20-02-SO	15-20		2/15/16	ND (0.0729)	ND (0.0729) X	ND (0.0729) X
	SB20-03-SO	25-30		2/15/16	ND (0.0628) H	ND (0.0628) H,X	ND (0.0628) X
	SB20-04-SO	40-45		2/15/16	ND (0.0640) H	ND (0.0640) H,X	ND (0.0640) X

Notes: bold font = detected Value

(1) ADEC Method Two Soil Cleanup Levels; Table B1; Migration to Groundwater Pathway

Key:

ADEC = Alaska Department of Environmental Conservation
bgs = Below ground surface
BHI - Baker Hughes, Inc.
EPA = United States Environmental Protection Agency
1,1,1-TCA = 1,1,1-Trichloroethane
BNT = Baker Nikiski Tool
EPA = United States Environmental Protection Agency
ND = non-detect, Reported Detection Limit provided in parenthesis.
SIM = Selective ion monitoring
NS = not sampled
SB = Soil Boring
SIM = Selective ion monitoring
SO = Soil
mg/kg = Milligrams per kilograms
TCE = Trichloroethene
PCE = Tetrachloroethene
MW = Monitoring Well
MW = Monitoring well
GW = Groundwater

Data Flags

B - Analyte was detected within 5 times of the detected concentration in a corresponding method blank sample.
J = Estimated concentration; analyte was detected between the method detection limit and the practical quantitation limit.
H - Method holding times were exceeded, results may be biased low
X = Analyte was not detected and MRLs exceeded, the applicable ADEC Migration to Groundwater Soil Cleanup Level.

TABLE 4: DRO, RRO, VOC, SVOC, PCBs METALS ANALYTICAL RESULTS - SOIL BORINGS

Phase III Site Characterization Work Plan
Baker Hughes Nikiski Completions Facility
Nikiski, Alaska

Location:						Excavation Confirmation	Injection Point			Underground Tank			IP-03/SB-08/ MW-04	IP-03/SB-08/ MW-04	IP-03/SB-08/ MW-04	IP-03/SB-08/ MW-04	IP-01/SB-09/ MW-05	IP-01/SB-09/ MW-05	IP-01/SB-09/ MW-05	IP-01/SB-09/ MW-05	IP-01/SB-09/ MW-05
Sample ID (14-BHI-):						EX-07-SO	IP-01-SO	IP-02-SO	IP-03-SO	UT-01-SO	UT-02-SO	UT-03-SO	SB08-01-SO	SB08-02-SO	SB08-03-SO	SB08-04-SO	SB09-01-SO	SB09-02-SO	SB09-03-SO	FD01-SO	SB09-04-SO
Depth:													6.91	17.25	30	43	8.33	17.67	28.67		41.5
Date Collected:						8/19/14	8/19/14	8/19/14	8/20/14	8/20/14	8/20/14	8/20/14	5/15/15	5/15/15	5/15/15	5/15/15	5/16/15	5/16/15	5/16/15	5/16/15	5/16/15
Status:						In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ
Analyte	CAS	2020 ADEC Health Based Cleanup Level (mg/kg)	2020 ADEC Migration to Groundwater CLeanup Level (mg/kg)	Csat or 100K Over-ride Cleanup Level (mg/kg)	2016 ADEC Soil Cleanup Levels(1)	Phase 2 Removal	Phase 2 Removal	Phase 2 Removal	Phase 2 Removal	Phase 2 Removal	Phase 2 Removal	Phase 2 Removal	Phase 2 Site Characterization	Phase 2 Site Characterization	Phase 2 Site Characterization	Phase 2 Site Characterization	Phase 2 Site Characterization	Phase 2 Site Characterization	Phase 2 Site Characterization	Phase 2 Site Characterization	Phase 2 Site Characterization
Total Solids (%)					--	95.8	95.7	94.8	85.2	95.5	96.6	96.7	92	96	95	97	92	94	96	97	96.7
ADEC Fuels (AK101, AK102, AK103; mg/kg)																					
Gasoline-range organics		1400	300		300	ND	ND	ND	ND	ND	ND	ND									
Diesel-range organics		12500	250		250	**ND**	**320**	**32**	**2600**	**270**	**12**	ND	**970**	ND (10)	ND (11)	ND (10)	**43**	ND (10)	ND (10)	ND (10)	
Residual-range organics		10000	11000		10000	**28**	**970**	**100**	**6200**	**660**	**41**	ND	**1600**	ND (21)	ND (21)	ND (21)	**140**	ND (21)	ND (21)	ND (21)	ND (10)
BTEX (EPA 8260B; mg/kg)																					ND (21)
Benzene	71-43-2	11.2572	0.0221	-	0.025	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Toluene	108-88-3	5,757.0724	6.6965	202.6627	6.5	ND (0.14)	ND (0.17)	ND (0.19)	ND (0.34)	ND (0.25)	ND (0.23)	ND (0.20)	ND (0.16)	ND (0.14)	ND (0.18)	ND (0.16)	ND (0.14)	ND (0.16)	ND (0.17)	ND (0.15)	ND (0.3)
Ethylbenzene	100-41-4	49.3217	0.1343	-	6.9	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Xylenes (total)	1330-20-7	486.2455	1.5563	56.6266	63	ND (0.084)	ND (0.102)	ND (0.114)	ND (0.080)	ND (0.148)	ND (0.139)	ND (0.121)	ND (0.098)	ND (0.084)	ND (0.108)	ND (0.096)	ND (0.086)	ND (0.096)	ND (0.105)	ND (0.09)	ND (0.179)
VOCs (EPA 8260B; mg/kg)																					
Dichlorodifluoromethane	75-71-8	149.3886	3.9163	-	140	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.039)	ND (0.059)
Chloromethane	74-87-3	168.4491	0.6114	-	0.21	ND (0.14)	ND (0.17)	ND (0.19)	ND (0.34)	ND (0.25)	ND (0.23)	ND (0.20)	ND (0.16)	ND (0.14)	ND (0.18)	ND (0.16)	ND (0.14)	ND (0.16)	ND (0.17)	ND (0.15)	ND (0.3)
Vinyl Chloride	75-01-4	0.6533	0.0008	-	0.0085	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Bromomethane	74-83-9	10.2329	0.0240	-	0.16	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Chloroethane	75-00-3	19,506.1938	72.5883	1393.2540	23	ND (0.14)	ND (0.17)	ND (0.19)	ND (0.34)	ND (0.25)	ND (0.23)	ND (0.20)	ND (0.16)	ND (0.14)	ND (0.18)	ND (0.16)	ND (0.14)	ND (0.16)	ND (0.17)	ND (0.15)	ND (0.3)
Trichlorofluoromethane	75-69-4	30,416.6667	40.9690	984.0837	86	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
1,1-Dichloroethene	75-35-4	330.6294	1.2361	-	0.03	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Acetone	67-64-1	81,270.5325	37.7635	-	88	ND (0.14)	ND (0.17)	ND (0.19)	ND (0.34)	ND (0.25)	ND (0.23)	ND (0.20)	ND (0.16)	ND (0.14)	ND (0.18)	ND (0.16)	ND (0.14)	ND (0.16)	ND (0.17)	ND (0.15)	ND (0.3)
Iodomethane	74-88-4	--	--	--	--	ND (0.14)	ND (0.17)	ND (0.19)	ND (0.34)	ND (0.25)	ND (0.23)	ND (0.20)	ND (0.16)	ND (0.14)	ND (0.18)	ND (0.16)	ND (0.14)	ND (0.16)	ND (0.17)	ND (0.15)	ND (0.3)
Carbon Disulfide	75-15-0	1,116.2307	2.9511	503.6662	12	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Methylene Chloride	75-09-2	458.0153	0.3304	-	0.016	ND (0.14)	ND (0.17)	ND (0.19)	ND (0.34)	ND (0.25)	ND (0.23)	ND (0.20)	ND (0.16)	ND (0.14)	ND (0.18)	ND (0.16)	ND (0.14)	ND (0.16)	ND (0.17)	ND (0.15)	ND (0.3)
(trans) 1,2-Dichloroethene	156-60-5	2,027.7778	1.3126	959.1282	0.37	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Methyl t-Butyl Ether	1634-04-4	668.0820	0.4057	-	1.3	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
1,1-Dichloroethane	75-34-3	45.8393	0.0921	-	25	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Vinyl Acetate	108-05-4	1,438.7667	1.1246	-	100	ND (0.14)	ND (0.17)	ND (0.19)	ND (0.34)	ND (0.25)	ND (0.23)	ND (0.20)	ND (0.16)	ND (0.14)	ND (0.18)	ND (0.16)	ND (0.14)	ND (0.16)	ND (0.17)	ND (0.15)	ND (0.3)
2,2-Dichloropropane	594-20-7	--	--	--	--	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
(cis) 1,2-Dichloroethene	156-59-2	202.7778	0.1220	-	0.24	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
2-Butanone	78-93-3	38,227.0513	15.1196	23403.9342	59	ND (0.14)	ND (0.17)	ND (0.19)	ND (0.34)	ND (0.25)	ND (0.23)	ND (0.20)	ND (0.16)	ND (0.14)	ND (0.18)	ND (0.16)	ND (0.14)	ND (0.16)	ND (0.17)	ND (0.15)	ND (0.3)
Bromochloromethane	74-97-5	149 RSL	0.0208 RSL	--	--	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Chloroform	67-66-3	3.9955	0.0072	-	0.046	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
1,1,1-Trichloroethane	71-55-6	10,837.9517	32.6081	357.3421	0.82	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0044)	ND (0.0025)	ND (0.0025)	0.0025	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.003)
Carbon Tetrachloride	56-23-5	9.1194	0.0208	-	0.023	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
1,1-Dichloropropene	563-58-6	--	--	--	--	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
1,2-Dichloroethane	107-06-2	5.4502	0.0055	-	0.016	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Trichloroethene	79-01-6	4.9114	0.0111	-	0.02	ND (0.0025)	**0.0035**	**0.0031**	ND (0.0044)	ND (0.0025)	ND (0.0025)	0.0025	ND (0.0025)	**0.0037**	**0.014**	**0.020**	**0.0065**	**0.0043**	**0.0076**	**0.0077**	**0.0068**
1,2-Dichloropropane	78-87-5	17.1890	0.0297	-	0.018	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Dibromomethane	74-95-3	30.8813	0.0249	-	1.1	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Bromodichloromethane	75-27-4	3.6330	0.0043	-	0.044	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
2-Chloroethyl Vinyl Ether	110-75-8	--	--	--	--	ND (0.14)	ND (0.17)	ND (0.19)	ND (0.34)	ND (0.25)	ND (0.23)	ND (0.20)	ND (0.22)	ND (0.19)	ND (0.24)	ND (0.22)	ND (0.19)	ND (0.22)	ND (0.24)	ND (0.15)	ND (0.4)
(cis) 1,3-Dichloropropene	542-75-6	20.5086	0.0178	-	--	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Methyl Isobutyl Ketone	108-10-1	47,291.8292	17.6950	2159.6930	8.1	ND (0.14)	ND (0.17)	ND (0.19)	ND (0.34)	ND (0.25)	ND (0.23)	ND (0.20)	ND (0.16)	ND (0.14)	ND (0.18)	ND (0.16)	ND (0.14)	ND (0.16)	ND (0.17)	ND (0.15)	ND (0.3)
(trans) 1,3-Dichloropropene	542-75-6	20.5086	0.0178	-	--	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
1,1,2-Trichloroethane	79-00-5	1.5930	0.0015	-	0.018	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Tetrachloroethene	127-18-4	94.5989	0.1936	68.3774	0.024	ND (0.0025)	ND (0.0025)	ND (0.0025)	**0.071**	**0.003**	**0.0094 J**	**0.0049 J**	**0.0053**	**0.0052**	**0.0039**	ND (0.0025)	**0.0035**	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0030)
1,3-Dichloropropane	142-28-9	16700 RSL	0.128 RSL	--	--	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
2-Hexanone	591-78-6	270.0398	0.1086	-	--	ND (0.14)	ND (0.17)	ND (0.19)	ND (0.34)	ND (0.25)	ND (0.23)	ND (0.20)	ND (0.16)	ND (0.14)	ND (0.18)	ND (0.16)	ND (0.14)	ND (0.16)	ND (0.17)	ND (0.3)	ND (0.3)
Dibromochloromethane	124-48-1	107.2898	0.0271	-	0.032	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
1,2-Dibromoethane	106-93-4	0.4244	0.0002	-	0.00016	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Chlorobenzene	108-90-7	253.8320	0.4594	178.2690	0.63	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
1,1,1,2-Tetrachloroethane	630-20-6	20.5315	0.0225	-	--	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Styrene	100-42-5	5,646.0121	10.5373	175.8889	0.96	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Bromoform	75-25-2	237.3033	0.1019	-	0.34	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Isopropylbenzene	98-82-8	1,724.5401	5.6201	54.3611	51	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Bromobenzene	108-86-1	289.2570	0.3658	157.4454		ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
1,1,2,2-Tetrachloroethane	79-34-5	6.1131	0.0030	-	0.017	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
1,2,3-Trichloropropane	96-18-4	0.0662	0.0000	-	0.00053	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
n-Propylbenzene	103-65-1	3,674.8801	9.1537	51.9058	15	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
2-Chlorotoluene	95-49-8	16700 RSL	0.232 RSL	--	--	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
4-Chlorotoluene	106-43-4	16700 RSL	0.241 RSL	--	--	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
1,3,5-Trimethylbenzene	108-67-8	250.5600	0.6672	37.1128	23	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
tert-Butylbenzene	98-06-6	10,138.8889	11.4536	35.4933	12	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
1,2,4-Trimethylbenzene	95-63-6	283.5104	0.6182	43.4326	23	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
sec-Butylbenzene	135-98-8	10,138.8889	42.4557	27.5830	12	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
1,3-Dichlorobenzene	541-73-1	1,424.8029	2.3164	61.9569	28	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
p-Isopropyltoluene	99-87-6	--	--	--	--	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
1,4-Dichlorobenzene	106-46-7	21.4173	0.0373	-	0.64	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
1,2-Dichlorobenzene	95-50-1	1,622.7174	2.3766	77.6505	5.1	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
n-Butylbenzene	104-51-8	5,069.4444	23.1546	20.1197	15	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
1,2-Dibromo-3-chloropropane	96-12-8	0.0526 RSL	.00000144 RS	--	--	ND (0.14)	ND (0.17)	ND (0.19)	ND (0.34)	ND (0.25)	ND (0.23)	ND (0.20)	ND (0.16)	ND (0.14)	ND (0.18)	ND (0.16)	ND (0.14)	ND (0.16)	ND (0.17)	ND (0.15)	ND (0.3)
1,2,4-Trichlorobenzene	120-82-1	44.8446	0.0826	-	0.85	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
Hexachlorobutadiene	87-68-3	9.9137	0.0199	3.2797	0.12	ND (0.14)	ND (0.17)	ND (0.19)	ND (0.34)	ND (0.25)	ND (0.23)	ND (0.20)	ND (0.16)	ND (0.14)	ND (0.18)	ND (0.16)	ND (0.14)	ND (0.16)	ND (0.17)	ND (0.15)	ND (0.3)
Naphthalene	91-20-3	28.6047	0.0383	-	20	ND (0.14)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.15)	ND (0.059)
1,2,3-Trichlorobenzene	87-61-6	81.1111	0.1484	-	--	ND (0.028)	ND (0.034)	ND (0.038)	ND (0.067)	ND (0.049)	ND (0.046)	ND (0.040)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
SVOCs (8270D mg/kg)																					
Acenaphthene	83-32-9	4,649.1248	37.1133	-	180	ND (0.034)	ND (0.17)	ND (0.035)	ND (0.77)	ND (0.034)	ND (0.034)	ND (0.034)	ND (0.0073)	ND (0.007)	ND (0.007)	ND (0.0069)	ND (0.0072)	ND (0.0071)	ND (0.0069)	ND (0.0069)	ND (0.0069)
Acenaphthylene	208-96-8	2,324.5624	18.0968	-	180	ND (0.034)	ND (0.17)	ND (0.035)	ND (0.77)	ND (0.034)	ND (0.034)	ND (0.034)	ND (0.0073)	ND (0.007)	ND (0.007)	ND (0.0069)	ND (0.0072)	ND (0.0071)	ND (0.0069)	ND (0.0069)	ND (0.0069)
Anthracene	120-12-7	23,245.6241	387.9264	-	3000	ND (0.034)	ND (0.17)	ND (0.035)	ND (0.77)	ND (0.034)	ND (0.034)	ND (0.034)	ND (0.0073)	ND (0.007)	ND (0.007)	ND (0.0069)	ND (0.0072)	ND (0.0071)	ND (0.0069)	ND (0.0069)	ND (0.0069)
Benzidine	92-87-5	0.0053 RSL	.00000275 RS	--	--	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (1.8)	ND (0.35)	ND (0.35)	ND (0.35)	ND (0.36)	ND (0.36)	ND (0.35)	ND (0.34)	ND (0.34)
Benzo(a)anthracene	56-55-3	14.4870	0.6999	-	3.6	ND (0.034)	ND (0.17)	ND (0.035)	ND (0.77)	ND (0.034)	ND (0.034)	ND (0.034)	ND (0.0073)	ND (0.007)	ND (0.007)	ND (0.0069)	ND (0.0072)	ND (0.0071)	ND (0.0069)	ND (0.0069)	ND (0.0069)

TABLE 4: DRO, RRO, VOC, SVOC, PCBs METALS ANALYTICAL RESULTS - SOIL BORINGS

Phase III Site Characterization Work Plan

Baker Hughes Nikiski Completions Facility

Nikiski, Alaska

					Location:	Excavation Confirmation	Injection Point			Underground Tank			IP-03/SB-08/ MW-04	IP-03/SB-08/ MW-04	IP-03/SB-08/ MW-04	IP-03/SB-08/ MW-04	IP-01/SB-09/ MW-05	IP-01/SB-09/ MW-05	IP-01/SB-09/ MW-05	IP-01/SB-09/ MW-05	IP-01/SB-09/ MW-05
					Sample ID (14-BHI-):	EX-07-SO	IP-01-SO	IP-02-SO	IP-03-SO	UT-01-SO	UT-02-SO	UT-03-SO	SB08-01-SO	SB08-02-SO	SB08-03-SO	SB08-04-SO	SB09-01-SO	SB09-02-SO	SB09-03-SO	FD01-SO	SB09-04-SO
					Depth:								6.91	17.25	30	43	8.33	17.67	28.67		41.5
					Date Collected:	8/19/14	8/19/14	8/19/14	8/20/14	8/20/14	8/20/14	8/20/14	5/15/15	5/15/15	5/15/15	5/15/15	5/16/15	5/16/15	5/16/15	5/16/15	5/16/15
					Status:	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ
Analyte	CAS	2020 ADEC Health Based Cleanup Level (mg/kg)	2020 ADEC Migration to Groundwater CLeanup Level (mg/kg)	Csat or 100K Over-ride Cleanup Level (mg/kg)	2016 ADEC Soil Cleanup Levels$^{(1)}$	Phase 2 Removal	Phase 2 Removal	Phase 2 Removal	Phase 2 Removal	Phase 2 Removal	Phase 2 Removal	Phase 2 Removal	Phase 2 Site Characterization	Phase 2 Site Characterization	Phase 2 Site Characterization	Phase 2 Site Characterization	Phase 2 Site Characterization	Phase 2 Site Characterization	Phase 2 Site Characterization	Phase 2 Site Characterization	Phase 2 Site Characterization
Benzo(b)fluoranthene	205-99-2	14.8843	19.9332	-	12	ND (0.034)	ND (0.17)	ND (0.035)	ND (0.77)	ND (0.034)	ND (0.034)	ND (0.034)	ND (0.0073)	ND (0.007)	ND (0.007)	ND (0.0069)	ND (0.0072)	ND (0.0071)	ND (0.0069)	ND (0.0069)	ND (0.0069)
Benzo(k)fluoranthene	207-08-9	148.8434	195.3430	-	49	ND (0.034)	ND (0.17)	ND (0.035)	ND (0.77)	ND (0.034)	ND (0.034)	ND (0.034)	ND (0.0073)	ND (0.007)	ND (0.007)	ND (0.0069)	ND (0.0072)	ND (0.0071)	ND (0.0069)	ND (0.0069)	ND (0.0069)
Benzo(g,h,i)perylene	191-24-2	2,324.5624	15578.5556	-	1400	ND (0.034)	ND (0.17)	ND (0.035)	ND (0.77)	ND (0.034)	ND (0.034)	ND (0.034)	**0.025**	ND (0.0070)	ND (0.0070)	ND (0.0069)	ND (0.0072)	ND (0.0071)	ND (0.0069)	ND (0.0069)	ND (0.0069)
Benzo(a)pyrene	50-32-8	1.4884	1.9534	-	0.49	ND (0.034)	ND (0.17)	ND (0.035)	ND (0.77)	ND (0.034)	ND (0.034)	ND (0.034)	ND (0.0073)	ND (0.007)	ND (0.007)	ND (0.0069)	ND (0.0072)	ND (0.0071)	ND (0.0069)	ND (0.0069)	ND (0.0069)
Bis(2-chlorethoxy)methane	111-91-1	1760 RSL	0.0135 RSL	--	--	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
Bis(2-chloroethyl)ether	111-44-4	2.8347	0.0004	-	0.0022	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
Bis(2-chloroisopropyl)ether	#N/A	--	--	--	--	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
4-Bromophenyl-phenylether	#N/A	--	--	--	--	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
2-Chloronaphthalene	#N/A	--	--	--	120	ND (0.034)	ND (0.17)	ND (0.035)	ND (0.77)	ND (0.034)	ND (0.034)	ND (0.034)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
4-Chlorophenyl-phenylether	#N/A	--	--	--	--	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
Chrysene	218-01-9	1,488.4338	600.7229	-	360	ND (0.034)	ND (0.17)	ND (0.035)	ND (0.77)	ND (0.034)	ND (0.034)	ND (0.034)	ND (0.0073)	ND (0.007)	ND (0.007)	ND (0.0069)	ND (0.0072)	ND (0.0071)	ND (0.0069)	ND (0.0069)	ND (0.0069)
Dibenz(a,h)anthracene	53-70-3	1.4884	6.3570	-	--	ND (0.034)	ND (0.17)	ND (0.035)	ND (0.77)	ND (0.034)	ND (0.034)	ND (0.034)	ND (0.0073)	ND (0.007)	ND (0.007)	ND (0.0069)	ND (0.0072)	ND (0.0071)	ND (0.0069)	ND (0.0069)	ND (0.0069)
3,3-Dichlorobenzidine	91-94-1	15.6285	0.0563	-	0.19	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.91)	ND (0.17)	ND (0.18)	ND (0.17)	ND (0.18)	ND (0.18)	ND (0.17)	ND (0.17)	ND (0.17)
2,4-Dinitrotoluene	121-14-2	22.5888	0.0244	-	0.0093	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
2,6-Dinitrotoluene	606-20-2	4.6994	0.0051	-	0.0094	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
Fluoranthene	206-44-0	3,099.4165	592.4198	-	1400	ND (0.034)	ND (1.7)	ND (0.035)	ND (0.77)	ND (0.034)	ND (0.034)	ND (0.034)	ND (0.0073)	ND (0.007)	ND (0.007)	ND (0.0069)	ND (0.0072)	ND (0.0071)	ND (0.0069)	ND (0.0069)	ND (0.0069)
Fluorene	86-73-7	3,099.4165	36.5470	-	220	ND (0.034)	ND (1.7)	ND (0.035)	ND (0.77)	ND (0.034)	ND (0.034)	ND (0.034)	ND (0.0073)	ND (0.007)	ND (0.007)	ND (0.0069)	ND (0.0072)	ND (0.0071)	ND (0.0069)	ND (0.0069)	ND (0.0069)
Hexachlorobenzene	118-74-1	1.9753	0.0083	-	0.047	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
Hexachloro-1,3-butadiene	87-68-3	9.9137	0.0199	3.2797	0.12	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
Hexachlorocyclopentadiene	77-47-4	1.3990	0.0093	-	1.3	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
Hexachloroethane	67-72-1	16.8340	0.0179	-	0.21	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
Indeno(1,2,3-cd)pyrene	193-39-5	14.8843	64.8661	-	4.9	ND (0.034)	ND (0.17)	ND (0.035)	ND (0.77)	ND (0.034)	ND (0.034)	ND (0.034)	ND (0.0073)	ND (0.007)	ND (0.007)	ND (0.0069)	ND (0.0072)	ND (0.0071)	ND (0.0069)	ND (0.0069)	ND (0.0069)
Isophorone	78-59-1	7,403.7562	2.7473	-	3.1	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
Naphthalene	91-20-3	28.6047	0.0383	-	20	ND (0.034)	ND (0.17)	ND (0.035)	ND (0.77)	ND (0.034)	ND (0.034)	ND (0.034)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.15)	ND (0.059)
bis-2-Ethylhexyladipate	106-23-1	-	--	-		--	--	--	--	--	--	--	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	**0.12**
Nitrobenzene	98-95-3	43.3597	0.0079	-	0.094	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
n-Nitrosodimethylamine	62-75-9	0.0258	0.000003	-	0.000053	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
n-Nitrosodiphenylamine	86-30-6	1,435.3139	4.5818	-	15	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
n-Nitrosodi-n-propylamine	621-64-7	1.0048	0.0007	-	0.0011	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
Phenanthrene	85-01-8	2,324.5624	39.1757	-	3000	ND (0.034)	ND (0.17)	ND (0.035)	ND (7.8)	ND (0.034)	ND (0.034)	ND (0.034)	ND (0.0073)	ND (0.007)	ND (0.007)	ND (0.0069)	ND (0.0072)	ND (0.0071)	ND (0.0069)	ND (0.0069)	ND (0.0069)
Benzylbutyl phthalate	85-68-7	3,701.8781	16.0000	-	920	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
Bis(2-ethylhexyl)phthalate	117-81-7	502.3855	88.4697	-	13	**0.024 J**	**0.15 J**	**0.33 J**	**0.66 J**	ND (0.35)	**0.16 J**	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	**0.37**	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
Di-n-butyl phthalate	84-74-2	8,194.3659	16.2501	-	80	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
Diethyl phthalate	84-66-2	65,554.9269	60.0476	-	130	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.91)	ND (0.17)	ND (0.18)	ND (0.17)	ND (0.18)	ND (0.18)	ND (0.17)	ND (0.17)	ND (0.17)
Dimethyl phthalate	131-11-3	--	--	--	1100	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
Di-n-octyl phthalate	?	--	--	--	3100	ND (0.35)	ND (1.7)	0.014 U3	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
Pyrene	129-00-0	2,324.5624	87.4408	-	1000	ND (0.034)	ND (0.17)	ND (0.035)	ND (0.77)	ND (0.034)	ND (0.034)	ND (0.034)	ND (0.0073)	ND (0.0070)	ND (0.0070)	ND (0.0069)	ND (0.0072)	ND (0.0071)	ND (0.0069)	**0.01**	**0.016**
1,2,4-Trichlorobenzene	120-82-1	44.8446	0.0826	-	0.85	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.033)	ND (0.028)	ND (0.036)	ND (0.032)	ND (0.029)	ND (0.032)	ND (0.035)	ND (0.03)	ND (0.059)
4-Chloro-3-methylphenol	59-50-7	58700 RSL	1.71 RSL	--	--	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
Chlorophenol, 2-	95-57-8	506.9444	0.7124	-	1.5	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
2,4-Dichlorophenol	120-83-2	245.8310	0.2104	-	1.3	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
2,4-Dimethylphenol	105-67-9	1,638.8732	3.2622	-	8.8	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
4,6-Dinitro-2-methylphenol	#N/A	--	--	--	--	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.91)	ND (0.17)	ND (0.18)	ND (0.17)	ND (0.18)	ND (0.18)	ND (0.17)	ND (0.17)	ND (0.17)
2,4-Dinitrophenol	51-28-5	163.8873	0.3405	-	0.54	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.91)	ND (0.17)	ND (0.18)	ND (0.17)	ND (0.18)	ND (0.18)	ND (0.17)	ND (0.17)	ND (0.17)
2-Nitrophenol	88-75-5	--	--	--	--	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
4-Nitrophenol	#N/A	--	--	--	--	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	**0.043**
Pentachlorophenol	87-86-5	13.2275	0.0043	-	0.047	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.91)	ND (0.17)	ND (0.18)	ND (0.17)	ND (0.18)	ND (0.18)	ND (0.17)	ND (0.17)	ND (0.17)
Phenol	108-95-2	24,581.4534	29.6459	-	68	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
2,4,6-Trichlorophenol	88-06-2	81.9437	0.0929	-	1.4	ND (0.35)	ND (1.7)	ND (0.35)	ND (7.8)	ND (0.35)	ND (0.34)	ND (0.34)	ND (0.18)	ND (0.035)	ND (0.035)	ND (0.035)	ND (0.036)	ND (0.036)	ND (0.035)	ND (0.034)	ND (0.034)
RCRA Metals (EPA 6010C/7470 mg/kg)																					
Mercury	7439-97-6	8.8265	0.3627	3.1300	1.4	**0.0057 J**	**0.0034 J**	**0.0061 J**	**0.25**	**0.0087 J**	**0.021**	**0.019 J**	ND (0.27)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.27)	ND (0.27)	ND (0.26)	ND (0.26)	ND (0.26)
Arsenic	7440-38-2	8.7721	0.2002	-	3.9	ND (2.1)	ND (2.1)	ND (2.1)	**0.77 J**	**ND (2.1)**	**0.74 J**	**1.1 J**	**2**	**3.5**	**4.1**	**7.7**	**2.8**	**7.2**	**4.6**	**2.8**	**3.5**
Barium	7440-39-3	19,839.9214	2063.0906	-	1100	**79**	**180**	**100**	**2600**	**120**	**70**	**69**	**180**	**40**	**41**	**37**	**150**	**43**	**52 J**	**28 J**	**59**
Cadmium	7440-43-9	92.1351	9.1963	-	5	ND (0.52)	ND (0.52)	ND (0.53)	**7**	ND (0.52)	ND (0.52)	ND (0.52)	**0.58**	ND (0.52)	ND (0.53)	ND (0.52)	ND (0.54)	ND (0.53)	ND (0.52)	ND (0.51)	ND (0.52)
Chromium, Total	7440-47-3	152,083.3333	536,659,592	100000.0000	25	**15**	**26**	**13**	**81**	**29**	**19**	**16**	**19**	**13**	**17**	**13**	**12**	**7.3**	**11**	**6.6**	**23**
Chromium(2)	18540-29-9	3.8977	0.0892	-	25	**15**	**26**	**13**	**81**	**29**	**19**	**16**	**19**	**13**	**17**	**13**	**12**	**7.3**	**11**	**6.6**	**23**
Lead	7439-92-1	400.0000	N/A	-	400	**4.7**	**48**	**16**	**1000**	**42**	**3.6**	**4.2**	**340**	ND (5.2)	ND (5.3)	ND (5.2)	**24**	ND (5.3)	ND (5.2)	ND (5.1)	ND (5.2)
Selenium	7782-49-2	506.9375	6.8892	-	3.4	ND (2.1)	ND (2.1)	ND (2.1)	ND (2.3)	ND (2.1)	ND (2.1)	ND (2.1)	ND (1.4)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.4)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)
Silver	7440-22-4	506.9444	10.6095	-	11.2	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.2)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.1)	ND (1.0)	ND (1.1)	ND (1.0)	ND (1.1)	ND (1.1)	ND (1.0)	ND (1.0)	ND (1.0)
Nickel	7440-02-0	2,003.2167	339.5603	-	86	--	--	--	--	**15**	**16**	**14**									
Vanadium	7440-62-2	509.5830	1147.1703	-	3400	--	--	--	--	**50**	**49**	**42**									
PCBs (EPA 8082 mg/kg)																					
PCB 1016				-	1	--	--	--	--	ND (0.018)	ND (0.018)	ND (0.018)									
PCB 1221				-	1	--	--	--	--	ND (0.018)	ND (0.018)	ND (0.018)									
PCB1232				-	1	--	--	--	--	ND (0.018)	ND (0.018)	ND (0.018)									
PCB 1242				-	1	--	--	--	--	ND (0.018)	ND (0.018)	ND (0.018)									
PCB1248				-	1	--	--	--	--	ND (0.018)	ND (0.018)	ND (0.018)									
PCB1254				-	1	--	--	--	--	ND (0.018)	ND (0.018)	ND (0.018)									
PCB1260				-	1	--	--	--	--	**0.0086 J**	ND (0.018)	ND (0.018)									
PCBs Total		1	N/A	-	1	--	--	--	--	**0.0086 J**	ND	ND									

TABLE 4: DRO, RRO, VOC, SVOC, PCBs METALS ANALYTICAL RESULTS - SOIL BORINGS

Phase III Site Characterization Work Plan
Baker Hughes Nikiski Completions Facility
Nikiski, Alaska

					Location:	Excavation Confirmation						Drum Contents	Steel UST/Oil-Water Separator	Stockpile		Waste Water Sump Soil	Soil Stockpile
					Sample ID (14-BHI-):	EX-01-SO	EX-02-SO	EX-03-SO	EX-04-SO	EX-05-SO (DUP)	EX-06-SO	DR-01-SL	TA-01-SL	SP-01-SO	SP-02-SO	WS-01-SO	SP-03-SO
					Depth:												
					Date Collected:	8/5/14	8/6/14	8/6/14	8/6/14	8/6/14	8/6/14	8/5/14	8/6/14	8/7/14	8/7/14	8/7/14	8/19/14
					Status:	Excavated After Sampling	Excavated After Sampling	Excavated After Sampling	Excavated After Sampling	Excavated After Sampling	Excavated After Sampling	Removed from Site	Removed from Site	Removed from Site	Removed from Site	Removed from Site	Removed from Site
Analyte	CAS	2020 ADEC Health Based Cleanup Level (mg/kg)	2020 ADEC Migration to Groundwater CLeanup Level (mg/kg)	Csat or 100K Over-ride Cleanup Level (mg/kg)	2016 ADEC Soil Cleanup Levels$^{(1)}$	Phase 1 Removal	Phase 1 Removal	Phase 1 Removal	Phase 1 Removal	Phase 1 Removal	Phase 1 Removal	Phase 1 Removal	Phase 1 Removal	Phase 1 Removal	Phase 1 Removal	Phase 1 Removal	Phase 2 Removal
Total Solids (%)					--	--	91	91.6	90.7	92.2	95.1	55.5	87.7	93.9	95.2	92.3	62.8
ADEC Fuels (AK101, AK102, AK103; mg/kg)																	
Gasoline-range organics		1400	300		300	ND (16)	ND (3.5)	ND (3)	ND (3.4)	ND (4.6)	ND (2.4)	**16**	**47**	ND (3.3)	ND (3.2)	ND (3)	**350**
Diesel-range organics		12500	250		250	**100**	**740**	**120**	**29**	**14**	**94**	**17000**	**6800**	**190**	**78**	**18**	**47000**
Residual-range organics		10000	11000		10000	**350**	**2200**	**350**	**120**	**55**	**290**	**33000**	**7300**	**430**	**250**	**59**	**83000**
BTEX (EPA 8260B; mg/kg)																	
Benzene	71-43-2	11.2572	0.0221	-	0.025	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	**0.34**	**0.042**	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
Toluene	108-88-3	5,757.0724	6.6965	202.6627	6.5	ND (0.14)	ND (0.18)	ND (0.15)	ND (0.17)	ND (0.23)	ND (0.12)	ND (0.53)	**12**	ND (0.17)	ND (0.16)	ND (0.15)	**26**
Ethylbenzene	100-41-4	49.3217	0.1343	-	6.9	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	**0.99**	**0.53**	ND (0.033)	ND (0.032)	ND (0.03)	**13**
Xylenes (total)	1330-20-7	486.2455	1.5563	56.6266	63	ND (0.083)	ND (0.105)	ND (0.09)	ND (0.101)	ND (0.139)	ND (0.072)	**6.3**	**3.1**	ND (0.099)	ND (0.095)	ND (0.091)	**51**
VOCs (EPA 8260B; mg/kg)																	
Dichlorodifluoromethane	75-71-8	149.3886	3.9163	-	140	ND (0.041)	ND (0.053)	ND (0.045)	ND (0.05)	ND (0.069)	ND (0.036)	ND (0.16)	ND (0.038)	ND (0.05)	ND (0.048)	ND (0.046)	ND (0.16)
Chloromethane	74-87-3	168.4491	0.6114	-	0.21	ND (0.17)	ND (0.22)	ND (0.19)	ND (0.21)	ND (0.29)	ND (0.15)	ND (0.67)	ND (0.16)	ND (0.21)	ND (0.2)	ND (0.19)	ND (0.80)
Vinyl Chloride	75-01-4	0.6533	0.0008	-	0.0085	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
Bromomethane	74-83-9	10.2329	0.0240	-	0.16	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
Chloroethane	75-00-3	19,506.1938	72.5883	1393.2540	23	ND (0.14)	ND (0.18)	ND (0.15)	ND (0.17)	ND (0.23)	ND (0.12)	ND (0.53)	ND (0.13)	ND (0.17)	ND (0.16)	ND (0.15)	ND (0.80)
Trichlorofluoromethane	75-69-4	30,416.6667	40.9690	984.0837	86	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
1,1-Dichloroethene	75-35-4	330.6294	1.2361	-	0.03	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
Acetone	67-64-1	81,270.5325	37.7635	-	88	ND (0.14)	ND (0.18)	ND (0.15)	ND (0.17)	ND (0.23)	ND (0.12)	**0.7 J**	**1.2 J**	**0.19 J**	ND (0.16)	ND (0.15)	ND (0.80)
Iodomethane	74-88-4	--	--	--	--	ND (0.14)	ND (0.18)	ND (0.15)	ND (0.17)	ND (0.23)	ND (0.12)	ND (0.53)	ND (0.13)	ND (0.17)	ND (0.16)	ND (0.15)	ND (0.80)
Carbon Disulfide	75-15-0	1,116.2307	2.9511	503.6662	12	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
Methylene Chloride	75-09-2	458.0153	0.3304	-	0.016	ND (0.14)	ND (0.18)	ND (0.15)	ND (0.17)	ND (0.23)	ND (0.12)	ND (0.53)	ND (0.13)	ND (0.17)	ND (0.16)	ND (0.15)	ND (0.80)
(trans) 1,2-Dichloroethene	156-60-5	2,027.7778	1.3126	959.1282	0.37	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
Methyl t-Butyl Ether	1634-04-4	668.0820	0.4057	-	1.3	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
1,1-Dichloroethane	75-34-3	45.8393	0.0921	-	25	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
Vinyl Acetate	108-05-4	1,438.7667	1.1246	-	100	ND (0.14)	ND (0.18)	ND (0.15)	ND (0.17)	ND (0.23)	ND (0.12)	ND (0.53)	ND (0.13)	ND (0.17)	ND (0.16)	ND (0.15)	ND (0.80)
2,2-Dichloropropane	594-20-7	--	--	--	--	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
(cis) 1,2-Dichloroethene	156-59-2	202.7778	0.1220	-	0.24	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	**0.028**	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
2-Butanone	78-93-3	38,227.0513	15.1196	23403.9342	59	ND (0.14)	ND (0.18)	ND (0.15)	ND (0.17)	ND (0.23)	ND (0.12)	ND (0.53)	**0.14 J**	ND (0.17)	ND (0.16)	ND (0.15)	ND (0.80)
Bromochloromethane	74-97-5	149 RSL	0.0208 RSL	--	--	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
Chloroform	67-66-3	3.9955	0.0072	-	0.046	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
1,1,1-Trichloroethane	71-55-6	10,837.9517	32.6081	357.3421	0.82	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.11)	ND (0.025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0080)
Carbon Tetrachloride	56-23-5	9.1194	0.0208	-	0.023	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
1,1-Dichloropropene	563-58-6	--	--	--	--	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
1,2-Dichloroethane	107-06-2	5.4502	0.0055	-	0.016	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
Trichloroethene	79-01-6	4.9114	0.0111	-	0.02	ND (0.0025)	**0.0054**	**0.0041**	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.11)	**0.054**	ND (0.0025)	ND (0.0025)	ND (0.0025)	**2.7**
1,2-Dichloropropane	78-87-5	17.1890	0.0297	-	0.018	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
Dibromomethane	74-95-3	30.8813	0.0249	-	1.1	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
Bromodichloromethane	75-27-4	3.6330	0.0043	-	0.044	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
2-Chloroethyl Vinyl Ether	110-75-8	--	--	--	--	ND (0.14)	ND (0.18)	ND (0.15)	ND (0.17)	ND (0.23)	ND (0.12)	ND (0.53)	ND (0.13)	ND (0.17)	ND (0.16)	ND (0.15)	ND (0.80)
(cis) 1,3-Dichloropropene	542-75-6	20.5086	0.0178	-	--	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
Methyl Isobutyl Ketone	108-10-1	47,291.8292	17.6950	2159.6930	8.1	ND (0.14)	ND (0.18)	ND (0.15)	ND (0.17)	ND (0.23)	ND (0.12)	ND (0.53)	**1**	ND (0.17)	ND (0.16)	ND (0.15)	ND (0.80)
(trans) 1,3-Dichloropropene	542-75-6	20.5086	0.0178	-	--	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
1,1,2-Trichloroethane	79-00-5	1.5930	0.0015	-	0.018	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
Tetrachloroethene	127-18-4	94.5989	0.1936	68.3774	0.024	ND (0.0025)	**0.0034**	ND (0.0025)	ND (0.0025)	ND (0.0025)	**0.0055**	ND (0.11)	ND (0.025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	**0.13**
1,3-Dichloropropane	142-28-9	16700 RSL	0.128 RSL	--	--	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
2-Hexanone	591-78-6	270.0398	0.1086	-	--	ND (0.14)	ND (0.18)	ND (0.15)	ND (0.17)	ND (0.23)	ND (0.12)	ND (0.53)	ND (0.13)	ND (0.17)	ND (0.16)	ND (0.15)	ND (0.16)
Dibromochloromethane	124-48-1	107.2898	0.0271	-	0.032	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
1,2-Dibromoethane	106-93-4	0.4244	0.0002	-	0.00016	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
Chlorobenzene	108-90-7	253.8320	0.4594	178.2690	0.63	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
1,1,1,2-Tetrachloroethane	630-20-6	20.5315	0.0225	-	--	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
Styrene	100-42-5	5,646.0121	10.5373	175.8889	0.96	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
Bromoform	75-25-2	237.3033	0.1019	-	0.34	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
Isopropylbenzene	98-82-8	1,724.5401	5.6201	54.3611	51	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	**0.25**	ND (0.033)	ND (0.032)	ND (0.03)	**0.79**
Bromobenzene	108-86-1	289.2570	0.3658	157.4454		ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
1,1,2,2-Tetrachloroethane	79-34-5	6.1131	0.0030	-	0.017	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
1,2,3-Trichloropropane	96-18-4	0.0662	0.0000	-	0.00053	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
n-Propylbenzene	103-65-1	3,674.8801	9.1537	51.9058	15	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	**0.65**	ND (0.033)	ND (0.032)	ND (0.03)	**1.6**
2-Chlorotoluene	95-49-8	16700 RSL	0.232 RSL	--	--	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
4-Chlorotoluene	106-43-4	16700 RSL	0.241 RSL	--	--	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
1,3,5-Trimethylbenzene	108-67-8	250.5600	0.6672	37.1128	23	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	**1.4**	ND (0.033)	ND (0.032)	ND (0.03)	**4.2**
tert-Butylbenzene	98-06-6	10,138.8889	11.4536	35.4933	12	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
1,2,4-Trimethylbenzene	95-63-6	283.5104	0.6182	43.4326	23	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	**5.2**	ND (0.033)	ND (0.032)	ND (0.03)	**13**
sec-Butylbenzene	135-98-8	10,138.8889	42.4557	27.5830	12	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	**0.19**	ND (0.033)	ND (0.032)	ND (0.03)	**0.94**
1,3-Dichlorobenzene	541-73-1	1,424.8029	2.3164	61.9569	28	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
p-Isopropyltoluene	99-87-6	--	--	--	--	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	**6.1**	ND (0.033)	ND (0.032)	ND (0.03)	**4.9**
1,4-Dichlorobenzene	106-46-7	21.4173	0.0373	-	0.64	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
1,2-Dichlorobenzene	95-50-1	1,622.7174	2.3766	77.6505	5.1	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
n-Butylbenzene	104-51-8	5,069.4444	23.1546	20.1197	15	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	**0.72**	ND (0.033)	ND (0.032)	ND (0.03)	**4**
1,2-Dibromo-3-chloropropane	96-12-8	0.0526 RSL	.00000144 RS	--	--	ND (0.14)	ND (0.18)	ND (0.15)	ND (0.17)	ND (0.23)	ND (0.12)	ND (0.53)	ND (0.13)	ND (0.17)	ND (0.16)	ND (0.15)	ND (0.80)
1,2,4-Trichlorobenzene	120-82-1	44.8446	0.0826	-	0.85	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
Hexachlorobutadiene	87-68-3	9.9137	0.0199	3.2797	0.12	ND (0.14)	ND (0.18)	ND (0.15)	ND (0.17)	ND (0.23)	ND (0.12)	ND (0.53)	ND (0.13)	ND (0.17)	ND (0.16)	ND (0.15)	ND (0.80)
Naphthalene	91-20-3	28.6047	0.0383	-	20	ND (0.14)	ND (0.18)	ND (0.15)	ND (0.17)	ND (0.23)	ND (0.12)	ND (0.53)	**3.4**	ND (0.17)	ND (0.16)	ND (0.15)	**5.7**
1,2,3-Trichlorobenzene	87-61-6	81.1111	0.1484	-	--	ND (0.027)	ND (0.035)	ND (0.03)	ND (0.034)	ND (0.046)	ND (0.024)	ND (0.11)	ND (0.025)	ND (0.033)	ND (0.032)	ND (0.03)	ND (0.16)
SVOCs (8270D mg/kg)																	
Acenaphthene	83-32-9	4,649.1248	37.1133	-	180	--	ND (0.032)	ND (0.0064)	ND (0.0064)	ND (0.0064)	ND (0.0064)	ND (0.64)	**0.91**	ND (0.064)	ND (0.032)	ND (0.0064)	ND (2.6)
Acenaphthylene	208-96-8	2,324.5624	18.0968	-	180	--	ND (0.034)	ND (0.0067)	ND (0.0067)	ND (0.0067)	ND (0.0067)	ND (0.67)	ND (0.13)	ND (0.067)	ND (0.034)	ND (0.0067)	**1.6 J**
Anthracene	120-12-7	23,245.6241	387.9264	-	3000	--	ND (0.032)	ND (0.0063)	ND (0.0063)	ND (0.0063)	ND (0.0063)	**3.4 J**	**1.5**	ND (0.063)	ND (0.032)	ND (0.0063)	ND (2.6)
Benzidine	92-87-5	0.0053 RSL	.00000275 RS	--	--	--	ND (0.32)	ND (0.064)	ND (0.064)	ND (0.064)	ND (0.064)	ND (6.4)	ND (1.3)	ND (0.64)	ND (0.32)	ND (0.064)	ND (26)
Benzo(a)anthracene	56-55-3	14.4870	0.6999	-	3.6	--	ND (0.021)	ND (0.0043)	ND (0.0043)	ND (0.0043)	ND (0.0043)	ND (0.43)	ND (0.086)	ND (0.043)	ND (0.021)	ND (0.0043)	ND (2.6)

TABLE 4: DRO, RRO, VOC, SVOC, PCBs METALS ANALYTICAL RESULTS - SOIL BORINGS

Phase III Site Characterization Work Plan
Baker Hughes Nikiski Completions Facility
Nikiski, Alaska

Location:						Excavation Confirmation						Drum Contents	Steel UST/Oil-Water Separator	Stockpile		Waste Water Sump Soil	Soil Stockpile
Sample ID (14-BHI-):						EX-01-SO	EX-02-SO	EX-03-SO	EX-04-SO	EX-05-SO (DUP)	EX-06-SO	DR-01-SL	TA-01-SL	SP-01-SO	SP-02-SO	WS-01-SO	SP-03-SO
Depth:																	
Date Collected:						8/5/14	8/6/14	8/6/14	8/6/14	8/6/14	8/6/14	8/5/14	8/6/14	8/7/14	8/7/14	8/7/14	8/19/14
Status:						Excavated After Sampling	Excavated After Sampling	Excavated After Sampling	Excavated After Sampling	Excavated After Sampling	Excavated After Sampling	Removed from Site	Removed from Site	Removed from Site	Removed from Site	Removed from Site	Removed from Site
Analyte	CAS	2020 ADEC Health Based Cleanup Level (mg/kg)	2020 ADEC Migration to Groundwater CLeanup Level (mg/kg)	Csat or 100K Over-ride Cleanup Level (mg/kg)	2016 ADEC Soil Cleanup Levels$^{(1)}$	Phase 1 Removal	Phase 1 Removal	Phase 1 Removal	Phase 1 Removal	Phase 1 Removal	Phase 1 Removal	Phase 1 Removal	Phase 1 Removal	Phase 1 Removal	Phase 1 Removal	Phase 1 Removal	Phase 2 Removal
Benzo(b)fluoranthene	205-99-2	14.8843	19.9332	-	12	--	ND (0.035)	ND (0.007)	ND (0.007)	ND (0.007)	ND (0.007)	ND (0.7)	ND (0.14)	ND (0.07)	ND (0.035)	ND (0.007)	ND (2.6)
Benzo(k)fluoranthene	207-08-9	148.8434	195.3430	-	49	--	ND (0.029)	ND (0.0058)	ND (0.0058)	ND (0.0058)	ND (0.0058)	ND (0.58)	ND (0.12)	ND (0.058)	ND (0.029)	ND (0.0058)	ND (2.6)
Benzo(g,h,i)perylene	191-24-2	2,324.5624	15578.5556	-	1400	--	ND (0.036)	ND (0.0072)	ND (0.0072)	ND (0.0072)	ND (0.0072)	ND (0.72)	ND (0.14)	ND (0.072)	ND (0.036)	ND (0.0072)	ND (2.6)
Benzo(a)pyrene	50-32-8	1.4884	1.9534	-	0.49	--	ND (0.027)	ND (0.0055)	ND (0.0055)	ND (0.0055)	ND (0.0055)	ND (0.55)	ND (0.11)	ND (0.055)	ND (0.027)	ND (0.0055)	ND (2.6)
Bis(2-chlorethoxy)methane	111-91-1	1760 RSL	0.0135 RSL	--	--	--	ND (0.038)	ND (0.0077)	ND (0.0077)	ND (0.0077)	ND (0.0077)	ND (0.77)	ND (0.15)	ND (0.077)	ND (0.038)	ND (0.0077)	ND (26)
Bis(2-chloroethyl)ether	111-44-4	2.8347	0.0004	-	0.0022	--	ND (0.045)	ND (0.009)	ND (0.009)	ND (0.009)	ND (0.009)	ND (0.9)	ND (0.18)	ND (0.09)	ND (0.045)	ND (0.009)	ND (26)
Bis(2-chloroisopropyl)ether	#N/A	--	--	--	--	--	ND (0.038)	ND (0.0076)	ND (0.0076)	ND (0.0076)	ND (0.0076)	ND (0.76)	ND (0.15)	ND (0.076)	ND (0.038)	ND (0.0076)	ND (26)
4-Bromophenyl-phenylether	#N/A	--	--	--	--	--	ND (0.057)	ND (0.011)	ND (0.011)	ND (0.011)	ND (0.011)	ND (1.1)	ND (0.23)	ND (0.11)	ND (0.057)	ND (0.011)	ND (26)
2-Chloronaphthalene	#N/A	--	--	--	120	--	ND (0.032)	ND (0.0064)	ND (0.0064)	ND (0.0064)	ND (0.0064)	ND (0.64)	ND (0.13)	ND (0.064)	ND (0.032)	ND (0.0064)	ND (2.6)
4-Chlorophenyl-phenylether	#N/A	--	--	--	--	--	ND (0.031)	ND (0.0063)	ND (0.0063)	ND (0.0063)	ND (0.0063)	ND (0.63)	ND (0.12)	ND (0.063)	ND (0.031)	ND (0.0063)	ND (26)
Chrysene	218-01-9	1,488.4338	600.7229	-	360	--	ND (0.028)	ND (0.0056)	ND (0.0056)	ND (0.0056)	ND (0.0056)	ND (0.56)	ND (0.11)	ND (0.056)	ND (0.028)	ND (0.0056)	ND (2.6)
Dibenz(a,h)anthracene	53-70-3	1.4884	6.3570	-	--	--	ND (0.041)	ND (0.0082)	ND (0.0082)	ND (0.0082)	ND (0.0082)	ND (0.82)	ND (0.16)	ND (0.082)	ND (0.041)	ND (0.0082)	ND (2.6)
3,3-Dichlorobenzidine	91-94-1	15.6285	0.0563	-	0.19	--	ND (0.4)	ND (0.079)	ND (0.079)	ND (0.079)	ND (0.079)	ND (7.9)	ND (1.6)	ND (0.79)	ND (0.4)	ND (0.079)	ND (26)
2,4-Dinitrotoluene	121-14-2	22.5888	0.0244	-	0.0093	--	ND (0.03)	ND (0.0061)	ND (0.0061)	ND (0.0061)	ND (0.0061)	ND (0.61)	ND (0.12)	ND (0.061)	ND (0.03)	ND (0.0061)	ND (26)
2,6-Dinitrotoluene	606-20-2	4.6994	0.0051	-	0.0094	--	ND (0.037)	ND (0.0074)	ND (0.0074)	ND (0.0074)	ND (0.0074)	ND (0.74)	ND (0.15)	ND (0.074)	ND (0.037)	ND (0.0074)	ND (26)
Fluoranthene	206-44-0	3,099.4165	592.4198	-	1400	--	ND (0.025)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	**1.4 J**	ND (0.099)	ND (0.05)	ND (0.025)	ND (0.005)	ND (2.6)
Fluorene	86-73-7	3,099.4165	36.5470	-	220	--	ND (0.034)	ND (0.0068)	ND (0.0068)	ND (0.0068)	ND (0.0068)	**2 J**	**2.2**	ND (0.068)	ND (0.034)	ND (0.0068)	ND (2.6)
Hexachlorobenzene	118-74-1	1.9753	0.0083	-	0.047	--	ND (0.043)	ND (0.0086)	ND (0.0086)	ND (0.0086)	ND (0.0086)	ND (0.86)	ND (0.17)	ND (0.086)	ND (0.043)	ND (0.0086)	ND (26)
Hexachloro-1,3-butadiene	87-68-3	9.9137	0.0199	3.2797	0.12	--	ND (0.05)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (1)	ND (0.2)	ND (0.1)	ND (0.05)	ND (0.01)	ND (26)
Hexachlorocyclopentadiene	77-47-4	1.3990	0.0093	-	1.3	--	ND (0.29) J	ND (0.059)	ND (0.059)	ND (0.059)	ND (0.059)	ND (5.9)	ND (1.2) J	ND (0.59) J	ND (0.29) J	ND (0.059)	ND (26)
Hexachloroethane	67-72-1	16.8340	0.0179	-	0.21	--	ND (0.067)	ND (0.013)	ND (0.013)	ND (0.013)	ND (0.013)	ND (1.3)	ND (0.27)	ND (0.13)	ND (0.067)	ND (0.013)	ND (26)
Indeno(1,2,3-cd)pyrene	193-39-5	14.8843	64.8661	-	4.9	--	ND (0.039)	ND (0.0077)	ND (0.0077)	ND (0.0077)	ND (0.0077)	ND (0.77)	ND (0.15)	ND (0.077)	ND (0.039)	ND (0.0077)	ND (2.6)
Isophorone	78-59-1	7,403.7562	2.7473	-	3.1	--	ND (0.026)	ND (0.0052)	ND (0.0052)	ND (0.0052)	ND (0.0052)	**6.8 J**	**2 J**	ND (0.052)	ND (0.026)	ND (0.0052)	ND (26)
Naphthalene	91-20-3	28.6047	0.0383	-	20	--	ND (0.044)	ND (0.0089)	ND (0.0089)	ND (0.0089)	ND (0.0089)	**1.6 J**	**7.3**	ND (0.089)	ND (0.044)	ND (0.0089)	**1.6 J**
bis-2-Ethylhexyladipate	106-23-1	-	--	-		--	--	--	--	--	--						
Nitrobenzene	98-95-3	43.3597	0.0079	-	0.094	--	ND (0.035)	ND (0.007)	ND (0.007)	ND (0.007)	ND (0.007)	ND (0.7)	ND (0.14)	ND (0.07)	ND (0.035)	ND (0.007)	ND (26)
n-Nitrosodimethylamine	62-75-9	0.0258	0.000003	-	0.000053	--	ND (0.32)	ND (0.065)	ND (0.065)	ND (0.065)	ND (0.065)	ND (6.5)	ND (1.3)	ND (0.65)	ND (0.32)	ND (0.065)	ND (26)
n-Nitrosodiphenylamine	86-30-6	1,435.3139	4.5818	-	15	--	ND (0.03)	ND (0.0059)	ND (0.0059)	ND (0.0059)	ND (0.0059)	**7 J**	ND (0.12)	ND (0.059)	ND (0.03)	ND (0.0059)	ND (26)
n-Nitrosodi-n-propylamine	621-64-7	1.0048	0.0007	-	0.0011	--	ND (0.045)	ND (0.0091)	ND (0.0091)	ND (0.0091)	ND (0.0091)	ND (0.91)	ND (0.18)	ND (0.091)	ND (0.045)	ND (0.0091)	ND (26)
Phenanthrene	85-01-8	2,324.5624	39.1757	-	3000	--	ND (0.026)	ND (0.0053)	ND (0.0053)	ND (0.0053)	ND (0.0053)	**4.3 J**	**3**	ND (0.053)	ND (0.026)	ND (0.0053)	**1 J**
Benzylbutyl phthalate	85-68-7	3,701.8781	16.0000	-	920	--	ND (0.052)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (1)	**6.8 J**	ND (0.1)	ND (0.052)	ND (0.01)	ND (26)
Bis(2-ethylhexyl)phthalate	117-81-7	502.3855	88.4697	-	13	--	**0.22 J**	**0.039 J**	ND (0.011)	ND (0.012)	**0.061 J**	**220**	39	1 J	0.49 J	ND (0.012)	**640**
Di-n-butyl phthalate	84-74-2	8,194.3659	16.2501	-	80	--	ND (0.054)	ND (0.011)	ND (0.0069)	ND (0.011)	ND (0.011)	ND (1.1)	ND (0.22)	ND (0.11)	ND (0.054)	ND (0.011)	**1.4 J**
Diethyl phthalate	84-66-2	65,554.9269	60.0476	-	130	--	ND (0.034)	ND (0.0069)	ND (0.0054)	ND (0.0069)	ND (0.0069)	ND (0.69)	ND (0.14)	ND (0.069)	ND (0.034)	ND (0.0069)	ND (26)
Dimethyl phthalate	131-11-3	--	--	--	1100	--	ND (0.027)	ND (0.0054)	ND (0.0091)	ND (0.0054)	ND (0.0054)	ND (0.54)	ND (0.11)	ND (0.054)	ND (0.027)	ND (0.0054)	ND (26)
Di-n-octyl phthalate	?	--	--	--	3100	--	ND (0.045)	ND (0.0091)	ND (0.0091)	ND (0.0091)	ND (0.0091)	ND (0.91)	ND (0.18)	ND (0.091)	ND (0.045)	ND (0.0091)	ND (26)
Pyrene	129-00-0	2,324.5624	87.4408	-	1000	--	ND (0.062)	ND (0.012)	ND (0.012)	ND (0.012)	ND (0.012)	**2.5**	**0.96**	ND (0.12)	ND (0.062)	ND (0.012)	ND (2.6)
1,2,4-Trichlorobenzene	120-82-1	44.8446	0.0826	-	0.85	--	ND (0.044)	ND (0.0088)	ND (0.0088)	ND (0.0088)	ND (0.0088)	ND (0.88)	ND (0.18)	ND (0.088)	ND (0.044)	ND (0.0088)	ND (26)
4-Chloro-3-methylphenol	59-50-7	58700 RSL	1.71 RSL	--	--	--	ND (0.024)	ND (0.0048)	ND (0.0048)	ND (0.0048)	ND (0.0048)	ND (0.48)	ND (0.095)	ND (0.048)	ND (0.024)	ND (0.0048)	ND (26)
Chlorophenol, 2-	95-57-8	506.9444	0.7124	-	1.5	--	ND (0.042)	ND (0.0083)	ND (0.0083)	ND (0.0083)	ND (0.0083)	ND (0.83)	ND (0.17)	ND (0.083)	ND (0.042)	ND (0.0083)	ND (26)
2,4-Dichlorophenol	120-83-2	245.8310	0.2104	-	1.3	--	ND (0.037)	ND (0.0075)	ND (0.0075)	ND (0.0075)	ND (0.0075)	ND (0.75)	ND (0.15)	ND (0.075)	ND (0.037)	ND (0.0075)	ND (26)
2,4-Dimethylphenol	105-67-9	1,638.8732	3.2622	-	8.8	--	ND (0.24)	ND (0.047)	ND (0.047)	ND (0.047)	ND (0.047)	ND (4.7)	ND (0.94)	ND (0.47)	ND (0.24)	ND (0.047)	ND (26)
4,6-Dinitro-2-methylphenol	#N/A	--	--	--	--	--	ND (0.62)	ND (0.12)	ND (0.12)	ND (0.12)	ND (0.12)	ND (12)	ND (2.5)	ND (1.2)	ND (0.62)	ND (0.12)	ND (26)
2,4-Dinitrophenol	51-28-5	163.8873	0.3405	-	0.54	--	ND (0.49)	ND (0.098)	ND (0.098)	ND (0.098)	ND (0.098)	ND (9.8)	ND (2)	ND (0.98)	ND (0.49)	ND (0.098)	ND (26)
2-Nitrophenol	88-75-5	--	--	--	--	--	ND (0.065)	ND (0.013)	ND (0.013)	ND (0.013)	ND (0.013)	ND (1.3)	ND (0.26)	ND (0.13)	ND (0.065)	ND (0.013)	ND (26)
4-Nitrophenol	#N/A	--	--	--	--	--	ND (0.26)	ND (0.052)	ND (0.052)	ND (0.052)	ND (0.052)	ND (5.2)	ND (1)	ND (0.52)	ND (0.26)	ND (0.052)	ND (26)
Pentachlorophenol	87-86-5	13.2275	0.0043	-	0.047	--	ND (0.24)	ND (0.048)	ND (0.048)	ND (0.048)	ND (0.048)	ND (4.8)	ND (0.96)	ND (0.48)	ND (0.24)	ND (0.048)	ND (26)
Phenol	108-95-2	24,581.4534	29.6459	-	68	--	ND (0.035)	ND (0.007)	ND (0.007)	ND (0.007)	ND (0.007)	**1.4 J**	ND (0.14)	ND (0.07)	ND (0.035)	**0.013 J**	ND (26)
2,4,6-Trichlorophenol	88-06-2	81.9437	0.0929	-	1.4	--	ND (0.039)	ND (0.0078)	ND (0.0078)	ND (0.0078)	ND (0.0078)	ND (0.78)	ND (0.16)	ND (0.078)	ND (0.039)	ND (0.0078)	ND (26)
RCRA Metals (EPA 6010C/7470 mg/kg)																	
Mercury	7439-97-6	8.8265	0.3627	3.1300	1.4	--	**0.14**	**0.022**	**0.016 J**	**0.016 J**	**0.032**	**0.65**	**0.026**	**0.036**	**0.041**	**0.024**	**2.4**
Arsenic	7440-38-2	8.7721	0.2002	-	3.9	--	**4.6**	**4.1**	**3.6**	**3.8**	**4.4**	**4.7**	**3.5**	**3.7**	**3.5**	**5.1**	**3.2 J**
Barium	7440-39-3	19,839.9214	2063.0906	-	1100	--	**230**	**99**	**140**	**74**	**270**	**27000**	**340**	**150 J**	**410**	**200**	**22000**
Cadmium	7440-43-9	92.1351	9.1963	-	5	--	**0.28 J**	ND (0.07)	ND (0.07)	ND (0.07)	**0.21 J**	ND (0.07)	**0.11 J**	**0.22 J**	**0.1 J**	ND (0.07)	**33**
Chromium, Total	7440-47-3	152,083.3333	536,659,592	100000.0000	25	--	**19**	**23**	**22**	**20**	**21**	**230**	**20**	**13**	**19**	**18**	**250**
Chromium(2)	18540-29-9	3.8977	0.0892	-	25	--	**19**	**23**	**22**	**20**	**21**	**230**	**20**	**13**	**19**	**18**	**250**
Lead	7439-92-1	400.0000	N/A	-	400	--	**43**	**25**	**10**	**10**	**100**	**1500**	**75**	**28**	**61**	**12**	**6400**
Selenium	7782-49-2	506.9375	6.8892	-	3.4	--	ND (0.74)	ND (0.74)	ND (0.74)	ND (0.74)	ND (0.74)	**3.6 J**	ND (0.74)	ND (0.74)	ND (0.74)	ND (0.74)	ND (3.2)
Silver	7440-22-4	506.9444	10.6095	-	11.2	--	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	**1.4 J**	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	**3**
Nickel	7440-02-0	2,003.2167	339.5603	-	86												--
Vanadium	7440-62-2	509.5830	1147.1703	-	3400												--
PCBs (EPA 8082 mg/kg)																	
PCB 1016				-	1												--
PCB 1221				-	1												--
PCB1232				-	1												--
PCB 1242				-	1												--
PCB1248				-	1												--
PCB1254				-	1												--
PCB1260				-	1												--
PCBs Total		1	N/A	-	1												--

Notes: bold font = detected Value

[1] ADEC Method Two Soil Cleanup Levels; Table B1; Migration to Groundwater Pathway

[2] If present as chromium VI

Key:

ADEC = Alaska Department of Environmental Conservation	NS = not sampled
bgs = Below ground surface	SB = Soil Boring
BHI - Baker Hughes, Inc.	SIM = Selective ion monitoring
EPA = United States Environmental Protection Agency	SO = Soil
1,1,1-TCA = 1,1,1-Trichloroethane	mg/kg = Milligrams per kilograms
BNT = Baker Nikiski Tool	TCE = Trichloroethene
EPA = United States Environmental Protection Agency	PCE = Tetrachloroethene
ND = non-detect, Reported Detection Limit provided in parenthe	MW = Monitoring Well
SIM = Selective ion monitoring	MW = Monitoring well
	GW = Groundwater

Data Flags

B - Analyte was detected within 5 times of the detected concentration in a corresponding method blank sample.

J = Estimated concentration; analyte was detected between the method detection limit and the practical quantitation limit.

H - Method holding times were exceeded, results may be biased low

X = Analyte was not detected and MRLs exceeded, the applicable ADEC Migration to Groundwater Soil Cleanup Level.

ATTACHMENT 3

Conceptual Site Model (Human Health & Eco Screening)

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HUMAN HEALTH CONCEPTUAL SITE MODEL GRAPHIC FORM

Site: Baker Hughes Nikiski Completions Facility, Nikiski, Alaska

Completed By: DNA & Geosphere
Date Completed: 7-28-20

***Instructions*: Follow the numbered directions below. Do not consider contaminant concentrations or engineering/land use controls when describing pathways.**

(1) *Check the media that could be directly affected by the release.*

(2) *For each medium identified in (1), follow the top arrow and check possible transport mechanisms. Check additional media under (1) if the media acts as a secondary source.*

(3) *Check all exposure media identified in (2).*

(4) *Check all pathways that could be complete. The pathways identified in this column must agree with Sections 2 and 3 of the Human Health CSM Scoping Form.*

(5) *Identify the receptors potentially affected by each exposure pathway: Enter "C" for current receptors, "F" for future receptors, "C/F" for both current and future receptors, or "I" for insignificant exposure.*

Media	Transport Mechanisms	
☐ Surface Soil (0-2 ft bgs)	Direct release to surface soil	check soil
	☐ Migration to subsurface	check soil
	☐ Migration to groundwater	check groundwater
	☐ Volatilization	check air
	☐ Runoff or erosion	check surface water
	☐ Uptake by plants or animals	check biota
	☐ Other (list):	
☑ Subsurface Soil (2-15 ft bgs)	Direct release to subsurface soil	check soil
	☑ Migration to groundwater	check groundwater
	☑ Volatilization	check air
	☐ Uptake by plants or animals	check biota
	☐ Other (list):	
☐ Ground-water	Direct release to groundwater	check groundwater
	☑ Volatilization	check air
	☐ Flow to surface water body	check surface water
	☐ Flow to sediment	check sediment
	☐ Uptake by plants or animals	check biota
	☐ Other (list):	
☐ Surface Water	Direct release to surface water	check surface water
	☐ Volatilization	check air
	☐ Sedimentation	check sediment
	☐ Uptake by plants or animals	check biota
	☐ Other (list):	
☐ Sediment	Direct release to sediment	check sediment
	☐ Resuspension, runoff, or erosion	check surface water
	☐ Uptake by plants or animals	check biota
	☐ Other (list):	

Current & Future Receptors

Exposure Media	Exposure Pathway/Route	Residents (adults or children)	Commercial or industrial workers	Site visitors, trespassers, or recreational users	Construction workers	Farmers or subsistence harvesters	Subsistence consumers	Other
☑ soil	☑ Incidental Soil Ingestion	F	C	I	I	I	I	
	☑ Dermal Absorption of Contaminants from Soil	F	C	I	I	I	I	
	☑ Inhalation of Fugitive Dust	F	C	I	I	I	I	
☑ groundwater	☑ Ingestion of Groundwater	F	C	I	I	I	I	
	☑ Dermal Absorption of Contaminants in Groundwater	F	C	I	I	I	I	
	☑ Inhalation of Volatile Compounds in Tap Water	F	C	I	I	I	I	
☑ air	☑ Inhalation of Outdoor Air	F	C	I	I	I	I	
	☑ Inhalation of Indoor Air	F	C	I	I	I	I	
	☑ Inhalation of Fugitive Dust	F	C	I	I	I	I	
☐ surface water	☐ Ingestion of Surface Water	I	I	I	I	I	I	
	☐ Dermal Absorption of Contaminants in Surface Water	I	I	I	I	I	I	
	☐ Inhalation of Volatile Compounds in Tap Water	I	I	I	I	I	I	
☐ sediment	☐ Direct Contact with Sediment	I	I	I	I	I	I	
☐ biota	☐ Ingestion of Wild or Farmed Foods	I	I	I	I	I	I	

Print Form

Appendix A - Human Health Conceptual Site Model
Scoping Form and Standardized Graphic

Site Name: Baker Hughes Nikiski Completions Facility, Nikiski, Alaska

File Number:

Completed by: DNA & Geosphere; 7-28-20

Introduction

The form should be used to reach agreement with the Alaska Department of Environmental Conservation (DEC) about which exposure pathways should be further investigated during site characterization. <u>From this information, summary text about the CSM and a graphic depicting exposure pathways should be submitted with the site characterization work plan and updated as needed in later reports.</u>

General Instructions: Follow the italicized instructions in each section below.

1. General Information:

Sources *(check potential sources at the site)*

☐ USTs
☐ ASTs
☐ Dispensers/fuel loading racks
☐ Drums
☐ Vehicles
☐ Landfills
☐ Transform
☒ Other: Dry wells; oil-water separator leach field and septic system leach field

Releases appear to have occurred from three separate sources -- 1) a series of 3 dry wells; 2) an oil-water discharging to a perforated pipe and leach field; and 3) dissolved phase discharges to a septic system leach field. The dry wells, and oil-water separator and leach field have been decommissioned and much of the contaminated soil has been excavated and properly disposed of.

Release Mechanisms *(check potential release mechanisms at the site)*

☐ Spills
☐ Leaks
☒ Direct discharge
☐ Burning
☐ Other:

Impacted Media *(check potentially-impacted media at the site)*

☐ Surface soil (0-2 feet bgs*)
☒ Subsurface soil (>2 feet bgs)
☒ Air
☐ Sediment
☒ Groundwater
☐ Surface water
☐ Biota
☐ Other:

Releases from dry wells and an oil-water separator leach field to sand and gravel soils ~4 to 12 ft. below grade; excavations associated with a removal action and borings at the dry well and leach field locations suggest that the released fluids are present as immobile residual within a few feet of the dry well and leach field perforated piping. Borings in the septic system leach field area appeared to encounter only three phase conditions.

Receptors *(check receptors that could be affected by contamination at the site)*

☒ Residents (adult or child)
☒ Commercial or industrial worker
☒ Construction worker
☒ Subsistence harvester (i.e. gathers wild foods)
☒ Subsistence consumer (i.e. eats wild foods)
☒ Site visitor
☒ Trespasser
☒ Recreational u
☐ Farmer
☐ Other:

Future residents and current and future commercial/ industrial workers, construction workers, site visitors, trespassers, recreational users, subsistence harvesters, and and subsistence users could potentially be exposed at the site. However, the frequency and duration of exposure is very limited for these receptors, other than the future residents and commercial/industrial workers.

---

* bgs - below ground surface

2. **Exposure Pathways:** *(The answers to the following questions will identify complete exposure pathways at the site. Check each box where the answer to the question is "yes".)*

a) Direct Contact -

1. Incidental Soil Ingestion

Are contaminants present or potentially present in surface soil between 0 and 15 feet below the ground surface? (Contamination at deeper depths may require evaluation on a site-specific basis.) ☒

If the box is checked, label this pathway complete: Complete

Comments:

DRO, RRO, VOCs, and metals remain at the site at or exceeding ADEC Method Two soil cleanup levels and/or one-tenth of the risk based cleanup level.

2. Dermal Absorption of Contaminants from Soil

Are contaminants present or potentially present in surface soil between 0 and 15 feet below the ground surface? (Contamination at deeper depths may require evaluation on a site specific basis.) ☒

Can the soil contaminants permeate the skin (see Appendix B in the guidance document)? ☒

If both boxes are checked, label this pathway complete: Complete

Comments:

RO, RRO, VOCs, and metals remain at the site at or exceeding ADEC Method Two soil cleanup levels and/or one-tenth of the risk based cleanup level.

b) Ingestion -

1. Ingestion of Groundwater

Have contaminants been detected or are they expected to be detected in the groundwater, or are contaminants expected to migrate to groundwater in the future? ☒

Could the potentially affected groundwater be used as a current or future drinking water source? Please note, only leave the box unchecked if DEC has determined the groundwater is not a currently or reasonably expected future source of drinking water according to 18 AAC 75.350. ☒

If both boxes are checked, label this pathway complete: Complete

Comments:

VOCs have been detected in groundwater and groundwater can be used as drinking water.

2. Ingestion of Surface Water

Have contaminants been detected or are they expected to be detected in surface water, or are contaminants expected to migrate to surface water in the future? ☐

Could potentially affected surface water bodies be used, currently or in the future, as a drinking water source? Consider both public water systems and private use (i.e., during residential, recreational or subsistence activities). ☐

If both boxes are checked, label this pathway complete: Incomplete

Comments:

Cook Inlet is the regional base level and discharge location for groundwater in the area and a dissolved phase plume extending to surface water and/or sediment has not been identified at the site.

3. Ingestion of Wild and Farmed Foods

Is the site in an area that is used or reasonably could be used for hunting, fishing, or harvesting of wild or farmed foods? ☒

Do the site contaminants have the potential to bioaccumulate (see Appendix C in the guidance document)? ☒

Are site contaminants located where they would have the potential to be taken up into biota? (i.e. soil within the root zone for plants or burrowing depth for animals, in groundwater that could be connected to surface water, etc.) ☒

If all of the boxes are checked, label this pathway complete: Complete

Comments:

The site is within a developed portion of Nikiski, so hunting will likely not occur at the site; fish are not present at the site, so fishing will not occur; harvesting of a limited quantity of wild plants cannot be ruled out, but because plants tend to not accumulate hydrocarbons, the ingestion of wild foods is considered insignificant.

c) Inhalation-

1. Inhalation of Outdoor Air

Are contaminants present or potentially present in surface soil between 0 and 15 feet below the ground surface? (Contamination at deeper depths may require evaluation on a site specific basis.) ☒

Are the contaminants in soil volatile (see Appendix D in the guidance document)? ☒

If both boxes are checked, label this pathway complete: Complete

Comments:

A few VOCs have been detected and one VOC (TCE) exceeds Method 2 migration to groundwater cleanup levels.

2. Inhalation of Indoor Air

Are occupied buildings on the site or reasonably expected to be occupied or placed on the site in an area that could be affected by contaminant vapors? (within 30 horizontal or vertical feet of petroleum contaminated soil or groundwater; within 100 feet of non-petroleum contaminted soil or groundwater; or subject to "preferential pathways," which promote easy airflow like utility conduits or rock fractures) ☒

Are volatile compounds present in soil or groundwater (see Appendix D in the guidance document)? ☒

If both boxes are checked, label this pathway complete: Complete

Comments:

The Completions Building is close to the known source areas and future development could be close to or over the source areas -- so the vapor intrusion pathway could potentially be complete.

3. Additional Exposure Pathways: *(Although there are no definitive questions provided in this section, these exposure pathways should also be considered at each site. Use the guidelines provided below to determine if further evaluation of each pathway is warranted.)*

Dermal Exposure to Contaminants in Groundwater and Surface Water

Dermal exposure to contaminants in groundwater and surface water may be a complete pathway if:

- Climate permits recreational use of waters for swimming.
- Climate permits exposure to groundwater during activities, such as construction.
- Groundwater or surface water is used for household purposes, such as bathing or cleaning.

Generally, DEC groundwater cleanup levels in 18 AAC 75, Table C, are deemed protective of this pathway because dermal absorption is incorporated into the groundwater exposure equation for residential uses.

Check the box if further evaluation of this pathway is needed: ☐

Comments:

The routes are adequately addressed by the risk equations. The incidental ingestion of and dermal contact with surface water pathways are considered insignificant for all receptors.

Inhalation of Volatile Compounds in Tap Water

Inhalation of volatile compounds in tap water may be a complete pathway if:

- The contaminated water is used for indoor household purposes such as showering, laundering, and dish washing.
- The contaminants of concern are volatile (common volatile contaminants are listed in Appendix D in the guidance document.)

DEC groundwater cleanup levels in 18 AAC 75, Table C are protective of this pathway because the inhalation of vapors during normal household activities is incorporated into the groundwater exposure equation.

Check the box if further evaluation of this pathway is needed: ☐

Comments:

The routes are adequately addressed by the risk equations. No additional evaluation is needed.

Inhalation of Fugitive Dust

Inhalation of fugitive dust may be a complete pathway if:

- Nonvolatile compounds are found in the top 2 centimeters of soil. The top 2 centimeters of soil are likely to be dispersed in the wind as dust particles.
- Dust particles are less than 10 micrometers (Particulate Matter - PM_{10}). Particles of this size are called respirable particles and can reach the pulmonary parts of the lungs when inhaled.

DEC human health soil cleanup levels in Table B1 of 18 AAC 75 are protective of this pathway because the inhalation of particulates is incorporated into the soil exposure equation.

Check the box if further evaluation of this pathway is needed: ☐

Comments:

Contaminants are currently several feet below grade but future development could bring impacted soils to the ground surface. The particulate inhalation pathway is considered complete (and was found to present insignificant risk for the analytes present at the site).

Direct Contact with Sediment

This pathway involves people's hands being exposed to sediment, such as during some recreational, subsistence, or industrial activity. People then incidentally ingest sediment from normal hand-to-mouth activities. In addition, dermal absorption of contaminants may be of concern if the the contaminants are able to permeate the skin (see Appendix B in the guidance document). This type of exposure should be investigated if:

- Climate permits recreational activities around sediment.
- The community has identified subsistence or recreational activities that would result in exposure to the sediment, such as clam digging.

Generally, DEC direct contact soil cleanup levels in 18 AAC 75, Table B1, are assumed to be protective of direct contact with sediment.

Check the box if further evaluation of this pathway is needed: ☐

Comments:

Sediments are not present on the Nikiski site and there does not appear to be a groundwater plume extending to sediment of surface water at risk based concentrations. This exposure pathway is considered to be insignificant. Note that the soil direct contact pathway risk calculations are protective of the contact with sediment pathway.

4. Other Comments *(Provide other comments as necessary to support the information provided in this form.)*

Appendix C: Blank Ecoscoping Form

Site Name: Baker Hughes Nikiski Completions Facility, Nikiski, Alaska
Completed by: Dan Frank & Larry Acomb
Date: 7-28-20

Instructions: Follow the italicized instructions in each section below. "Off-ramps," where the evaluation ends before completing all of the sections, can be taken when indicated by the instructions. Comment boxes should be used to help support your answers.

1. Direct Visual Impacts and Acute Toxicity

Are direct impacts that may result from the site contaminants evident, or is acute toxicity from high contaminant concentrations suspected? C*heck the appropriate box.*

☐ Yes – De*scribe observations below and evaluate all of the remaining sections* *without taking any off-ramps*.
☒ No – *Go to next section.*

Comments:
There have been no visually stained soils, no visibly stressed vegetation and no dead biota observed at the site. The impacted soils are several feet below grade and under pavement.

2. Terrestrial and Aquatic Exposure Routes

Check each terrestrial and aquatic route that could occur at the site.

Terrestrial Exposure Routes

☐ Exposure to water-borne contaminants as a result of wading or swimming in contaminated waters or ingesting contaminated water.
☐ Contaminant uptake in terrestrial plants whose roots are in contact with contaminated surface water.
☐ Contaminant migration via saturated or unsaturated groundwater zones and discharge at upland "seep" locations (not associated with a wetland or waterbody).
☐ Contaminant uptake by terrestrial plants whose roots are in contact with soil moisture or groundwater present within the root zone (generally no more than 4 feet below ground surface.
☐ Particulates deposited on plants directly or from rain splash.
☐ Incidental ingestion and/or exposure while animals grub for food, burrow (up to 2 feet for small animals or 6 feet for large animals), or groom.

Also refer to the text box below.
Terrestrial Routes: There is no wading risk and no surface water or upland seeps are present. Hydrocarbon and VOC uptake and accumulation by plants is generally insignificant, so there is insignificant plant ingestion risk associated with these compounds; metals may accumulate in plant tissues. Risk associated with particulate deposition on leaves from rain splash is insignificant (the source area is currently vegetated). Note the impacted soils are about 4 feet below grade, in densely compacted soils and under pavement, which limits potential burrowing animal exposure. The soils are generally to dense to provide good habitat for burrowing animals and soil invertebrates. Metals impacts may be addressed when more representative exposure point concentration data is available.

☐ Inhalation of fugitive dust or vapors disturbed by foraging or burrowing activities.

☐ Bioaccumulatives (other than PAHs, which bioaccumulate more readily in aquatic environments) taken up by soil invertebrates, which are in turn eaten by higher food chain organisms (see the *Policy Guidance on Developing Conceptual Site Models*).

☐ Other site-specific exposure pathways.

Aquatic Exposure Routes

☐ Contaminated surface runoff migration to water bodies through swales, drainage ditches, or overland flow.

☐ Aquatic receptors exposed through osmotic exchange, respiration, or ventilation of surface waters.

☐ Contaminant migration via saturated or unsaturated groundwater zones and discharge at “seep” locations along banks or directly to surface water.

☐ Deposition into sediments from upwelling of contaminated groundwater.

☐ Aquatic receptors may be exposed directly to contaminated sediments through foraging or burrowing, or indirectly exposed due to osmotic exchange, respiration, or ventilation of sediment pore water.

☐ Aquatic plants rooted in contaminated sediments.

☐ Bioaccumulatives (see the *Policy Guidance on Developing Conceptual Site Models*) taken up by sediment invertebrates, which are in turn eaten by higher food chain organisms.

☐ Other site-specific exposure pathways.

If any of the above boxes are checked, go on to the next section. If none are checked, end the evaluation and check the box below.

☒ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Aquatic Routes: The impacted soils are about 4 feet below grade and under pavement, so there is not impacted surface water or sediment runoff from the site to surface water or wetlands. Groundwater plumes appear to not extend off site at concentrations that could cause issues in downgradient seeps or surface waters.
Aquatic routes associated with the Nikiski Completions Building site are interpreted to be incomplete or insignificant. Hydrocarbon and/or VOCs uptake and accumulation by wetland plants is generally insignificant. Plants tend to not take-up or accumulate PAHs, so risk associated with higher organisms feeding on site plants is insignificant.

3. Habitat

Check all that may apply. See Ecoscoping Guidance for additional help.

☐ Habitat that could be affected by the contamination supports valued species (i.e., species that are regulated, used for subsistence, have ceremonial importance, have commercial value, or provide recreational opportunity).

☐ Critical habitat or anadromous stream in an area that could be affected by the contamination.

☐ Habitat that is important to the region that could be affected by the contamination.

☐ Contamination is in a park, preserve, or wildlife refuge.

If any of the above boxes are checked, go on to the next scoping factor. If none are checked, end the evaluation and check the box below.

☒ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Comments:

The Completions Building site is in a developed portion of Nikiski and there are not sensitive environments, or critical habitat, or anadromous streams at the site. The contaminated soil is in an active equipment yard, about 4 feet below grade and under pavement. The site is not in or immediately adjacent to parkland. Given these conditions the site appears to qualify for the ADEC ecological scoping form off-ramp associated with item 3, Habitat.

4. Contaminant Quantity

Check all that may apply. See Ecoscoping Guidance for additional help.

☐ Endangered or threatened species are present.
☐ The aquatic environment is or could be affected.
☐ Non-petroleum contaminants may be present, or the total area of petroleum-contaminated surface soil exceeds one-half acre.

If any of the above boxes are checked, go on to the next scoping factor. If none are checked, end the evaluation and check the box below.

☐ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Comments:

5. Toxicity Determination

Check all that apply.

☐ Bioaccumulative chemicals are present (see *Policy Guidance on Developing Conceptual Site Models*).
☐ Contaminants exceed benchmark levels (see the Ecological Benchmark Tool in RAIS, available at: http://rais.ornl.gov/tools/eco_search.php).

If either box is checked, complete a detailed Ecological Conceptual Site Model (see DEC's Policy Guidance on Developing Conceptual Site Models*) and submit it with the form to your DEC project manager.*

If neither box is checked, check the box below and submit this form to your DEC project manager.

☐ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Comments:

ATTACHMENT 4

HRC Calculations and Tables

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Table 1 HRC Data Sources for Exposure Point Concentrations -- Generator Building, Remote Site, Alaska

Compound	Soil Concentration Data	Groundwater Concentration Data	Dissolved Phase Half Life (days)
Benzene (c & nc)	max non-detect LOD	gw modeled using soil data	literature value for BTEX compounds and conservative order of magnitude values for all other compounds
Toluene (nc)	max non-detect LOD	gw modeled using soil data	
Ethylbenzene (c & nc)	max non-detect LOD	gw modeled using soil data	
Xylenes (total) (nc)	max non-detect LOD	gw modeled using soil data	
GRO	max detection	gw modeled using soil data	
DRO	max detection	gw modeled using soil data	
RRO	max detection	gw modeled using soil data	
GRO aromatics	average of AK data	gw modeled using soil data	
DRO aromatics	average of AK data	gw modeled using soil data	
RRO aromatics	average of AK data	gw modeled using soil data	
GRO aliphatics	average of AK data	gw modeled using soil data	
DRO aliphatics	average of AK data	gw modeled using soil data	
RRO aliphatics	average of AK data	gw modeled using soil data	
Acenaphthene (nc)	max non-detect LOD	gw modeled using soil data	
Acenaphthylene (nc)	max non-detect LOD	gw modeled using soil data	
Anthracene (nc)	max non-detect LOD	gw modeled using soil data	
Benzo(g,h,i)perylene (nc)	max non-detect LOD	gw modeled using soil data	
Fluoranthene (nc)	max non-detect LOD	gw modeled using soil data	
Fluorene (nc)	max non-detect LOD	gw modeled using soil data	
Naphthalene (c & nc)	max non-detect LOD	gw modeled using soil data	
Phenanthrene (nc)	max non-detect LOD	gw modeled using soil data	
Pyrene (nc)	max non-detect LOD	gw modeled using soil data	
Benzo(a)anthracene (c)	max non-detect LOD	gw modeled using soil data	
Benzo(b)fluoranthene (c)	max non-detect LOD	gw modeled using soil data	
Benzo(k)fluoranthene (c)	max non-detect LOD	gw modeled using soil data	
Benzo(a)pyrene (c)	max non-detect LOD	gw modeled using soil data	
Chrysene (c)	max non-detect LOD	gw modeled using soil data	
Dibenz(a,h)anthracene (c)	max non-detect LOD	gw modeled using soil data	
Indeno(1,2,3-cd)pyrene (c)	max non-detect LOD	gw modeled using soil data	
Trichloroethylene (c & nc)	max source area detection	max 2016 detection	
Tetrachloroethylene (c & nc)	max source area detection	max detection 2015	
Trichloroethane, 1,1,2- (c & nc)	max source area non-detect LOD	max detection 2014	
0			
0			
0			
0			
0			
0			
0			
0			
0			
0			
0			
0			
Trichloroethylene (c & nc)	max source area detection	max 2016 detection	
Tetrachloroethylene (c & nc)	max source area detection	max detection 2015	
Trichloroethane, 1,1,2- (c & nc)	max source area non-detect LOD	max detection 2014	
0			
0			
0			
0			

0= columns for site specific additional carcinogenic and non-carcinogenic compounds that were not used at this site

Table 2 HRC Input Values & Data Sources, Non-Contaminant Parameters -- Generator Building, Remote Site, Alaska

Source Area Soil Conditions:	**Input Values**			**Source of Data**
bulk density (lbs/ft^3)	115			Site specific estimated value
specific gravity	2.65			ADEC default input value
moisture content (% by weight)	10			Site specific estimated value
foc	0.001			ADEC default input value
Soil temp (C)	5			Estimated average ground temperature
Soil Grain Size Description (USCS or other; used to label CSM)	Sand & Gravel (SW, SP, GW, GP)			Site specific estimated soils texture range
Hydrogeologic Conditions:				
Source length (ft)	60			Site specific estimated value
Average precipitation (in/yr)	18.21			NOAA Climate Data
Aquifer hydraulic conductivity (cm/sec)	2.78E-03			ADEC default input value
Aquifer thickness (ft; below low water at downgradient edge of source)	32.8			Estimated site specific value
Infiltration rate (m/yr)	0.093			ADEC default input value = 20% of average precipitation
Hydraulic gradient	0.003			ADEC default input value
Potable or Non-potable Aquifer?	1			Non-potable (arctic supra-permafrost water)
Climate Related Outdoor Air Inhalation and Soil Direct Contact Exposure Parameters				
Climate Zone of site (enter "1" for an arctic site; "2" for the <40" precip zone; and "3" for the >40" precip zone)	2			Under 40" precip zone
Groundwater Depth & Fluctuation and Soil Source Depth				
depth to groundwater at seasonal low water level at downgradient end of source (ft)	40			Estimated depth to low water
seasonal water table fluctuation (ft)	4			Estimated seasonal fluctuation
depth to bottom of source zone at downgradient edge of source (ft)	12			Depth of bottom of DRO source area as indicated by borings & test pits
depth to top of area wide source zone at downgradient edge of source (ft)	4			Depth of top of DRO source area as indicated by boring & test pits
Exposure Routes Complete at Present Time				
Soil Direct Contact	1			Site specific conceptual site model
Outdoor Air	1			Site specific conceptual site model
Indoor Air	0			Site specific conceptual site model
Groundwater Ingestion	0			Site specific conceptual site model
Other Input:				
ADEC Hazard ID	0			ADEC CS database
Latitude	0			ADEC CS database
Longitude	0			ADEC CS database
Width of Source (ft)	0			scaled from site maps
Area of NAPL contaminated soil source (ft^2)	0			scaled from site maps
Ground surface slope (ft/ft, assumed to be in direction of groundwater flow)	0			Measured slope of water table
Johnson & Ettinger Vapor Intrusion Model Parameters				
Soil Properties:	Upper Layer	Middle Layer	Bottom Layer	
bulk density (lbs/ft^3)	115.0	115.0	115.0	Site specific estimated value
specific gravity of solids	2.65	2.65	2.65	ADEC default input value -- measured value similar
moisture content (% by weight)	10.00	10.00	10.00	ADEC default input value
foc	0.001	0.001	0.001	ADEC default input value
Thickness of uncontaminated soil layers above source at building location (ft; upper most layer must extend below the depth of foundation; used to define the source-building separation distance)	3.8	0.1	0.1	Site Specific (small foundation-source separation distance distributed among 3 layers)
Building Properties:				
Abf= surface area of enclosed space below grade (m^2)	150			EPA default input value
ER = air exchange rate (1/hr)	0.45			EPA default input value
Hb = height of building (cm)	2.44			EPA default input value
Lb = depth below grade of bottom of floor slab or basement (m)	0.1			EPA default input value
Lf = Lcrack = foundation thickness or slab thickness (m)	0.1			EPA default input value for slab on grade - shallow GW
eta = fraction of foundation area with cracks	0.001			EPA default input value
Qsoil/Qbldg	0.003			EPA default input value
Q building =building ventilation rate (m^3/hr)	0			EPA default input value
Qsoil (m^3/hr)	0			EPA default input value

Table 3

Hydrocarbon Risk Calculator

Facility Location:
Baker Hughes

Facility Name:
Nikiski, Alaska

Page 1

Model Input Parameters:

Version 2.3 Lawrence Acomb, Geosphere, Inc., 6-28-2020

Solver solution based on work of Hun Seak Park, 1999; VBA macro by Ted Cahalane, 2010

Site Specific and/or Field Data in Yellow Highlighted Cells			**Chemical Concentrations in Site Groundwater (ug/L):**	Calculate	**Dissolved Phase Half Life (days; used in DAF calculations):**
Concentrations in Site Soils (mg/kg):			Benzene (ug/L)	0.9552	231
Benzene (c & nc)		0.067	Toluene (ug/L)	0.4262	100
Toluene (nc)		0.34	Ethylbenzene (ug/L)	0.0144	100
Ethylbenzene (c & nc)		0.067	Xylene (ug/L)	0.0125	100
Xylenes (nc)		0.08	GRO (ug/L)	0.1266	100
GRO (mg/kg)		50.	DRO (ug/L)	0.1158	100
DRO (mg/kg)		2,600.	RRO (ug/L)	2.93E-46	100
RRO (mg/kg)		6,200.	GRO aromatics (ug/L)	0.1266	100
Total Petroleum Hydrocarbons (mg/kg)		8,850.000	DRO aromatics (ug/L)	0.1158	100
GRO Aromatics Fraction (ADEC default=0.50)		0.45	RRO aromatics (ug/L)	2.93E-46	100
DRO Aromatics Fraction (ADEC default=0.40)		0.19	GRO aliphatics (ug/L)	1.56E-22	100
RRO Aromatics Fraction (ADEC default=0.40)		0.40	DRO aliphatics (ug/L)	4.16E-171	100
See Note #1 regarding use of ND values			RRO aliphatics (ug/L)	1.95E-107	100
Acenaphthene (nc)		0.13	Acenaphthene (nc)	0.0238	10,000
Acenaphthylene (nc)		0.13	Acenaphthylene (nc)	0.0928	10,000
Anthracene (nc)		0.13	Anthracene (nc)	0.0014	10,000
Benzo[g,h,i]perylene (nc)		0.025	Benzo[g,h,i]perylene (nc)	4.36E-20	10,000
Fluoranthene (nc)		0.099	Fluoranthene (nc)	1.29E-04	10,000
Fluorene (nc)		0.14	Fluorene (nc)	0.0109	10,000
Naphthalene (c & nc)		0.067	Naphthalene (c & nc)	0.0047	200
Phenanthrene (nc)		0.1	Phenanthrene (nc)	0.002	10,000
Pyrene (nc)		0.25	Pyrene (nc)	4.66E-04	10,000
Benz[a]anthracene (c)		0.086	**Benz[a]anthracene (c)**	2.48E-07	10,000
Benzo[b]fluoranthene (c)		0.14	**Benzo[b]fluoranthene (c)**	4.17E-10	10,000
Benzo[k]fluoranthene (c)		0.12	**Benzo[k]fluoranthene (c)**	7.07E-10	10,000
Benzo[a]pyrene (c & nc)		0.11	**Benzo[a]pyrene (c & nc)**	5.22E-10	10,000
Chrysene (c)		0.11	**Chrysene (c)**	3.35E-06	10,000
Dibenz[a,h]anthracene (c)		0.16	**Dibenz[a,h]anthracene (c)**	3.72E-18	10,000
Indeno[1,2,3-cd]pyrene (c)		0.15	**Indeno[1,2,3-cd]pyrene (c)**	1.43E-20	10,000
Trichloroethylene (c & nc)	nc	0.0037	Trichloroethylene (c & nc)	15.9	10,000
Tetrachloroethylene (c & nc)	nc	0.071	Tetrachloroethylene (c & nc)	0.59	10,000
Trichloroethane, 1,1,2- (c & nc)	nc	0.067	Trichloroethane, 1,1,2- (c & nc)	0.45	10,000
	nc				
	nc				
	nc				
	nc				
	nc				
	nc				
	nc				
	nc				
	nc				
	nc				
	nc				
	nc				
Trichloroethylene (c & nc)	c	0.065	**Trichloroethylene (c & nc)**	15.9	10,000
Tetrachloroethylene (c & nc)	c	0.0053	**Tetrachloroethylene (c & nc)**	0.59	10,000
Trichloroethane, 1,1,2- (c & nc)	c	0.067	**Trichloroethane, 1,1,2- (c & nc)**	0.45	10,000
	c				
	c				
	c				
	c				

Soil Conditions:	Site Specific and/or Field Data in Yellow Highlighted Cells	ADEC Default Value (all climate zones)	
bulk density (lbs/ft^3)	115.0	93.6	
bulk density (g/cm^3)	1.84	1.5	
specific gravity	2.65	2.65	
porosity	0.305	0.43	
moisture content (% by weight)	10	10 for risk (20 for mtgw)	
foc	0.0010	0.001	
water filled porosity	0.184	0.15	
air filled porosity	0.102	0.28	
NAPL filled porosity	0.018		
water saturation	60.51%		
NAPL saturation	5.96%		
Soil temp (C)	5	25	
Soil Grain Size Description (USCS or other; used to label CSM)	Sand & Gravel (SW, SP, GW, GP)		
Hydrogeologic Conditions:		ADEC Default Values <40" precip/yr	ADEC Default Values >40" precip/yr
Source length (ft)	60	105	105
Average precipitation (in/yr)	18.21	25.59	118.11
Default Estimated Infiltration Rate (20% of precip, m/yr)	0.093	0.13	0.6
Aquifer hydraulic conductivity (cm/sec)	2.78E-03	2.78E-03	2.78E-03
Aquifer thickness (ft; below low water at downgradient edge of source)	32.8	32.8	32.8
Source length (m)	18	32	32
Infiltration rate (m/yr)	0.093	0.13	0.6
Hydraulic gradient	0.0030	0.002	0.002
Aquifer hydraulic conductivity (m/yr)	8.77E+02	8.76E+02	8.76E+02
Aquifer thickness (ft; below low water)	10.0	10.0	10.0
Mixing Zone Depth minimum of (m)	5.5	5.5 maximum	5.5 maximum
Dilution Factor (lower seasonal value)	8.5	minimum DAF (for all compounds)	8.8
Vadose Zone or Smear Zone Source?	4	4 indicates vadose zone source, 1 indicates a saturated zone source	
Potable or Non-potable Aquifer?	1	Enter 1 for potable aquifer, 10 for non-potable aquifer (to be considered non-potable the groundwater must have been evaluated and determined to be non-potable by the ADEC as per 18 AAC 75.350	
ADEC Reckey No.:			
ADEC File ID			
Latitude			
Longitude			
Width of Source (ft)			
Area of NAPL contaminated soil source (ft^2)			
Ground surface slope (ft/ft, assumed to be in direction of groundwater flow)			

FYI Unit Conversions	
bulk density conversion input (g/cm^3)	bulk density output (lbs/ft^3)
1.66	103.584
K (ft/day)	K (cm/sec)
400	0.141111111
Exposure Routes Complete at Present Time	
Exposure Routes	enter 1 for complete pathways; 0 for incomplete pathways
Soil Direct Contact & Particulate	1
Outdoor Air Vapor Inhalation	1
Indoor Air	0
Groundwater Direct Contact & i	0

Solver Instructions & Information:

"Solver" is an Excel add-in tool, installed from the program discs. In addition, the "macro" which performs the calculations must be "enabled" while the spreadsheet is opening.

1. Enter site specific hydrocarbon concentration data, and soil and groundwater conditions data.
2. Click on the "Calculate" button in cell D4. The phase partitioning equations are solved and the results are saved in the spreadsheet.
3. Any time data entry values are changed the spreadsheet should be re-calculated (click on the "Calculate" button again).

Molar density (mol/L)*NAPL filled porosity initial value=.0001	0.067564357
Initial air filled porosity (used to start iterations)	0.120
Conservation of volume equation (should be zero or close to zero, i.e. a very small number)	1.40E-11
industrial/commercial scenario: 2 = outdoor worker; 3 = indoor worker	2
To use: Andelman factor enter "1"; CDC ATSDR volatilization factor enter "2"	2
To use: ADEC DAF enter "1"; HRC DAF enter "2"	2

Climate Related Outdoor Air Inhalation and Soil Direct Contact Exposure Parameters

Climate Zone of site (enter "1" for an arctic site; "2" for the <40" precip zone; and "3" for the >40" precip zone)			2
Soil Ingestion & Inhalation Exposure Frequency (days/yr)		ADEC Default Values	
Residential	Industrial	arctic zone; precip <40"; precip >40"	
270	250	Res 200; 270; 330 / Indus 200; 250; 250	
Q/C for volatilization to Outdoor Air calcs.			
Residential	Industrial		
90.82	90.82	100.13; 90.82; 82.72	

depth to groundwater at seasonal low water level (ft)	40
seasonal water table fluctuation (ft)	4
depth to bottom of source zone (ft)	12
depth to top of area wide source zone (ft)	4
saturated source thickness at low water level (ft; depth of NAPL source below low water table)	0
saturated source thickness at high water level (ft; thickness of saturated source zone below high water table)	0.00
total thickness of the source zone (ft)	8
seasonal water table fluctuation (m)	1.219
saturated source thickness at low water level (m; depth of source below low water table)	0.000
saturated source thickness at high water level (m; thickness of source zone below high water table)	0.000

True Vadose Zone Source

Table 3

Migration to Indoor Air-- Data Entry

Baker Hughes

Nikiski, Alaska

Page 2

NAPL source area soil gas concentrations or measured soil gas concentrations used as input. Attenuation factor "alpha" calculated by the Johnson & Ettinger model following the EPA advanced soil gas solution to the J & E model. Incremental risk posed by NAPL source area soil gas concentrations via the migration to indoor air pathway shown in section 6 below and entered into the cumulative risk calculations.

Site Specific and/or Field Data in Yellow Highlighted Cells

Soil Properties:		Upper most uncontaminated soil layer immediately below slab	Middle Layer (not contaminated)	Bottom Layer (not contaminated)	**Building Properties:**	input value for residential scenario	input value for commercial scenario	residential	commercial			Industrial Scenario Exposure Frequency input values	
bulk density (lbs/ft^3)		115.00	115.00	115.00	**A_{bf}**= surface area of enclosed space below grade (m^2)	150	1500	150	1500			days per week (default=5)	5
bulk density (g/cm^3)		1.84	1.84	1.84	**ER** = air exchange rate (1/hr)	0.45	1.5	0.45	1.5			hours per day (default=8)	8
specific gravity of solids		2.65	2.65	2.65				default input values: **basement (residential)**	default input values: **slab on grade (residential)**	default input values: **crawl space (residential or commercial)**	default input values: **commercial**	weeks per year (default=50)	50
porosity		0.305	0.305	0.305	**Hb** = height of building (m)	2.44	3	3.66	2.44	1.3	3	depth below grade of bottom of floor slab or basement (ft)	3.28E-01
moisture content (% by weight)		10.00	10.00	10.00	**Lb** = depth below grade of bottom of floor slab or basement (m)	0.1	0.1	2	0.1	1		building separation distance (limited to 0.1 m, m)	1.119214826
foc		0.001	0.001	0.001	**Lf** = Lcrack = foundation thickness or **slab thickness** (m)	0.1	0.1	0.1	0.1	0	0.2		
water filled porosity		0.184	0.184	0.184	**eta** = fraction of foundation area with cracks	0.001	0.001	0.001	0.001	1	0.001		
air filled porosity		0.120	0.120	0.120	**Enter a "Qsoil/Qbldg" value or enter "Qsoil" and "Qbldg" values (but not both; if a "Qsoil/Qbldg" values is entered it will be used in subsequent calculations)**							residential Qsoil/Qbldg, Qbldg & Qsoil used in calcs	commercial Qsoil/Qbldg, Qbldg & Qsoil used in calcs
Thickness of uncontaminated soil layers above source at building location (ft; upper most layer must extend below the depth of foundation; used to define the source-building separation distance)		3.8	0.1	0.1	**Qsoil/Qbldg**	0.003	0.003	0.003	0.003	NA	0.003	0.003	0.003
layer thickness (m)		1.158	0.030	0.030	**Q building** =building ventilation rate (m^3/hr)			164.7	6750			164.7	6750
Ls (ft) = Total depth to contaminant or to soil gas sample if soil gas data used as input to model		4	**Ls** (m)	1.22	**Qsoil** (m^3/hr)			5 L/min = standard; 1 to 10 L/min typical range; 5 L/min = 0.3 m^3/hr; 1 L/min = 0.06 m^3/hr; 10 L/min = 0.6 m^3/hr				0.4941	20.25
					Scenario- enter 1 for sub slab soil gas, 2 for soil gas at depth below foundation, 3 for dirt floor basement of crawl space		2						

Table 3		Phase Partitioning Results			Baker Hughes			Nikiski, Alaska					
Page 3 column 1	2	3	4	5	6	7	8	9	10	11	12	13	14
Hydrocarbon Fractions		**Median Equivalent Carbon**	**Distribution of DRO & GRO into Aromatic & Aliphatic Equivalent Carbon Ranges (varies by fuel type)**	**Bulk Soil Concentration (mg/kg)**	**Fraction of TPH Mass**	**Xi (Mole Fraction in NAPL using 4-phase model; unique solution)**	**Concentration in Soil Water (mg of chemical/L of pore water)**	**Concentration in Soil Gas (mg/L pore air)**	**% of Hydrocarbon Mass in Dissolved Phase**	**% of Hydrocarbon Mass in Vapor Phase**	**% of Hydrocarbon Mass Adsorbed to Soils**	**% of Hydrocarbon Mass in NAPL**	**Sum of Dissolved, Vapor, Adsorbed and NAPL Phases**
Benzene C_5-C_7		6.50	from analysis	0.067	0.000008	2.02E-05	3.62E-02	3.27E-03	5.404%	0.270%	7.880%	86.45%	100.00%
Toluene C_7-C_8		7.58	from analysis	0.340	0.000038	9.55E-05	5.03E-02	4.78E-03	1.478%	0.078%	3.457%	94.99%	100.00%
Ethylbenzene C_8-C_9		8.50	from analysis	0.067	0.000008	1.68E-05	2.84E-03	2.84E-04	0.424%	0.023%	1.891%	97.66%	100.00%
Xylene C_8-C_9		8.63	from analysis	0.080	0.000009	2.03E-05	2.15E-03	1.79E-04	0.269%	0.012%	1.029%	98.69%	100.00%
Aromatic C_9-C_{10}		9.50	from analysis	21.946	0.002480	4.95E-03	2.51E-01	2.36E-02	0.114%	0.006%	2.034%	97.85%	100.00%
Aromatic C_{10}-C_{12}		11.00	0.14052	69.418	0.007844	1.44E-02	3.52E-01	1.14E-02	0.051%	0.001%	1.275%	98.67%	100.00%
Aromatic C_{12}-C_{16}		13.00	0.41388	204.458	0.023103	3.82E-02	3.56E-01	5.39E-03	0.017%	0.000%	0.694%	99.29%	100.00%
Aromatic C_{16}-C_{21}		17.00	0.44560	220.124	0.024873	3.47E-02	4.68E-02	1.81E-04	0.002%	0.000%	0.213%	99.79%	100.00%
Aromatic C_{21}-C_{35}		25.00	1.0000	2480.000	0.280226	3.05E-01	8.59E-03	1.60E-06	0.000%	0.000%	0.022%	99.98%	100.00%
Aliphatic C_5-C_6		5.50	0.07000	1.925	0.000218	6.34E-04	2.27E-02	4.37E-01	0.118%	1.257%	0.949%	97.68%	100.00%
Aliphatic C_6-C_8		7.00	0.18000	4.950	0.000559	1.31E-03	7.04E-03	1.39E-01	0.014%	0.155%	0.541%	99.29%	100.00%
Aliphatic C_8-C_{10}		9.00	0.75000	20.625	0.002331	4.30E-03	1.83E-03	4.28E-02	0.001%	0.012%	0.269%	99.72%	100.00%
Aliphatic C_{10}-C_{12}		11.00	0.25000	526.500	0.059492	9.05E-02	3.07E-03	8.74E-02	0.000%	0.001%	0.140%	99.86%	100.00%
Aliphatic C_{12}-C_{16}		13.00	0.56000	1179.360	0.133261	1.72E-01	4.64E-04	3.13E-02	0.000%	0.000%	0.075%	99.92%	100.00%
Aliphatic C_{16}-C_{21}		17.00	0.19000	400.140	0.045214	4.51E-02	7.66E-07	3.29E-04	0.000%	0.000%	0.023%	99.98%	100.00%
Aliphatic C_{21}-C_{35}		25.00	1.0000	3720.000	0.420339	2.89E-01	1.95E-10	2.40E-06	0.000%	0.000%	0.003%	100.00%	100.00%
				8850.000	**100.0000%**	**1.00000**	**1.14E+00**	**7.86E-01**					

Table 3 Soil Ingestion, Dermal Contact & Particulate Inhalation Risk (directly based on soil concentration, no phase partitioning involved)

Page 4 Baker Hughes Nikiski, Alaska

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Compounds		Sample Concentrations (mg/kg)	Soil Direct Contact Risk Based Level Residential Land Use	% of direct contact risk associated with ingestion	% of direct contact risk associated with dermal contact	% of direct contact risk associated with particulate inhalation	Residential Land Use Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Check for compliance with risk levels (0= in compliance; 1= not in compliance)	Soil Direct Contact Risk Based Level Industrial Land Use	% of direct contact risk associated with ingestion	% of direct contact risk associated with dermal contact	Industrial Land Use Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Check for compliance with risk levels (0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	0.067	406.	100%	-	0.0007%	1.65E-04	0	5,191.	100%	-	1.29E-05	0
Toluene (nc)	nc	0.34	8,111.	100%	-	0.0001%	4.19E-05	0	103,822.	100%	-	3.27E-06	0
Ethylbenzene (c & nc)	nc	0.067	10,139.	100%	-	0.001%	6.61E-06	0	129,775.	100%	-	5.16E-07	0
Xylenes (nc)	nc	0.08	20,276.	100%	-	0.011%	3.95E-06	0	259,454.	100%	-	3.08E-07	0
GRO Aromatics (nc)	nc	21.946	20,278.				0.0011	0	408,800.			5.37E-05	0
DRO Aromatics (nc)	nc	494.	4,056.				**0.1218**	0	81,760.			0.006	0
RRO Aromatics (nc)	nc	2,480.	3,042.				**0.8153**	0	61,320.			0.0404	0
GRO Aliphatics (nc)	nc	27.5	506,944.				5.42E-05	0	10,220,000.			2.69E-06	0
DRO Aliphatics (nc)	nc	2,106.	10,139.				**0.2077**	0	204,400.			0.0103	0
RRO Aliphatics (nc)	nc	3,720.	202,778.				0.0183	0	4,088,000.			9.10E-04	0
Acenaphthene (nc)	nc	0.13	4,649.	76%	24%	-	2.80E-05	0	50,230.	65%	35%	2.59E-06	0
Acenaphthylene (nc)	nc	0.13	2,325.	76%	24%	-	5.59E-05	0	25,115.	65%	35%	5.18E-06	0
Anthracene (nc)	nc	0.13	23,246.	76%	24%	-	5.59E-06	0	251,148.	65%	35%	5.18E-07	0
Benzo[g,h,i]perylene (nc)	nc	0.025	2,325.	76%	24%	-	1.08E-05	0	25,115.	65%	35%	9.95E-07	0
Fluoranthene (nc)	nc	0.099	3,099.	76%	24%	-	3.19E-05	0	33,486.	65%	35%	2.96E-06	0
Fluorene (nc)	nc	0.14	3,099.	76%	24%	-	4.52E-05	0	33,486.	65%	35%	4.18E-06	0
Naphthalene (c & nc)	nc	0.067	1,549.	76%	24%	0.03%	4.32E-05	0	16,729.	64%	35%	4.00E-06	0
Phenanthrene (nc)	nc	0.1	2,325.	76%	24%	-	4.30E-05	0	25,115.	65%	35%	3.98E-06	0
Pyrene (nc)	nc	0.25	2,325.	76%	24%	-	1.08E-04	0	25,115.	65%	35%	9.95E-06	0
Benzene (c & nc)	**c**	0.067	164.	100%	-	0.003%	4.09E-04	0	661.	100%	-	1.01E-04	0
Ethylbenzene (c & nc)	**c**	0.067	819.	100%	-	0.004%	8.18E-05	0	3,303.	100%	-	2.03E-05	0
Benz[a]anthracene (c)	**c**	0.086	14.8843	75%	25%	0.005%	0.0058	0	234.	65%	35%	3.67E-04	0
Benzo[b]fluoranthene (c)	**c**	0.14	14.8843	75%	25%	0.005%	0.0094	0	234.	65%	35%	5.97E-04	0
Benzo[k]fluoranthene (c)	**c**	0.12	149.	75%	25%	0.005%	8.06E-04	0	2,344.	65%	35%	5.12E-05	0
Benzo[a]pyrene (c & nc)	**c**	0.11	1.4884	75%	25%	0.005%	0.0739	0	23.4387	65%	35%	0.0047	0
Chrysene (c)	**c**	0.11	1,488.	75%	25%	0.005%	7.39E-05	0	23,439.	65%	35%	4.69E-06	0
Dibenz[a,h]anthracene (c)	**c**	0.16	1.4884	75%	25%	0.005%	**0.1075**	0	23.4387	65%	35%	0.0068	0
Indeno[1,2,3-cd]pyrene (c)	**c**	0.15	14.8843	75%	25%	0.005%	0.0101	0	234.	65%	35%	6.40E-04	0
Naphthalene (c & nc)	**c**	0.067	1,455,139.	-	-	100%	4.60E-08	0	5,448,039.	-	-	1.23E-08	0
Trichloroethylene (c & nc)	nc	0.0037	50.6937	100%	-	0.0014%	7.30E-05	0	649.	100%	-	5.70E-06	0
Tetrachloroethylene (c & nc)	nc	0.071	608.	100%	-	0.0008%	1.17E-04	0	7,786.	100%	-	9.12E-06	0
Trichloroethane, 1,1,2- (c & nc)	nc	0.067	405.	100%	-	0.1102%	1.65E-04	0	5,171.	100%	-	1.30E-05	0
	nc												
	nc												
	nc												
	nc												
	nc												
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	nc												
	nc												
	nc												
Trichloroethylene (c & nc)	**c**	0.065	114.	100%	-	0.0014%	5.71E-04	0	790.	100%	-	8.23E-05	0
Tetrachloroethylene (c & nc)	**c**	0.0053	4,291.	100%	-	0.0023%	1.24E-06	0	17,303.	100%	-	3.06E-07	0
Trichloroethane, 1,1,2- (c & nc)	**c**	0.067	158.	100%	-	0.0051%	4.24E-04	0	637.	100%	-	1.05E-04	0
	c												
	c												
	c												
	c												
Carcinogenic Cumulative Risk							0.209	0				0.0135	0
Non-carcinogenic Cumulative Risk							9.44E-04	0				7.91E-05	0

Values shown in the fourth and seventh columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

Table 3 Migration to Outdoor Air -- Vapor Inhalation Risks

Page 5 Baker Hughes Nikiski, Alaska

1	2	3	4	5	6	7	8	9
Compounds		Vapor Concentration in Source (based on 3 or 4- phase partitioning, whichever is more representative, mg/L)	Residential Site Hypothetical Soil Vapor Concentration when HQ=1 or Target Risk =10^-5 (mg/L; from 3-phase equation)	Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Check for compliance with risk levels (0= in compliance; 1= not in compliance)	Industrial Site Hypothetical Soil Vapor Concentration when HQ=1 or Target Risk =10^-5 (mg/L; from 3-phase equation)	Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Check for compliance with risk levels (0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	0.0033	230.	1.42E-05	0	829.	3.94E-06	0
Toluene (nc)	nc	0.0048	38,753.	1.23E-07	0	125,561.	3.81E-08	0
Ethylbenzene (c & nc)	nc	2.84E-04	7,088.	4.01E-08	0	22,965.	1.24E-08	0
Xylenes (nc)	nc	1.79E-04	692.	2.58E-07	0	2,241.	7.98E-08	0
GRO Aromatics (nc)	nc	0.0236	723.	3.27E-05	0	2,139.	1.11E-05	0
DRO Aromatics (nc)	nc	0.017	179.	9.47E-05	0	530.	3.20E-05	0
RRO Aromatics (nc)	nc	1.60E-06	No RfC	0.00E+00	0	No RfC	0.00E+00	0
GRO Aliphatics (nc)	nc	0.618	127,765.	4.84E-06	0	377,892.	1.64E-06	0
DRO Aliphatics (nc)	nc	0.119	2,782.	4.28E-05	0	8,230.	1.45E-05	0
RRO Aliphatics (nc)	nc	2.40E-06	No RfC	0.00E+00	0	No RfC	0.00E+00	0
Acenaphthene (nc)	nc	4.71E-07	-	0.00E+00	0	-	0.00E+00	0
Acenaphthylene (nc)	nc	1.36E-06	-	0.00E+00	0	-	0.00E+00	0
Anthracene (nc)	nc	1.72E-08	-	0.00E+00	0	-	0.00E+00	0
Benzo[g,h,i]perylene (nc)	nc	1.00E-13	-	0.00E+00	0	-	0.00E+00	0
Fluoranthene (nc)	nc	7.56E-10	-	0.00E+00	0	-	0.00E+00	0
Fluorene (nc)	nc	1.74E-07	-	0.00E+00	0	-	0.00E+00	0
Naphthalene (c & nc)	nc	5.99E-06	3.0918	1.94E-06	0	10.0176	5.98E-07	0
Phenanthrene (nc)	nc	2.08E-08	-	0.00E+00	0	-	0.00E+00	0
Pyrene (nc)	nc	3.21E-09	-	0.00E+00	0	-	0.00E+00	0
Benzene (c & nc)	**c**	0.0033	26.4799	1.23E-04	0	89.2265	3.66E-05	0
Ethylbenzene (c & nc)	**c**	2.84E-04	76.3325	3.72E-06	0	257.	1.10E-06	0
Benz[a]anthracene (c)	**c**	1.18E-11	0.0023	5.11E-09	0	0.0215	5.47E-10	0
Benzo[b]fluoranthene (c)	**c**	7.55E-13	-	0.00E+00	0	-	0.00E+00	0
Benzo[k]fluoranthene (c)	**c**	7.60E-13	-	0.00E+00	0	-	0.00E+00	0
Benzo[a]pyrene (c & nc)	**c**	2.65E-13	-	0.00E+00	0	-	0.00E+00	0
Chrysene (c)	**c**	6.01E-11	-	0.00E+00	0	-	0.00E+00	0
Dibenz[a,h]anthracene (c)	**c**	1.13E-13	-	0.00E+00	0	-	0.00E+00	0
Indeno[1,2,3-cd]pyrene (c)	**c**	2.75E-14	-	0.00E+00	0	-	0.00E+00	0
Naphthalene (c & nc)	**c**	5.99E-06	0.8161	7.34E-06	0	2.7499	2.18E-06	0
Trichloroethylene (c & nc)	nc	1.43E-04	27.5641	5.17E-06	0	89.3077	1.60E-06	0
Tetrachloroethylene (c & nc)	nc	5.77E-04	758.	7.62E-07	0	2,455.	2.35E-07	0
Trichloroethane, 1,1,2- (c & nc)	nc	6.11E-04	0.8581	7.12E-04	0	2.7804	2.20E-04	0
	nc							
	nc							
	nc							
	nc							
	nc							
	nc							
	nc							
	nc							
	nc							
	nc							
	nc							
	nc							
Trichloroethylene (c & nc)	**c**	0.0025	63.2128	3.96E-05	0	305.	8.21E-06	0
Tetrachloroethylene (c & nc)	**c**	4.31E-05	1,961.	2.20E-08	0	6,609.	6.52E-09	0
Trichloroethane, 1,1,2- (c & nc)	**c**	6.11E-04	7.22	8.47E-05	0	24.3284	2.51E-05	0
	c							
	c							
	c							
	c							
Carcinogenic Cumulative Risk				2.59E-04	0		7.32E-05	0
Non-carcinogenic Cumulative Risk				7.35E-04	0		2.26E-04	0

Values shown in the fourth and seventh columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

Table 3

Migration to Indoor Air Vapor Inhalation Risks

Page 6

Baker Hughes

Nikiski, Alaska

1	2	3	4	5	6	7	8	9	10	11
Compounds		Vapor Concentration in Sample (ug/m^3)	Building Vapor Concentration given site conditions (ug/m^3)	Residential Land Use Building Vapor Concentration when HQ=1 or Target Risk =10^-5 (ug/m^3; Value listed depends on whether C or NC risks are being evaluated)	Residential Land Use Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Residential Land Use check for compliance with risk levels (0= in compliance; 1= not in compliance)	Building Vapor Concentration given site conditions (ug/m^3)	Building Vapor Concentration when HQ=1 or Target Risk =10^-5 (ug/m^3; Value listed depends on whether C or NC risks are being evaluated)	Industrial Land Use Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Industrial Land Use check for compliance with risk levels (0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	3,267.	0.7644	31.2857	0.02443	0	0.19399	131.4.	0.00582	0
Toluene (nc)	nc	4,784.	0.9825	5,214.	1.884E-04	0	0.24745	21,900.0.	4.486E-05	0
Ethylbenzene (c & nc)	nc	284.	0.0518	1,043.	4.964E-05	0	0.01296	4,380.0.	1.182E-05	0
Xylenes (nc)	nc	179.	0.0326	104.	3.129E-04	0	0.00817	438.0.	7.451E-05	0
GRO Aromatics (nc)	nc	23,649.	6.1192	417.	0.01467	0	1.56346	1,752.0.	0.00349	0
DRO Aromatics (nc)	nc	16,958.	4.4215	209.	0.0212	0	1.13031	876.0.	0.00505	0
RRO Aromatics (nc)	nc	1.6	0.0011	No RfC	0.000E+00	0	3.238E-04	No RfC	0.000E+00	0
GRO Aliphatics (nc)	nc	618,007.	159.	19,189.	0.0083	0	40.68277	80,592.0.	0.00198	0
DRO Aliphatics (nc)	nc	119,018.	30.6731	1,043.	0.02941	0	7.83478	4,380.0.	0.007	0
RRO Aliphatics (nc)	nc	2.4005	6.19E-04	No RfC	0.000E+00	0	1.580E-04	No RfC	0.000E+00	0
Acenaphthene (nc)	nc	0.471	1.00E-04	-	0.000E+00	0	2.532E-05	-	0.000E+00	0
Acenaphthylene (nc)	nc	1.3636	2.85E-04	-	0.000E+00	0	7.184E-05	-	0.000E+00	0
Anthracene (nc)	nc	0.0172	6.83E-06	-	0.000E+00	0	1.813E-06	-	0.000E+00	0
Benzo[g,h,i]perylene (nc)	nc	1.00E-07	3.30E-10	-	0.000E+00	0	2.730E-10	-	0.000E+00	0
Fluoranthene (nc)	nc	7.56E-04	1.05E-06	-	0.000E+00	0	3.874E-07	-	0.000E+00	0
Fluorene (nc)	nc	0.1736	4.45E-05	-	0.000E+00	0	1.137E-05	-	0.000E+00	0
Naphthalene (c & nc)	nc	5.9901	0.0011	3.1286	3.506E-04	0	2.746E-04	13.14	8.349E-05	0
Phenanthrene (nc)	nc	0.0208	8.15E-06	-	0.000E+00	0	2.160E-06	-	0.000E+00	0
Pyrene (nc)	nc	0.0032	4.05E-06	-	0.000E+00	0	1.421E-06	-	0.000E+00	0
Benzene (c & nc)	**c**	3,267.	0.7644	3.5996	**0.21235**	0	0.19399	15.72308	0.04862	0
Ethylbenzene (c & nc)	**c**	284.	0.0518	11.2308	0.00461	0	0.01296	49.056	0.00106	0
Benz[a]anthracene (c)	**c**	1.18E-05	1.62E-08	0.169	9.612E-08	0	5.968E-09	2.044	7.946E-09	0
Benzo[b]fluoranthene (c)	**c**	7.55E-07	2.15E-09	0.169	1.273E-08	0	1.817E-09	2.044	1.052E-09	0
Benzo[k]fluoranthene (c)	**c**	7.60E-07	2.23E-09	1.6898	1.322E-09	0	1.934E-09	20.44	1.093E-10	0
Benzo[a]pyrene (c & nc)	**c**	2.65E-07	9.31E-10	0.0169	5.508E-08	0	7.347E-10	0.2044	4.554E-09	0
Chrysene (c)	**c**	6.01E-05	1.26E-07	16.8981	7.482E-09	0	6.476E-08	204.4.	6.185E-10	0
Dibenz[a,h]anthracene (c)	**c**	1.13E-07	6.02E-09	0.0169	3.565E-07	0	1.628E-09	0.2044	2.947E-08	0
Indeno[1,2,3-cd]pyrene (c)	**c**	2.75E-08	9.62E-11	0.169	5.690E-10	0	7.608E-11	2.044	4.704E-11	0
Naphthalene (c & nc)	**c**	5.9901	0.0011	0.8258	0.00133	0	2.746E-04	3.60706	3.041E-04	0
Trichloroethylene (c & nc)	nc	143.	0.026	2.0857	0.01248	0	0.00652	8.76	0.00297	0
Tetrachloroethylene (c & nc)	nc	577.	0.0786	41.7143	0.00189	0	0.01944	175.2.	4.488E-04	0
Trichloroethane, 1,1,2- (c & nc)	nc	611.	0.1141	0.2086	**0.54714**	0	0.0286	0.876	**0.13027**	0
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Trichloroethylene (c & nc)	**c**	2,505.	0.4572	2.4729	**0.1849**	0	0.11446	29.9122	0.01529	0
Tetrachloroethylene (c & nc)	**c**	43.0787	0.0059	108.	5.436E-05	0	0.00145	471.7.	1.244E-05	0
Trichloroethane, 1,1,2- (c & nc)	**c**	611.	0.1141	1.7548	0.06503	0	0.0286	7.665	0.01489	0
	c									
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Carcinogenic Cumulative Risk					0.4683	0			0.0802	0
Non-carcinogenic Cumulative Risk					0.5868	0			0.1397	0

Values shown in the fifth and eighth columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

Table 3 Calculated Migration to Groundwater Levels

Page 7 **Baker Hughes** **Nikiski, Alaska**

1	2	3	4	5	6	7	8	9	10	11	12
Compounds		Dissolved Concentration in Soil Sample (based on 3 or 4 phase partitioning, whichever is accurate, ug/l)	Solubility Limit Cleanup Level (ug/L)	Residential Land Human Health Risk Based Drinking Water Concentration (ug/l)	Residential Land Soil Moisture Target Concentration (Solubility Limit or Risk Based Concentration Multiplied by the DAF…..Solubility Limit values used for compounds with Solubility Limits)	Hypothetical Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target; RBC used; solubility limit & MCL not used; if water is non-potable then hypothetical risk is 0)	Overall Check for Compliance with risk, solubility limit & MCLs (0= in compliance; 1, 2, 3, 4, 5 ,6 & 7 = not in compliance with the number indicating the compliance concern or action as shown in cells W345 to AA354)	Industrial Land Human Health Risk Based Drinking Water Concentration (ug/l)	Industrial Land Soil Moisture Target Concentration (Solubility Limit or Risk Based Concentration Multiplied by the DAF…..Solubility Limit values used for compounds with a Solubility Limit)	Hypothetical Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target; Solubility Limit not used)	Check for compliance with regulatory levels (Solubility Limit used for compounds with a Solubility Limit & Residential RBCs used for compounds without a Solubility Limit: 0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	36.2091	-	44.1464	1,673.487	0.0216	0	122.	4,630.968	0.0078	0
Toluene (nc)	nc	50.2564	-	1,164.	137,226.55	3.66E-04	0	2,715.	320,164.533	1.57E-04	0
Ethylbenzene (c & nc)	nc	2.8402	-	1,019.	201,316.399	1.41E-05	0	2,559.	505,512.44	5.62E-06	0
Xylenes (nc)	nc	2.1495	-	386.	66,384.268	3.24E-05	0	1,438.	247,129.986	8.70E-06	0
GRO Aromatics (nc)	nc	251.		7,300.	1.45E+07	1.73E-05	0	9,344.	1.85E+07	1.36E-05	0
DRO Aromatics (nc)	nc	755.		1,460.	9.52E+06	7.93E-05	0	1,869.	1.22E+07	6.20E-05	0
RRO Aromatics (nc)	nc	8.5897		1,095.	3.21E+49	2.68E-49	0	1,402.	4.10E+49	2.09E-49	0
GRO Aliphatics (nc)	nc	31.6197		182,500.	3.70E+28	8.54E-28	0	233,600.	4.74E+28	6.67E-28	0
DRO Aliphatics (nc)	nc	3.5301		3,650.	>1E+308	1/>1E+308	0	4,672.	>1E+308	1/>1E+308	0
RRO Aliphatics (nc)	nc	1.95E-07		73,000.	>1E+308	1/>1E+308	0	93,440.	>1E+308	1/>1E+308	0
Acenaphthene (nc)	nc	0.41928	-	535.	9,417.957	4.45E-05	0	1,178.	20,735.715	2.02E-05	0
Acenaphthylene (nc)	nc	1.63439	-	261.	4,592.505	3.56E-04	0	574.	10,100.438	1.62E-04	0
Anthracene (nc)	nc	0.0652	43.4	1,765.	2,010.862	7.97E-07	0	3,829.	2,010.862	3.67E-07	0
Benzo[g,h,i]perylene (nc)	nc	2.023E-04	0.26	602.	1.21E+15	7.25E-23	0	1,402.	1.21E+15	3.11E-23	0
Fluoranthene (nc)	nc	0.02262	260.	802.	45,498.305	1.61E-07	0	1,869.	45,498.305	6.92E-08	0
Fluorene (nc)	nc	0.29488	-	294.	7,982.81	3.69E-05	0	643.	17,441.762	1.69E-05	0
Naphthalene (c & nc)	nc	1.4977	-	13.5751	4,325.297	3.46E-04	0	54.4883	17,361.084	8.63E-05	0
Phenanthrene (nc)	nc	0.09408	-	175.	8,259.995	1.14E-05	0	379.	17,913.396	5.25E-06	0
Pyrene (nc)	nc	0.07945	-	121.	20,614.467	3.85E-06	0	260.	44,319.426	1.79E-06	0
Benzene (c & nc)	**c**	36.2091	-	6.454	244.657	0.148	0	10.071	381.768	0.0948	0
Ethylbenzene (c & nc)	**c**	2.8402	-	23.4293	4,628.7	6.14E-04	0	36.5412	7,219.093	3.93E-04	0
Benz[a]anthracene (c)	**c**	3.706E-04	-	1.4319	2,141.727	1.73E-07	0	6.6379	9,928.562	3.73E-08	0
Benzo[b]fluoranthene (c)	**c**	5.901E-04	1.5	2.5051	2.12E+06	1.66E-10	0	13.0816	2.12E+06	3.19E-11	0
Benzo[k]fluoranthene (c)	**c**	8.235E-04	0.8	25.0515	931,848.275	2.82E-11	0	131.	931,848.275	5.40E-12	0
Benzo[a]pyrene (c & nc)	**c**	6.075E-04	-	0.2505	291,802.18	2.08E-09	0	1.3082	1.52E+06	3.99E-10	0
Chrysene (c)	**c**	0.00531	2.	251.	3,172.388	1.34E-08	0	1,308.	3,172.388	2.56E-09	0
Dibenz[a,h]anthracene (c)	**c**	0.00917	-	0.2505	6.17E+14	1.49E-17	0	1.3082	3.22E+15	2.84E-18	0
Indeno[1,2,3-cd]pyrene (c)	**c**	6.632E-05	0.19	2.5051	8.81E+14	5.71E-21	0	13.0816	8.81E+14	1.09E-21	0
Naphthalene (c & nc)	**c**	1.4977	-	3.7846	1,205.839	0.0012	0	5.5103	1,755.701	8.53E-04	0
Trichloroethylene (c & nc)	nc	0.93999	-	3.6094	31.837	0.0295	0	11.3055	99.72	0.0094	0
Tetrachloroethylene (c & nc)	nc	2.38647	-	54.3904	482.385	0.0049	0	143.	1,268.443	0.0019	0
Trichloroethane, 1,1,2- (c & nc)	nc	54.56067	-	0.8415	7.422	7.3511	5	3.5023	30.892	1.7662	5
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Trichloroethylene (c & nc)	**c**	16.51339	-	5.9176	52.196	0.3164	0	13.356	117.806	0.1402	0
Tetrachloroethylene (c & nc)	**c**	0.17815	-	155.	1,376.919	1.29E-04	0	247.	2,188.465	8.14E-05	0
Trichloroethane, 1,1,2- (c & nc)	**c**	54.56067	-	4.5886	40.474	1.348	5	7.0134	61.862	0.882	5
	c										
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	c										
	c										
Carcinogenic Cumulative Risk						1.8144	1			1.1183	1
Non-carcinogenic Cumulative Risk						7.4084	1			1.7858	1

Values shown in the sixth and tenth columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

">1E+308" indicates that the DAF value is greater can be calculated in excel (i.e. compounds are essentially immobile) and "1/>1E+308" indicates that the risk and or equilibrium concentration is very low (inconsequential).

Table 3

Groundwater Use Risk (Ingestion, Dermal Contact & Vapor Inhalation from Tap Water)

Page 8

Baker Hughes

Nikiski, Alaska

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Compounds		Dissolved Concentration Measured in Water Sample (ug/l)	Solubility Limit Cleanup Level (ug/L)	Overall Residential Land Use Human Health Risk Based Water Concentration (ug/l)	Groundwater Compliance Concentration (Solubility or Residential Land Use Health Based Water Concentration in source area; ug/l)	Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target; MCLs not used)	Compliance with risk, solubility limit & MCLs (0= in compliance; 1, 2, 3, 4, 5 ,6 & 7 = not in compliance with the number indicating the compliance concern or action as shown in cells W345 to AA354)	Ingestion - percent of risk contributed by the pathway	Dermal Absorbtion - percent of risk contributed by the pathway	Inhalation Vapors - percent of risk contributed by the pathway	Industrial Land Use Human Health Based Water Concentration (ug/l)	Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target; Solubility Limit not used)	Compliance with risk, solubility limit & MCLs (0= in compliance; 1, 2, 3, 4, 5 ,6 & 7 = not in compliance with the number indicating the compliance concern or action as shown in cells W345 to AA354)
Benzene (c & nc)	nc	0.9552	-	44.1464	44.1464	0.0216	0	55%	7%	38%	122.	0.0078	0
Toluene (nc)	nc	0.4262	-	1,164.	1,164.	3.66E-04	0	73%	22%	5%	2,715.	1.57E-04	0
Ethylbenzene (c & nc)	nc	0.0144	-	1,019.	1,019.	1.41E-05	0	51%	27%	22%	2,559.	5.62E-06	0
Xylenes (nc)	nc	0.0125	-	386.	386.	3.24E-05	0	10%	5%	85%	1,438.	8.70E-06	0
GRO Aromatics (nc)	nc	0.1266		7,300.	7,300.	1.73E-05	0				9,344.	1.36E-05	0
DRO Aromatics (nc)	nc	0.1158		1,460.	1,460.	7.93E-05	0				1,869.	6.20E-05	0
RRO Aromatics (nc)	nc	2.93E-46		1,095.	1,095.	2.68E-49	0				1,402.	2.09E-49	0
GRO Aliphatics (nc)	nc	1.56E-22		182,500.	182,500.	8.54E-28	0				233,600.	6.67E-28	0
DRO Aliphatics (nc)	nc	4.16E-171		3,650.	3,650.	1.14E-174	0				4,672.	8.91E-175	0
RRO Aliphatics (nc)	nc	0.067		73,000.	73,000.	9.18E-07	0				93,440.	7.17E-07	0
Acenaphthene (nc)	nc	0.0238	-	535.	535.	4.45E-05	0	44%	56%	-	1,178.	2.02E-05	0
Acenaphthylene (nc)	nc	0.0928	-	261.	261.	3.56E-04	0	43%	57%	-	574.	1.62E-04	0
Anthracene (nc)	nc	0.0014	43.4	1,765.	43.4	7.97E-07	0	29%	71%	-	3,829.	3.67E-07	0
Benzo[g,h,i]perylene (nc)	nc	4.36E-20	0.26	602.	0.26	7.25E-23	0	100%	-	-	1,402.	3.11E-23	0
Fluoranthene (nc)	nc	1.29E-04	260.	802.	260.	1.61E-07	0	100%	-	-	1,869.	6.92E-08	0
Fluorene (nc)	nc	0.0109	-	294.	294.	3.69E-05	0	37%	63%	-	643.	1.69E-05	0
Naphthalene (c & nc)	nc	0.0047	-	13.5751	13.5751	3.46E-04	0	3%	2%	95%	54.4883	8.63E-05	0
Phenanthrene (nc)	nc	0.002	-	175.	175.	1.14E-05	0	29%	71%	-	379.	5.25E-06	0
Pyrene (nc)	nc	4.66E-04	-	121.	121.	3.85E-06	0	20%	80%	-	260.	1.79E-06	0
Benzene (c & nc)	**c**	0.9552	-	6.454	6.454	**0.148**	0	46%	7%	48%	10.071	0.0948	0
Ethylbenzene (c & nc)	**c**	0.0144	-	23.4293	23.4293	6.14E-04	0	33%	19%	48%	36.5412	3.93E-04	0
Benz[a]anthracene (c)	**c**	2.48E-07	-	1.4319	1.4319	1.73E-07	0	57%	-	43%	6.6379	3.73E-08	0
Benzo[b]fluoranthene (c)	**c**	4.17E-10	1.5	2.5051	1.5	1.66E-10	0	100%	-	-	13.0816	3.19E-11	0
Benzo[k]fluoranthene (c)	**c**	7.07E-10	0.8	25.0515	0.8	2.82E-11	0	100%	-	-	131.	5.40E-12	0
Benzo[a]pyrene (c & nc)	**c**	5.22E-10	-	0.2505	0.2505	2.08E-09	0	100%	-	-	1.3082	3.99E-10	0
Chrysene (c)	**c**	3.35E-06	2.	251.	2.	1.34E-08	0	100%	-	-	1,308.	2.56E-09	0
Dibenz[a,h]anthracene (c)	**c**	3.72E-18	-	0.2505	0.2505	1.49E-17	0	100%	-	-	1.3082	2.84E-18	0
Indeno[1,2,3-cd]pyrene (c)	**c**	1.43E-20	0.19	2.5051	0.19	5.71E-21	0	100%	-	-	13.0816	1.09E-21	0
Naphthalene (c & nc)	**c**	0.0047	-	3.7846	3.7846	0.0012	0	-	-	100%	5.5103	8.53E-04	0
Trichloroethylene (c & nc)	nc	15.9	-	3.6094	3.6094	**4.4051**	5	36%	5%	59%	11.3055	**1.4064**	5
Tetrachloroethylene (c & nc)	nc	0.59	-	54.3904	54.3904	0.0108	0	45%	24%	31%	143.	0.0041	0
Trichloroethane, 1,1,2- (c & nc)	nc	0.45	-	0.8415	0.8415	**0.5348**	0	1%	0%	99%	3.5023	**0.1285**	0
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Trichloroethylene (c & nc)	**c**	15.9	-	5.9176	5.9176	**2.6869**	5	50%	8%	42%	13.356	**1.1905**	5
Tetrachloroethylene (c & nc)	**c**	0.59	-	155.	155.	0.0038	0	42%	24%	34%	247.	0.0024	0
Trichloroethane, 1,1,2- (c & nc)	**c**	0.45	-	4.5886	4.5886	0.0981	0	34%	2%	64%	7.0134	0.0642	0
	c												
	c												
	c												
	c												
Carcinogenic Cumulative Risk						2.9386	1					1.3531	1
Non-carcinogenic Cumulative Risk						4.9736	1					1.5473	1

Values shown in the seventh and eleventh columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

If the groundwater is non-potable then groundwater ingestion risk is zero.

Table 3

Potential Cumulative Risk Assuming All Pathways Complete

DRO, GRO and RRO not included in cumulative risk calculations

Baker Hughes

Nikiski, Alaska

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Compounds		Fraction of Soil Direct Contact Risk, Residential Site	Fraction of Outdoor Air Inhalation Risk, Residential Site	Fraction of Indoor Air Inhalation Risk, Residential Site	Fraction of Groundwater Ingestion Risk, Residential Site	Sum of Fraction of Risk Values for Residential Site	Residential Site Check for compliance with risk levels (0= in compliance; 1= not in compliance)	Fraction of Soil Direct Contact Risk, Industrial Site	Fraction of Outdoor Air Inhalation Risk, Industrial Site	Fraction of Indoor Air Inhalation Risk, Industrial Site	Fraction of Groundwater Ingestion Risk, Industrial Site	Sum of Fraction of Risk Values for Industrial Site	Industrial Site Check for compliance with risk levels (0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	1.65E-04	1.42E-05	0.0244	0.0216	0.0462	0	1.29E-05	3.94E-06	0.0058	0.0078	0.0137	0
Toluene (nc)	nc	4.19E-05	1.23E-07	1.88E-04	3.66E-04	5.97E-04	0	3.27E-06	3.81E-08	4.49E-05	1.57E-04	2.05E-04	0
Ethylbenzene (c & nc)	nc	6.61E-06	4.01E-08	4.96E-05	1.41E-05	7.04E-05	0	5.16E-07	1.24E-08	1.18E-05	5.62E-06	1.80E-05	0
Xylenes (total) (nc)	nc	3.95E-06	2.58E-07	3.13E-04	3.24E-05	3.50E-04	0	3.08E-07	7.98E-08	7.45E-05	8.70E-06	8.36E-05	0
GRO Aromatics (nc)	nc												
DRO Aromatics (nc)	nc												
RRO Aromatics (nc)	nc												
GRO Aliphatics (nc)	nc												
DRO Aliphatics (nc)	nc												
RRO Aliphatics (nc)	nc												
Acenaphthene (nc)	nc	2.80E-05	0.00E+00	0.00E+00	4.45E-05	7.25E-05	0	2.59E-06	0.00E+00	0.00E+00	2.02E-05	2.28E-05	0
Acenaphthylene (nc)	nc	5.59E-05	0.00E+00	0.00E+00	3.56E-04	4.12E-04	0	5.18E-06	0.00E+00	0.00E+00	1.62E-04	1.67E-04	0
Anthracene (nc)	nc	5.59E-06	0.00E+00	0.00E+00	7.97E-07	6.39E-06	0	5.18E-07	0.00E+00	0.00E+00	3.67E-07	8.85E-07	0
Benzo(g,h,i)perylene (nc)	nc	1.08E-05	0.00E+00	0.00E+00	7.25E-23	1.08E-05	0	9.95E-07	0.00E+00	0.00E+00	3.11E-23	9.95E-07	0
Fluoranthene (nc)	nc	3.19E-05	0.00E+00	0.00E+00	1.61E-07	3.21E-05	0	2.96E-06	0.00E+00	0.00E+00	6.92E-08	3.03E-06	0
Fluorene (nc)	nc	4.52E-05	0.00E+00	0.00E+00	3.69E-05	8.21E-05	0	4.18E-06	0.00E+00	0.00E+00	1.69E-05	2.11E-05	0
Naphthalene (c & nc)	nc	4.32E-05	1.94E-06	3.51E-04	3.46E-04	7.42E-04	0	4.00E-06	5.98E-07	8.35E-05	8.63E-05	1.74E-04	0
Phenanthrene (nc)	nc	4.30E-05	0.00E+00	0.00E+00	1.14E-05	5.44E-05	0	3.98E-06	0.00E+00	0.00E+00	5.25E-06	9.23E-06	0
Pyrene (nc)	nc	1.08E-04	0.00E+00	0.00E+00	3.85E-06	1.11E-04	0	9.95E-06	0.00E+00	0.00E+00	1.79E-06	1.17E-05	0
Benzene (c & nc)	**c**	4.09E-04	1.23E-04	**0.2124**	**0.148**	**0.3609**	0	1.01E-04	3.66E-05	0.0486	0.0948	**0.1436**	0
Ethylbenzene (c & nc)	**c**	8.18E-05	3.72E-06	0.0046	6.14E-04	0.0053	0	2.03E-05	1.10E-06	0.0011	3.93E-04	0.0015	0
Benzo(a)anthracene (c)	**c**	0.0058	5.11E-09	9.61E-08	1.73E-07	0.0058	0	3.67E-04	5.47E-10	7.95E-09	3.73E-08	3.67E-04	0
Benzo(b)fluoranthene (c)	**c**	0.0094	0.00E+00	1.27E-08	1.66E-10	0.0094	0	5.97E-04	0.00E+00	1.05E-09	3.19E-11	5.97E-04	0
Benzo(k)fluoranthene (c)	**c**	8.06E-04	0.00E+00	1.32E-09	2.82E-11	8.06E-04	0	5.12E-05	0.00E+00	1.09E-10	5.40E-12	5.12E-05	0
Benzo(a)pyrene (c)	**c**	0.0739	0.00E+00	5.51E-08	2.08E-09	0.0739	0	0.0047	0.00E+00	4.55E-09	3.99E-10	0.0047	0
Chrysene (c)	**c**	7.39E-05	0.00E+00	7.48E-09	1.34E-08	7.39E-05	0	4.69E-06	0.00E+00	6.19E-10	2.56E-09	4.70E-06	0
Dibenz(a,h)anthracene (c)	**c**	**0.1075**	0.00E+00	3.56E-07	1.49E-17	**0.1075**	0	0.0068	0.00E+00	2.95E-08	2.84E-18	0.0068	0
Indeno(1,2,3-cd)pyrene (c)	**c**	0.0101	0.00E+00	5.69E-10	5.71E-21	0.0101	0	6.40E-04	0.00E+00	4.70E-11	1.09E-21	6.40E-04	0
Naphthalene (c & nc)	**c**	4.60E-08	7.34E-06	0.0013	0.0012	0.0026	0	1.23E-08	2.18E-06	3.04E-04	8.53E-04	0.0012	0
Trichloroethylene (c & nc)	nc	7.30E-05	5.17E-06	0.0125	**4.4051**	**4.4177**	1	5.70E-06	1.60E-06	0.003	**1.4064**	**1.4094**	1
Tetrachloroethylene (c & nc)	nc	1.17E-04	7.62E-07	0.0019	0.0108	0.0129	0	9.12E-06	2.35E-07	4.49E-04	0.0041	0.0046	0
Trichloroethane, 1,1,2- (c & nc)	nc	1.65E-04	7.12E-04	**0.5471**	**0.5348**	**1.0828**	1	1.30E-05	2.20E-04	**0.1303**	**0.1285**	**0.259**	0
	nc												
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Trichloroethylene (c & nc)	**c**	5.71E-04	3.96E-05	**0.1849**	**2.6869**	**2.8724**	1	8.23E-05	8.21E-06	0.0153	**1.1905**	**1.2059**	1
Tetrachloroethylene (c & nc)	**c**	1.24E-06	2.20E-08	5.44E-05	0.0038	0.0039	0	3.06E-07	6.52E-09	1.24E-05	0.0024	0.0024	0
Trichloroethane, 1,1,2- (c & nc)	**c**	4.24E-04	8.47E-05	0.065	0.0981	**0.1636**	0	1.05E-04	2.51E-05	0.0149	0.0642	0.0792	0
	c												
	c												
	c												
	c												
Carcinogenic Cumulative Risk						3.6162						1.4468	1
Non-carcinogenic Cumulative Risk						5.5621						1.6873	1

Values shown in the second through sixth and eighth through twelfth columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

Table 3

Cumulative Risk for Pathways Complete at Present Time

DRO, GRO and RRO not included in cumulative risk calculations

Page 10

Baker Hughes

Nikiski, Alaska

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Compounds		Fraction of Soil Direct Contact Risk, Residential Site	Fraction of Outdoor Air Inhalation Risk, Residential Site	Fraction of Indoor Air Inhalation Risk, Residential Site	Fraction of Groundwater Ingestion Risk, Residential Site	Sum of Fraction of Risk Values for Residential Site	Residential Site Check for compliance with risk levels (0= in compliance; 1= not in compliance)	Fraction of Soil Direct Contact Risk, Industrial Site	Fraction of Outdoor Air Inhalation Risk, Industrial Site	Fraction of Indoor Air Inhalation Risk, Industrial Site	Fraction of Groundwater Ingestion Risk, Industrial Site	Sum of Fraction of Risk Values for Industrial Site	Industrial Site Check for compliance with risk levels (0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	1.65E-04	1.42E-05	0.00E+00	0.00E+00	1.79E-04	0	1.29E-05	3.94E-06	0.00E+00	0.00E+00	1.69E-05	0
Toluene (nc)	nc	4.19E-05	1.23E-07	0.00E+00	0.00E+00	4.20E-05	0	3.27E-06	3.81E-08	0.00E+00	0.00E+00	3.31E-06	0
Ethylbenzene (c & nc)	nc	6.61E-06	4.01E-08	0.00E+00	0.00E+00	6.65E-06	0	5.16E-07	1.24E-08	0.00E+00	0.00E+00	5.29E-07	0
Xylenes (total) (nc)	nc	3.95E-06	2.58E-07	0.00E+00	0.00E+00	4.20E-06	0	3.08E-07	7.98E-08	0.00E+00	0.00E+00	3.88E-07	0
GRO Aromatics (nc)	nc												
DRO Aromatics (nc)	nc												
RRO Aromatics (nc)	nc												
GRO Aliphatics (nc)	nc												
DRO Aliphatics (nc)	nc												
RRO Aliphatics (nc)	nc												
Acenaphthene (nc)	nc	2.80E-05	0.00E+00	0.00E+00	0.00E+00	2.80E-05	0	2.59E-06	0.00E+00	0.00E+00	0.00E+00	2.59E-06	0
Acenaphthylene (nc)	nc	5.59E-05	0.00E+00	0.00E+00	0.00E+00	5.59E-05	0	5.18E-06	0.00E+00	0.00E+00	0.00E+00	5.18E-06	0
Anthracene (nc)	nc	5.59E-06	0.00E+00	0.00E+00	0.00E+00	5.59E-06	0	5.18E-07	0.00E+00	0.00E+00	0.00E+00	5.18E-07	0
Benzo(g,h,i)perylene (nc)	nc	1.08E-05	0.00E+00	0.00E+00	0.00E+00	1.08E-05	0	9.95E-07	0.00E+00	0.00E+00	0.00E+00	9.95E-07	0
Fluoranthene (nc)	nc	3.19E-05	0.00E+00	0.00E+00	0.00E+00	3.19E-05	0	2.96E-06	0.00E+00	0.00E+00	0.00E+00	2.96E-06	0
Fluorene (nc)	nc	4.52E-05	0.00E+00	0.00E+00	0.00E+00	4.52E-05	0	4.18E-06	0.00E+00	0.00E+00	0.00E+00	4.18E-06	0
Naphthalene (c & nc)	nc	4.32E-05	1.94E-06	0.00E+00	0.00E+00	4.52E-05	0	4.00E-06	5.98E-07	0.00E+00	0.00E+00	4.60E-06	0
Phenanthrene (nc)	nc	4.30E-05	0.00E+00	0.00E+00	0.00E+00	4.30E-05	0	3.98E-06	0.00E+00	0.00E+00	0.00E+00	3.98E-06	0
Pyrene (nc)	nc	1.08E-04	0.00E+00	0.00E+00	0.00E+00	1.08E-04	0	9.95E-06	0.00E+00	0.00E+00	0.00E+00	9.95E-06	0
Benzene (c & nc)	**c**	4.09E-04	1.23E-04	0.00E+00	0.00E+00	5.32E-04	0	1.01E-04	3.66E-05	0.00E+00	0.00E+00	1.38E-04	0
Ethylbenzene (c & nc)	**c**	8.18E-05	3.72E-06	0.00E+00	0.00E+00	8.55E-05	0	2.03E-05	1.10E-06	0.00E+00	0.00E+00	2.14E-05	0
Benzo(a)anthracene (c)	**c**	0.0058	5.11E-09	0.00E+00	0.00E+00	0.0058	0	3.67E-04	5.47E-10	0.00E+00	0.00E+00	3.67E-04	0
Benzo(b)fluoranthene (c)	**c**	0.0094	0.00E+00	0.00E+00	0.00E+00	0.0094	0	5.97E-04	0.00E+00	0.00E+00	0.00E+00	5.97E-04	0
Benzo(k)fluoranthene (c)	**c**	8.06E-04	0.00E+00	0.00E+00	0.00E+00	8.06E-04	0	5.12E-05	0.00E+00	0.00E+00	0.00E+00	5.12E-05	0
Benzo(a)pyrene (c)	**c**	0.0739	0.00E+00	0.00E+00	0.00E+00	0.0739	0	0.0047	0.00E+00	0.00E+00	0.00E+00	0.0047	0
Chrysene (c)	**c**	7.39E-05	0.00E+00	0.00E+00	0.00E+00	7.39E-05	0	4.69E-06	0.00E+00	0.00E+00	0.00E+00	4.69E-06	0
Dibenz(a,h)anthracene (c)	**c**	**0.1075**	0.00E+00	0.00E+00	0.00E+00	**0.1075**	0	0.0068	0.00E+00	0.00E+00	0.00E+00	0.0068	0
Indeno(1,2,3-cd)pyrene (c)	**c**	0.0101	0.00E+00	0.00E+00	0.00E+00	0.0101	0	6.40E-04	0.00E+00	0.00E+00	0.00E+00	6.40E-04	0
Naphthalene (c & nc)	**c**	4.60E-08	7.34E-06	0.00E+00	0.00E+00	7.39E-06	0	1.23E-08	2.18E-06	0.00E+00	0.00E+00	2.19E-06	0
Trichloroethylene (c & nc)	nc	7.30E-05	5.17E-06	0.00E+00	0.00E+00	7.82E-05	0	5.70E-06	1.60E-06	0.00E+00	0.00E+00	7.30E-06	0
Tetrachloroethylene (c & nc)	nc	1.17E-04	7.62E-07	0.00E+00	0.00E+00	1.17E-04	0	9.12E-06	2.35E-07	0.00E+00	0.00E+00	9.35E-06	0
Trichloroethane, 1,1,2- (c & nc)	nc	1.65E-04	7.12E-04	0.00E+00	0.00E+00	8.78E-04	0	1.30E-05	2.20E-04	0.00E+00	0.00E+00	2.33E-04	0
	nc												
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Trichloroethylene (c & nc)	**c**	5.71E-04	3.96E-05	0.00E+00	0.00E+00	6.11E-04	0	8.23E-05	8.21E-06	0.00E+00	0.00E+00	9.05E-05	0
Tetrachloroethylene (c & nc)	**c**	1.24E-06	2.20E-08	0.00E+00	0.00E+00	1.26E-06	0	3.06E-07	6.52E-09	0.00E+00	0.00E+00	3.13E-07	0
Trichloroethane, 1,1,2- (c & nc)	**c**	4.24E-04	8.47E-05	0.00E+00	0.00E+00	5.08E-04	0	1.05E-04	2.51E-05	0.00E+00	0.00E+00	1.30E-04	0
	c												
	c												
	c												
	c												
Carcinogenic Cumulative Risk						0.2093						0.0136	0
Non-carcinogenic Cumulative Risk						0.0017						3.06E-04	0

Values shown in the second through sixth and eighth through twelfth columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

Table 3 Partitioning into Groundwater & Surface Water

Page 11 **Baker Hughes** **Nikiski, Alaska**

1	2	3	4	5	6	7	8	9
Compounds		Calculated Equilibrium Conc. (from soil data & solver or goal seek) (ug/L)	Measured Dissolved Phase Conc. (ug/L)	Groundwater Residential Land Use Health Based Water Concentration at down gradient edge of source area (ug/L)	Check for vadose zone fill potential (DAF of 3.3; 0 =suitable for vadose zone fill; 1 =not suitable for vadose zone fill; "ND" input concentrations not assessed)	Check for saturated zone fill potential (DAF of 1; 0 =suitable for saturated zone fill; 1 =not suitable for saturated zone fill; "ND" input concentrations not assessed)	Ambient Water Quality Criteria (ug/L)	Check for surface water body fill potential (DAF of 1; 0 =suitable for fill in surface water; 1 =not suitable for fill in surface water; "ND" input concentrations not assessed)
Benzene		36.2091	0.9552	6.454	1	1	5	1
Toluene		50.2564	0.4262	1,164.	0	0		
Ethylbenzene		2.8402	0.0144	23.4293	0	0		
Xylene		2.1495	0.0125	386.	0	0		
GRO Aromatics		251.	0.1266	7,300.	0	0		
DRO Aromatics		755.	0.1158	1,460.	0	0		
RRO Aromatics		8.5897	2.93E-46	1,095.	0	0		
GRO Aliphatics		31.6197	1.56E-22	182,500.	0	0		
DRO Aliphatics		3.5301	4.16E-171	3,650.	0	0		
RRO Aliphatics		1.95E-07	0.067	73,000.	0	0		
Acenaphthene		0.4193	0.0238	535.	0	0		
Acenaphthylene		1.6344	0.0928	261.	0	0		
Anthracene		0.0652	0.0014	1,765.	0	0		
Benzo(g,h,i)perylene		2.02E-04	4.36E-20	602.	0	0		
Fluoranthene		0.0226	1.29E-04	802.	0	0		
Fluorene		0.2949	0.0109	294.	0	0		
Naphthalene		1.4977	0.0047	3.7846	0	0		
Phenanthrene		0.0941	0.002	175.	0	0		
Pyrene		0.0794	4.66E-04	121.	0	0		
Benzo (a) Anthracene		3.71E-04	2.48E-07	1.4319	0	0		
Benzo (b) fluoranthene		5.90E-04	4.17E-10	2.5051	0	0		
Benzo (k) fluoranthene		8.24E-04	7.07E-10	25.0515	0	0		
Benzo (a) pyrene		6.07E-04	5.22E-10	0.2505	0	0		
Chrysene		0.0053	3.35E-06	251.	0	0		
Dibenz (a,h) anthracene		0.0092	3.72E-18	0.2505	0	0		
Indeno (1,2,3-cd) pyrene		6.63E-05	1.43E-20	2.5051	0	0		
Trichloroethylene (c & nc)		0.94	15.9	3.6094	0	0		
Tetrachloroethylene (c & nc)		2.3865	0.59	54.3904	0	0		
Trichloroethane, 1,1,2- (c & nc)		54.5607	0.45	0.8415	1	1		
Trichloroethylene (c & nc)		16.5134	15.9	5.9176	0	1		
Tetrachloroethylene (c & nc)		0.1781	0.59	155.	0	0		
Trichloroethane, 1,1,2- (c & nc)		54.5607	0.45	4.5886	1	1		
TAH		91.4552	1.4083				10	1
TAqH		95.58	1.5445				15	1
DRO sheen (mg/kg)							230	1
				sum	3	4	sum	4

These calculations may be used to assess the potential limitations on the off-site transport and placement of hydrocarbon impacted soil.

Table 3		**Site Status Summary**					
Page 12		**Baker Hughes**				**Nikiski, Alaska**	
1	2	3	4	5	6	7	8
		Cumulative Risks for Residential Site (rounded to 1 significant digit)	soil ingestion check for compliance with risk criteria (0= in compliance; 1 or >1 = not in compliance; number is the number of carcinogenic and non-carcinogenic direct contact criteria exceeded)	migration to outdoor air check for compliance with risk criteria (0= in compliance; 1= not in compliance)	migration to indoor air check for compliance with risk criteria (0= in compliance; 1= not in compliance)	groundwater ingestion check for compliance with risk criteria (0= in compliance; 1 or >1 = not in compliance; number is the number of carcinogenic and non-carcinogenic direct contact criteria exceeded)	migration to groundwater check for compliance (0= in compliance; 1 = not in compliance)
Potential Carcinogenic Cumulative Fraction of Risk		**4**	0			1	
Potential Non-carcinogenic Cumulative Risk		**6**	0			1	
Existing Carcinogenic Cumulative Fraction of Risk		0.2093					
Existing non-carcinogenic Cumulative Risk		0.0017					
GRO Aromatics			0	0	0	0	0
DRO Aromatics			0	0	0	0	0
RRO Aromatics			0	0	0	0	0
GRO Aliphatics			0	0	0	0	0
DRO Aliphatics			0	0	0	0	0
RRO Aliphatics			0	0	0	0	0
check for ultimate GRO, DRO, RRO compliance			**0**				
Site conditons do not meet the ADEC human health risk standard established in 18 AAC 75.325. Site conditions are not protective of human health under an unrestricted (residential) landuse scenario.							**1**
Migration to groundwater criteria have not been attained in surface and subsurface soils.							**1**
Site does not meet closeout criteria, eligible only for a 'cleanup complete with institutional controls' determination							

Metals Risk Calculations and Summary of Human Health Risk & Site Closure Criteria

Table 4

Metals Soil Ingestion, Dermal Contact, Outdoor Air & Particulate Inhalation Risk (based on soil concentration & three phase partitioning)

Baker Hughes — **Nikiski, Alaska**

1	2	3	4	5	6	7		8	9	10	11	12			13	14
Compounds		Sample Concentrations (mg/kg)	Soil Direct Contact & Inhalation Risk Based Level Residential Land Use	% of risk associated with ingestion	% of risk associated with dermal contact	% of risk associated with outdoor air inhalation	% of risk associated with particulate inhalation	Residential Land Use Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Check for compliance with risk levels (0= in compliance; 1= not in compliance)	Soil Direct Contact Risk Based Level Industrial Land Use	% of risk associated with ingestion	% of risk associated with dermal contact	% of risk associated with outdoor air inhalation	% of risk associated with particulate inhalation	Industrial Land Use Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Check for compliance with risk levels (0= in compliance; 1= not in compliance)
Barium (nc)	nc	2,600.	19,840.	98%	-	-	2.2%	**0.131**	0	240,670.	93%	-	-	7%	0.0108	0
Cadmium (Diet) (c & nc)	nc	7.	92.1351	91%	9%	-	0.5%	0.076	0	1,092.	84%	14%	-	2%	0.0064	0
Chromium(VI) (c & nc)	nc	81.	304.	100%	-	-	0.2%	**0.2667**	0	3,871.	99%	-	-	1%	0.0209	0
Chromium, Total (nc)	nc	1.	152,083.	100%	-	-	-	6.58E-06	0	1,946,667.	100%	-	-	-	5.14E-07	0
	nc															
	nc															
	nc															
Cadmium (Diet) (c & nc)	**c**	7.	27,486.	-	-	-	100.0%	2.55E-04	0	102,907.	-	-	-	100%	6.80E-05	0
Chromium(VI) (c & nc)	**c**	1.	3.8977	98%	-	-	1.8%	**0.2566**	0	70.3568	97%	-	-	3%	0.0142	0
	c															
	c															
	c															
	c															
	c															
Carcinogenic Cumulative Risk								0.2568	0						0.0143	0
Non-carcinogenic Cumulative Risk								0.4738	0						0.0381	0

Table 4

Metals Groundwater Use Risk (Ingestion, Dermal Contact & Vapor Inhalation from Tap Water)

Baker Hughes — **Nikiski, Alaska**

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Compounds		Dissolved Concentration Measured in Water Sample (ug/l)	Solubility Limit Cleanup Level (ug/L)	Residential Land Use Human Health Risk Based Water Concentration (ug/l)	Groundwater Compliance Concentration (Solubility or Residential Land Use Health Based Water Concentration in source area; ug/l)	Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target; MCLs not used)	Check for Compliance with Risk(0= in compliance; 1 = not in compliance)	Ingestion - percent of risk contributed by the pathway	Dermal Absorbtion - percent of risk contributed by the pathway	Inhalation Vapors - percent of risk contributed by the pathway	Industrial Land Use Human Health Based Water Concentration (ug/l)	Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target; Solubility Limit not used)	Check for Compliance with Risk(0= in compliance; 1 = not in compliance)
Barium (nc)	nc	0.1	-	3,773.	3,773.	2.65E-05	0	94%	6%	-	8,654.	1.16E-05	0
Cadmium (Diet) (c & nc)	nc	0.1	-	9.2153	9.2153	0.0109	0	92%	8%	-	21.0143	0.0048	0
Chromium(VI) (c & nc)	nc	0.1	-	44.4834	44.4834	0.0022	0	74%	26%	-	96.8964	0.001	0
Chromium, Total (nc)	nc	0.1	-	22,467.	22,467.	4.45E-06	0	75%	25%	-	49,030.	2.04E-06	0
	nc												
	nc												
	nc												
Cadmium (Diet) (c & nc)	**c**	0.1	-	-	-	**-**	-	-	-	-	-	**-**	-
Chromium(VI) (c & nc)	**c**	0.1	-	0.3501	0.3501	**0.2856**	0	70%	30%	-	1.8087	0.0553	0
	c												
	c												
	c												
	c												
	c												
Carcinogenic Cumulative Risk						0.2856	0					0.0553	0
Non-carcinogenic Cumulative Risk						0.0131	0					0.0058	0

Table 4 Lead Compliance in Soil and Water

Baker Hughes Nikiski, Alaska

		Concentration in Soil & Water Sample (mg/kg & ug/l)	Residential Land Use Human Health Risk Based Water Concentration	Check for Compliance with Risk(0= in compliance; 1 = not in compliance)		Residential Land Use Human Health Risk Based Water Concentration	Check for Compliance with Risk(0= in compliance; 1 = not in compliance)		
Lead in soil (mg/kg)		1,000.	400	1		800	1		
Lead in water (ug/L)		10.	15	0		15	0		

Notes: Lead is not included in the cumulative risk calculation, rather lead is a separate or independent pass-fail criteria for site closure.

Table 4 Organics & Metals Potential Cumulative Risk

Baker Hughes Nikiski, Alaska

		Soils, Air & Water Cumulative Risk			Soils & Air Cumulative Risk				
		Residential Fraction of Risk Organics & Metals	Industrial Fraction of Risk Organics & Metals		Residential Fraction of Risk given IC restricting use of groundwater	Industrial Fraction of Risk given IC restricting use of groundwater			
		fraction of allowable risk; values above 1.5 exceed c			fraction of allowable risk				
organics carcinogenic risk		3.62	1.45		0.68	0.09			
metals carcinogenic risk		0.54	0.07		0.26	0.01			
Cumulative Carcinogenic Risk		4.16	1.52		0.93	0.11			
organics non-carcinogenic		5.56	1.69		0.59	0.14			
metals non-carcinogenic		0.49	0.04		0.47	0.04			
Cumulative Non-carcinogenic Risk		6.05	1.73		1.06	0.18			

Table 4 Summary of Human Health Risk & Site Closure Criteria

Baker Hughes Nikiski, Alaska

Citeria:		Residential Scenario All Pathways Complete (0= criteria met; 1= criteria not met)	Industrial Scenario All Pathways Complete (0= criteria met; 1= criteria not met)		Residential Scenario given IC restricting use of groundwater (0= criteria met; 1= criteria not met; 0 (NA)= criteria met because it is not applicable)	Industrial Scenario given IC restricting use of groundwater (0= criteria met; 1= criteria not met; 0 (NA)= criteria met because it is not applicable)			
Cumulative Carcinogenic Risk		1	1		0	0			
Cumulative Non-carcinogenic Risk		1	1		0	0			
GRO risk		0	0		0	0			
DRO risk		0	0		0	0			
RRO risk		0	0		0	0			
Migration to Groundwater Criteria		1	1		0 (NA)	0 (NA)			
Table C Criteria		1	1		0 (NA)	0 (NA)			
Lead in Soil		1	1		1	1			
Lead in Groundwater		0	0		0 (NA)	0 (NA)			

Notes: For site closure under the four scenarios listed above all of the listed criteria have to met (the scenario column needs to contain all zeros).

ATTACHMENT 5

Field Forms

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Soil Borehole / Monitoring Well Construction Log

Borehole ID ____________ Monitoring Well ID ______________

Project Name: ______________________________
Project Number: ______________________________
Location: ______________________________
Project Manager: ______________________________
Logged by: ______________________________

Start Time/End Time:
Date Completed:
Total Borehole Depth/ Borehole Diameter:
Drilling Contractor:
Drill Rig Type:
Sampling Method:

Driven/ Recovered (Inches)	Blows per 6 in.	Samples	PID (ppm)	Color-Tec (ppm)	GW Depth	Well Detail	Depth	Lithology Graphic	Lithologic Description
							1 2 3 4 5 6 7 8 9 0		

Date: Checked by: Drawn: Project:	dnaENVIRONMENTAL	Comments:	Sheet of

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Groundwater Sampling Worksheet

Project Name: ______________________
Client: ______________________
Sampler: ______________________
Weather Conditions: ______________________

Sample Location (ie. MW1): ______________
Date: ______________
Purge Start Time: ______________

Sample ID: ______________________ Time: __________ primary dup split ms/msd
Sample ID: ______________________ Time: __________ primary dup split ms/msd
Sample ID: ______________________ Time: __________ primary dup split ms/msd

Analyses	**Number/type of Bottles**	**Comments/ preservation:**	**Analyses**	**Number/type of Bottles**	**Comments/ preservation:**
GRO/BTEX			Nitrate/Nitrite		
DRO			Sulfate		
RRO			Total Metals (Fe & Mg)		
DRO w/silica			Dissolved Metals (Fe & Mg)		
RRO w/silica			Alkalinity		
PAHs			Methane		

Well Information / Purge Volume Calculation

Well Casing Diameter (in): ____________
Product Present? *(y/n/sheen)* ____________
Depth to Top of Product (ft BTOC): ____________
Depth to Oil/Water Interface (ft BTOC): ____________
(BTOC = below top of casing)

Total Well Depth (ft BTOC): ________ (depth to bottom)
Depth to Water (ft BTOC): ________
Water Column (ft) ________
One Purge Volume (gal): ________
purge calcluation formula on back

Sensory Observations

Color:	Clear, Amber, Tan, Brown, Grey, Milky White, Other:
Odor:	None, Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown
Turbidity:	None, Low, Medium, High, Very Turbid, Heavy Silts

Instrument Observations

Round	**Time**	**Volume (gal)**	**Temp °C**	**pH**	**Conductivity ( )**	**Turbidity (NTUs)**	**DO (mg/L)**	**ORP (mV)**	**Color**	**Odor**	**Water Level (ft BTOC)**	**Draw-down (ft)**
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												

see back for additional entry lines if needed

Purge Rate (low flow): __________ L/min
Total Volume Purged: __________
Measured Drawdown (ft): __________

Notes: Drawdown should be less than 0.3 feet while sampling. Minimal drawdown shall be achieved and measured by pumping at a low rate (approximately 0.1 to 0.5 liter/minute) and continually measuring water levels in the well. Note that site's hyrogeology may make it difficult to achieve this specification.

Purge Method (disposable bailer, teflon bailer, submersible pump, etc.): ______________
Sample Method (disposable bailer, teflon bailer, submersible pump, etc.): ______________

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.):

Remarks (well recovery, unusual conditions/observations):

Signed: ______________________ Date: ______________

Signed/Reviewer: ______________________ Date: ______________

Instrument Observations (continued)

Round	Time	Volume (gal)	Temp °C	pH	Conductivity ( )	Turbidity (NTUs)	DO (mg/L)	ORP (mV)	Color	Odor	Water Level (ft BTOC)	Draw-down (ft)
13												
14												
15												
16												
17												
18												
19												
20												
21												

Purge Rate (low flow): _________ L/min Total Volume Purged: __________ Measured Drawdown (ft): ____________

Calculating Purge Volume

Well Casing Diameter:	Multiply c) by:
2	0.16
4	0.65
6	1.47

Sand Pack Diameter:	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

Criteria for Stable Parameters (three successive readings within stability critieria)

Parameter	Working Range	Stability Criteria	Notes
Temperature:	>0.00 °C	± 0.5 °C	
pH:	0-14	± 0.1	
Conductivity:	0-999 mS/m	± 5%	
ORP:	± 1999 mV		
Dissolved Oxygen:	0-19.99 mg/L	± 10%	DO in GW typically does not exceed 13 mg/L
Turbidity;	0-800 NTU		

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MONITORING WELL INSTALLATION REPORT

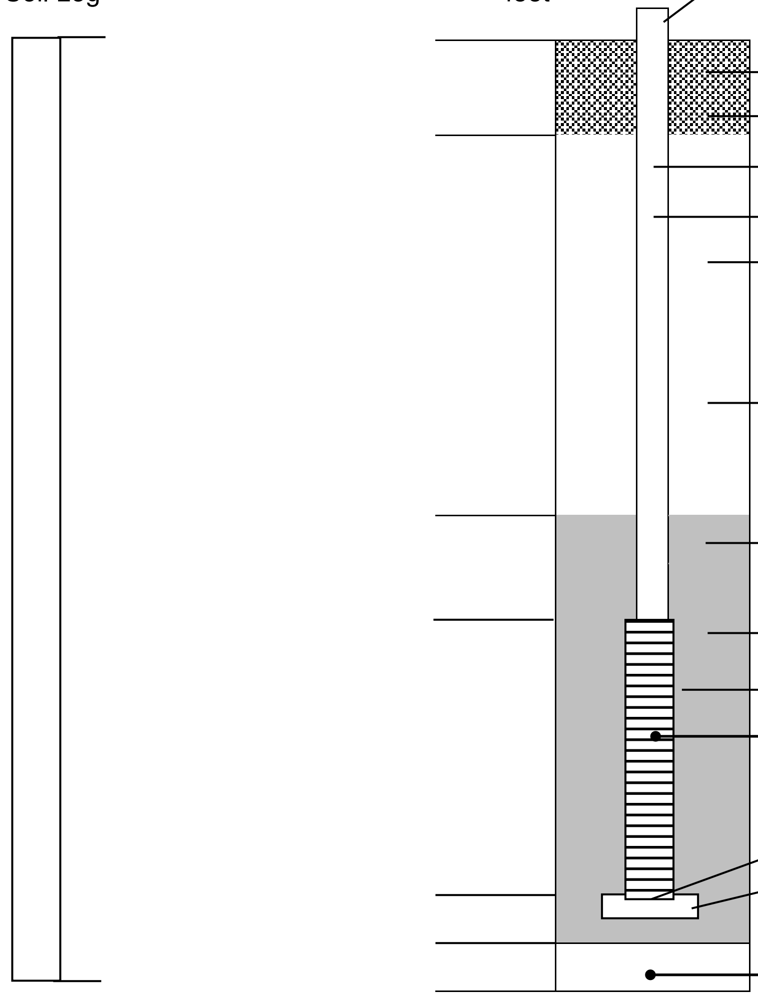
Project Name: ______________________________ Well No.: ____________________

Project No.: ______________________________ Observer: ____________________

Date/Time: ______________________________ Drilling Method: ____________________

Soil Log

Depth of Components in feet



Stick up (feet) ____________

Approximate ground surface elevation (feet) ________

Diameter of borehole (inches) ______________

Type of surface seal ______________

I.D. of riser pipe (inches) ______________

Type of riser pipe ______________

Type of backfill around riser ______________

Type of well seal ______________

Type of sand ______________

Length of top screen blank ______________

Screen size and type ______________

Water level ______________

Length of bottom screen blank ______________

Length of end cap ______________

Type of backfill material ______________

Remarks: ____

Amount of	Sand ____________	Monument ____________	
Materials:	Cement ____________	Riser ____________	
	Bentonite pellets ____________	Screen ____________	
	Bentonite/Volclay ____________	Other ____________	

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WELL CONSTRUCTION LOG

PROJECT NUMBER:	WELL NUMBER:	SHEET: of

PROJECT NAME		SITE	
CLIENT		SCIENTIST	
DATE		WEATHER	
DRILLING COMPANY		RIG TYPE	
BORING SIZE		DRILLING METHOD	
TOTAL DEPTH		WELL TYPE	
NORTHING		DEPTH TO GW	
EASTING		ELEVATION	

LOCATION SKETCH/EXTRA FIELD NOTES:
[surface condition, ie. Asphalt, grass]

N ↑

DEPTH (FEET)	FIELD ILLUSTRATION	WELL INSTALLATION INFO	SOIL DESCRIPTION	WELL DATA
0				

Monument Type: ____________

Surface Seal: ____________

Stickup Height: ____________

____ -inch Schedule PVC Well Casing

Screened Interval: ____________

____ " Slotted Screen

Other:

Amount of Materials:

Sand: ____________

Cement: ____________

Bentonite pellots: ____________

Bentonite/volclay: ____________

Other: ____________

Remarks: ____________

WELL DEVELOPMENT FORM

WELL #:

PROJECT : ______________________________

LOCATION: ______________________________

DATE: ____________
____
PROJECT NO. : ____________

DRILLING METHOD (s): ____________________
PUMP METHOD (s): ____________________
SURGE METHOD (s): ____________________
INSTALLATION DATE: ____________________

INSPECTOR: ____________
CONTRACTOR: ____________
SITE PERSONNEL: ____________
START DEVELOPMENT DATE: ____________
END DEVELOPMENT DATE: ____________

WATER DEPTH (TOC): ____________ ft
WELL DIA. (ID CASING): ____________ ft
BORING DIAMETER: ____________ ft

INSTALLED DEPTH(TOC): ____________ ft
MEASURED DEPTH(TOC): ____________ ft
SILT THICKNESS: ____________ ft
TD AFTER DEVELOPMENT: ____________ ft

DIAMETER FACTORS (GAL/FT):

DIAMETER (IN):	0.75	1	2	3	4	5	6	7	8	9	10	11
GALLONS/ FT:	0.023	0.041	0.163	0.367	0.654	1.02	1.47	2.00	2.61	3.30	4.08	4.93

CASING VOLUME INSIDE WELL = WATER COLUMN LENGTH X WELL DIAMETER FACTOR

____________GAL. (A)

MINIMUM VOLUME TO BE REMOVED = 5 X A

____________ GALS.

ACTIVITY	START TIME	END TIME	ELAPSED TIME	TOTAL GAL	Turbidity	pH	CONDUCTIVITY	TEMP	COLOR	OTHER
TOTALS/FINAL										

COMMENTS:

ATTACHMENT 6

Soil Gas SOPs

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SOP-5a Standard Operating Procedure for the Installation of Temporary Soil Gas Sampling Probes

1.0 Scope and Application

This standard operating procedure (SOP) is recommended as a practical approach for the installation of temporary soil gas sampling probes where the intent is to collect soil gas samples only on a single occasion. A common use of this SOP is during vapor intrusion assessments associated with subsurface volatile organic compound (VOC) contamination. This SOP should be used when its application is consistent with the project's data quality objectives (DQOs) and in conjunction with the *SOP for the Collection of Soil Gas Samples from Temporary Probes and Permanent Implants Using Canisters*. The project team is responsible for ensuring this procedure meets all applicable regulatory standards and receives approval/concurrence from the leading regulatory agency for the project. Only persons trained in the installation of soil gas probes should attempt this procedure.

2.0 Project-Specific Considerations

2.1 As with all intrusive site work, a utility clearance should be performed prior to mobilization. It may also be necessary to acquire permits and site access.

2.2 Soil gas sampling should not be performed until 48 hours after a significant rain event (defined as >1 inch of rainfall).

2.3 It is common practice to both install and remove soil gas probes by the direct push method using equipment specifically designed for this purpose (Geoprobe® or equivalent drill rig). Operation of direct-push machinery shall be performed only by trained and licensed personnel. It is also possible to install soil gas probes with a slide hammer; however, this method is only for relatively shallow probes.

2.4 Prior to attempting installing soil gas probes there should be an understanding of subsurface conditions at the site.

2.4.1 Depth to Groundwater – soil gas samples must be collected in the vadose zone (and above the capillary fringe).

2.4.2 Soil permeability **-** It may not be feasible to collect soil gas from finer-grained or tight soils with little pore volume, such as clays; if there are clay layers present in the subsurface, these intervals should be avoided. For sampling in these soils, using permanent soil gas implants with a wider borehole is recommended. Care should be taken during purging and sampling so that the vacuum in the sampling system never exceeds 7 inches mercury (inches Hg) or approximately 100 inches water.

2.5 Select the probe interval length – typically probe sample intervals are 6 inches or 1 foot; however, smaller or larger intervals may be selected depending on the project's DQOs.

2.6 Selecting the probe depth interval

2.6.1 The top of the soil gas probe should be at least 5 feet below ground surface (bgs) to avoid short circuiting with outdoor air. If there is impermeable ground cover (e.g., concrete, asphalt), shallower sampling depths may be considered.

2.6.2 The bottom of the soil gas probe must be above the capillary fringe.

2.6.3 As the depth of the sampling interval increases, the difficulty of installing the probe also increases, with the primary challenge being threading the post-run tubing (PRT) adapter into the PRT point holder.

2.6.4 It is advisable to collect a soil core from the proposed sampling area prior to installing the soil gas probe to identify the exact depth of the capillary fringe and determine where the most permeable soil layers are located.

2.6.5 Sampling at multiple depths at each sample location (or a subset of the locations) should be considered to obtain a vertical profile of soil gas conditions if the vadose zone height is long enough; typically the bottom of a probe should be at least 5 feet from the top of the probe beneath it. Multi-depth sampling can be performed in one hole by starting with the shallowest depth first and then continuing downward.

2.7 Temporary soil gas probes can be installed either with or without the sample tubing in place. The sample tubing is attached after the probe is pushed to depth in the PRT method. However, the probe can be pushed with the tubing attached by using a slotted drive cap and slotted pull cap. This method is better for deeper sampling intervals.

3.0 Materials

3.1 Direct push drill rig or slide hammer

3.2 Drive rods – 1.25-inch outer diameter drive rods (typically supplied by the drilling subcontractor)

3.3 Expendable drive points – steel or aluminum 1.1-inch outer diameter expendable drive points (typically supplied by the drilling subcontractor)

3.4 PRT expendable point holder (typically supplied by the drilling subcontractor)

3.5 PRT adapters (typically supplied by the drilling subcontractor)

3.6 Post-run point popper (typically supplied by the drilling subcontractor)

3.7 Probe tubing - 1/4-inch outer diameter (OD) Teflon® (or inert nylon) tubing (may be supplied by the drilling subcontractor)

3.8 MultiRae five gas meter for health and safety monitoring during drilling

3.9 Electrical tape

4.0 Temporary Soil Gas Probe System Set-Up

4.1 Obtain soil gas sampling probes in sufficient quantity to carry out the assessment. These systems and their installation can be obtained from geotechnical firms that provide direct-push supplies and services. Their basic installation procedures can be followed as long as the details below are included.

4.2 Manufactured soil gas probes (such as the Geoprobe® PRT system) are specifically manufactured for soil gas collection and facilitate installation, improve sampling, are easily decontaminated between each use, and offer consistency and ease of use.

4.3 It is necessary to coordinate the hardware (i.e., size of tubing, fittings, sampling interface assembly, etc.) that mates the soil gas probe sampling line to the sampling system (e.g., Tedlar® bags, SUMMA® canisters). Appropriate hardware is critical to achieving a leak-free system. All connections should be inert gas-tight compression fittings (i.e., Swagelok® or equivalent), and all sample transfer lines should be made of Teflon® or inert nylon tubing. Typically, all tubing and fittings should be 1/4-inch OD. These fittings will match up with the sampling manifold specified in the soil gas sampling SOP.

4.4 The soil gas probes must be decontaminated prior to use. Steam cleaning is the preferred method of decontamination. Once decontaminated, the probes must be shown to be free of contaminants. At a minimum, a suitably sensitive organic vapor meter should be used for this purpose. Any probe that does not pass decontamination should not be used.

4.5 New tubing must be used for each soil gas probe; the tubing cannot be decontaminated.

4.6 Handle and store decontaminated soil gas probes in a manner that prevents contamination.

4.7 Inspect all probe parts for wear before each use. Replace probe tips, o-rings, adapters, and probe rods as needed. New parts and parts in good working condition greatly reduce the chances of ambient air leaking into the soil gas sample and reduce the need for re-pushing probes. Ideally, the expendable point holder will be a single piece (as opposed to two or more).

5.0 Soil Gas Probe Installation & Removal

5.1 Assemble the probe as shown in Figure 1. Note: A slotted drive cap may be used if the probe is assembled with the inner Teflon® tube before pushing into the ground.

5.2 Push the probe to the desired depth. Ensure that the final depth of the drive point includes extra depth to include the length of the tip and the sampling interval when retracted (e.g., for a depth of 5 feet bgs with a 6-inch screen, push the probe to 5 feet 6 inches bgs).

5.3 Retract the probe to create an annular space. The retraction length is equal to the selected sampling interval length. It is advisable to check that the tip detached during retraction. This can be done by poking a small-diameter rod down the inside of the probe. Note: Sometimes an o-ring may be used between the tip and tip holder. If so, the tip is more likely to stay attached to the holder when the probe is retracted. Since a leak-check procedure will be utilized prior to collecting soil gas samples, it is not necessary to use an o-ring on the tip. The force of the direct push will hold the tip against the tip holder during the push. In other words, there is no need to create a leak-free seal at this connection, as the tip will be removed before sampling.

5.4 Attach the PRT adapter to the 1/4-inch OD Teflon® tubing and secure in place by wrapping the connection with about 2 inches of electrical tape. This prevents the tubing from slipping on the nipple while tightening. Double check that the o-ring on the PRT adapter is new and undamaged.

5.5 Feed the PRT adapter and tubing down the probe. When it reaches the point holder, cut the tubing so that an additional 2 to 3 feet of tubing remains above ground.

5.6 While pushing down on the tubing, twist in a counter-clockwise direction until the probe adapter and tubing seat. Test the connection by lightly tugging on the tubing.

5.7 Install the probes in a manner that creates a leak-free seal between the above-ground atmosphere and the probe tip, while minimizing the impact on ground surface covers (e.g., asphalt, concrete, driveways, lawns). Achieving a leak-free seal will require placement of an inert sealing material (i.e., hydrated powdered bentonite) at the point where the probe penetrates the ground surface. See Figure 2.

5.8 In the event the direct-push installation technique does not work, and a pre-drilled pilot hole is needed, this procedure must be coordinated with the project engineer. Use of pre-drilled holes will require careful control as to not over-drill and may also create the need for back-grouting to overcome leakage from the aboveground ambient atmosphere.

5.9 Wait 30 minutes after the probe is installed and sealed properly to begin sampling, so that the subsurface has time to equilibrate. Follow the proper procedures as presented in the *SOP for the Collection of Soil Gas Samples from Temporary Probes and Permanent Implants Using Canisters*, and **be sure that leak-check procedures are employed**.

5.10 Removal of the probes is to be carried out by trained personnel using the direct-push machinery. The probe will be removed in a manner that minimizes disruption of ground surface covers (e.g., asphalt, concrete, driveways, lawns). Abandon the borehole by filling with a hydrated bentonite slurry or concrete.

5.11 Replace ground surface covers and repair to original condition.

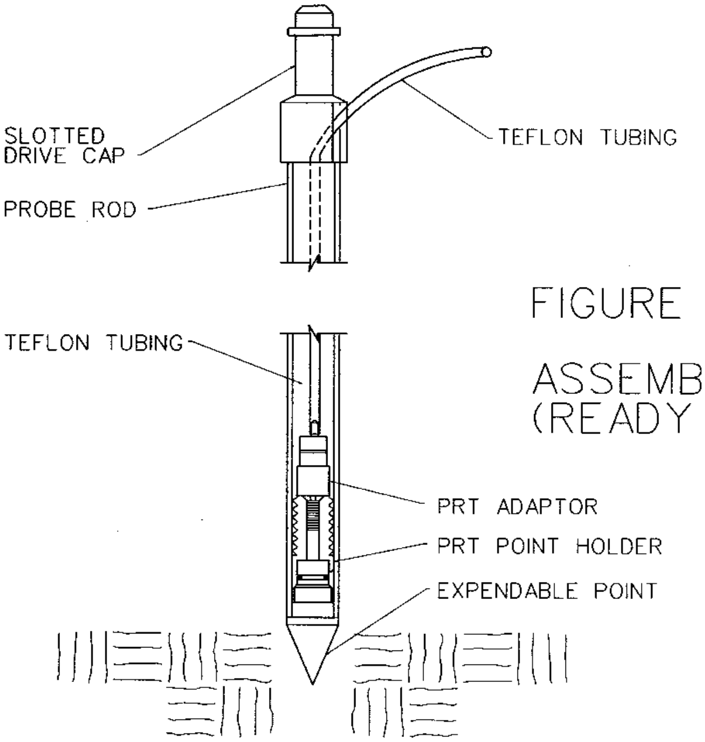


FIGURE 1

ASSEMBLED SOIL/GAS PROBE (READY FOR INSTALLATION)

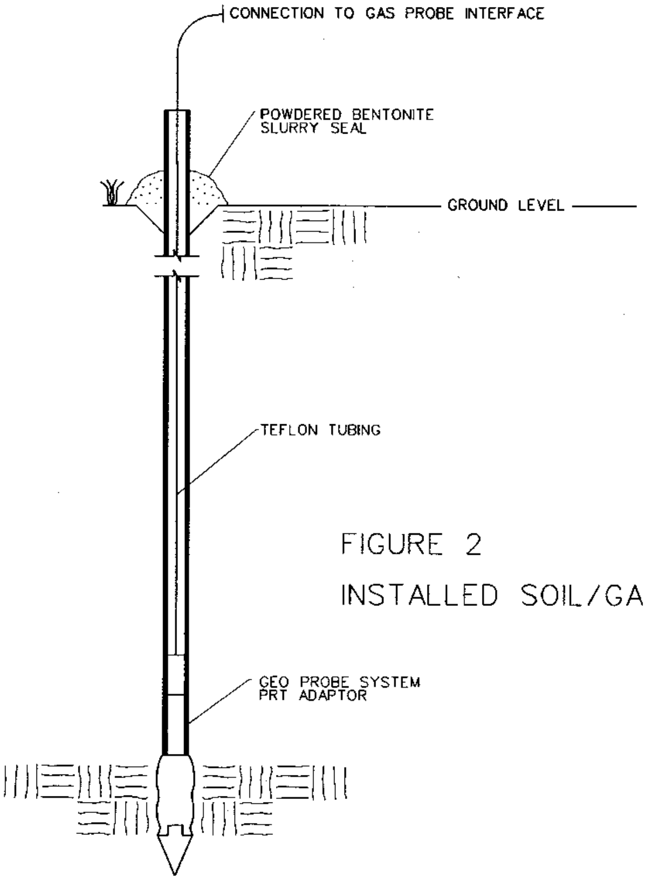


FIGURE 2

INSTALLED SOIL/GAS PROBE

SOP-5b Standard Operating Procedure for the Installation of Permanent Soil Gas Sampling Probes

1.0 Scope and Application

This standard operating procedure (SOP) is recommended as a practical approach for the installation of permanent soil gas sampling probes where the intent is to collect soil gas samples on multiple occasions. A common use of this SOP is during vapor intrusion assessments associated with subsurface volatile organic compound (VOC) contamination. This SOP should be used when its application is consistent with the project's data quality objectives (DQOs) and in conjunction with the *SOP for the Collection of Soil Gas Samples from Temporary Probes and Permanent Implants Using Canisters*. The project team is responsible for ensuring this procedure meets all applicable regulatory standards and receives approval/concurrence from the leading regulatory agency for the project. Only persons trained in the installation of soil gas probes should attempt this procedure.

2.0 Project-Specific Considerations

2.1 As with all intrusive site work, a utility clearance should be performed prior to mobilization. It may also be necessary to acquire permits and site access.

2.2 Soil gas sampling should not be performed until 48 hours after a significant rain event (defined as >1 inch of rainfall).

2.3 It is common practice to install soil gas probes using a drill rig. Operation of such machinery shall be performed only by trained and licensed personnel. It is also possible to install soil gas probes with a slide hammer; however, this method is only for relatively shallow probes.

2.4 The probe can be finished at the ground surface with a stick up or flush mount cover similar to groundwater monitoring wells.

2.5 Prior to attempting installing soil gas probes there should be an understanding of subsurface conditions at the site.

2.5.1 Depth to Groundwater – soil gas samples must be collected in the vadose zone (and above the capillary fringe).

2.5.2 Soil permeability **-** It may not be feasible to collect soil gas from finer-grained or tight soils with little pore volume, such as clays; if there are clay layers present in the subsurface, these intervals should be avoided. For sampling in these soils, using permanent soil gas implants with a wider borehole is recommended. Care should be taken during purging and sampling so that the vacuum in the sampling system never exceeds 7 inches mercury (inches Hg) or approximately 100 inches water.

2.6 Select the probe interval length – typically probe sample intervals are 6 inches or 1 foot; however, smaller or larger intervals may be selected depending on the project's DQOs.

2.7 Selecting the probe depth interval

2.7.1 The top of the soil gas probe should be at least 5 feet below ground surface (bgs) to avoid short circuiting with outdoor air. If there is impermeable ground cover (e.g., concrete, asphalt), shallower sampling depths may be considered.

2.7.2 The bottom of the soil gas probe must be above the capillary fringe.

2.7.3 It is advisable to collect a soil core from the proposed sampling area prior to installing the soil gas probe to identify the exact depth of the capillary fringe and determine where the most permeable soil layers are located.

2.7.4 Sampling at multiple depths at each sample location (or a subset of the locations) should be considered to obtain a vertical profile of soil gas conditions if the vadose zone height is long enough; typically the bottom of a probe should be at least 5 feet from the top of the probe beneath it. Multi-depth probes can be installed in one hole by starting with the deepest depth first and then continuing upward.

3.0 Materials

3.1 Direct push drill rig or slide hammer

3.2 Drive rods – 1.25-inch outer diameter (OD) drive rods (typically supplied by the drilling subcontractor)

3.3 Expendable drive points – steel or aluminum 1.1-inch OD expendable drive points (typically supplied by the drilling subcontractor)

3.4 Stainless steel probe screen (typically supplied by the drilling subcontractor) such as the GeoProbe Systems® implants. Several screen lengths are available (6-inch, 14-inch, 21-inch) but for discrete intervals required in Vapor Intrusion investigations, a 6-inch screen is typically recommended.

3.5 Probe tubing - 1/4-inch OD Teflon® (or inert nylon) tubing (may be supplied by the drilling subcontractor)

3.6 Probe cap – Swagelok® part number SS-400-C

3.7 Materials to create a flush mount or stick up casing

3.8 Glass beads (very small beads, similar to sand) to create a permeable layer around the probe screen.

3.9 Bentonite seal mixture (25 percent glass beads and 75 percent powdered bentonite clay [hi-yield type]) to grout the hole from above the screen to the ground surface.

3.10 MultiRae five gas meter (or equivalent) for health and safety monitoring during drilling

4.0 Permanent Soil Gas Probe System Set-Up

4.1 Obtain soil gas sampling probes in sufficient quantity to carry out the assessment. See Figure 1. These systems and their installation can be obtained from geotechnical firms that provide direct-push supplies and services. Their basic installation procedures can be followed as long as the details below are included.

4.2 It is necessary to coordinate the hardware (i.e. size of tubing, fittings, sampling interface assembly, etc.) that mates the soil gas probe sampling line to the sampling system (e.g., Tedlar bags, Summa canisters). This step is critical to achieve a leak free system. All connections should be inert gas tight compression fittings (i.e., Swagelok® or equal) and all sample transfer lines should be made of Teflon® tubing.

4.3 The soil gas probes must be decontaminated prior to use. Steam cleaning is the preferred method of decontamination. Once decontaminated, the probes must be shown to be free of contaminates. As a minimum, a suitably sensitive organic vapor meter should be used for this purpose. Any probe that does not pass decontamination should not be used.

4.4 Handle and store decontaminated soil gas probes in a manner that prevents contamination.

4.5 Inspect each gas probe assembly for ware and faulty parts. Replace probe tips, o-rings, adapters, and probe rods as needed.

5.0 Soil Gas Permanent Probe Installation

5.1 Assemble the drive point holder, implant anchor/drive point, and drive rod. Drive the rod to the desired bottom screen depth (e.g., for a probe screened from 5 feet 6 inches to 5 feet bgs, the rod should be driven to 5 feet 6 inches). Do not disengage the drive point at this time.

5.2 Attach the 1/4-inch Teflon tubing to the probe screen. Use enough tubing so that at least 2 feet will be left above ground. Make sure that the tubing does not spin on the probe screen; if it does, it will not be possible to screw the probe screen into the drive point/anchor. Electrical tape can be used to secure the tubing to the screen. Plug the exposed end of the tubing with the probe cap.

5.3 Remove the drive head and thread the probe screen (Geoprobe Systems® implant) and tubing down the inside of the drive rod. Once the implant reaches the drive point, turn the tubing counterclockwise with a gentle downward force to thread the screen into the drive point/anchor. Test that the screen is seated by gently pulling up on the tubing. It is very important to ensure that the screen is seated before moving on to the next step.

5.4 Retract the drive rod 12 inches while pushing down on the Teflon tubing. This is to ensure that as the rod is being removed while the anchor/drive point and implant stay at depth.

5.5 Thread the tubing through a funnel and place the funnel on top of the drive rod. Determine the volume of glass beads needed to fill the space around the screen plus an additional 6-inch space above the screen. Remove the cap placed over the end of the tubing. Pour the beads into the funnel and down the inside diameter of the drive rod. Use the Teflon tubing to stir the glass beads and ensure they make it all the way down to the bottom. Do not pull on the tubing. Note: Failure to remove the cap during this step can result in bridging of glass beads (due to air displacement issue) and therefore an insufficient filter pack around screen. See Figure 2.

5.6 Lift the drive rod up an additional 18 to 24 inches and pour in the bentonite seal mixture. The mixture is 25 percent glass beads and 75 percent powdered bentonite clay (hi-yield type). It takes approximately 154 milliliters (ml) of this mixture per foot. At least 2 feet of the mixture are recommended to adequately seal the hole and prevent contribution from ambient air during sampling. Pour 50 ml of water down the drive rod to initiate the bentonite seal.

5.7 Replace cap over end of tubing. Pull the drive rod the rest of the way out of the ground and fill the remaining hole to about 1 foot from the ground surface with either bentonite or cement.

5.8 Install either a stick up or flush mount cover to finish the probe. Coil the extra tubing inside the enclosure and cover.

5.9 Wait at least 24 hours before sampling.

5.10 When calculating dead volume, use the internal volume of the Teflon tubing, the internal volume of the screen, and the volume of the glass bead pack (assume 30 percent porosity).

5.11 The ground surface shall be replaced and repaired to original condition.

Figure 1 – Installed Geoprobe Implant with Flush Mount Cover

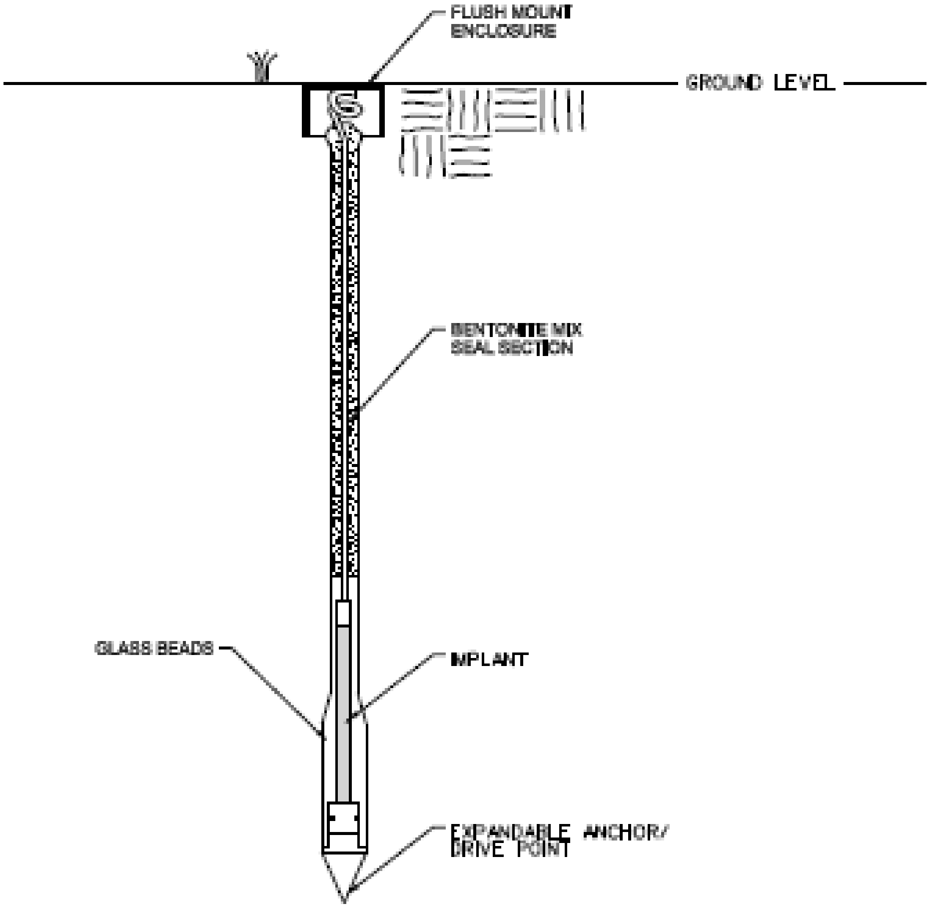
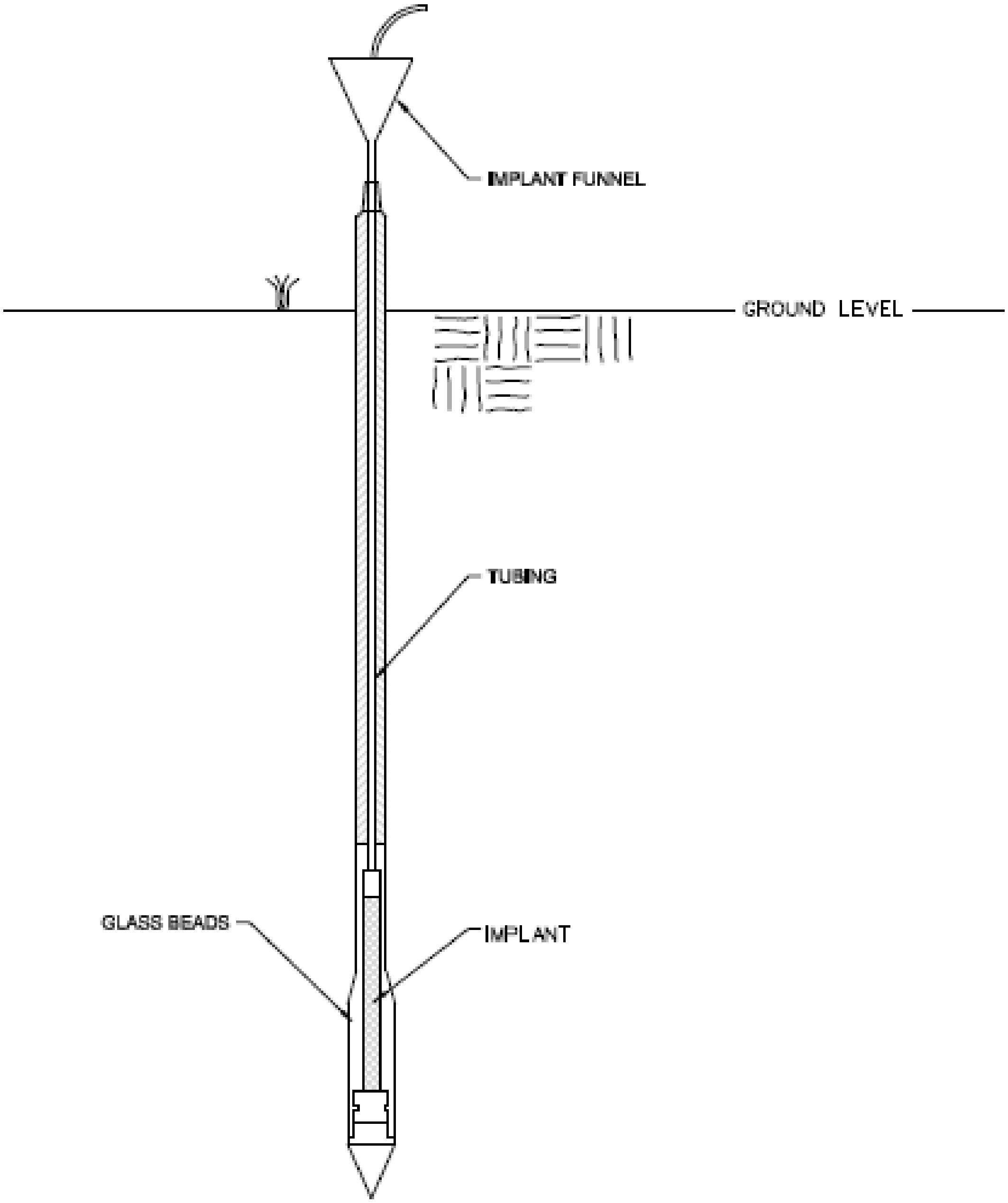

FLUSH MOUNT ENCLOSURE
GROUND LEVEL
BENTONITE MIX SEAL SECTION
GLASS BEADS
IMPLANT
EXPANDABLE ANCHOR/ DRIVE POINT

Figure 2 – Adding Glass Beads to the Geoprobe Implant



SOP-5c Standard Operating Procedure for the Collection of Soil Gas Samples from Temporary and Permanent Probes Using Canisters

1.0 Scope and Application

This procedure offers a practical approach for the collection of soil gas samples from temporary soil gas probes (such as the Geoprobe® direct-push system with post-run tubing [PRT] adapters), or from permanently installed soil gas probes, into SUMMA® (or equivalent) canisters. Soil gas sample integrity is verified by using a real-time leak checking procedure before taking each sample. This must be done after probe installation and prior to sampling, as well as before each subsequent soil gas sample from permanent probes. This standard operating procedure (SOP) should be used when its application is consistent with the project's data quality objectives (DQOs) and in conjunction with the *SOP for the Installation of Temporary Soil Gas Sampling Probes* or the *SOP for the Installation of Permanent Soil Gas Sampling Probes*. It is the responsibility of the project team to make sure this procedure meets all applicable regulatory standards and receives approval/concurrence from the leading regulatory agency for the project. Vapor intrusion (VI) subject-matter experts (SMEs) should be consulted as needed to address technical, regulatory or field implementation issues associated with the use of this SOP. Only persons trained in the collection of soil gas samples should attempt this procedure.

2.0 Project-Specific Considerations

2.1 Soil gas sampling should not be performed until 48 hours after a significant rain event (defined as >1 inch of rainfall).

2.2 It is common practice to both install and remove soil gas probes by the direct push method using equipment specifically designed for this purpose (Geoprobe® or equivalent drill rig). Operation of direct-push machinery shall be performed only by trained and licensed personnel. It is also possible to install soil gas probes with a slide hammer; however, this method is only for relatively shallow probes.

2.3 Methane and carbon dioxide (CO_2) can cause positive bias with a helium leak detector, if a helium leak-check procedure is used as detailed in this SOP. If methane or CO_2 are expected or encountered at a site, then it may be necessary to explore different strategies to determine well integrity.

2.4 The subsurface needs time to equilibriate after probe installation; 30 minutes for temporary probes and 24 hours for permanent probes.

2.5 Prior to attempting sampling of soil gas probes, there should be an understanding of subsurface conditions at the site.

  2.5.1 Depth to Groundwater – soil gas samples must be collected in the vadose zone (and above the capillary fringe).

  2.5.2 Soil permeability **-** It may not be feasible to collect soil gas from finer-grained or tight soils with little pore volume, such as clays; if there are clay layers present in the subsurface, these intervals should be avoided. For sampling in these soils, using permanent soil gas probes with a wider borehole is recommended. Care should be taken during purging and sampling so that the vacuum in the sampling system never exceeds 7 inches mercury (inches Hg) or approximately 100 inches water.

3.0 Materials

3.1 The soil gas probes should be installed by a licensed driller.

3.2 Teflon® tubing 1/4-inch outside diameter (OD) sample tubing. Ensure there is enough tubing to use new tubing at each sample location.

3.3 Swagelok® 1/4-inch nut and ferrule sets for connecting the probe tubing to the sampling manifold (part #SS-400-NFSET).

3.4 The helium leak-check equipment (or equivalent), including the enclosure, helium cylinder (high purity helium), and helium detector (Dielectric MGD® is preferred). The enclosure may be provided by the driller or can be constructed from polyvinyl chloride (PVC) pipe. The helium detector can be rented from an equipment rental company.

3.5 MultiRae® Fivegas meter. (Optional if on-site atmospheric gas analysis is required)

3.6 Vacuum pump for purging with rotometer to control flow to 200 milliliters/minute (mL/min) (should be a Cole Parmer # R-79200-00 grey diaphragm pump or equivalent)

3.7 Electric supply for the pump (either generator or power inverter with adapter for car battery).

3.8 Sampling manifold consisting of Swagelok® gas-tight fittings with three valves and one vacuum gauge to attach the probe to the air pump and the sample canister. See Figure 1. This manifold must be clean, free of oils, and flushed free of VOCs before use. This is accomplished by flushing three or four volumes of purge gas (ultra-high-purity [UHP] air or nitrogen) through the manifold and associated tubing.

3.9 Swagelok® valve (only necessary for extended sampling periods [i.e., greater than 30 minutes] so that the sampling manifold can be disconnected without introducing indoor air into the probe) (part # SS-4P4T)

3.10 Wrenches (clean and free of contaminants), various sizes as needed for connecting fittings and making adjustments to the flow controller (if field-adjustable). A 9/16-inch wrench fits the 1/4-inch Swagelok® fittings, which most canisters and flow controllers have.

3.11 Gas sampling bag (e.g., Tedlar® bag) (1-L or 3-L) to collect the purged soil gas, so the volume of purged soil gas can be measured and field screening with a PID or GEM2000 meter can be performed on the purged gas

3.12 GEM2000® Landfill Gas Meter (or equivalent) – this is optional if field measurements of CO_2, O_2, or CH_4 are necessary (aerobic biodegradation parameters typically measured for petroleum hydrocarbon sites)

3.13 MiniRae® PID Meter for health and safety to ensure breathing zone VOC concentrations remain below levels specified by the health and safety plan. It is also optional to collect field measurements of total VOCs from the probe or purged soil gas; it may warn the lab if high concentrations are detected so they can dilute the sample before analysis.

3.14 Canister, stainless steel, polished, certified-clean, and evacuated. These are typically cleaned, evacuated, and provided by the laboratory.

3.15 Flow controller or critical orifice, certified-clean, and set at desired sampling rate. These are typically cleaned, set, and provided by the laboratory. Soil gas samples are typically collected in 1 or 6 liter canisters at a flow rate of 200 mL/min; however, lesser flow rates may be used in finer grainer soils.

3.16 Negative pressure (vacuum) gauge—oil-free and clean—to check canister vacuum. The vacuum gauges are typically provided by the laboratory. The laboratory may either provide one vacuum gauge to be used with all of the canisters, or a vacuum gauge for each canister to be left on during sample collection. Sometimes the canisters are fitted with built-in vacuum gauges that are not removable. Gauges sent by the laboratory are for field use only, and are an approximate measure of the actual vacuum. Regularly calibrated – and less rugged – vacuum gauges are used at the laboratory to measure vacuum before shipment and again after sample receipt.

3.17 Shipping container, suitable for protection of canister(s) during shipping. Typically, strong cardboard boxes are used for canister shipment. The canisters should be shipped to the laboratory in the same shipping container(s) in which they were received.

4.0 System Set Up

4.1 Acquire all the necessary hardware and sampling equipment shown in Figure 1. Be sure to place the helium leak-check enclosure over the probe, and push the sample tubing through the hole in the cap before attaching the sampling manifold. ***Do not connect the canister at this time***.

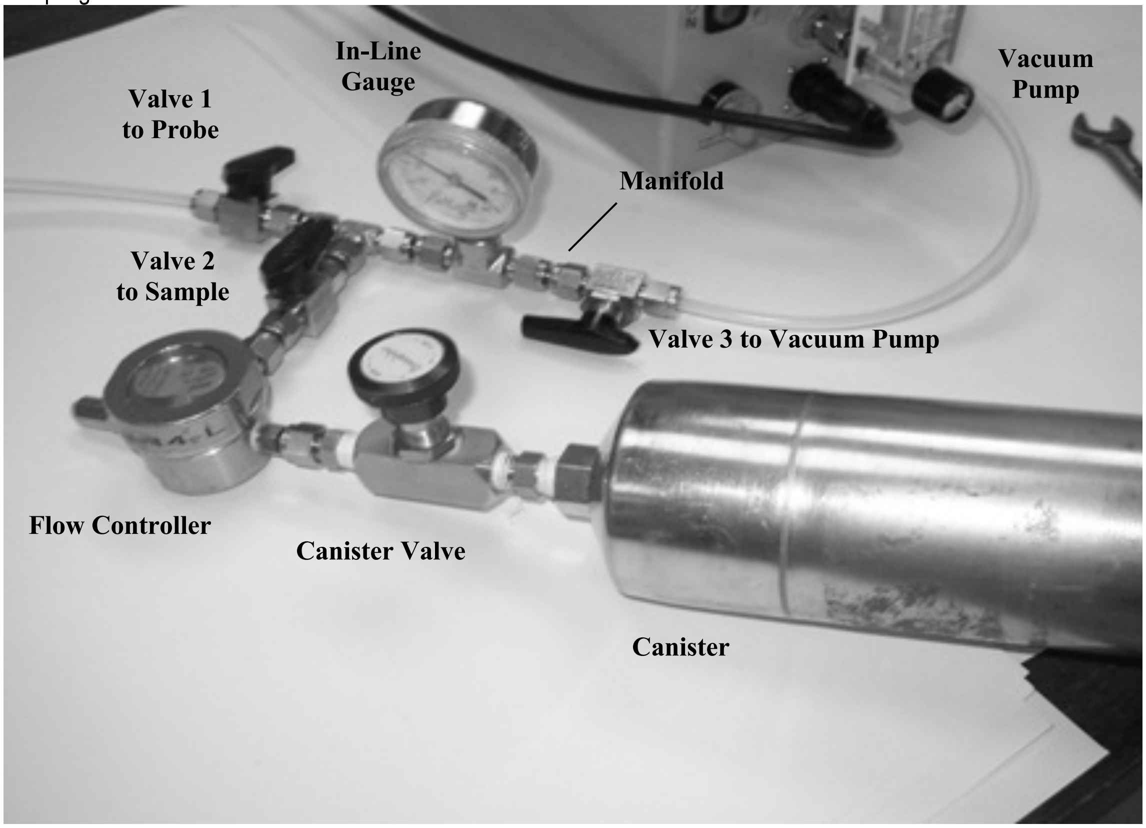
4.2 Adjust the purge system evacuation pump sampling rate to achieve the desired flow rate of 200 milliters per minute (ml/min) or less. Flow rate measurements should be performed at the outlet of the vacuum pump prior to purging, either by using a suitable flow meter or by determining the amount of time required to fill a 1-liter gas sampling bag.

4.3 If the sample will be collected over a period of time greater than 30 minutes a flow diversion valve (Swagelok® part# SS-4P4T) should be placed in-line between the probe and the manifold. Once purging has been completed, the flow diversion valve can be turned to the off position, allowing disconnection of the manifold and vacuum pump for use at another location, without the loss of purge integrity at the purged location.

4.4 Sampling canisters are evacuated prior to shipment by the laboratory. The vacuum will need to be verified in the field with the supplied vacuum gauge and properly recorded prior to use.

4.5 Attach the air pump to the sampling manifold and the Tedlar® bag to the air pump exhaust. See Figure 1. Do not attach the canister at this time.

FIGURE 1
Sampling Manifold



5.0 Soil Gas Sampling System Leak Checking and Purging Procedure

5.1 Physical Leak Check - Perform a leak check of the sample manifold system (Figure 1):

5.1.1 Make sure the gas probe valve (valve #1) is closed and the sample valve (valve #2) is open.

5.1.2 Open the purge valve (valve #3) and start the vacuum pump. Verify that the flow is set to 200 ml/min.

5.1.3 Close the sample valve (valve #2) and achieve a vacuum gauge reading of 10 inches of mercury (inches Hg) or to a vacuum that will be encountered during sampling, whichever is greater.

5.1.4 A leak-free system will be evident by closing off the purge valve (valve #3), turning off the vacuum pump, and observing no loss of vacuum within the sampling manifold system for a period of 30 seconds. Repair any leaks prior to sample collection by tightening the fittings on the manifold. Re-test to make the sure the manifold passes the physical leak check before proceeding.

5.1.5 Record the leak check date and time on the Soil Gas Sampling Log.

5.2 System Purge and Helium Leak Check - A purge of the soil gas probe and sampling manifold system is required before taking each sample. The helium leak-check procedure is also performed during this step. This helium leak check will verify the integrity of the sampling adapter (or PRT adapter if using the Geoprobe® system) seal as well as the probe and ground interface. This is accomplished by doing the following steps:

5.2.1 Place the helium leak-check enclosure around the soil gas probe to achieve a buildup of helium in the leak-check enclosure. The enclosure should not be tightly sealed and there should be an exhaust for the helium so pressure doesn't build up in the enclosure. Where the ground surface is soft, the helium leak-check enclosure is pressed down slightly into the ground surface. In situations where the ground surface is hard (for example, asphalt), apply a slight downward pressure to achieve a buildup of helium in the leak-check enclosure.

5.2.2 Start the flow of helium under the leak-check enclosure at 200 ml/min. Try to position the tube so the helium is directed at the interface between the probe and the ground. Let the helium fill the enclosure for a couple of minutes.

5.2.3 Turn the helium leak detector on while in outdoor air and ensure that the detector is not reading any helium before proceeding. Verify that the helium concentration inside the leak-check enclosure is >10 percent by placing the probe of the helium detector into the hole where the sample tubing comes out or under the enclosure wall. It is not necessary to verify that the helium concentration is 100%, as this may damage the detector.

5.2.4 Purging is carried out by pulling soil gas through the system at a rate of 200 ml/min for a time period sufficient to achieve a purge volume that equals 3 to 5 dead volumes (internal volume) of the in-ground annular space, sample line, and sampling manifold system. When calculating the dead volume, be sure to take into account the inside diameter and length of the Teflon® sample tubing, as well as the probe outside diameter and retraction distance for the annular space of temporary probes. For permanent probes, calculate the volume of the annular space using a nominal 30 percent porosity for the sand or glass bead pack. If, during the purge (or sampling), the vacuum exceeds 7 inches Hg, then reduce the pump flow rate. The system vacuum must stay below this level at all times to minimize the risk of inducing leaks or altering conditions in the subsurface .

5.2.5 Open the sample valve (valve #2) and the purge valve (valve #3) and start the purge pump. Verify that the flow rate is still 200 ml/min.

5.2.6 To start the soil gas probe purge, simultaneously open the gas probe valve (valve #1) and close the sample valve (valve #2), and start timing.

5.2.7 If there is shallow groundwater in the area, carefully watch the tubing as the pump is turned on. If water is observed in the sample tubing, shut the pump off immediately. Soil gas collection will not be feasible if the probe is in contact with water.

5.2.8 Connect the helium detector to the enclosure exhaust to confirm that helium is present in the enclosure during purging. It is optional to measure the helium concentration within the enclosure (see Step 5.2.12). Make sure that the helium detector is exposed to ambient air and "zeros out" before measuring the purged soil gas in Step 5.2.12.

5.2.9 During the last 5 minutes of the purge (or the entire purge time if less than 5 minutes), attach a gas sampling bag to the purge pump exhaust and open the bag's valve. This bag/sample will be used for analysis of helium using the leak detector.

5.2.10 If the vacuum gauge reads >7 inches Hg during the purge, then close the purge valve (valve #3) and monitor the vacuum in the manifold and probe. If there is no noticeable change in vacuum after a minute, then there is an insufficient amount of soil gas to collect a sample and the vacuum is too great to collect a soil gas sample. Several factors can cause this situation. Consult with the project manager and take corrective action.

5.2.10.1 The soil formation is too "tight" (i.e., high clay or moisture content). Try using a lower flow rate. (temporary or permanent probe)

5.2.10.2 The soil formation is too tight. Try a different depth or location. (temporary probe)

5.2.10.3 With a temporary probe system, the expendable tip may not have released when the drive rod was retracted. Try retracting the probe a little further, or use a long, thin rod to poke the tip loose.

5.2.10.4 If water is visible in the flexible soil gas tubing, stop the purging immediately. It is not possible to take a soil gas sample at that depth or location.

5.2.11 At the end of the calculated purge time and after the system is verified to be leak free, close the purge valve (valve #3), close the valve to the gsa sampling bag, and turn off the pump. Do not open the purge valve again. Doing so will result in loss of the purge integrity and will require re-purging.

5.2.12 Attach the gas sampling bag to the helium detector using a piece of flexible silicone or rubber tubing and open the valve. **The helium concentration in the purged soil gas must be less than 1 percent of what it was in the helium enclosure during purging to pass the leak test** (10,000 parts per million by volume [ppmv] if the helium concentration was 100%) **(verify that this limit is consistent with appropriate project-specific regulatory guidance)**. Either: 1) calculate what 1 percent of the helium concentration was in the enclosure from the measured concentration in Step 7.2.6; or 2) use a limit of 0.1 percent (1,000 ppmv) which allows for a 10-times safety margin. If the probe fails the leak check then corrective action is required. This includes first checking the fittings and connections and trying another purge and leak check. It may also be necessary to remove the soil gas probe and re-install it in a nearby location.

Note: **Helium leak detectors may be sensitive to high concentrations of methane or other atmospheric gasses.** If these are expected to be present in the soil gas, then caution should be used with this technique, as false positive readings may be encountered during leak testing. Use a GEM2000® landfill gas meter to determine if methane is present in subslab soil gas.

5.2.13 At the end of the purge and after the system is verified to be leak-free, close the purge valve (valve #3). Do not open it again. Doing so will result in loss of the purge integrity and will require re-purging. Turn off the helium leak detector.

5.2.14 The purged subslab soil gas in the Tedlar® bag can be screened with a GEM2000® landfill gas meter to get field measurements of CO_2, O_2, and CH_4 and/or a MiniRae® PID can be used to measure concentrations of total VOCs in the field. If soil oxygen data is collected using a handheld meter, the meter will be calibrated on a daily basis and laboratory confirmation samples will be collected at about 10% of the soil gas sampling locations.

5.2.15 Record the purge and leak check information on the Soil Gas Sampling Log.

5.2.16 Immediately move on to the sampling phase. Little to no delay should occur between purging and sampling.

6.0 Sample Collection

6.1 Clean sampling protocols must be followed when handling and collecting samples. This requires care in the shipping, storage, and use of sampling equipment. Cleanliness of personnel who come in contact with the sampling equipment is also important: for example, no smoking, eating, or drinking; no perfumes or deodorants; and no dry-cleaned clothing. Canisters should not be transported in vehicles with gas-powered equipment or fuel cans. Sharpie®-type markers should not be used for labeling or note-taking during sampling.

6.2 The sampling canisters are certified clean and evacuated by the laboratory to 30 inches Hg vacuum. Care should be used at all times to prevent inadvertent loss of canister vacuum. Never open the canister's valve unless the intent is to collect a sample or check the canister vacuum.

6.3 The air sampling canisters are certified clean and evacuated by the laboratory to ~29 to 30 inches Hg vacuum. Initial canister vacuums that are less than certified by the laboratory are a potential indication of leakage that could affect the accuracy of analytical results. Care should be used at all times to prevent inadvertent loss of canister vacuum. Never open the canister's valve unless the intent is to collect a sample or check the canister vacuum with an attached gauge.

6.4 Verify that the canister has sufficient initial vacuum for sampling. Measure the initial canister vacuum using an external vacuum gauge as described below:

6.4.1 Remove the protective cap from the valve on the canister.

6.4.2 Attach an external gauge, attach the gauge to the canister and open the valve. If the vacuum gauge has two openings, make sure that the other opening is closed; the canister cap can be used for this. After taking the reading, close the canister and remove the gauge.If using assigned vacuum gauges, attach the vacuum gauge to the canister, then attach the flow controller. As sample collection begins, record the initial vacuum.

6.4.3 Measure the initial canister pressure using a digital vacuum gauge with 0.25% accuracy at the -30 to 0 inches Hg range and NIST-traceable calibration for vacuum measurements. See the *Technical Bulletin: Use of External Vacuum Gauges with Canisters* for a recommended model of vacuum gauge[1] for use with Summa canisters used for vapor intrusion sampling.

6.4.4 Do not sample using a canister without sufficient initial vacuum. Be advised that sampling data may be flagged or rejected from canisters with low initial vacuum (less than 28 inches Hg). Low initial vacuum could create a low bias in analytical results due to air leakage. While there is a also a smaller risk that air leakage could introduce contaminants into the canister, the primary concern is the low bias to analytical results; this bias is within the range of analytical variability allowed with the EPA Method TO-15 (±30%) for initial vacuums >24 inches Hg. The table presented in Paragraph 6.4.5 identifies the field team's response based on the initial vacuum reading for a canister. In addition, this table also identifies the potential bias to results at different initial canister vacuums.

6.4.5 Use the following table to determine when to use canisters based on initial vacuum readings.

Initial Vacuum Reading	Potential Error in Analytical Results Due to Leakage	Field Team Response
>30 to 28 inches Hg	Up to -10% error	Use canister for sampling – no limitations on use.
>26 to 28 inches Hg	Up to -21% error	Use canister for sampling if necessary; replace canister with a spare if spares are available.
>24 to 26 inches Hg	Up to -30% error	Sampling with canister is not advisable. Contact project manager and obtain direction before sampling with this canister. Be advised that qualifiers may be applied to analytical results sampled with canisters with vacuums less than 26 inches Hg.
<24 inches Hg	>-30% error	Do not use this canister for sampling. Analytical results will be rejected.

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[1] A PG5 Digital Pressure Gauge from Automation Products Group (APG), Inc.(http://www.apgsensors.com/products/pressure-sensors/digital-pressure-gauges/pg5) with National Institute of Standards and Technology (NIST)-traceable calibration certificate, or equivalent, is recommended for making vacuum measurements.

6.5 Attach the canister to the flow controller and then connect the flow controller to the sample valve (valve #2) on the sampling manifold. Open the sample valve (valve #2).

6.6 Before collecting the sample, confirm that the sampling system valves are set as follows: (1) the purge valve (valve #3) is confirmed to be closed; (2) the gas probe valve (valve #1) is open; and (3) the sample valve (valve #2) is open.

6.7 Slowly open (counter-clockwise) the canister's valve approximately one full turn.

6.8 After sampling for the appropriate amount of time (determined from project instructions; see Table 1), close the sample valve (valve #2) and the canister's valve. If the canister has a built-in or assigned vacuum gauge, allow the canister to fill until the vacuum reaches 2 to 10 inches Hg for 6-liter canisters and 2 to 5 inches Hg for 1-liter canisters. Remove the canister from the sampling manifold.

6.9 If using an external vacuum gauge, re-attach it, open the canister valve, and record the final vacuum. Close the valve, remove the gauge, and replace and tighten the cap on the canister. Ideal final vacuum in the canister is between 2 and 10 inches Hg. More than 10 inches Hg of vacuum can greatly increase reporting limits; however, a small amount of vacuum should be left in the canister so the laboratory can confirm that the canister was not opened during shipment.

6.10 Consult with the project manager before submitting the sample to the laboratory if a final vacuum greater than 10 inches Hg, or less than 2 inches Hg are encountered. Use the following table for guidance to determine how to address final vacuum measurements:

Final Vacuum Reading	Field Team Response
< 2 inches Hg	Contact Project Manager before submitting sample. Notify analytical laboratory to report their laboratory-measured pressure and to get direction from the Project Manager before analyzing sample.
> 2 inches Hg and <10 inches Hg	Submit sample for analysis - no limitations on data use
>10 inches Hg	Contact Project Manager before submitting sample. Verify final vacuum with the analytical laboratory before analysis.

6.11 Canisters with no vacuum left (i.e., 0 inches Hg) should not be analyzed. Contact the Project Manager before submitting a sample with a final vacuum of 0 inches Hg to determine the appropriate course of action. One option is to verify the final vacuum with the analytical laboratory. If there is vacuum remaining in the canister according to the laboratory vacuum gauge, the Project Manager may direct the analytical laboratory to analyze the sample.

6.12 The analytical laboratory should be directed to not analyze a sample showing a final vacuum of 0 inches Hg (as measured by the laboratory), and to notify the Project Manager and obtain further guidance regarding that sample.

6.13 Record the sampling date, times, canister identification (ID), flow controller ID, vacuum gauge ID(s), and any other observations pertinent to the sampling event on the Soil Gas Sampling Log. Also record the weather conditions (temperature, barometric pressure, precipitation, etc.) during sampling.

6.14 Fill out all appropriate documentation (sampling forms, sample labels, chains of custody, sample tags, etc.).

6.15 Disassemble the sampling system.

6.16 For permanent probes, replace the probe cap and make sure it is securely in place. For temporary probes, remove the probe and abandon the bore hole.

7.0 Altitude Correction

7.1 Air pressure decreases with elevation. Therefore, a canister evacuated at a laboratory located at sea level will show a lower vacuum measurement at a higher altitude. Generally, a 1,000 foot rise in elevation corresponds to a 1 inch Hg drop in pressure OR a 1 inch Hg decrease in measured vacuum. For example, a canister evacuated to 30 inches at sea level and used at 3,000 ft would show an initial vacuum of 27 inches Hg.

7.2 If you plan to sample at altitude, be sure to inform the laboratory ahead of time so they adjust the flow controllers accordingly.

7.3 If sampling is being conducted at higher elevations, verify the elevation difference between the analytical laboratory and field location and determine the associated decrease in measured vacuum.

7.3.1 Calculate the pressure difference between the laboratory and field location as follows: Difference from Sea Level (field) – Difference from Sea Level (laboratory). Use the Altitude Correction Table attached to this SOP.

7.3.2 Subtract the pressure difference determined in Section 7.3.1 from allowable initial vacuum levels (Section 6.4.5) and final vacuum levels (Section 6.10) to determine appropriate initial and final vacuum levels.

8.0 Sample Handling and Shipping Procedure

8.1 Fill out all appropriate documentation (chain of custody, sample tags) and return canisters and equipment to the laboratory

8.2 The canisters should be shipped back to the laboratory in the same shipping container in which they were received. The samples should not be cooled during shipment. DO NOT put ice in the shipping container.

8.3 When packing the canisters for shipment, verify that the valve (just past finger-tight) and valve caps are snug (1/4 turn past finger tight), and use sufficient clean packing to prevent the valves from rubbing against any hard surfaces. Never pack the canisters with other objects or materials that could cause them to be punctured or damaged. Ensure that flow controllers and gauges are separately and adequately wrapped to prevent damage.

8.4 **Do not place sticky labels or tape on any surface of the canister.**

8.5 Place a custody seal over the openings to the shipping container.

8.6 Make sure to insure the package for the value of the sample containers and flow controllers if corporate card policy does not cover this.

8.7 Ship canisters for overnight delivery. NOTE: If sampling on a Friday, ensure the laboratory accepts samples on Saturdays (you do not want the canisters sitting on some loading dock (or worse) for 3 days).

9.0 Quality Control

9.1 Laboratories supplying canisters must follow the performance criteria and quality assurance prescribed in U.S. Environmental Protection Agency (EPA) Method TO-14/15 for canister cleaning, certification of cleanliness, and leak checking. SOPs are required.

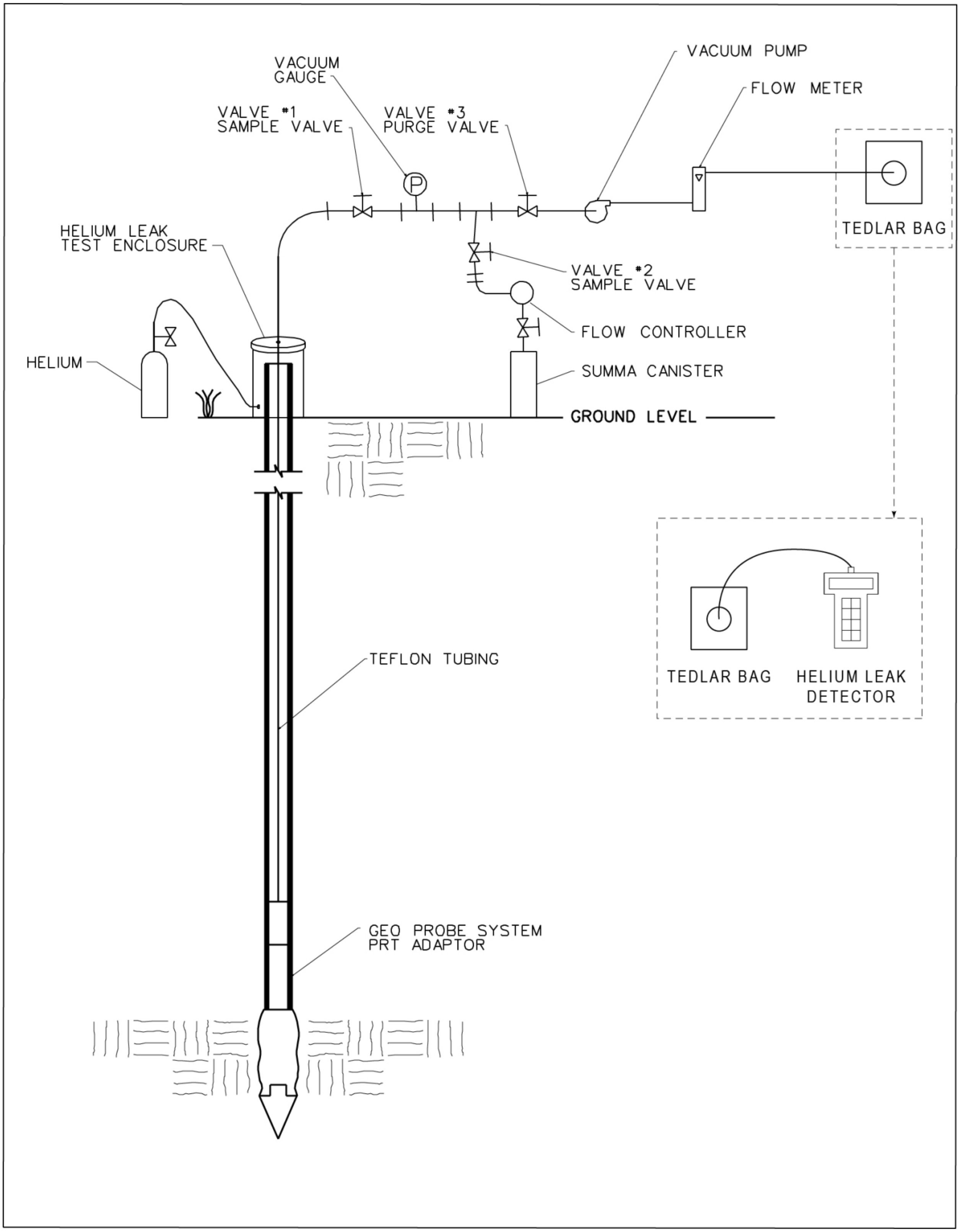
9.2 Laboratories supplying flow controllers must follow the performance criteria and quality assurance prescribed in EPA Method TO-14/15 for flow controller cleaning and adjustment. SOPs are required.

10.0 Attachments

10.1 *Exterior Soil Gas Probe Installation and Sampling Log - Canister Method*

10.2 *Altitude correction table*

Figure 2 Soil Gas Sampling System



Altitude Correction Table

Elevation (ft)	Pressure (in Hg)	Difference from Sea-Level (in Hg)	Elevation (ft)	Pressure (in Hg)	Difference from Sea-Level (in Hg)
0	29.92	0	1500	28.37	1.553
50	29.87	0.053	1550	28.32	1.603
100	29.81	0.106	1600	28.27	1.653
150	29.76	0.159	1650	28.22	1.703
200	29.71	0.212	1700	28.17	1.753
250	29.66	0.265	1750	28.12	1.803
300	29.60	0.317	1800	28.07	1.853
350	29.55	0.370	1850	28.02	1.903
400	29.50	0.422	1900	27.97	1.953
450	29.45	0.474	1950	27.92	2.002
500	29.39	0.527	2000	27.87	2.052
550	29.34	0.579	2050	27.82	2.101
600	29.29	0.631	2100	27.77	2.151
650	29.24	0.683	2150	27.72	2.200
700	29.19	0.735	2200	27.67	2.249
750	29.13	0.787	2250	27.62	2.298
800	29.08	0.838	2300	27.57	2.347
850	29.03	0.890	2350	27.52	2.396
900	28.98	0.941	2400	27.47	2.445
950	28.93	0.993	2450	27.43	2.494
1000	28.88	1.044	2500	27.38	2.543
1050	28.82	1.095	2550	27.33	2.591
1100	28.77	1.147	2600	27.28	2.640
1150	28.72	1.198	2650	27.23	2.688
1200	28.67	1.249	2700	27.18	2.736
1250	28.62	1.299	2750	27.14	2.785
1300	28.57	1.350	2800	27.09	2.833
1350	28.52	1.401	2850	27.04	2.881
1400	28.47	1.452	2900	26.99	2.929
1450	28.42	1.502	2950	26.94	2.977
			3000	26.90	3.025

Note: use the following equation to calculate atmospheric for altitudes not shown on this table:

$P = P_o \exp(-35.523 \times 10^{-6} y)$, where P is the pressure at the desired elevation, P_o is the atmospheric pressure at sea level, and y is the desired elevation. Source: NASA, 1996. *Elevation Correction Factor for Absolute Pressure Measurements*. NASA Technical Memorandum 107240.