In-Situ Remediation Plan

Airport Kwik Stop and Cabin Grill Site
Ione, Washington

for
Washington State Department of Ecology

May 10, 2017

GeoEngineers

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In-Situ Remediation Plan

Airport Kwik Stop and Cabin Grill Site
Ione, Washington

File No. 0504-058-06

May 10, 2017

Prepared for:

Washington State Department of Ecology
Toxics Cleanup Program
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1.0 INTRODUCTION

This Remediation Plan describes proposed remedial actions at the Airport Kwik Stop and Cabin Grill site located near Ione, Washington. The approximate location of the site is shown in the Vicinity Map, Figure 1. The site encompasses portions of several properties, including the former Airport Kwik Stop, portions of Washington State Department of Transportation (WSDOT) right-of-way within State Route 31, private property east of the former Airport Kwik Stop, the Cabin Grill property (located southeast of the intersection of State Route 31 and Dewitt Road), and undeveloped property located east of the Airport Kwik Stop. The location of the properties relative to existing site features is shown in the Site Plan, Figure 2.

This Remediation Plan describes the proposed in-situ treatment program recommended to address soil and groundwater petroleum contamination. GeoEngineers' site-specific Health and Safety Plan (HASP) for the project is presented as Appendix B of this Remediation Plan. The site is managed by the Washington State Department of Ecology (Ecology) under contract C1100145 and Work Assignment C11145E6.

2.0 BACKGROUND INFORMATION

This section presents background information for the site, including soil and groundwater conditions; historical and current site uses; previous environmental investigations; and contaminants of concern.

2.1. Property Descriptions

A complete description the site is included in the Remedial Investigation/Feasibility Study Work Plan (GeoEngineers 2010). This section presents a summary of current conditions for various portions of the site.

2.1.1. Former Airport Kwik Stop

The former Kwik Stop building, fronting State Route 31 and Greenhouse Road, is currently operated as a general store. The general store no longer dispenses gasoline; however, the fuel pumps and associated lines are still on site. A soil vapor extraction (SVE) and air sparge system operates at the site and is tied into six SVE wells (SVE-1 through SVE-6); two monitoring points (MP-1 and MP-2) and 11 air sparge wells (AS-1, and AS-5 through AS-14).

2.1.2. Cabin Grill

The Cabin Grill property is currently a private residence. Drinking water is obtained from a well located near the Cabin Grill. Currently, an activated carbon filtration system treats the groundwater to remove the gasoline-related contaminants and render the water safe for use. Air sparge remediation recently was conducted by Ecology at the site, utilizing wells AS-2 through AS-4.

2.1.3. Undeveloped Properties East of the Airport Kwik Stop

The properties remain undeveloped and most of the ground surface is covered with field grass.

2.2. Geologic and Soil Conditions

The site is situated within the Pend Oreille River Valley in Pend Oreille County, Washington. Topography slopes gently downward to the north along the main axis of the river valley, and the valley is bounded by

upland areas to the east and west. A detailed discussion of the Site geologic and soil conditions is provided in Site Characterization Report, Ione Petroleum Contamination Site (GeoEngineers 2010).

Soil conditions encountered in explorations completed from 2010 to 2017 generally confirm the published geologic conditions. Fifty-two direct-push borings (DP-1 through DP 52) and seven hollow-stem auger borings (B-1 through B-7) were drilled; and six soil vapor extraction wells (SVE-1 through SVE-6), 14 air-sparge wells (AS-1 through AS-14) and 27 groundwater monitoring wells (MP-1, MP-2 and MW-1 through MW-25) were installed at the site during previous site characterization activities conducted from 2010 to 2017. Subsurface conditions encountered in the borings generally consisted of an upper layer of sand with variable silt content, which extended to depths in the range of about 17 to 50 feet below ground surface, underlain by low-permeability silt and clay. Several published geologic reports indicate the clay layer is several hundred feet thick.

2.3. Groundwater Conditions

Based on results of quarterly groundwater measurements of site monitoring wells conducted since August 2010, an unconfined shallow aquifer is present below the site. Depth to groundwater measured in wells at the Kwik Stop and Cabin Grill properties has ranged from about 33 to 38 feet below grade. Groundwater flow generally is towards the east, from upland areas towards the Pend Oreille River. A shift in the general groundwater flow direction was observed in late 2011, from a southeasterly direction, to a more easterly direction.

2.3.1. Hydraulic Conductivity

During remedial investigation activities conducted in 2012, rising head slug tests were conducted on five monitoring wells (MW-6, MW-7, MW-9, MW-10 and MW-19) to measure hydraulic conductivity and estimate groundwater velocity. The hydraulic conductivity results are summarized below in Table 1. A description of the slug test methods and interpretation of the results is included in the Remedial Investigation Report (GeoEngineers 2013).

TABLE 1. HYDRAULIC CONDUCTIVITY SUMMARY

Monitoring Well	Average Hydraulic Conductivity[1] (feet per day)
Upgradient	
MW-7	2.4×10^{1}
Central and Downgradient	
MW-6	8.3×10^{2}
MW-9	5.8×10^{2}
MW-10	4.8×10^{2}
MW-19	6.2×10^{2}
Geometric Mean[2]	6.2×10^{2}

Notes:

[1]Hydraulic conductivity estimates represent average result of rising-head slug tests conducted at each location.

[2]Geometric mean of the central and downgradient monitoring wells

2.3.2. Groundwater Velocity

Groundwater flow velocity for the shallow unconfined aquifer underlying the Site was estimated using a standard Darcy's Law-based analysis described in the Remedial Investigation Report (GeoEngineers 2013). Two groundwater velocities were calculated: one for the upgradient portion of the site (represented by MW-7) and one for the central and downgradient portion of the site. The upgradient groundwater flow velocity is about 1.5 feet per day. The central and downgradient velocity is about 5.2 feet per day.

2.4. Site Use History and Existing Data

GeoEngineers and Ecology have conducted assessment and remediation activities since April 2010. Actions included collecting soil and groundwater samples from soil borings, installing monitoring wells, soil vapor extraction (SVE) wells and air sparge (AS) wells, collecting groundwater samples and conducting an AS and SVE pilot test.

Site characterization and groundwater monitoring results indicate gasoline-range petroleum hydrocarbon (GRPH)-contaminated groundwater is present beneath the site, extending from the former Airport Kwik Stop property, downgradient through the Cabin Grill property to undeveloped property (referred to as the Vacant Property) located south and east of the Cabin Grill property. Recent groundwater monitoring results, conducted by Ecology during March 2016, indicate GRPH concentrations were 23,200 micrograms per liter (µg/L) in monitoring well MW-8, located at the Former Airport Kwik Stop site, and 19,200 µg/L in monitoring well MW-5 located near the Cabin Grill.

A SVE and bioventing system was installed at the Kwik Stop to remediate the source area. Contaminated subsurface vapors were extracted through six SVE wells (SVE-1 through SVE-6) and two monitoring points (MP-1 and MP-2). The extracted contaminated vapors were treated using a catalytic oxidizer and polished using granular activated carbon. Alternatively, the SVE extraction wells and monitoring points also were used to biovent the subsurface. Ecology also installed and utilized air sparge wells near the Kwik Stop and the Cabin Grill.

2.5. Site Contaminants of Potential Concern (COPCs)

COPCs for site soil and groundwater include contaminants detected at concentrations exceeding MTCA Method A cleanup levels. COPCs for the Site include the following constituents:

1. GRPH; and
2. Benzene, toluene, ethylbenzene and xylenes (BTEX).

3.0 IN-SITU REMEDIATION PLAN

3.1. Purpose

GeoEngineers prepared this Remediation Plan based on the Statement of Work (SOW) provided by Ecology (received January 30, 2017), The goals of the Remediation Plan, based on the SOW, will include:

1. Remediate groundwater near the Cabin Grill to concentrations protective of human health;
2. Reduce residual petroleum contamination near the former Airport Kwik Stop; and

3. Accelerate groundwater remediation site wide to concentrations protective of human health.

3.2. Treatment Options

GeoEngineers evaluated in-situ groundwater cleanup technologies commonly used to reduce petroleum contamination in groundwater. Specifically, bioremediation amendments and in-situ chemical oxidation (ISCO) technologies were considered for the former Kwik Stop and Cabin Grill.

1. **In-situ bioremediation amendments** are a class of subsurface remediation technologies that are used to enhance biological attenuation processes by supplying pre-acclimated hydrocarbon-degrading bacteria and supplying nitrogen, phosphorus and potassium to support ongoing biological growth.
2. **ISCO** is a class of subsurface remediation technologies that use chemical oxidants to destroy organic contaminants by breaking the molecular bonds of organic contaminants and degrading these compounds to residual compounds.

Both technologies were evaluated for this plan to assess the effectiveness and risks associated with injection near the Cabin Grill well. We requested proposals and cost estimates from multiple vendors that supply either ISCO or bioremediation products. Two vendors responded to our request:

1. **PeroxyChem** provided an estimate to apply a sodium persulfate (Klozur® SP) product to oxidize the petroleum contamination. Based on soil and groundwater chemical analytical results we provided, PeroxyChem estimated the residual dissolved phase GRPH groundwater concentration is about 23 milligrams per liter (mg/L) and the residual GRPH soil contamination is 500 milligrams per kilogram (mg/kg). Note: PeroxyChem also provided estimates based on assumptions of 250 mg/kg and 1,000 mg/kg of residual GRPH soil contamination.

   PeroxyChem proposed applying almost 46,000 pounds (lbs) of Klozur® SP to the subsurface at a material cost of about $66,000. In addition to the sodium persulfate, either a high pH or a hydrogen peroxide activation is required to convert the Klozur® SP into reactive radicals. PeroxyChem's recommended high pH activation uses about 75,000 lbs of 25%wt sodium hydroxide (NaOH). The NaOH costs between about $0.15 to $0.26 per lbs depending on the delivery method (totes, tanker, or drums) for an estimated cost of $11,250 to $19,500. The total material (product) cost for the Klozur application with NaOH activation is between $77,000 to $86,000.

   Alternatively, hydrogen peroxide could be used to activate the persulfate. PeroxyChem estimated over 21,000 gallons of 17%wt hydrogen peroxide will be required to activate the persulfate. Depending on the delivery method, they estimate the peroxide will cost between $22,500 to $52,200. PeroxyChem estimates the residual petroleum mass would reduce to 0 mg/L in groundwater and 100 mg/kg in soil.
2. **Environmental Technologies (Etec), LLC** proposed to apply amendments to enhance natural bioremediation processes. The product mixture they propose includes:
   a. TPH Bacterial Consortium (EZT-A2™), a component of their PetroBac™ bundle;
   b. Enzyme Accelerator (EZT-EA™), another component of the PetroBac bundle; and
   c. Custom Blend Nutrients (CBN™).

   The combination of these products will: (1) supply bacteria to enhance the growth of hydrogen-degrading microbes; (2) maximize contact between the bacteria and GRPH; and (3) supply required nutrients, such as nitrogen, phosphorus, and potassium to promote microbial growth.

Etec proposes to mix 3,000 lbs of CBN and 90 gallons of PetroBac with water to create 3,000 gallons of injectate solution that will be split evenly between the Cabin Grill and the Airport Kwik Stop. The solution will be applied to available monitoring and remediation wells; the quantity applied to each well will vary based on the contaminant concentrations at each injection point.

Based on the chemical analytical data provided, Etec estimated the contaminant mass near the Kwik Stop to be greater than 2,000 lbs and over 1,000 lbs near the Cabin Grill. Etec estimates that the total injection will degrade about 360 lbs of petroleum mass. Etec estimated the following costs: PetroBac (90 gallons) = $9,000; CBN (3,000 lbs) = $9,000. The estimate also included about $12,000 to cover the expenses associated with the shipping the products and providing injection services.

3.3. Recommended Remedial Alternative

Because the Cabin Grill domestic well is located near the treatment zone, we do not recommend ISCO injection near the Cabin Grill. The corrosive nature of ISCO could permanently damage the Cabin Grill domestic well and cause unacceptable risks to human health. Mitigation of the ISCO risks to the Cabin Grill well is uncertain. We recommend limiting ISCO application to the wells located near the Kwik Stop.

Based on this approach, the quantities and associated cost will be revised from those described above (the original quotes from PeroxyChem and Etec were to apply their products to both the Kwik Stop and the Cabin Grill). The planned remedial activities include:

1. Inform local emergency responders of pending chemical applications.
2. Injecting PeroxyChem's Klozur product into SVE wells SVE-2 and SVE-6, and monitoring points MP-1 and MP-2 (see Proposed Injection Wells – Kwik Stop, Figure 3) at the Kwik Stop. The revised estimate from PeroxyChem, to only apply Klozur to the Kwik Stop, reduces the product volume to about 20,000 lbs (for about $31,000). We further recommend using the NaOH activator instead of hydrogen peroxide. Both the hydrogen peroxide and NaOH have health and safety risks associated with handling the product, however, NaOH is the cheaper option. Based on the revised quote, PeroxyChem estimates about 33,500 lbs of a 25%wt NaOH solution will be required at an estimated cost between $4,900 and $17,400.

   About 250 lbs of Klozur will be mixed with about 90 gallons of water to create an approximately 25%wt solution. Based on 20,000 lbs of Klozur, about 7,200 gallons of the 25% solution will be split between the 4 injection points (about 1,800 gallons in each point). About 800 gallons of 25%wt NaOH will also be injected in each monitoring point. The solution will be injected into each well in two or three rounds, based on the ability of each injection point to receive the solution.
3. Injecting Etec's PetroBac bundle and CBN nutrients into monitoring wells MW-3, MW-19, MW-22 through MW-24. Etec's estimated quantity of products was based on injecting at both the Kwik Stop and the Cabin Grill; therefore, half the quantity recommended in Etec's proposal (1,500 lbs of CBN and 45 gallons of PetroBac) will be injected in to the Cabin Grill (see Proposed Injection Wells – Cabin Grill, Figure 4) wells at an estimated cost of $9,000. These products will supply the population of hydrocarbon-degrading bacteria and nutrients to support biological growth.

   The bioremediation amendments will be mixed with about 1,500 gallons of water to produce the remediation solution. The solution will be split evenly between the selected wells, about 300 gallons of solution per well and will be injected in 2 or 3 rounds based on the ability of the wells to accept the solution.

3.4. Cabin Grill Well Protection

The Cabin Grill well is currently the sole source of potable water for the residents on the property. Protecting the well from adverse effects caused by introducing amendments into the nearby monitoring and remediation wells is of primary importance. Because the effects of injecting ISCO products near the Cabin Grill well are not well understood and therefore potential mitigation strategies are also not well defined, the ISCO application will be restricted to the wells near the Kwik Stop.

Etec's product bundle (CBN and PetroBac) primarily consists of nutrients that can impact drinking water quality by elevating the concentrations of nitrates and/or sulfates. Use of the well likely creates a cone of depression that might accelerate migration of the bioremediation amendments applied in the nearby monitoring wells toward the Cabin Grill well. To protect the well, we propose installing an ion exchange or reverse osmosis water filtration system to remove nitrates and sulfates. The filter system will be installed prior to injecting the bioremediation amendments into the wells near the Cabin Grill per manufacturer specifications. We recommend collecting a water sample from the Cabin Grill well on a weekly basis for a period of at least 4 weeks to confirm that nitrate and sulfate concentrations remain less than the maximum contaminant level (MCL) of 10 mg/L for nitrates and the secondary MCL of 250 mg/L for sulfates.

In addition to the health risks associated with nitrate and sulfate based nutrients migrating to the Cabin Grill well, biofouling also might occur if there is sufficient microbial population and petroleum concentrations near the Cabin Grill well. If biofouling occurs, the well can be rehabilitated using various means, such as carbon dioxide injection or acid cleaning.

4.0 PROCEDURES

This section describes the task required to prepare for, conduct and monitor the remedial activities.

4.1. Product Injections

1. Complete Ecology's Underground Injection Control (UIC) Well Registration for the proposed injection wells.
2. Subcontract and coordinate with Etec and PeroxyChem to provide bioremediation amendments and ISCO products in accordance with their quotes (included in Appendix A).
3. Subcontract Able Cleanup Technologies, LLC (Able) to mix and inject the recommended bioremediation amendments and ISCO products. The injection system could consist of a combination of large poly tanks, totes, submersible pumps/controllers, injection lines, manifolds and other ancillary equipment. About 12,000 gallons of water will be required for the injections that will be supplied using a water truck.
4. Provide a field engineer or geologist to observe and document product applications. During injections, product concentrations, injection rates and cumulative volumes will be recorded at each injection point. Monitoring will also include collecting water elevations in nearby monitoring wells prior to and during injections.

4.2. Protection Monitoring

1. Before applying bioremediation amendments, install a water treatment system capable of removing nitrates and sulfates from drinking water at the Cabin Grill well. Commercially available nitrate treatment systems are available that remove nitrate and sulfate from drinking water. The subcontractor that provided the existing treatment system, Fogle Pump, will be retained to design and install additional treatment to address the nitrates and sulfates. A groundwater sample will be collected from the Cabin Grill well before the injections and analyzed nitrates and sulfates. Following injections and treatment installation, the Cabin Grill Well will be sampled for nitrates and sulfates weekly to verify the effectiveness of the treatment system.

2. Collect water level readings from site monitoring wells to characterize flow direction prior to injections. Depth to groundwater relative to the monitoring well casings will be measured to the nearest 0.01 foot using an electronic water level indicator.

3. Collect background groundwater samples from downgradient wells MW-6, -12, -13 -18, and 21 prior to injections. Based on a groundwater velocity of about 5.2 feet per day (Section 2.3.2) and a distance of about 200 feet from the Cabin Grill injection points, we estimate groundwater migration to these wells will require at least 40 days. If residual bioremediation amendments or byproducts migrate downgradient, we recommend collecting groundwater samples from these wells about 6 weeks following bioremediation injections and conducting monthly samples for at least three months. Groundwater samples will be collected using low-flow purging methods. During well purging, water quality parameters (temperature, pH, conductivity, dissolved oxygen and turbidity) will be monitored and recorded.

4. Submit groundwater samples to TestAmerica Laboratories, Inc. (TestAmerica) located in Spokane Valley, Washington for chemical analysis of nitrates and sulfates using EPA Method 300, ammonia using EPA Method 350.1, GRPH using Northwest Method NWTPH-Gx and BTEX using Environmental Protection Agency (EPA) Method 8260. The groundwater samples will be placed in laboratory-prepared sample containers and kept cool during transport. Chain-of-custody (COC) procedures will be observed from the time of sample collection to delivery to TestAmerica.

5. Review groundwater analytical data to assess if the groundwater chemistry has changed in monitoring wells MW-6, -12, -13, -18 and -21 relative to the pre-injection samples. If the above selected wells indicate a significant increase in ammonia, nitrate or sulfate concentrations relative to the pre-injection concentrations, then the following actions will be implemented:

    a. Collect groundwater samples from downgradient monitoring wells MW-11, -14 and -15 for chemical GRPH, BTEX, ammonia, nitrates and sulfates using the methods listed above.

    b. Review analytical data to assess if groundwater upgradient of domestic wells (monitoring wells MW-11, -14 and -15) indicate a significant increase in ammonia, nitrate or sulfate concentrations relative to background concentrations.

    c. If the above selected wells indicate a significant increase in ammonia, nitrate or sulfate concentrations, point-of-use water treatment systems designed to remove nitrate and sulfate from drinking water should be installed in residences supplied by potentially impacted domestic wells.

4.3. Performance Monitoring

1. Collect monthly groundwater samples from selected site monitoring wells within the treatment areas (MW-8 at the Kwik Stop and MW-5, MW-22 through MW-23 at the Cabin Grill) to assess injection performance, avoid over-treatment and potentially modify subsequent injection events. The established quarterly groundwater sampling will serve as the performance monitoring.
2. Performance monitoring groundwater samples should be submitted for chemical analysis of nitrates, sulfate, ammonia, GRPH and BTEX using the methods described above.

4.4. Reporting

Complete a Technical Report describing the remedial activities and protection and performance monitoring analytical results. This report will include:

- Tables of analytical data, injection rates, volumes and concentrations;
- A scaled map of the site showing the locations of wells used for injections and pertinent surface features;
- A groundwater elevation contour map of the shallow aquifer underlying the site (for each monitoring event); and
- A recommendation for follow up treatment options.

5.0 SUMMARY

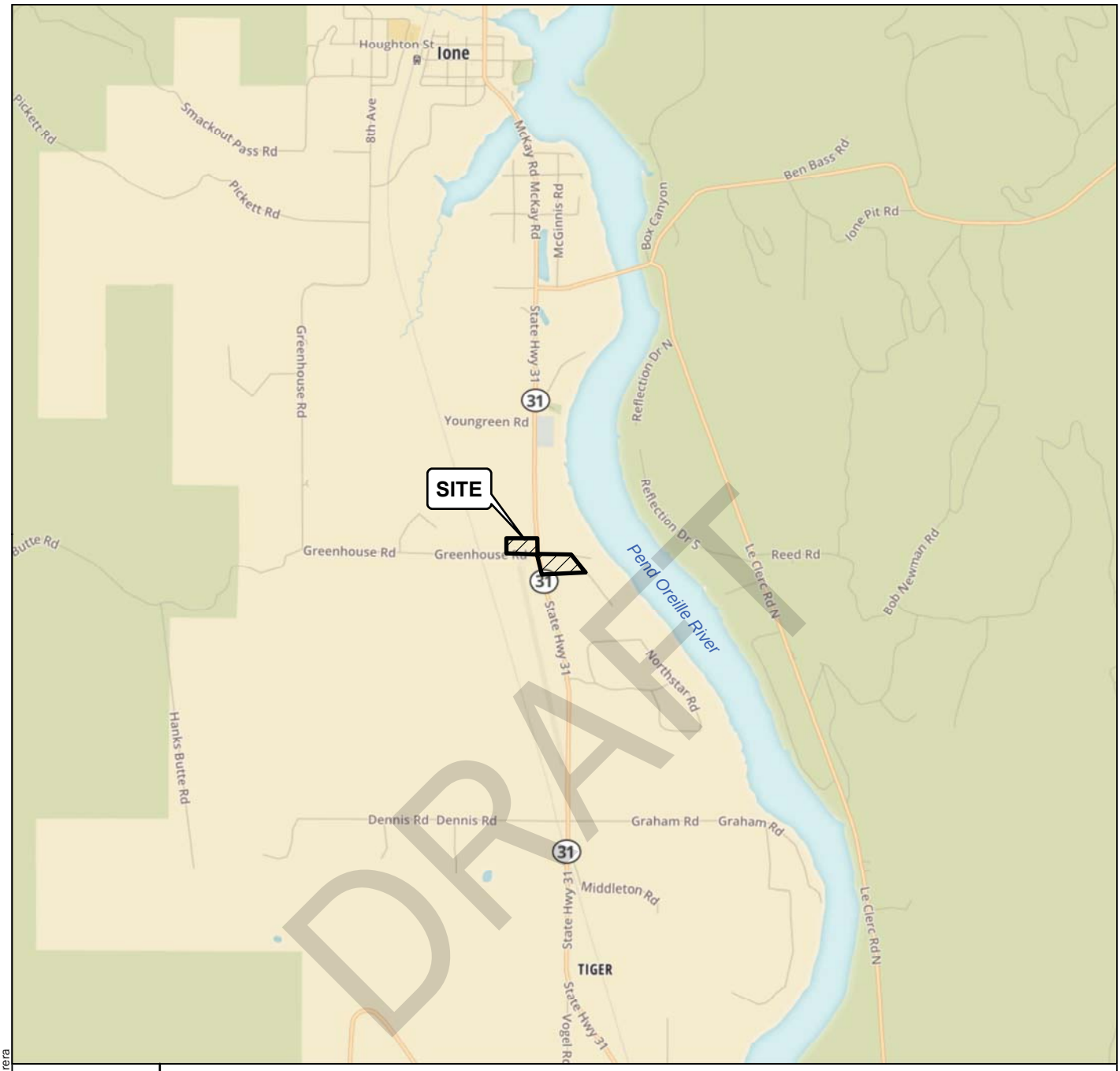
The proposed remediation technology (bioremediation amendment and ISCO injections) does not readily translate into quick results and it is likely that additional injection events will be necessary to achieve the remediation goals. However, we expect observable and quantifiable changes to groundwater quality in the short term (less than three months) and data can be evaluated to assess if and where additional injections are beneficial.

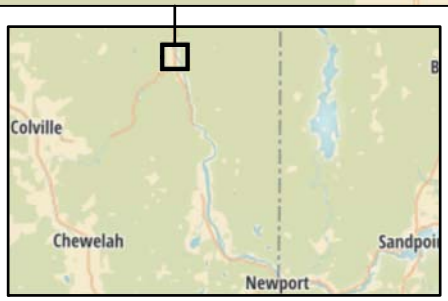
6.0 REFERENCES

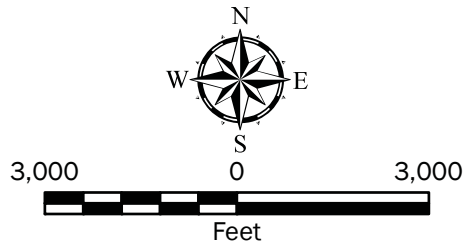
GeoEngineers, Inc. "Work Plan, Site Characterization, Ione Petroleum Contamination Project, Ione, Washington," GeoEngineers File No. 0504-058-00. April 9, 2010.

GeoEngineers, Inc. "Site Characterization Report, Ione Petroleum Contamination Site, Ione. Washington," GeoEngineers File No. 0504-058-00. October 14, 2010.

GeoEngineers, Inc. "Remedial Investigation, Airport Kwik Stop Site, Ione, Washington," GeoEngineers File No. 0504-058-02. January 29, 2013.







Notes:

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

Data Source: Mapbox Open Street Map, 2016

Projection: NAD 1983 UTM Zone 11N

Vicinity Map

Airport Kwik Stop Site
Ione, Washington

GeoEngineers

Figure 1

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Legend

- MW-1 — Approximate Location of Monitoring Well
- Ⓦ — Approximate Location of Existing Water Well
- Property Boundary

Reference: Aerial from ESRI, Online Data Resource Center.
Parcel boundaries digitized from Pend Oreille County GIS,
https://gis.pendoreilleco.org/pocgisweb/map.html

N W E S

250 0 250
Feet

Notes:
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Site Plan
Proposed Bioremediation Injection Wells

Airport Kwik Stop Site
Ione, Washington

GeoEngineers

Figure 2

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Legend

- MW-1 — Approximate Location of Monitoring Well
- MP-1 — Approximate Location of 2" Monitoring Point
- AS-1 — Approximate Location of Air Sparge Pilot Well
- Approximate Location of Bioremediation Injection Wells
- Approximate Location of 4" SVE Extraction Well

N W E S

30 0 30

Feet

Airport Kwik Stop
Proposed Bioremediation Injection Wells

Airport Kwik Stop Site
Ione, Washington

GeoEngineers

Figure 3

Reference: Reference: 2016 Image from Google Earth Pro.

Notes:
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Legend

- MW-3 — Approximate Location of Monitoring Well
- AS-2 — Approximate Location of Air Sparge Pilot Well
- Approximate Location of Bioremediation Injection Wells
- W — Approximate Location of Existing Water Well

N
W E
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50 0 50
Feet

Reference: 2016 Image from Google Earth Pro.

Notes:
1. The locations of all features shown are approximate.
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Cabin Grill
Proposed Bioremediation Injection Wells

Airport Kwik Stop Site
Ione, Washington

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Figure 4

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APPENDIX A
Vendor Estimates

PMB 133, 3307 Evergreen Way, Ste 707
Washougal, WA 98671
(971) 222-3616 • (971) 222-3903 Fax
www.etecllc.com

March 29, 2017

Mr. Justin Rice, P.G.
GeoEngineers, Inc.
523 East Second Avenue
Spokane, WA 99202

RE: PROPOSAL FOR BIOREMEDIATION ENHANCEMENT, IONE QWIK STOP, IONE, WASHINGTON

Mr. Rice:

This quote includes costs for bioremediation products and also contains recommendations for application to impacted soil/groundwater.

PROJECT UNDERSTANDING

Based on your provided information, we understand that:

- A fuel release(s) has impacted multiple properties
- Soil borings DP-18, B-1, DP-22, DP-24 and DP-25 contain exceedances of GRPH (MTCA A)
- Soil borings DP-18, B-1, DP-21, DP-22, MW-3 and MW-6 contain exceedances of BTEX (MTCA A)
- Groundwater wells MW-3, MW-5, MW-6, MW-8, MW-20, MW-21, MW-22, and MW-25 contain exceedances of GRPH (MTCA A)
- Groundwater wells MW-3, MW-6, MW-8 and MW-13 contain exceedances of BTEX (MTCA A)
- 2011-2013 data shows the following wells are impacted by:
    - MW-3 – 7,900 µg/L GRPH
    - MW-5 – 19,200 µg/L GRPH
    - MW-6 – 18,800 µg/L GRPH
    - MW-8 – 23,200 µg/L GRPH
    - Cabin Grill Well – 10,300 µg/L GRPH
- Soil onsite is sand or silty sand with gravel
- DTW is 30-40 feet bgs
- Bioremediation product application to the available wells onsite is desired
- Potable water is available for use on both the Qwik Stop site and the Cabin Grill site (ETEC will not be responsible for water usage)

This data and the associated assumptions were used to determine appropriate biological product and equipment requirements, and to provide recommendations for site-specific application.

PRODUCT RECOMMENDATIONS

For biological products at this site, we recommend our TPH Bacterial Consortium (EZT-A2™) and Enzyme Accelerator (EZT-EA™) which make up our PetroBac™ product bundle. Our CBN™ (NutriMax™) nutrients, which include macro- and micro-nutrients specially blended for in-situ bioremediation, will be necessary. These products work together to efficiently degrade TPH and their application will perform three critical in-situ functions, including:

1. Supply of a large population of pre-acclimated bacteria to optimize initial growth of a healthy, in situ, hydrocarbon-degrading microbial population.

2. Maximize contact between the contaminants and the bacteria. Bioremediation is a contact technology – the bacteria must physically contact the heating oil food source and the electron acceptors (oxygen, nitrate, and sulfate) to biochemically oxidize the petroleum to CO_2 and water.
3. Supply of critical nutrients like nitrogen, phosphorus, and potassium to support ongoing biological growth. The nitrogen compounds also act as secondary electron acceptors to ensure continuous contaminant degradation during temporary absences of dissolved oxygen.

SITE APPLICATION

To treat the remaining impacted area, we offer the following site application recommendations:

1. Utilize ETEC's injection equipment to apply a minimum of 3,000 gallons of bioremediation product solution to the wells available for injection.
    a. On the Qwik stop site, a minimum of 1,500 gallons of solution will be applied to the DP-17, DP-18 and DP-19 area. AS/SVE wells can also be utilized if available.
    b. On the Cabin Grill site, a minimum of 1,500 gallons of solution will be applied to the MW-5, MW-22, MW-23 and MW-24 area. AS/SVE wells can also be utilized if available.
2. For the impacted area, 3,000 lbs. of CBN and 90 gallons of our PetroBac bioremediation products will be mixed with enough water to make a minimum 3,000 gallons of injectate. This solution will be delivered either evenly across the available wells for injection or focused into the areas with the most remaining contamination.
3. Potable water is available onsite and can be used for mixing and injection.

NUTRIENT AND PLATE COUNT SAMPLING

To maximize the effectiveness of the treatment, scheduled collection of some specific parameters is recommended. These parameters include field readings (DO, pH, ORP, conductivity, temperature), inorganic parameters (nutrient components are nitrate, ammonia, and sulfate), and plate count concentrations to evaluate in situ microbial growth. The cost table below does not include a line item for plate count and nutrient analysis for 1-2 groundwater samples per quarter by local laboratories that specialize in these parameters (recommended).

MASS BALANCE

Using the average groundwater TPH concentration onsite (using impacted well groundwater data), the total estimated TPH mass in the saturated soil zone (includes groundwater) in the MW-3/MW-8 treatment area is estimated to be over 2,000 lbs. and over 1,000 lbs. within the Cabin Grill treatment area. Please note that this is an estimate and is dependent on the amount of connection between the monitoring well and any possible areas of trapped contamination.

In order for any remediation strategy to be effective, it must be based on dealing not only with the contaminants of concern, but all TPH constituents. Any approach that does not incorporate the appropriate masses of amendments based on this estimated contaminant mass will not succeed.

Assuming the prescribed amounts of CBN™ below will be injected during the one-time event, the mass of electron acceptors delivered in the injection will be over 1,800 lbs. and capable of degrading over 360 lbs. of TPH contaminants.

BIOREMEDIATION INJECTION EVENT COST

The following table outlines project costs as described above.

Item	Cost
Bioremediation Products & Application	
PetroBac™ Product Bundle – 90 gal.	$9,000.00
CBN™ Nutrients – 3,000 lbs.	$9,000.00
Injection Trailer Rental – 3 days	$3,000.00
Labor – 5 days, mobilization, demobilization	$4,000.00
Expenses	$1,185.00
Shipping	$2,200.00
Sales Tax 8.7%	$2,469.50
INJECTION EVENT TOTAL	**$30,854.50**

We believe that a one-time treatment will show reductions in the soil and dissolved-phase constituents. After the first treatment, the collected data will need to be examined and the treatment modified if necessary. Additional treatments may be necessary due to the large impacted area onsite and the large amount of contamination present.

At the time of purchase, we will provide GeoEngineers with specific recommendations for product mixing, dilution, and inoculation. Please review the summarized costs and call me at 971-222-3616 x104 with any questions or comments. Thank you for this opportunity, and we look forward to working with you on this project.

Respectfully,

ETEC, LLC

_____

Eric Bueltel, P.E.
Technical Director

APPENDIX B
Health and Safety Plan

APPENDIX B
HEALTH AND SAFETY PLAN

This Health and Safety Plan (HASP) is to be used in conjunction with the GeoEngineers Safety Program Manual. Together, the written safety programs and this HASP constitute the site safety plan for this site. This plan is to be used by GeoEngineers personnel on this site and must be available on site. If the work entails potential exposures to other substances or unusual situations, additional safety and health information will be included and the plan will be approved by the GeoEngineers Health and Safety Manager. All plans are to be used in conjunction with current standards and policies outlined in the GeoEngineers Health and Safety Program Manual.

TABLE B-1. GENERAL PROJECT INFORMATION

Project Name:	Former Priceless Gas
Project Number:	0504-058-06
Type of Project:	Bioremediation Amendment Injections
Project Address:	2111 Highway 31, Ione, Washington
Start/Completion:	April 2017; May 2017
Subcontractors:	Able Cleanup Technologies, LLC Etec, LLC. TestAmerica, Inc.

Liability Clause - This Site Safety Plan is intended for use by GeoEngineers Employees only. It does not extend to the other contractors or subcontractors working on this site. If requested by subcontractors, this site safety plan may be used as a minimum guideline for those entities to develop safety plans or procedures for their own staff to work under. In this case, Form 3 shall be signed by the subcontractor.

Personnel participating in this project must receive initial health and safety orientation (Form 1). Thereafter, brief tailgate safety meetings will be held at least daily by the Site Safety and Health Supervisor.

The orientation and the tailgate safety meetings shall include a discussion of emergency response, site communications and site hazards.

TABLE B-2. ORGANIZATION CHART

Chain of Command	Title	Name	Telephone Numbers
1	Project Manager	Scott Lathen	O: 509.209.2830 C: 509.251.5239
2	Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) Supervisor	Justin Rice	O: 509.209.2840 C: 208.589.3384

Chain of Command	Title	Name	Telephone Numbers
3	Field Engineer/Geologist	Justin Rice	See above
4	Site Safety and Health Supervisor (Site Safety Officer; [SSO])	Justin Rice	See above
5	Client Assigned Site Supervisor	Bruce Williams	509.363.3125
6	Health and Safety Program Manager (HSM)	Wayne Adams	O: 425.861.6000 C: 253.350.4387
N/A	Subcontractor(s)	Etec, LLC PeroxyChem Able Cleanup Technologies, LLC	971.222.3616 509.466.5255

SITE SAFETY AND HEALTH SUPERVISOR

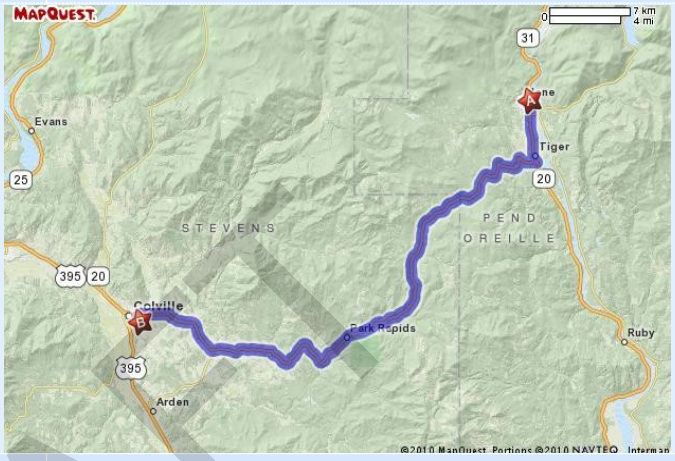
The individual present at a hazardous waste site responsible to the employer and who has the authority and knowledge necessary to establish the site-specific health and safety plan and verify compliance with applicable safety and health requirements.

GeoEngineers employees often do not have stop work authority on projects controlled by other contractors; however, any GeoEngineers employee, regardless of job title, working in the field will be responsible for contacting the Project Manager if they observe practices on the job site that are serious safety violations that are not under their control. They will document the unsafe practices and will contact the site supervisor as identified by the client. If no one is on site, the Project Manager, once notified, will contact the client. This action establishes GeoEngineers commitment to site health and safety on all job sites as our duty of care to the public, contractors, and clients.

TABLE B-3. PERSONNEL TRAINING RECORDS

Name of Employee On Site	Level of HAZWOPER Training (24-/40-hour)	Date of 8-Hour Refresher Training	First Aid/ Cardiopulmonary Resuscitation (CPR)	Date of Respirator Fit Test
Justin Rice	40-hr	03/17/2017	03/11/16	03/19/16

TABLE B-4. EMERGENCY INFORMATION

Hospital Name and Address:	Mount Caramel Hospital 982 E Columbia Colville, WA 99114
Phone Numbers (Hospital ER):	(509) 685-5100 or 911
Distance:	40 miles
Route to Hospital: 1. Head south on WA-31 2. Turn right on WA-20 3. Turn left onto N Alder Street 4. Turn right onto E Birch Ave 5. Turn left onto E Columbia Ave 6. Arrive 982 E Columbia Ave on right	
Ambulance:	911
Poison Control:	800.222.1222
Police:	911
Fire:	911
Location of Nearest Telephone:	Cell phones are carried by field personnel.
Nearest Fire Extinguisher:	Located in the GeoEngineers' vehicle on site.
Nearest First-Aid Kit:	Located in the GeoEngineers' vehicle on site.

STANDARD EMERGENCY PROCEDURES

1. Get help
    a. Send another worker to phone 911 (if necessary)
    b. As soon as feasible, notify GeoEngineers' project manager
1. Reduce risk to injured person
    c. Turn off equipment
    d. Move person from injury location (if possible)
    e. Keep person warm
    f. Perform CPR (if necessary)
2. Transport injured person to medical treatment facility (if necessary)

g. By ambulance (if necessary) or GeoEngineers vehicle

h. Stay with person at medical facility

i. Keep GeoEngineers manager apprised of situation and notify human resources manager of situation

COMPREHENSIVE WORK PLAN

- Mix and inject bioremediation amendment products.
- Collect groundwater samples from selected site monitoring wells.
- Submit groundwater wells for laboratory analysis of one or more of the following: nitrates and sulfates.

TABLE B-5. LIST OF FIELD ACTIVITIES

Check the Activities to be Completed during the Project	
X	Site reconnaissance
	Exploratory borings
X	Bioremediation amendment injections
	Test pit exploration
	Monitoring well installation
	Monitoring well development
	Soil sample collection
	Field screening of soil samples
	Soil Vapor measurements
	Soil Vapor sampling
X	Groundwater sampling
X	Groundwater depth
X	Product sample measurement (if any)
	Soil stockpile testing
	Remedial excavation
	UST removal monitoring
	Remediation system monitoring
	Recovery of free product

HAZARD ANALYSIS

Note: A hazard assessment will be completed at every site prior to beginning field activities. Updates will be included in the daily log. This list is a summary of hazards listed on the form.

TABLE B-6. PHYSICAL HAZARDS

	Drill rigs
	Overhead hazards/power lines
X	Tripping/puncture hazards
X	Snow, rain, ice, freezing temperatures
X	Heat/ Cold, Humidity
	Utilities/ utility locate
	Contaminated soil
X	Contaminated groundwater
X	Loud noise
	Backhoe
	Trackhoe
	Crane
	Front End Loader
	Excavations/trenching (1:1 slopes for Type B soil)
	Shored/braced excavation if greater than 4 feet of depth

- Utility check list completed: there may be site specific procedures for preventing drilling or digging into utilities. Add these procedures to the standard GeoEngineers utility check list.
- Lifting hazards: use proper techniques, mechanical devices where appropriate.
- Terrain obstacles: terrain could be soft and activities will be conducted to minimize lawn damage and the potential for vehicles to get stuck.
- Personnel will wear high-visibility vests for increased visibility by vehicle and equipment operators.
- Field personnel will be aware constantly of the location and motion of heavy equipment. A safe distance will be maintained between personnel and the equipment. Personnel will be visible to the operator at all times and will remain out of the swing and/or direction of the equipment apparatus. Personnel will approach operating heavy equipment only when they are certain the operator has indicated it is safe to do so.
- Heavy equipment and/or vehicles used on this site will not work within 20 feet of overhead utility lines without first ensuring that the lines are not energized. This distance may be reduced to 10 feet depending on the client and the use of a safety watch.
- Working equipment around overhead power lines requires distance and a spotter. Before a job begins, call the utility company and find out voltage in lines. Have the equipment de-energized if possible. Ensure that the equipment remains de-energized by using some type of lockout and tag procedure, and ensure that the electrician uses grounding lines when they are required.
- Keep a safe distance from energized parts which is a minimum of 10 feet for 50 kilovolt (kV) and under. The minimum distance will be more for higher voltages (above 50 kV). The only exception is for trained and qualified electrical workers using insulated tools designed for high voltage lines.

- Don't operate equipment around overhead power lines unless you are authorized and trained to do so. If an object (scaffolds, crane, etc.) must be moved in the area of overhead power lines, appoint a competent worker whose sole responsibility is to observe the clearance between the power lines and the object. Warn others if the minimum distance is not maintained.
- Never touch an overhead line if it has been brought down by machinery or has fallen. Never assume lines are dead. When a machine is in contact with an overhead line, DO NOT allow anyone to come near or touch the machine. Stay away from the machine and summon outside assistance. Never touch a person who is in contact with a live power line.
- If you are in a vehicle that is in contact with an overhead power line, DON'T LEAVE THE VEHICLE. As long as you stay inside and avoid touching metal on the vehicle, you may avoid an electrical hazard. If you need to get out to summon help or because of fire, jump out without touching any wires or the machine, keep your feet together, and hop to safety.
- When mechanical equipment is being operated near overhead power lines, employees standing on the ground may not contact the equipment unless it is located so that the required clearance cannot be violated even at the maximum reach of the equipment.
- When working near overhead power lines, the use of nonconductive wooden or fiberglass ladders is recommended. Aluminum ladders and metal scaffolds or frames are efficient conductors of electricity.
- Avoid storing materials under or near overhead power lines.
- Personnel will avoid tripping hazards, steep slopes, pit and other hazardous encumbrances. If it becomes necessary to work within 6 feet of the edge of a pit, slope, pier or other potentially hazardous area, appropriate fall protection measures will be implemented by the Site Safety and Health Supervisor in accordance with Occupational Safety and Health Administration (OSHA)/Division of Occupational Safety and Health (DOSH) regulations and the GeoEngineers Safety Program manual.
- Heat stress control measures must be implemented according to the GeoEngineers, Inc. program with water provided on site. See Additional Programs at end of this HASP.
- Excessive levels of noise (exceeding 85 decibels [dBA]) are anticipated. Personnel potentially exposed will wear ear plugs or muffs with a noise reduction rating of at least 25 dBA whenever it becomes difficult to carry on a conversation 6 feet away from a co-worker or whenever noise levels become bothersome. (Increasing the distance from the source will decrease the noise level noticeably.)
- Work may be conducted in rain, freezing rain, snow or icy conditions. Care will be taken to wear warm water proof clothing that limits exposure to cold.

TABLE B-7. ENGINEERING CONTROLS

	Trench shoring (1:1 slope for Type B Soils)
X	Locate work spaces upwind/wind direction monitoring
	Other soil covers (as needed)
	Other (specify _____

TABLE B-8. CHEMICAL HAZARDS (POTENTIALLY PRESENT AT SITE)

Petroleum Products	
Suspected	Gasoline-range Hydrocarbons
Suspected	Aromatic hydrocarbons (BTEX)

TABLE B-9. SUMMARY OF CHEMICAL HAZARDS

Compound/ Description	**Exposure Limits/Immediately Dangerous to Life or Health (IDLH)**	**Exposure Routes**	**Toxic Characteristics**
Gasoline Fuel—liquid with a characteristic odor	OSHA PEL 300 ppm IDLH 20,000 (LEL)	Ingestion, inhalation, skin absorption, skin and eye contact	Irritated eyes, skin, mucous membrane; fatigue; blurred vision; dizziness; slurred speech; confusion; convulsions; and headache; dermatitis.
Benzene	PEL 5 ppm IDLH 500 ppm	Inhalation, ingestion, skin absorption, and/or direct contact	Irritation of eyes, skin, nose, respiratory system, dizziness, headache, nausea, staggered gait, anorexia, exhaustion, dermatitis, bone marrow depression (leukemia).
Toluene	PEL 100 ppm IDLH 500 ppm	Inhalation, absorption, ingestion, direct contact	Irritation to eyes, nose, exhaustion, confusion, dizziness, headaches, dilated pupils, euphoria, anxiety, teary eyes, muscle fatigue, insomnia, paresthesia, dermatitis, liver and kidney damage.
Ethyl benzene	PEL 100 ppm IDLH 800 ppm	Inhalation, ingestion, direct contact	Irritation to eyes, skin, respiratory system, burning of skin, dermatitis.
Xylenes	PEL 100 ppm IDLH 900 ppm	Inhalation, skin absorption, ingestion, direct contact	Irritation to eyes, skin, nose, throat, dizziness, excitement, drowsiness, incoordination, staggering gait, corneal vacuolization, anorexia, nausea, vomiting, abdominal pain, dermatitis.

Notes:
ppm = parts per million
LEL = lower explosive limit
PEL = permissible exposure limit

Groundwater Sampling: Splash hazard associated with groundwater extraction and sample collection. Possible corrosion hazard associated with sample preservatives. Wear protective clothing and eye protection and chemical-resistant gloves are required when handling samples.

Sample handling, packaging, and processing: skin contact with contaminated media and preservative acids. Wear modified Level D personal protection equipment (PPE).

Decontamination of equipment: inhalation or eye contact or skin contact with airborne mists or vapors, or contaminated liquids. Wear safety glasses; decontaminate clothing and skin prior to eating, drinking or other hand to mouth contact.

TABLE B-10. BIOLOGICAL HAZARDS AND PROCEDURES

Y/N	Hazard	Procedures
N	Poison Ivy or other vegetation	
N	Insects or snakes	
	Others	

Site personnel shall avoid contact with or exposures to potential biological hazards encountered.

Additional Hazards (Update in Daily Log)

Include evaluation of:

- Physical Hazards (equipment, traffic, tripping, heat stress, cold stress and others)
- Chemical Hazards (odors, spills, free product, airborne particulates and others present)
- Biological Hazards (snakes, spiders, other animals, poison ivy and others present)

Air Monitoring Plan

Work upwind if at all possible.

Check Instrumentation to be Used

_____ TLV Monitor (flammability only, for methane and petroleum vapors)

___X___ PID (Photoionization Detector)

_____ Other (i.e., detector tubes): _____

Check Monitoring Frequency/Locations: and Type (Specify: Work Space, Borehole, Breathing Zone)

_____15 minutes—Continuous during soil disturbance activities or handling samples

_____ 15 minutes

_____ 30 minutes

___X___ Hourly (in breathing zone during excavations, drilling, sampling)

Exposure to airborne vapors shall be monitored using a PID with an 11.7 eV lamp. The PID has the ability to detect vapor concentrations from 1 ppm to 1,000 ppm. PID monitoring shall be conducted in the breathing zone. Chemicals in air should be avoided by working upwind of investigation locations where possible. Field personnel shall identify the wind direction in relationship to the investigation location and seek to position themselves upwind from the investigation location. Additional air monitoring will be performed as needed.

A vapor (i.e., PID) measurement survey of the investigation area (i.e., area to be investigated in a given day) should be conducted every 30 minutes during initial investigation activities. If the vapor concentration is

below 5 ppm in the breathing zone and workspace, measurement surveys can be conducted hourly (or more often if persistent odors are detected). If vapor concentrations exceed 5 ppm continuously for a 10-minute period as measured in the breathing zone and workspace, field personnel shall upgrade to Level C PPE or move to a non-contaminated area.

SITE CONTROL PLAN

The site control plan will be modified in the field if needed to minimize employee exposure to hazardous substances. A site map and hospital route map are included in this HASP.

Traffic or Vehicle Access Control Plans

Survey tape and traffic cones will be used to cordon off any areas on site where borings will be conducted in order to restrict public vehicular and pedestrian access. Temporary signage and traffic cones will be placed in accordance with WSDOT Traffic Control Plans while working within roadway shoulder or traffic lanes.

Site Work Zones

Exclusion zones will be established within approximately 10 feet around each boring or well during drilling/sampling. Only persons with the appropriate training will enter this perimeter while work is being conducted there.

Method of Delineation / Excluding Non-Site Personnel	
	Fence
X	Traffic Cones
X	Other Road Work Signs

Buddy System

Personnel on-site should use the buddy system (pairs), particularly whenever communication is restricted. If only one GeoEngineers employee is on-site, a buddy system can be arranged with subcontractor / contractor personnel.

Site Communication Plan

Positive communications (within sight and hearing distance or via radio) should be maintained between pairs on-site, with the pair remaining in proximity to assist each other in case of emergencies. The team should prearrange hand signals or other emergency signals for communication when voice communication becomes impaired (including cases of lack of radios or radio breakdown). In these instances, consider suspending work until communication can be restored; if not, the following are some examples for communication:

- Hand gripping throat: Out of air, can't breathe.
- Gripping partner's wrist or placing both hands around waist: Leave area immediately, no debate.
- Hands on top of head: Need assistance.
- Thumbs up: Okay, I'm all right. or I understand.

- Thumbs down: No, negative.
- Extended fist: Stop.

Decontamination Procedures

Non-dedicated sampling equipment will be decontaminated with Liquinox® soap and rinsed with distilled water prior to collecting any samples for analysis.

Personal decontamination consists of removing outer protective Tyvek clothing (if used), washing soiled boots, removing respirator (if used); hands and face will be washed in either a portable wash station or a bathroom facility in the support zone. Employees will perform decontamination procedures and wash prior to eating, drinking or leaving the site. Disposable personal protective clothing (i.e., nitrile gloves) will be bagged with other miscellaneous waste and discarded in the appropriate refuse receptacle in the contamination reduction zone.

PERSONAL PROTECTIVE EQUIPMENT

PPE will consist of standard Level D equipment. Disposable PPE (gloves) will be placed into plastic trash bags and disposed as solid waste. Minimum level of protective equipment for this site is Level D. After the initial and/or daily hazard assessment has been completed, increase the level of PPE, if needed. Task-specific levels of PPE shall be reviewed with field personnel during the pre-work briefing conducted prior to the start of site operations.

Check Applicable Personal Protection Equipment to be Used	
X	Hardhat
X	Steel-toed boots
X	Safety glasses
X	Hearing protection
X	Rubber boots (if wet conditions)
Gloves (specify)	
X	Nitrile
	Latex
	Liners
	Leather
	Other (specify) _____
Protective clothing	
	Tyvek (if dry conditions are encountered, Tyvek is sufficient)
	Saranex (personnel shall use Saranex if liquids are handled or splash may be an issue)
X	Cotton
X	Rain gear (as needed)
X	Layered warm clothing (as needed)

Check Applicable Personal Protection Equipment to be Used	
Inhalation hazard protection	
X	Level D
	Level C (respirators with organic vapor filters / P100 filters)

Limitations of Protective Clothing

PPE clothing ensembles designated for use during site activities shall be selected to provide protection against known or anticipated hazards. However, no protective garment, glove, or boot is entirely chemical-resistant, nor does any PPE provide protection against all types of hazards. To obtain optimum performance from PPE, site personnel shall be trained in the proper use and inspection of PPE. This training shall include the following:

- Inspect PPE before and during use for imperfect seams, non-uniform coatings, tears, poorly functioning closures, or other defects. If the integrity of the PPE is compromised in any manner, proceed to the contamination reduction zone and replace the PPE.
- Inspect PPE during use for visible signs of chemical permeation such as swelling, discoloration, stiffness, brittleness, cracks, tears, or other signs of punctures. If the integrity of the PPE is compromised in any manner, proceed to the contamination reduction zone and replace the PPE.
- Disposable PPE should not be reused after breaks unless it has been properly decontaminated.

Respirator Selection, Use and Maintenance

GeoEngineers has developed a written respiratory protection program in compliance with OSHA requirements contained in 29 code of federal regulations (CFR) 1910.134. Site personnel shall be trained on the proper use, maintenance, and limitations of respirators. Site personnel that are required to wear respiratory protection shall be medically qualified to wear respiratory protection in accordance with 29 CFR 1910.134. Site personnel that will use a tight-fitting respirator must have passed a qualitative or quantitative fit test conducted in accordance with an OSHA-accepted fit test protocol. Fit testing must be repeated annually or whenever a new type of respirator is used. Respirators will be stored in a protective container.

Respirator Cartridges

If site personnel are required to wear air-purifying respirators, the appropriate cartridges shall be selected to protect personnel from known or anticipated site contaminants. The respirator/cartridge combination shall be certified and approved by National Institute for Occupational Safety and Health (NIOSH). A cartridge change-out schedule shall be developed based on known site contaminants, anticipated contaminant concentrations, and data supplied by the cartridge manufacturer related to the absorption capacity of the cartridge for specific contaminants. Site personnel shall be made aware of the cartridge change-out schedule prior to the initiation of site activities. Site personnel shall also be instructed to change respirator cartridges if they detect increased resistance during inhalation or detect vapor breakthrough by smell, taste, or feel although breakthrough is not an acceptable method of determining the change-out schedule. At a minimum, cartridges should be changed a minimum of once daily.

Respirator Inspection and Cleaning

The SSO shall inspect respirators at the project site as needed. Site personnel shall inspect respirators prior to each use in accordance with the manufacturer's instructions. In addition, site personnel wearing a tight-fitting respirator shall perform a positive and negative pressure user seal check each time the respirator is donned to ensure proper fit and function. User seal checks shall be performed in accordance with the GeoEngineers respiratory protection program or the respirator manufacturer's instructions.

Facial Hair and Corrective Lenses

Site personnel with facial hair that interferes with the sealing surface of a respirator shall not be permitted to wear respiratory protection or work in areas where respiratory protection is required. Normal eyeglasses cannot be worn under full-face respirators because the temple bars interfere with the sealing surface of the respirator. Site personnel requiring corrective lenses will be provided with spectacle inserts designed for use with full-face respirators. Contact lenses should not be worn with respiratory protection.

ADDITIONAL ELEMENTS

Cold Stress Related Hazards

Working in cold environments can present many hazards to site personnel that can result in frost nip (superficial freezing of the skin), frost bite (deep tissue freezing), or hypothermia (lowering of the core body temperature). The combination of wind and cold temperatures increases the degree of cold stress experienced by site personnel. Site personnel shall use the following as a guide to the signs and symptoms of cold-related illnesses and measures to prevent the onset of cold-related injuries.

TABLE B-11. COLD-RELATED ILLNESS: SYMPTOMS AND FIRST AID

Disorder	Symptoms	Signs	Causes	First Aid
Hypothermia	Chills; pain in extremities; fatigue or drowsiness.	Euphoria; slow, weak pulse; slurred speech: collapse; shivering; unconsciousness; body temperature < 95f (35c).	Excessive exposure, exhaustion or dehydration, subnormal tolerance, drug/alcohol abuse.	Move to warm area and remove wet clothing. Modest external warming (external hear packs, etc.). Drink warm, sweet fluids if conscious. Transport to hospital.
Frostbite	Burning sensation at first. Coldness, numbness, tingling.	Skin color white or grayish yellow to reddish violet to black. Blisters. Response to touch depends on depth of freezing.	Exposure to cold, vascular disease.	Move to warm area and remove wet clothing. External warming (warm water). Drink warm, sweet fluids if conscious. Transport to hospital.
Frostnip	Possible itching or pain.	Skin color white.	Exposure to cold (above freezing) and dampness.	Similar to frostbite.
Trench Foot	Severe pain; tingling, itching.	Edema; blisters; response to touch depends on depth of freezing.	Exposure to cold (above freezing) and dampness.	Similar to frostbite.

Emergency Response

- Personnel on-site should use the "buddy system" (pairs).
- Visual contact should be maintained between "pairs" on-site, with the team remaining in proximity to assist each other in case of emergencies.
- If any member of the field crew experiences any adverse exposure symptoms while on-site, the entire field crew should immediately halt work and act according to the instructions provided by the SSO.
- The discovery of any condition that would suggest the existence of a situation more hazardous than anticipated should result in the evacuation of the field team, contact of the project manager, and reevaluation of the hazard and the level of protection required.
- If an accident occurs, the SSO and the injured person are to complete, within 24 hours, an Accident Report for submittal to the project manager, the HSM and human resources. The project manager should ensure that follow-up action is taken to correct the situation that caused the accident or exposure.

Site Control Measures

Listed above in Site Control Plan.

Spill Containment Plans (Drum and Container Handling)

Drummed IDW will be placed in a secure location approved by the site owner. Drums will be labeled with their contents.

Standard Operating Procedures for Sampling, Managing, and Handling Drums and Containers

Drums and containers used during the cleanup shall meet the appropriate DOT, OSHA and EPA regulations for the waste that they contain. Site operations shall be organized to minimize the amount of drum or container movement. When practicable, drums and containers shall be inspected and their integrity shall be ensured before they are moved. Unlabeled drums and containers shall be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled. Before drums or containers are moved, employees involved in the transfer operation shall be warned of the potential hazards associated with the contents.

Drums or containers and suitable quantities of proper absorbent shall be kept available and used where spills, leaks or rupture may occur. Where major spills may occur, a spill containment program shall be implemented to contain and isolate the entire volume of the hazardous substance being transferred. Fire extinguishing equipment shall be on hand and ready for use to control incipient fires.

Personnel Medical Surveillance

GeoEngineers' employees are not in a medical surveillance program as they do not fall into the category of "Employees Covered" in OSHA 1910.120(f)(2) which states a medical surveillance program is required for the following employees:

1. Employees who are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits or, if there is no permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year;

2. Employees who wear a respirator for 30 days or more a year or as required by state and federal regulations;
3. Employees who are injured, become ill or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation; and
4. Members of hazardous materials (HAZMAT) teams.

Sanitation

Field staff and subcontractors must go off site to access sanitation facilities.

Lighting

Fieldwork will be conducted during daylight hours.

Other Programs

None.

Documentation to Be Completed for HAZWOPER Projects

NOTE: The Field Log is to contain the following information:

- Updates on hazard assessments, field decisions, conversations with subs, client or other parties.
- Air monitoring/calibration results; personnel, locations monitored, activity at the time of monitoring (if performed).
- Actions taken.
- Action level for upgrading PPE and rationale.
- Meteorological conditions (temperature, wind direction, wind speed, humidity, rain, snow, etc.).

Required forms:

- Field Log.
- Health and Safety Plan acknowledgment by GeoEngineers' employees (Form 2).
- Contractors Health and Safety Plan Disclaimer (Form 3).
- Conditional forms available at GeoEngineers office: Accident Report.

APPROVALS

1.			Date
2.	Plan Approval	PM Signature	Date
3.	Health & Safety Officer	Wayne Adams Health & Safety Program Manager	Date

FORM 1
HEALTH AND SAFETY PRE-ENTRY BRIEFING

Inform employees, contractors, and subcontractors or their representatives about:

- The nature, level, and degree of exposure to hazardous substances they're likely to encounter, all site-related emergency response procedures, any identified potential fire, explosion, health, safety, or other hazards.
- Conduct briefings for employees, contractors and subcontractors, or their representatives as follows:
- A pre-entry briefing before any site activity is started.
- Additional briefings, as needed, to make sure that the site-specific HASP is followed.
- Make sure all employees working on the site are: Informed of any risks identified and trained on how to protect themselves and other workers against the site hazards and risks
- Update all information to reflect current sight activities and hazards.
- Personnel participating in this project must receive initial health and safety orientation. Thereafter, daily brief tailgate safety meetings will be held or as deemed necessary by the Site Safety and Health Supervisor (such as a significant change in field conditions).
- The orientation and the tailgate safety meetings shall include a discussion of emergency response, site communications and site hazards.

Date	Topics	Attendee	Company Name	Employee Initials

FORM 2
SITE SAFETY PLAN – GEOENGINEERS' EMPLOYEE ACKNOWLEDGMENT
FORMER PRICELESS GAS

(All GeoEngineers' site workers complete this form, which should remain attached to the safety plan and filed with other project documentation).

I, _____, do hereby verify that a copy of the current Safety Plan has been provided by GeoEngineers, Inc., for my review and personal use. I have read the document completely and acknowledge a full understanding of the safety procedures and protocol for my responsibilities on site. I agree to comply with all required, specified safety regulations and procedures. I understand that I will be informed immediately of any changes that would affect site personnel safety.

Signed _____ Date _____

Range of Dates From: _____
To: _____

Signed _____ Date _____

Range of Dates From: _____
To: _____

Signed _____ Date _____

Range of Dates From: _____
To: _____

Signed _____ Date _____

FORM 3
SUBCONTRACTOR AND SITE VISITOR SITE SAFETY FORM
IONE FORMER KWIK STOP AND CABIN GRILL

I, _____, verify that a copy of the current site Safety Plan has been provided by GeoEngineers, Inc. to inform me of the hazardous substances on site and to provide safety procedures and protocols that will be used by GeoEngineers' staff at the site. By signing below, I agree that the safety of my employees is the responsibility of the undersigned company.

Signed _____ Date _____

Firm: _____

Signed _____ Date _____

Firm: _____

Signed _____ Date _____

Firm: _____

Signed _____ Date _____

Firm: _____

Signed _____ Date _____

Firm: _____

Signed _____ Date _____

Firm: _____