



Engineering +
Environmental

Focused Feasibility Study

10 East Bruneau
Kennewick, Washington 99336

Prepared for:
Welch Foods
401 Grandridge Boulevard
Grandview, Washington 98930

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EXECUTIVE SUMMARY

This report summarizes the evaluation performed at the 10 East Bruneau Avenue, Kennewick, Washington site, and presents the results of the current Focused Feasibility Study (FS) and PBS' preliminary alternative evaluations. This project is designed to meet the requirements of an Agreed Order (AO) between Welch's Foods and the Washington State Department of Ecology (WDOE).

The FS is designed to provide an evaluation of the feasibility of proposed environmental cleanup alternatives at the site and is a companion document for the previous Remedial Investigation (RI – PBS 2008).

The results of the FS provide a summary of work at the site, to-date, and presents the components of the FS. Additional risk assessment, alternative evaluations and a preliminary preferred alternative concerning future work at the site are provided in this FS.

The remedial alternatives evaluated in this study include; 1) No Action; 2) Soil Excavation and Disposal; 3) Contaminant Monitoring Barrier Wall; 4) Long-Term Monitoring; 5) Institutional Controls; 6) Biodegradable Oxidant/Solvent Remediation; 7) Thermal Steam Technology, and 8) Insitu Chemical Oxidation Methods. Alternatives were reviewed in consideration of protectiveness, permanence, cost, long-term effectiveness, short term implementation risk and technical and administrative feasibility.

The preliminary chosen alternative was Alternative #4 or long-term monitoring. This alternative includes components of some of the other alternatives, including source control (from Alternative #3) and institutional controls (Alternative #5). Public concerns will be evaluated following submission of the FS to WDOE.

1.0 INTRODUCTION

PBS Engineering + Environmental (PBS) has completed a Focused Feasibility Study (FS) at 10 East Bruneau Avenue, Kennewick, Washington. The Site was impacted by bunker fuel heavy oil contamination released from former underground storage tanks (USTs), with the release further described by the earlier PBS Remedial Investigation (RI), companion document, dated April 2008. This report summarizes the previous work performed at the Site, and presents the results of the current FS and PBS' conclusions.

1.1 Site Geology

The subject property is located in the Pasco Basin, which lies within the central portion of the Columbia River Plateau physiographic province. This province is comprised of a series of flood basalts covering much of central and eastern Washington. The basalt flows of the Columbia River Basalt Group (CRBG) are late Miocene Epoch and early Pliocene Epoch (between 17 and 6 million years ago) in age, forming an extensive volcanic plateau. Anticlinal ridges in the area include the Horseheaven Hills (to the south of the site) that generally trend east-west as part of the Yakima Fold Belt; which consists of basaltic lava flows that have faulted and folded from the late Tertiary to the present. Glacial outwash and river-deposited silt, sand and gravel deposits (alluvium) overlie the Columbia River Basalt in the area of the subject property.

1.2 General Subject Property Features

The subject property is in an area of industrial and commercial use. The subject property is the current location of J. Lieb Foods Company, which occupies the 10 East Bruneau property. Their food processing facility extends to the east from the intersection of Bruneau Avenue and intersecting Washington Street. The site is further described as Benton County Parcel #106802030001022, consisting of 1.79 acres of land. At this time mostly vitamin water, juice and jam is made at the facility.

Local topography slopes slightly to the north in the area of the site (see Figures 1 & 2). A large boiler facility is located immediately east of the contaminated area, with food processing buildings further east. Additional food processing structures are found on the north side of Bruneau Street.

1.3 Site History

Historical sources indicate that the subject property was used for a hay storage facility and agriculture in 1905, with Church Bottling Company (juice producer) active on the center of the site in 1925. The property was apparently owned by Mary Moore in 1934 and Harry Love in 1943, with the juice company remaining on the site throughout that period. The juice company occupied the west-central portion of the property; with irrigated land on what is now the east portion of the site. In 1953 the subject property transferred from Church Bottling to Welch's Juice Company. After Welch's purchased the site they also purchased the De Sota Creamery site to the north and more property to the east. The subject property has remained in control by Welch's up to early 2007, when J. Lieb Foods occupied the site.

2.0 PURPOSE AND SCOPE

The purpose of the FS was to evaluate alternatives for cleanup, taking into consideration the findings in the RI. The FS will be used by WDOE to solicit public and agency comments and select a cleanup action for the site under WAC 173-340-360 and 173-340-390. The FS is one of the

sequential requirements leading to site cleanup under the Model Toxics Control Act (MTCA). This project provides further environmental information and evaluation of cleanup alternatives in support of Agreed Order #DE 89931898 (AO) between Welch's Foods and the WDOE toward remedial action at the Site.

After the FS is finalized, WDOE will issue a cleanup action plan (WAC 173-340-380) that will present their selected cleanup actions used to address site contamination. The elements of the FS consisted of the following:

1. A history of the site and summary of environmental information from the RI and earlier reports.
2. An evaluation of the hazardous substances at the site related to human health and environmental risk.
3. Preparation of a Conceptual Site Model, which evaluates potential contaminant migration pathways and receptors. The Conceptual Site Model is intended to further refine the risk at the site from the hazardous substances.
4. Cleanup standards are defined in the FS for all media impacted by contamination on the site and at the points of compliance.
5. Preliminary remedial alternatives are presented.
6. This project summarizes information for WDOE to complete public comment and decision making concerning the site and to formulate a cleanup action plan.

3.0 PREVIOUS INVESTIGATIONS

3.1 Phase I Environmental Assessment

In June 2006, PBS completed a Phase I Environmental Site Assessment (Phase I) on the subject property (Project #61375.00). The Phase I findings recommended a Phase II Environmental Site Assessment (Phase II) to assess site groundwater adjacent to a 50,000-gallon underground storage tank (UST) and lines.

3.2 Phase II Environmental Assessment

In July 2006, PBS conducted a Phase II on the subject property by completing environmental oversight of seven soil borings to groundwater with soil and water samples collected for analysis (Project #61396.00). Soil borings were completed adjacent to the UST, lines and the shop area to the east. No contamination was observed near the tank. Groundwater and soil contamination (heavy oil) was detected along the UST lines to the east of the tank. Further work was recommended to characterize and cleanup the contamination.

3.3 Interim Soil Excavation Remedial Action

In response to the presence of heavy oil contamination identified by the Phase II, in August and September 2006, PBS oversaw excavation along the UST fuel lines to the Boiler Building (Project #61405.00). No contamination was detected and it was later determined that the initial source of the leakage was immediately to the south of the lines at the location of two former 12,000-gallon bunker fuel USTs removed in the mid 1980s. PBS' Interim

Remedial Action excavation proceeded below the location of the former USTs, with contaminated soil removed and hauled to an offsite disposal facility during that project.

The Interim Remedial Action was a pre-RI/FS “Good Faith” action to reduce contamination and should be considered a pre-engineered source control component of the RI/FS. The earlier Interim Remedial Action was designed, in part, to lessen the head of free product oil over water and reduce the possibility of further oil migration. The interim action also removed a limited amount of the smear zone contamination (at the water table surface).

3.4 UST Decommissioning and Site Assessment

A Limited Underground Storage Tank (UST) Assessment was performed in September 2006, concurrent with the closure of one 50,000-gallon bunker fuel UST at 10 East Bruneau Street, Kennewick, Washington (Project #61768.00). This project was required by the real estate agreement between Welch’s Foods and J. Lieb and is not a portion of the AO. Information concerning this project was added to the RI report, because if leakage had occurred, the scope of work concerning the RI could have been affected. Previous assessment immediately adjacent to the UST suggested that no leakage from the UST had occurred. The decommissioning/closure was performed by K. Kaser Company, with PBS environmental oversight.

The UST formerly contained bunker fuel, which was pumped out prior to decommissioning. Natural gas lines close to the tank were moved to support the UST decommissioning project. Soil sampling was completed around the tank base and in the stockpiled soil. Samples were analyzed for heavy oil, with no detection of fuel. The UST was closed and removed from the site for disposal in September 2007. The tank basin was backfilled with clean onsite soil and offsite structural fill after the project was completed.

3.5 Remedial Investigation

The RI was completed for the site in April 2008. To support the RI, three monitoring wells were completed on the subject property at locations approved by WDOE. One upgradient well (MW #1) was completed immediately southwest of the location where the heating oil was released. A second well (MW #2) was completed immediately north of the center of the office, to the north and downgradient from the contaminant release point. The third well (MW #3) was completed to the east of the office and northeast of the location of the contaminant release point. The first quarter of sampling was completed in the wells as a portion of the RI, with no contamination identified.

The RI evaluated the movement of the contaminant in groundwater and noted that the bunker fuel is hydrophobic and does not tend to move significant distances in the groundwater. At the site, the contaminated plume was judged to have moved approximately 14% of the distance that groundwater had travelled in the same time frame. The RI revealed no more elements of risk, other than those already known from previous assessments.

The RI recommended three more quarters of groundwater monitoring to be completed concurrently with the FS to provide further information concerning the site and contaminant behavior.

3.6 Quarterly Monitoring Concurrent with the Feasibility Study

Three wells were established on the subject property, with the first round of groundwater monitoring completed for evaluation in the RI. Three more quarters of groundwater monitoring have occurred during the completion of the FS. The monitoring concurrent with the FS is considered a “good faith” effort by Welch Foods to aid in characterizing the site and providing maximum support for the results of the FS. Four quarters of monitoring results are provided in Table 2.

4.0 NATURE AND EXTENT OF CONTAMINATION

4.1 Soil Quality

According to the Soil Survey for Benton County, Washington, the area of the subject property is underlain predominantly by Finley fine sandy loam soils. The Finley soils are well drained and underlain by gravel. The soils encountered during drilling and excavation consisted of sand, gravel, cobbles and boulders, with minor silt. All of the soils at the site appear to be of alluvial origin, with larger well rounded gravel and, in places, well stratified by the action of water. The soils are formed from loess (wind deposited fine sand) and basalt.

The soil zones encountered at the site include the surface soil consisting of the upper 2 feet of soil (A Horizon). Beneath the surface soil is the vadose zone (unsaturated), which includes mainly gravel and sand and less organic material than is characteristic of the surface soil. At the site the third zone is the smear zone or bunker fuel contaminated zone (saturated or periodically saturated). During earlier stages of contamination, fuel traveled through the soil on top of the water table, and as the water table elevation changed the fuel was deposited vertically through a shallow layer of soil representing the change of water table elevation through the years, becoming a smear zone. Based on a series of groundwater table elevation measurements throughout 2008 (changes in water table elevation mainly due to seasonal irrigation water influx), the thickness of the smear zone was measured at approximately 2 feet.

A deeper layer of soil is present below the water table referred to as the saturated zone. Results of drilling and well construction indicate that the deeper soil layers are medium through coarse grained sand and gravel. Since the free product floated on top of the water table, with little soluble components detected at the time of sampling, little contamination impacted the deeper portions of the saturated zone. Lighter or dissolved hydrocarbons have never been detected during soil or groundwater sampling on the site.

During the Phase II in July 2006, soil contamination was detected in Boring #4, approximately 15 feet north of the point of release. Contaminated soil was also detected and extensively removed during the subsequent Interim Remedial Action. The Interim Remedial Action was designed, in part, to lessen the free head of oil over water and reduce the possibility of further oil migration. During the Interim Remedial Action approximately 2,261 gallons of oil (not including soil) was removed from the site, significantly reducing risk and the probability that oil is continuing to advance in the groundwater system, and providing for clean soil on the site above the water table.

4.2 Groundwater Characteristics and Quality

Groundwater has been sampled from borings and wells throughout the site to assess the impacts of site contamination on groundwater quality (see Table 2). The groundwater was

tested for each of the contaminants listed in Section 4.5. Water quality results evaluated during the quarterly 2008 groundwater tests are non-detected for all constituents except pyrene in MW #1 – quarter 4. The Method B Reference cleanup standard for pyrene is 480 ug/l and the result in MW #1 is 0.11 ug/l. The pyrene result is too low to cause concern. There is a strong possibility the pyrene source is from upgradient (and not from the site) due to the upgradient location of MW#1, and upgradient industrial sites. Other parameters indicated during the 2008 monitoring period included pH (7.31 to 7.70); conductivity (502 to 636 micromhos/cm) and temperature (17.4 to 20.2^o Centigrade). These water quality results are not out of range of what would be expected in other groundwater in the area.

It is understood from the UST site assessment completed on the subject property that groundwater and soil contamination is present (Limited UST Assessment, PCBs Inspection and Well Water Review at Welch Food's, 10 East Bruneau, Kennewick, WA; PBS Project #61396.00; August 16, 2006). Results of that assessment indicated 16,000 and 20,000 ug/l diesel and oil, respectively, in groundwater in Boring #4. In Boring #7, 1,300 and 1,700 ug/l diesel and oil, respectively, were detected in groundwater. Both results exceed the groundwater cleanup levels for the diesel and oil constituents listed in Table 1.

The groundwater contamination detected during the August 2006 UST site assessment was strongly suspected of consisting of small globules of oil knocked loose and released into water from the soil when the smear zone soil was disrupted by drilling and soil sampling. Based on the results of quarterly sampling, PBS does not feel that, at this time, undisrupted groundwater flowing under the site has any free globules of oil in transit with groundwater.

In other areas of Kennewick and Richland, studies have shown the unconfined groundwater to be impacted with arsenic. Based on knowledge of the area and a review of other area well logs concerning the unconfined groundwater, PBS suggests that the unconfined water table aquifer is a non-potable water source. A review of wells in the area does not indicate any domestic water sources using the unconfined groundwater (see Appendix D - area well logs).

A limited pump test completed concurrent with the FS indicates groundwater hydraulic conductivity at the surface of the unconfined aquifer is approximately 0.36 centimeters/second or 0.71 feet per day. This is higher hydraulic conductivity than estimated for the RI and signals a greater possibility of potential contaminant movement. See Appendix B for hydraulic conductivity information.

Confined aquifers are present beneath basalt and sediment under the subject property. One production supply well, which is used to supply water for onsite food processing is located west of the Boiler Building and immediately adjacent to the zone of contamination. Well construction data indicates the well is 548 feet deep, with un-perforated casing to 365 feet below ground surface in basalt bedrock. Six pounds of artesian pressure is present at the well head. Laboratory analytical data was provided to PBS by Welch Foods, with analysis for inorganic chemicals, synthetic organic chemicals, metals, pesticides, herbicides, petroleum chemicals, volatile organic chemicals, trihalomethanes, semi-volatiles, PCBs and dioxins (PBS Project #61396.00). Detected constituents included fluoride (0.9 mg/l), sulfate (50 mg/l), sodium (100 mg/l), hardness (11 mg/l), total dissolved solids (319 mg/l), conductivity (503 micromhos/cm) and turbidity (0.5 NTUs); all results are within regulatory MCLs. The detected dioxins constituent (2,3,7,8 – TCDD) was at a concentration of 203.597 picograms/liter in the production well; this can also be written as 203.597 x 10⁻¹⁵ grams/l. EPA Region 9 Preliminary Remediation Goals (PRGs) indicates that the dioxins

screening level in groundwater is 4.5×10^{-7} grams/l, suggesting that dioxins levels within the well are safe. All of the other indicated results are non-detect for all constituents. The confined aquifer is considered a potable water system.

No production well water contamination issues are suspected. Positive pressure in the water supply suggests that it would be very difficult for contamination outside of the well casing to enter the artesian water supply (negative or neutral pressure would be required for liquids from outside the casing to enter the system).

4.3 Surface Water Characteristics and Quality

The Columbia River is the closest surface water to the subject property (2,000 feet north) and is considered non-potable without treatment. Surface water characteristics are not applicable to the site or the FS since no surface water is close to the site and no storm drains on the site drain to the river.

4.4 Air Quality

Due to the low volatility of the fuel product, no air quality issues are expected from the heavy oil release.

4.5 Analytical Methods for Contaminant Characterization

Analytical procedures were performed as indicated in Section VII (3) of the AO and as listed below. Testing was designed to determine whether the following hazardous substances have been released: benzene, toluene, ethyl benzene, xylenes (BTEX), other petroleum products, carcinogenic polycyclic aromatic hydrocarbons (PAHs), and naphthalenes. Petroleum products were tested through Northwest total petroleum hydrocarbons – diesel method (NWTPH-Dx and NWTPH-Dx Extended). The list of constituents and analytical procedures is provided below:

<u>Constituent</u>	<u>Proposed Analytical Procedures</u>
Petroleum Products (Oil)	EPA Method 8015M (NWTPH-Dx)
Petroleum Products (heavy oil)	EPA Method 8015M (NWTPH-Dx Extended)
Benzene	EPA Method 8021B
Toluene	EPA Method 8021B
Ethyl benzene	EPA Method 8021B
Xylenes	EPA Method 8021B
PAHs	EPA Method 8270C
Naphthalenes	EPA Method 8270 SIM

5.0 CONCEPTUAL SITE MODEL

Data collected during the RI, previous assessments and the interim remedial action provide the information necessary to understand the nature and extent of contamination and potential exposure to human health and the environment in the area of the site. This section synthesizes the available data into a conceptual site model (CMS) of contaminant occurrence, movement and potential exposure. The conceptual site model is presented and serves to translate available physical, chemical and biological data into a representation of site conditions. The model serves as a useful aid to the development of cleanup standards and cleanup action alternatives as the subject of this FS (see Table 4).

A CSM describes the known or suspected source of contamination, considers how the contaminants are likely to migrate (pathways), and identifies who is likely to be affected by the

contaminants (receptors). In order for risk to be present at the site, a source must be present, pathways must be complete, and receptors must be present. Current conditions as well as future conditions must be considered in the CSM. The risk is evaluated for each contaminant of interest to determine whether risk is present at a site. Table 4 presents a preliminary graphic CSM for the site, based on current information.

5.1 Source Characterization

The fuel release at the site appears to be mainly heavy oil that had occurred from one area: the two 12,000-gallon USTs formerly located immediately west of the southwest corner of the Boiler Building. The bunker fuel was released prior to the mid-1980s, when the two tanks were removed from the site. All of the soil contamination was removed immediately below the former location of the tanks during the “good faith” Interim Remedial Action (PBS Project #61405.00). Having migrated there from the former source, some petroleum product remains present at the site, with the greatest amount found in the smear zone on top of the water table.

5.2 Impacted Media

The CSM focuses on contamination of soil and groundwater as the impacted media arising from the release of petroleum fuels. The presence of impacted media at the interface between groundwater and soil is the driving force behind this FS. Drilling and excavating at the site has provided information concerning the extent of the fuel product contamination at the surface of the groundwater table beneath the site. The plan view size of the contamination zone ranges from 1,900 to no more than 4,000 square feet (Figure 2). The plume of contamination is likely elongated toward the north/northeast due to groundwater flow direction (determined by four quarters of monitoring). The impacted media is located in a two-foot vertical contamination zone beginning at 20 feet below ground surface.

5.3 Characteristics of the Released Fuel Product

Bunker fuel is the hazardous substance along with a lesser amount of diesel grade fuel (apparently used to improve fuel flow), with testing indicating that no benzene, ethylbenzene, toluene or xylenes (BTEX) or other lighter grade constituents are present. Although bunker fuel can be hazardous, it is usually not considered dangerous waste as a released product in accordance with WAC 173-303.

The previously described heavy petroleum hydrocarbon has the characteristics of a “light non-aqueous phase liquid” (LNAPL) and can be described as both a free and residual product. MTCA describes LNAPL as a hazardous substance that is present in soil, bedrock, groundwater or surface water as a liquid not dissolved in water. LNAPLs and other petroleum products are complex mixtures of organic (carbon-based) molecules with slight solubility in water. The petroleum product at the subject property is expected to be composed mostly of molecular structure incorporating 16 through 34 carbon atoms per molecule. Bunker fuel (#6 fuel oil) is known as a complex mixture of paraffinic, olefinic, naphthenic and aromatic hydrocarbons and probably expresses greater variability than most light grade fuel. The designation of “light” indicates that the product is less dense than water, not of low molecular weight.

The specific gravity of Bunker C is approximately 0.97, which is less than water, and explains why most of the fuel was found floating on groundwater and mixed in with a soil smear zone caused by yearly groundwater table elevation changes. Viscosity of the product

is very high, with a very low surface tension. The difference in surface tension between the fuel and water is a factor indicating why the two liquids will remain separate from each other.

Mostly residual product is present at the subject property. Residual product is fuel trapped in soil in an unsaturated condition, while free product infers product soil saturation, with the ability to move through soil or groundwater. Residual product can still be mobile in that its location in the smear zone can provide a source for water soluble volatiles to be released to groundwater. Residual fuel volatiles released to groundwater did not appear to be occurring on the site during the site characterization period (since no volatiles were detected in monitoring well water samples). Since no volatiles or soluble components have been detected in the groundwater or adjacent soil, the visible extent of the oil appears to be the full extent of contamination.

5.4 Exposure Assessment

This section identifies potential human and ecological exposures to contaminated media at the site. Consistent with WAC 173-340-350, this section identifies exposure scenarios that will assist in the selection of a cleanup action. It is understood that cleanup actions developed during the FS must “protect human health and the environment (including, as appropriate, aquatic and terrestrial ecological receptors)”. In order to evaluate cleanup actions, the cleanup standards must be determined. As outlined in WAC 173-340-700, and in order to address the cleanup standards the following issues must be addressed:

- Nature of the contamination
- Potentially contaminated media
- Current and potential land and resource uses
- Transport
- Current and potential receptors
- Current and potential pathways of exposure

The nature of the contamination and impacted media (bullets #1 & 2, above) were previously described in Section 5. The CSM illustration is available to illustrate potential exposure pathways present at the site (see Table 4).

5.4.1 Current and Potential Land and Resource Uses

An initial aspect of exposure assessment addresses current and potential land and resource uses (bullet #3 above). Cleanup levels must be derived from reasonable maximum exposures, defined as the “highest exposure that is reasonably expected to occur at the site under current and potential future site use”. This section describes the current and future potential uses of resources where contaminated media are known or suspected to be present. The resources under consideration here are land, groundwater, surface water and sediment.

The contaminated zone lies within the boundaries of the current J. Leib (former Welch Foods) processing facility. A small amount of smear zone contamination was present outside the fence in the railroad right-of-way, immediately to the south of the former tanks location. Local groundwater flow direction does not support further groundwater contaminant travel to the south onto the railroad area. No other off-property areas are expected to be contaminated. The entire area is zoned industrial. The general public is not allowed above the area of contamination, either on the J.

Lieb site (fenced area) or the railroad right-of-way. The highest and best potential use of the area remains industrial. Future use is expected to remain industrial.

Groundwater is contaminated with heavy oil within the smear zone under the site. Generally the highest and best use of groundwater is as a source of drinking water (WAC 173-340-720). However the unconfined aquifer in the impacted area is not a current source of drinking water, nor will it be a likely source in the future. Section 4.2 describes a production well within or very near to the zone of contamination that is used to provide a source of water for food processing. As indicated earlier, this well is completed in a deep basalt confined aquifer, with upgradient charging that produces artesian conditions. In accordance with WAC 173-340-720 the unconfined contaminated groundwater does not serve as a source of drinking water anywhere in the area (Appendix D). In addition, it is unlikely the contaminant will be transported from the site to other current or potential future sources of drinking water. Monitoring wells at the site have been tested for one year, with no indication that the current contamination is going to move past those wells (or offsite north/northeast). Due to the LNAPL and low volatility nature of the product it is also unlikely that the product will mobilize deeper in the aquifer. In support of institutional controls, future use in contaminated groundwater zones are protected by rules that require that new wells cannot be constructed within contaminated zones; minimum setback distances are required (WAC 173-340-171).

No surface water is available within ¼ mile of the subject property, with the closest source the Columbia River, to the north. The Columbia River is defined in WAC 173-201A as a Class A river, which indicates protection of the river is a high priority. Sampling of monitoring wells for nearly a year indicates that no observed contaminant movement toward the river is occurring.

5.4.2 Transport Mechanisms

Transport (bullet #4, above) is first considered from the release point at the base of the tank, through the vadose zone to groundwater. A review of the earlier Phase II report indicates that contamination is present as a smear zone on top of groundwater at the former location of Boring #4. Under the influence of gravity, some of the released tank contents percolated down to the surface of the water table and traveled with groundwater. With the release and assumed contaminant-saturated vadose zone pore space, the excess free product migrated freely to the underlying groundwater and contaminant smear zone. With the Interim Remedial Action completed to, and successful in removing, the excess vadose zone pore space product, the remaining contaminant is in the smear zone. The residual contamination is therefore assumed to be immobile and movement with groundwater may not be likely.

The 2008 groundwater flow directions were calculated and indicated to vary from approximately North, 4 degrees East to North, 47 degrees East. The groundwater slope or gradient was approximately 0.07 feet/100 feet. No pump tests or slug tests were completed for the RI. In order to help evaluate transport by groundwater for the FS, a limited pump test was performed on the site in MW #2. The test indicated faster groundwater flow than had been estimated during the RI (3.6×10^{-1} centimeters per second). Using Darcy's Law, new information from the pump test suggests that in 1.55 days groundwater is moving one foot (see Appendix B).

At a high end estimate, the oil has travelled less than 2% of the distance water has travelled in a similar time frame. Water is a polar molecular substance and oil is non-polar. The non-polar oil is hydrophobic with respect to water and tends to form round globs of oil in water. The globs of oil are not caused by internal cohesive forces (like surface tension in water) within the oil, but, rather represent the fact that the oil is hydrophobic. The hydrophobic oil tends to form a bond (or adhesion) with the soil and rock, with the soil providing a “refuge” from the polar water molecules, supporting non-movement of the product.

In effect, the soil forms a sieve, binding the oil away from the water and restricting the distance the oil has migrated. Although the oil obviously travelled north of Boring #4, RI and FS information indicates (based on MW #2 & #3) it could have travelled no further than 70 feet north/northeast of the release site.

Any dissolved components of the oil (for example BTEX) would travel approximately as fast as the water; RI and FS analytical results for volatile and semi-volatile substances indicated that currently, no such soluble substances were detected (see Table 1). A year of quarterly monitoring and groundwater flow direction analysis continues to suggest that no further oil movement is occurring and that volatile components are not present.

Another contaminant transportation issue concerns volatile movement through air. This issue could be exacerbated by basements in the area of the release. If soil based air pressure gradients support transport through soil, low pressure zones in basements or other buildings could cause flow of volatiles to the structure. Another method of volatiles transport can occur if groundwater is pumped from a well, the decrease in pressure that accompanies using a faucet releases volatiles into the air within a building. Since the product at the site is heavy oil, does not volatilize in air, and no volatiles of any kind were detected, no transport or impact by soil gas or air is expected on or near the site.

5.4.3 Potential Human Receptors

For the purposes of this exposure assessment (a portion of bullet #4, above), receptors and receptor activities are identified based on the highest beneficial use of each resource, as required in WAC 173-340-708. This section discusses human receptors that may be present at the site, based on the beneficial uses identified in the previous section and observed in the area of the subject property. Human receptors fall into several categories, including industrial workers, residential population, excavation workers and groundwater users.

Since the source of the contamination is located at 20 feet below ground surface in a smear zone at the top of the groundwater table most of the previously mentioned receptors are unlikely to be exposed to contamination. With the oil source apparently not mobile (based on four quarters of groundwater monitoring), the categories of receptors are further reduced.

Excavation or utility workers generally would not excavate to the depth necessary to encounter the contamination present at the site. Industrial workers on and off of the site would also not encounter the contamination only present at depth. Likewise, the contamination is not likely to reach the Columbia River, and river receptors, since the product is not moving with groundwater.

5.4.4 Potential Ecological Receptors

Under WAC 173-340-7490, a terrestrial ecological evaluation (a portion of bullet #1, above) must be performed unless conditions allowing exclusion of such evaluation are met. Under WAC 173-340-7492(2)(a)(ii) a Simplified Terrestrial Ecological Evaluation – Exposure Analysis was completed (see Table 5).

The contamination is deep enough that no ecological receptors would be likely to have direct contact with, or ingest the contaminant. The contaminant does not appear to be moving with groundwater so it is unlikely that receptors in the Columbia River would be in contact with the contaminant. There are no onsite storm water collection systems or unlined ditches that are developed deep enough to collect and transmit contamination to the river or other receptors. No surface contamination was present at the site and known contamination is not considered to have effects on surface water; therefore, there is no risk of ecological exposure via surface water.

A score comparison, with the use of Table 749-1 (in the MTCA Statute and Regulation; Publication #94-06; November 2007) is provided as a WDOE score sheet (Table 5). The table results are dependant upon the factors indicated in this paragraph. No undeveloped land is present in the area of the site, with the land use in that area all industrial and commercial. To properly address the site, the habitat rating is indicated to be high, with the likelihood to attract wildlife figured to be high. In addition, none of the contaminants of concern listed under #5 of Table 5 are known at the site. The accumulated number in Box #6 was larger than the number indicated in Box #1, so a further terrestrial ecological assessment is not deemed necessary under WAC 173-340-7492 (2) (A) (ii).

5.4.5 Human and Ecological Exposure Pathways

Several exposure pathways (bullet #6, above) involving human or ecological contact occurrence and an internal toxicologic reaction are considered. Contact is through three potential mechanisms including dermal/direct contact, inhalation and ingestion. Ingestion and dermal contact are the most probable methods of exposure to oil contamination. The contaminant is considered moderately irritating to the skin from prolonged exposure and can cause intoxication symptoms from respiratory exposure. Ingestion can cause excitation, loss of consciousness, convulsions and hemorrhaging. The contaminant is toxic and not considered a carcinogenic substance.

At the site, dermal contact could occur to a contractor excavating through an oil contaminated zone. This form of dermal contact is unlikely because of the depth of the remaining product (at groundwater elevation – 20 feet below ground surface).

Ingestion of contaminant at the site is unlikely because the onsite well is artesian and pressurized, completed into a deep basalt aquifer. Tests of the well water quality indicate no contaminants are present. Another aspect of ingestion, direct ingestion of contaminated soil is not possible due to the depth of contaminant burial.

Inhalation is possible by breathing in volatile substances only. With the contaminant at this site containing no volatile components such exposure is not considered likely. Further discussion of volatile transport is discussed in Section 5.4.2, above.

5.5 Cleanup Levels

Cleanup levels under WDOE - MTCA are defined as the concentration of hazardous substances that are protective of human health and the environment under exposure conditions. MTCA provides three methods for developing cleanup levels of soil, groundwater and surface water:

- 1) Method A defines cleanup levels for 25 common chemical and is generally designed for routine cleanups.
- 2) Method B determines cleanup levels at sites using a site-specific risk assessment with cancer risk levels established at 10^{-6} for individual carcinogens and 10^{-5} for total site risk, and non-cancer risk at or below a hazard index of 1.
- 3) Method C determines cleanup levels for specific site uses (i.e., industrial) using site-specific risk assessment when Method A and B levels are technically impossible to achieve.

Remedial action on the site is dependant on the analytical methods used for characterization of contamination (see Section 4.5, above). Since cleanup at the site has been routine, and the analytical scope of work detailed in the AO did not include analytical procedures for Extractable Petroleum Hydrocarbons (EPH) and Volatile Petroleum Hydrocarbons (VPH), our analysis focuses on using Method A cleanup levels. Method A cleanup levels are designed by WDOE to be at least as stringent as each of the following concentrations:

- Concentrations established under applicable state and federal laws
- Concentrations that protect human health
- Concentrations that protect the environment (terrestrial ecological receptors)
- Concentrations that protect groundwater quality
- Concentrations that protect air quality.

To a lesser degree Method B Formula Values from the Cleanup Levels and Risk Calculations under the Model Toxics Control Act Cleanup Regulation; Publication #94-145 (CLARC) were used to assess contaminants not listed under Method A. The CLARC values listed in Table 1 represent mostly volatile and semi-volatile constituents, with few of those constituents detected at the site during the RI, FS and previous investigations.

Although reviewed for reference, the Workbook for Calculating Soil and Ground Water Cleanup Levels under the Model Toxics Control Act Cleanup Regulation, Users Guide, Publication #01-09-073 was not used to support cleanup calculations. As indicated above, soil and groundwater cleanup levels for the direct contact pathway, leaching pathway and vapor pathway were evaluated by the less site specific and more stringent Method A cleanup levels. See Table 1 for a summary of cleanup levels applicable to the site and analytical methods used.

5.6 Points of Compliance

The points of compliance define the locations where the cleanup levels must be attained. The term includes both standard and conditional points of compliance. Points of compliance are established for each environmental medium in accordance with the requirements and procedures set forth in WAC 173-340-720 through 173-340-760. A discussion of the points of compliance is provided below, with the groundwater points of compliance most applicable to the site. A soil point of compliance is discussed below. Due to the nature, lack of migration,

depth, lack of volatility and the distance from surface water of the heavy oil contamination, no further discussion is provided for points of compliance related to sediment, air and surface water.

5.6.1 Soil Points of Compliance

Soil points of compliance for the soil exposure pathways must be considered, which include direct contact, soil leaching to groundwater, soil protection of vapor migration and protection of terrestrial species. The standard point of compliance for soil is defined as throughout the site from the surface to 15 feet below ground surface. Due to the interim remedial action, no contaminated soil remains within 15 feet of the surface of the ground. And, because no volatiles are involved, a soil point of compliance does not appear to be applicable to the site.

5.6.2 Groundwater Points of Compliance

Points of compliance will be set for groundwater. The standard point of compliance for groundwater consists of the groundwater throughout the site from the uppermost level to the lowest depth that could have been affected by contaminants. Although water and soil were disrupted at the time of sampling (with the water charged with oil), Boring #4 represents the location of onsite contaminated groundwater. Boring #4 represents the best location for the groundwater point of compliance, but it is impractical to use that location as such, since no well is present there to provide continuing monitoring.

A conditional point of compliance can be set for groundwater where it can be demonstrated that it is not practical to meet the cleanup levels throughout the site within a reasonable restoration time frame (WAC 173-340-720); the site represents such a condition.

The on-property conditional point of compliance must be established as close as possible to the source of the hazardous substance, but must not exceed the property boundary. The on-property conditional point of compliance is conditioned on use of all practical methods of treatment at the site. The alternatives considered in Section 6 are conditioned on the use of an on-property point of compliance.

Based on the existence and location of the onsite monitoring Wells #2 and #3, and more (and more accurate) groundwater analytical results collected from them than Boring #4, Wells #2 and #3 are the preliminary chosen points of compliance. Wells #2 and #3 also represent a more restrictive location than the downgradient property boundary.

6.0 REMEDIAL MEASURE EVALUATION PROCESS AND SELECTION

This section describes the remedial measure evaluation and selection for contaminated groundwater and soils at the former Welch Foods facility. The purpose, in support of the FS, is to develop and evaluate cleanup action alternatives to enable a cleanup action to be selected for the site. Further, the purpose is to protect human health and the environment by implementing an effective alternative. The technologies and process options identified for each general response action will be subjected to an initial evaluation (screening) to reduce the number of potential remedies.

6.1 Remedial Action Alternative Descriptions and Preliminary Screening

Remedial action measures for the contaminated zone in the groundwater smear zone are provided below. Because, in many cases, it seemed more practical to combine certain aspects of some alternatives, sub-alternatives may be combined to create the alternatives listed below.

Several alternatives were screened, but not considered viable enough to be discussed for this FS. One such alternative was Natural Attenuation, requiring implementation on a geologic time scale to naturally break down the contaminant. No pumping based alternatives (without chemical or physical modification of the contaminant) are considered either, because the hydrophobic and viscosity effect of the fuel remaining strongly tied to the soil would not support pumping. One of the alternatives not described fully because it involves pumping is air stripping; few if any volatiles are present in the contaminant and the oil would foul the stripper plates. Another pumping alternative is the use of a well based skimmer system that would capture and remove the floating fuel product; due to the fact the fuel is bound to the soil, this system is not expected to work. Insitu soil venting through sparging technology was reviewed, but not considered viable because the contaminant (at depth) would not be exposed to enough oxygen for breakdown.

Biological breakdown of the oil was strongly considered. Biological activity is capable of aerobic oxidation of some oils. Common oxidation use, of course occurs when petroleum product is combusted to power our vehicles. Deep in the rock formations oil reservoirs occur, with little or no breakdown of the oil due to biological activity. Most of the bacteria at that depth are anaerobic and do not use oxygen for respiration; anaerobic bacteria do not attack the oil. This is noted by the fact that crude oil (in a low oxygen environment) stays unchanged for millennia without alteration by bacteria. No oxygenation occurs at depth, which does not allow aerobic breakdown of the oil.

PBS explored biodegradation and found remediation scenarios where this action has occurred on heavy oil in exsitu techniques. Bench testing and pilot testing has been most successful using the aerobic *Rhodococcus* strains of bacteria, with addition of manure, 60-60-90 fertilizer, heat (to just below 272 °C) and multiple applications. Subsequent breakdown is furthered by growing *Avena Sativa* (oats), as a phytoremediation technique, following the stages of *Rhodococcus* breakdown. Graphs show that up to 75% of the heavy oil can be remediated.

PBS has screened out the bioremediation methods because they are exsitu (if we have to dig out the contamination, it is much less expensive to just take it to an acceptable landfill), it requires many applications and significant heat energy. Finally, it has never completely removed all of the contaminant.

The descriptions of the more fully evaluated alternatives are provided below:

6.1.1 Alternative 1: No Action (No further Action)

A “No Action” alternative is evaluated as a remedial action alternative. Alternative 1 would involve no further remedial action activities and no institutional controls. Under this alternative, current conditions at the site would remain without any change, without restrictions being placed on future operations or redevelopment and with no further remedial costs incurred.

6.1.2 Alternative 2: Excavation and Disposal

An abbreviated deployment of this alternative has already been implemented as a “good faith” source control action for removal of 516 cubic yards of contaminated soil (Interim Remedial Action – PBS Project #61405.00). Further excavation of contaminated soil from within the soil/groundwater smear zone is considered for this alternative, beyond the earlier applied action. Alternative 2 involves removal of the Boiler Building, gas line infrastructure and Office Building from the site so that further excavation of the smear zone can take place. The excavated contaminated soil would be shipped offsite to a MTCA approved landfill for final disposal.

6.1.3 Alternative 3: Contaminant Monitoring Barrier Wall

This alternative combines several actions designed to maximize isolation and monitoring of contamination that exists in the soil/groundwater interface. The combined use of source control, a downgradient barrier wall with monitoring wells and institutional controls seems to combine a group of alternatives into a potentially usable course of action. Alternative 3 presents a group of engineering controls for monitoring and controlling isolation of the contaminant.

With the removal of various site infrastructure, a semicircular excavation to several feet beneath the elevation of groundwater, with the installation of a barrier wall would reduce the possibility of contaminant migration. A driven sheet piling wall with monitoring ports could be a possible (but unlikely) alternative to excavation installation. The wall could be constructed, with the upgradient edges of the soil/water interface slightly upgradient and/or cross gradient from the contaminated area, supporting isolation of the contaminant. The base of the wall would need to be several feet below groundwater table elevation to discourage movement of contaminant under the wall (see Figure 3).

The semi-circular wall would cause an obstruction in groundwater flow and make it necessary for water moving downgradient on the upper side of the wall to either go around the wall laterally or move down and under the wall. The change of direction required to redirect groundwater would cause a slightly higher elevation of groundwater on the upper side of the barrier.

Product floating on water (the heavy oil contaminant) could breach the wall at three locations. Either the contaminant will go under the downgradient center of the wall, with water forced to flow down and under at that location, or the water and contaminant would back up behind the wall and flow around either or both of the upper lateral ending points of the wall. In order to make sure the contaminant does not flow downgradient, periodic monitoring would occur in the three wells installed in the wall (Figure 3).

The wells would be established and built into the barrier wall during the wall construction phase and would not be put in with a drill. The central downgradient well would be established to a depth of approximately 1-foot below the base of the wall, with screened interval from the base to the top of the wall. The other two wells would be established to the base of the wall, with screened interval throughout the depth of the wall. The elevation of all aspects of the wall would be known in relation to the wells. The wall would be built to take into consideration yearly changes in groundwater table elevation. If contaminant showed up in the screened interval below the base of the wall in the downgradient well, it would be known that

contaminant is moving under the wall and downgradient. If contaminant showed up in the screened interval anywhere in either of the lateral wall end point wells, it would be known that contaminant was escaping downgradient around the outside edges of the barrier wall. With this monitoring protocol, monitoring of existing wells would probably be used for assessment of groundwater flow direction only. Institutional controls could also be a portion of this alternative to protect the wall.

Source control is proposed to limit water percolation into the contaminated zone to further isolate and ensure no further contaminant movement with groundwater. The final expression of source control would be to pave the area above the contaminated zone and allow no further infiltration to groundwater in that area, as water infiltration could increase the possibility of downgradient contaminant movement.

6.1.4 Alternative 4: Long Term Monitoring

This monitoring would involve testing of the existing monitoring wells on the site and not follow the monitoring activities indicated in Alternative 3, above. Given the direction of groundwater flow, any released contaminant could be detected at Monitoring Wells #2 and/or #3. This alternative would probably also include use of institutional controls.

As a “good faith” measure, Welch Foods has already initiated this groundwater monitoring action in a proactive manner to check downgradient groundwater for the potential migration of contaminants. Quarterly monitoring in the three established wells was completed in January (as a portion of the RI) and during June, August and December 2008 (concurrent with the FS). Results of the groundwater monitoring do not indicate any contaminant movement to the three wells. Results also indicate groundwater flow directions in a north to northeast direction. See Table 4 for detailed monitoring results.

6.1.5 Alternative 5: Institutional Controls

This alternative includes the placement of restrictions on the subject property which would disallow shallow water well installation, deep excavation into the groundwater smear zone and any other activity that would cause contact with contaminated soil or groundwater. Common institutional control protective elements include deed restrictions and restrictive covenants. Institutional controls would most likely be a component of most of the other listed alternatives. Institutional controls are currently supported by WAC 173-340-171 that mandates well setbacks from contaminated or potentially contaminated zones.

6.1.6 Alternative 6: Biodegradable Solvent/Oxidant Remediation

The biodegradable solvent/oxidant remediation system has been used in the past to remove low volatility hydrocarbons from soil; it has not been thoroughly tested in groundwater. Wells into the contaminant zone would need to be completed to allow an avenue for solvent placement and contaminant removal. This system would use a biodegradable solvent, such as isopropyl alcohol to dissolve and reduce the viscosity of the fuel product. It is expected that this remedial method could work in groundwater and reduce the hydrophobic bond to soil, allowing the fuel to mobilize (with water) and be pumped from the groundwater system. A supporting action may also include modification by the addition of an oxidant such as hydrogen peroxide. The oxidant supports aerobic bacterial degradation, degrading the fuel to less

harmful product. The resulting product may become amenable to pumping from the groundwater to surface containers for further remedial action or separation.

6.1.7 Alternative 7: Thermal Steam Technology

Thermal Steam Technology has been proven for use in the oil and gas industry for crude oil product removal. Super-heated water as steam is injected into the well heating soil and groundwater in the oil-containing zone. Heating the crude oil releases volatiles that were not amenable for removal at indigenous rock, soil and groundwater temperatures. Vacuum - applied to some wells - further enhances volatile removal (this use for Thermal Steam Technology is not applicable to the site).

Volatiles removal is not the only element of Thermal Steam Technology. In addition, the steam lightens the heavy oil product increasing the difference in the specific gravity between the fuel product and water. Steam also adds oxygen, with the potential to increase microbial aerobic activity. Another effect of Thermal Steam Technology includes the breakdown of hydrophobic forces between the water and oil, occurring at or above 110^o Centigrade (230^o F) and allowing limited mixing of the oil and water (G.S. Hartley, 1936), which could enhance pumping removal of the product. Floatation technology is often used at the surface for the pumped removed oil, as an oil concentrator.

Another similar modification to this steam technology is the use of resistive heating to form the steam instead of pumping surface steam to complete the action. Resistive heating may be an even better technology due to the ability to heat an entire area between electrodes instead of just injecting steam through single point well location.

Steam technology could potentially support oil release from the soil and allow pumping. The resistive heating could also release any volatiles held in the oil, for removal by vapor extraction or air stripping (if below the water table).

6.1.8 Alternative 8: In Situ Chemical Oxidation

In situ chemical oxidation apparently has been tested at other sites for the remedial action of #6 fuel oil released from tanks and located in soil above groundwater. Apparently favorable results were achieved in degradation of oil concentration and thickness. This method is similar to 6.1.6 above, except that no surfactants are used and as such, less contaminant byproduct groundwater transport is expected.

Chemicals such as sodium persulfate (NA₂S₂O₈), activated and catalyzed by hydrogen peroxide (H₂O₂), are examples of oxidizers that could provide for the oxidation of the oil. Fenton's reagent and an induced hydroxyl radical through the use of iron (as Fe⁺³) can also be used to increase the oxidizing power toward accomplishment of this alternative.

In the Massachusetts test case, six wells were installed within the contaminant zone for the injection of the chemical and monitoring of groundwater in the system. The test case results suggested that more than 2/3 of the fuel oil was oxidized from the soil and the surface of the groundwater. Gaseous emanations occurred and a vapor extraction system was installed to protect inhabitants of nearby basements; this action may not be necessary at the subject property (MEC^x test case).

In the Massachusetts case wells were monitored during the use of the oxidizers. Groundwater monitoring was provided for dissolved oxygen, pH, specific conductance, temperature, oxidation/reduction potential and static water level. PBS suggests that other monitoring in groundwater could include: sodium, sulfate, nitrate, carbonic acid, pH, VOCs and biological oxygen demand.

The oxidants act on the oil to allow dissolution, phase change and polarity switch. Often, one introduction of oxidizer is not enough, with more phases required to reduce the oil volume. The approximately 18 carbon chain molecules require the use of multiple phases of smaller molecule oxidants to complete the job. The oxidized soluble product is more amenable to aerobic bacterial breakdown in water, with the product also able to be pumped and removed through a pump and treat system.

It also seems prudent that air quality monitoring should occur for gaseous emanations. Monitoring for carbon dioxide, carbon monoxide, oxygen, sulfur dioxide, VOCs, volume of emanations and nitrous oxide could be reasonable. Vapor extraction systems can be used concurrent with this installation to control emanations into basements.

Oxidation would be a major way of the natural breakdown cycle for oil in an undisturbed system. This method would speed up the natural cycle, which at this time is very slow. PBS completed limited bench testing (Appendix E) to test the use of this technology for the Welch Foods site.

6.2 Comparison of Remedial Action Alternatives

This section includes a comparison of the alternatives in terms of the remedy selection factors, as required by WAC 173-340-350. The alternative review process will provide evaluation in terms of protectiveness, permanence, long-term effectiveness, implementability, implementation risk and cost. A final screening parameter incorporating “the degree to which community concerns are addressed” will be addressed after comments concerning the site are received. The findings of the comparative evaluation are summarized below for each of the remedy selection factors.

Protectiveness

The overall protectiveness of each alternative is evaluated as follows:

Alternative 1: No Action

This alternative does not address future potential exposure pathways or reduce site contaminant concentrations. This alternative would not provide for future protection through institutional controls or provide an avenue for future monitoring to check for contaminant movement with groundwater. This alternative has the least protectiveness of the other alternatives.

Alternative 2: Excavation and Disposal

Further excavation of contaminated soil from within the soil/groundwater smear zone goes a step beyond the previously completed Interim Remedial Action. Alternative 2 involves removal of the Boiler Building, gas line infrastructure and Office Building from the site so that further excavation of the smear zone can take place. This alternative would certainly be effective at removing approximately 225 cubic yards of

contaminated smear zone soil, but it would not be effective at removing all of the remaining smear zone contamination. It is the most protective alternative in that this action would remove the most contaminant.

Alternative 3: Contaminant Monitoring Barrier Wall

The Alternative 3 wall should be effective in isolating the motion of contaminant on top of groundwater (if it is not already stopped). As planned, it would also be effective at monitoring the contamination and protecting the public through institutional controls. This method would be very effective at signaling when further work to stop contaminant migration is necessary, but would require continuing monitoring for protectiveness.

Alternative 4: Long Term Monitoring

Long term monitoring (already initiated) is evaluated as a continuing protective action. If properly planned, with well monitoring in a downgradient direction (Monitoring Wells #2 & #3), long term monitoring will test the effectiveness of any other alternatives or act as a test to determine if another primary alternative is necessary to prevent future potential contaminant migration. By itself, long term monitoring will be effective at determining whether contaminant movement is occurring. During the past year the ongoing monitoring has been effective in showing that no contamination moved downgradient to any of the wells during that period. This action will only be protective for as long as it is in use.

Alternative 5: Institutional Controls

With no product movement under the site, PBS expects that institutional controls would be a valuable protective measure for as long as the controls are in place at the site. This alternative could be effective at protection of receptors, human and ecological, but concurrent monitoring would probably be required.

Alternative 6: Biodegradable Solvent/Oxidant Remediation

Contaminated zone wells could be completed at the Welch's facility to provide access for completing biodegradable solvent/oxidant remediation. Applying a solvent and oxidant to the heavy hydrocarbon would support mobilization, making the product more pump-able for remediation above ground. This technology could potentially be protective by reducing the total volume of contaminant, but could also make the contaminant more soluble with water and exacerbate downgradient movement, reducing protectiveness.

Alternative 7: Thermal Steam Technology

The Thermal Steam Technology method would involve releasing very hot steam in the contaminant zone or causing heating through resistive heating between electrodes. This technology could potentially be protective by reducing the total volume of contaminant, but may also make the contaminant more mobile with water and exacerbate downgradient movement, reducing protectiveness.

Alternative 8: In Situ Chemical Oxidation

This technology could be protective by reducing the total volume of contaminant. This method would also form water soluble breakdown components of the contaminant and oxidizers, which, could affect downgradient groundwater chemical characteristics.

If secondary chemical impact based on excess oxidant and carbon chain byproduct release could be controlled, some protectiveness would be realized.

Permanence

The permanence of the contaminant destruction is evaluated for each alternative is as follows:

Alternative 1: No Action

This alternative provides no contaminant destruction beyond natural biodegradation.

Alternative 2: Excavation and Disposal

This alternative provides the greatest amount of permanence for final destruction of onsite contamination. Not all of the contamination would be removed, however, even by this scenario. A significant amount of contaminant removal and source control was already completed during the Interim Remedial Action (through limited excavation and disposal).

Alternative 3: Contaminant Monitoring Barrier Wall

Although Alternative 3 would provide for no further permanent destruction of contamination, this alternative provides the best regimen for monitoring and isolation. It would only be as permanent as the commitment to monitoring.

Alternative 4: Long Term Monitoring

Long term monitoring would provide no permanent destruction of contamination, but would be a favorable system for effectively monitoring to determine if the movement of contamination occurs. This alternative has been effective for 2008 in determining that no further contaminant movement has occurred, and would be as permanent as the commitment to monitor.

Alternative 5: Institutional Controls

Institutional controls would provide no permanence of contaminant disposal or destruction, but would significantly improve risk at the site in concert with monitoring. This action would be as permanent a solution as the commitment to continence.

Alternative 6: Biodegradable Solvent/Oxidant Remediation

This alternative would undoubtedly provide some permanent destruction of contamination; probably not to the degree of Alternative 2.

Alternative 7: Thermal Steam Technology

If this alternative works it would cause some permanent removal of contamination; probably not to the degree of Alternative 2 or 6.

Alternative 8: In Situ Chemical Oxidation

This technology would permanently reduce the total volume of contaminant. Any amount of contaminant oxidized would not be available for further contamination, but some secondary product contamination is expected.

Long-Term Effectiveness

The long-term effectiveness of each alternative is as follows:

Alternative 1: No Action

The no-action alternative does not eliminate or reduce the potential for exposure.

Alternative 2: Excavation and Disposal

Further excavation of contaminated soil from within the soil/groundwater smear zone would have significant positive effect. Since cleanup would be a one-time effort the results would be known early-on. It would not be effective on removing all of the remaining soil and groundwater contamination, but would provide the most long-term effectiveness of all the alternatives.

Alternative 3: Contaminant Monitoring Barrier Wall

When all the other aspects of this alternative are implemented, Alternative #3 could have favorable long-term effectiveness by supporting monitoring and isolation. This action would be as effective a solution as the long-term commitment to continence.

Alternative 4: Long Term Monitoring

Long-term monitoring will test the effectiveness of any other alternatives or act as a test to determine if another primary alternative is necessary to prevent future potential contaminant migration. By itself, long-term monitoring will be effective at determining whether contaminant movement is occurring for as long a term as monitoring is completed. As a pre-initiated alternative this alternative was shown to be effective for one-year at indicating no movement of contaminants beyond Wells #2 and #3.

Alternative 5: Institutional Controls

With no product movement indicated to date under the site, PBS expects that institutional controls would be a valuable protective measure for as long as the controls are in place at the site. Long-term reliability is expected for as long as the institutional controls are in place and no contaminant movement occurs.

Alternative 6: Biodegradable Solvent/Oxidant Remedial Action

Wells could be completed at the site to provide access for completing biodegradable solvent/oxidant remediation. This technology will not remediate all of the contamination and therefore would be limited in long-term reliability.

Alternative 7: Thermal Steam Technology

The Thermal Steam Technology method would involve releasing very hot steam in the contaminant zone. With the necessity to provide pressure in the remedial zone (and the continual pressure loss) long-term reliability would be poor. This method probably could not be reliable at removing all of the contaminant.

Alternative 8: In Situ Chemical Oxidation

Any amount of oil removed by this technology would be permanently removed and would assist in long-term reliability. In past testing it has not been shown to remove all of the contaminant.

Implementability

Technical and administrative implementability would increase as the complexity of the action increases. The relative implementability of each alternative is described below.

Alternative 1: No Action

This alternative can be readily implemented, as it involves no action; site conditions would not be modified from their current state.

Alternative 2: Excavation and Disposal

A significant amount of work (beyond what has already been done) would need to be completed onsite, probably with the removal, or partial removal, of buildings (including the office and boiler building), utilities and slab areas. Further, deep excavation of contaminant, impacting groundwater, shutdown of food processing and rebuilding of the site all present implementability issues.

Alternative 3: Contaminant Monitoring Barrier Wall

For implementation, a significant amount of work would need to be completed onsite, probably with the removal, or partial removal, of buildings (including the Boiler Building), utilities and slab areas. Also difficult deep excavation and shoring would be necessary during wall and monitoring infrastructure installation. To aid source control the ground surface above the contaminated zone would be paved. This completed action will be difficult to implement even if sheet piling is used.

Alternative 4: Long Term Monitoring

This already implemented alternative required expenditure of time and equipment to place the wells and continue quarterly monthly monitoring concurrent with the FS. The ongoing implementability does not present an issue as long as existing wells are used.

Alternative 5: Institutional Controls

With no product movement under the site, PBS expects that institutional controls would be a valuable protective measure for as long as the controls are in place at the site and some monitoring is completed concurrently.

Alternative 6: Biodegradable Solvent/Oxidant Remedial Action

Wells could be completed at the Welch's facility to provide access for completing biodegradable solvent/oxidant remediation within the contaminated zone. Implementing this technology would be an involved process. Significant testing would be required to determine the best surfactant to mobilize the contaminant. Not all of the contamination could be removed by this alternative.

Alternative 7: Thermal Steam Technology

The Thermal Steam Technology method would involve purchasing natural gas, releasing very hot steam (over 230⁰ F) and maintaining required pressure in the contaminant zone to heat and mobilize the heavy oil. As previously mentioned, electrode heating could be used to support this technology as well.

PBS expects that this type of system would display implementability problems and would not be reliable at removing all of the contamination. Unfortunately, such high

temperatures in water cannot be achieved without increasing pressure (boiling would occur at 210⁰ F and stop further heating). Achieving 230⁰ F would require some form of pressurization in the soil-groundwater interface to support this method. Pressure would continually be lost and it is unlikely (but not out of the question) that this system would be effective.

Limited bench testing was completed to gain an understanding of the usefulness of the steam or resistive heating methods and because some variation in the variety of #6 fuel oil exists on the market (concerning the amount of volatiles and the length of carbon chain molecules). The oil from the Welch facility was heated to observe at which temperature the semi-solid oil turned to a liquid (for pumping evaluation purposes) and to look for indications of volatiles through distillation and auto ignition (see Appendix E). Results indicated that the oil definitely thinned by 200⁰ Fahrenheit; no observed physical episodes of volatilization were obvious. No auto ignition was observed up to a temperature of 520⁰ Fahrenheit. No significant lower temperature distillation product was observed to form in cooled exterior copper tubing concurrent with the heating of the oil containing flask. Very few gases accumulated in the Tedlar bag at the cool end of the bench test infrastructure.

As suspected, results suggest that the oil would need to be heated up to near the boiling point of water to make it amenable to pumping. With heating to the boiling point of water required to make this work, the boiling energy uptake required would extract heat from the system to such a degree that liquefying of the oil would be greatly impeded. With low volatiles suggested by previous investigations analytical results, and by the bench test, little may be gained by steam or electrical heating, pumping and removal of the currently immobile oil product.

Alternative 8: In Situ Chemical Oxidation

This technology is dependant on different chemicals working together to oxidize and reduce heavy oil contamination. The theory is simple; oxidation reduces oil volume and produces water and carbon dioxide as byproducts. With chemical oxidation complications are many, with other elements and molecules present within the oil and the oxidants used in the process.

The results of the bench testing (Appendix E) suggests that multiple phases of oxidation would be required to break down the thick layers of oil. Each phase of oxidation would reduce the oil load on top of the groundwater. The contaminant reduction during bench testing (6%) suggested that multiple phases would be required. In the bench test, large amounts of oxidant were used (60 grams) to destroy a relatively small amount of oil (3.4 grams). This effect is to be expected with the breakdown of an 18 carbon chain molecule, which would require a high oxidant ratio to degrade the oil.

Bench test results suggested higher than ambient levels of oxygen are released as gaseous emanation (60.4% oxygen). Excess oxygen at three time ambient levels suggests that the system was inefficient, with not all of the oxygen used for the breakdown of oil. Elevated carbon dioxide at 5.5% (and the reduced weight of the oil after the test) did indicate that some of the oil was being broken down by the test.

Gaseous emanation contaminant byproduct release from the system would seem to be preferred because gases are more easily collected with a vapor extraction system

(and scrubber), without downgradient groundwater impact. Qualitative observations suggest that a significant amount of contaminant byproduct remained in the liquid phase.

In Situ Chemical Oxidation could certainly be completed at the Welch Foods site. However, the amount of infrastructure, drill holes, reagent, site visits, pumping, and vapor extraction installations necessary to remediate through this process would complicate implementability. Since previous installations have not removed all of the contaminant, it has limited implementability.

Implementation Risk

The relative short term implementation risk of each alternative is provided as follows:

Alternative 1: No Action

There is no implementation risk associated with this alternative.

Alternative 2: Excavation and Disposal

Further excavation of contaminated soil from within the soil/groundwater smear zone would clean up a great deal of contamination. On the other hand, short term worker risk would increase due to opening up the excavation and potential worker exposure to the contaminant. Some implementation risk is expected in that if excavation to below the smear zone occurs, some contaminant could be released to that greater depth. Higher horizontal hydraulic conductivity is possible at the greater depth causing the remaining contaminant to travel with groundwater. There is also an implementation risk involved in keeping the operating food processing in place at the site with this scenario. The office and boiler building would need to be taken down, with the gas lines moved; these actions would make continued processing more difficult.

Alternative 3: Contaminant Monitoring Barrier Wall

Like Alternative 2, this action would place a risk on the continued food processing on the site, because onsite buildings would need to be removed in order to perform needed excavation to complete the project. With this action also, short term worker risk would be increased due to potential worker exposure to contamination. Since the barrier wall would not be completed in the contaminated zone, less worker risk would be present than in Alternative 2.

This action presents some implementation risk and lowers general risk at the site significantly.

Alternative 4: Long Term Monitoring

No further implementation risk is expected from long term monitoring, because the monitoring wells have already been installed at the site.

Alternative 5: Institutional Controls

With no known product movement suspected under the site at this time, PBS expects that institutional controls would be a valuable protective measure for as long as the controls are in place at the site. Implementation risk would probably not be an issue, but concurrent monitoring is necessary.

Alternative 6: Biodegradable Solvent/Oxidant Remedial Action

Wells could be completed at the Welch's facility to provide access for completing biodegradable solvent/oxidant remediation. This technology would involve the use of applying solvents, surfactants and oxidants to the contaminated zone at the top of the water table at the site. Breaking down the oil with the use of solvents and surfactants would change the molecular polarity characteristics. The changes to the oil would support greater mobility, with the idea that the changed oil could be pumped to the surface and remediated. The same changes that aid in pumping would also make the oil more mobile, water soluble and more likely to move with groundwater. The more soluble mobilized solvent/oil could cause downgradient migration, changing the biological and chemical oxygen demand of the surface aquifer and supporting movement of the changed contaminant at approximately the speed of the current groundwater flow. Given the strong possibility that the current contaminant is not traveling through groundwater, the implementation risk for this option would be a negative factor.

Alternative 7: Thermal Steam Technology

The Thermal Steam Technology method would involve releasing very hot steam in the contaminant zone or using resistive electrical heating. PBS expects that this type of system would display implementability risk in that it would make the oil less viscous and more able to pump. As a negative factor, the less viscous oil would then temporarily be more amenable to travel downgradient with groundwater and place downgradient locations at risk.

A significant implementability risk issue with electrode heating could be the presence of a railroad track immediately south of the Welch Foods site; how would the major electrical field induced in the subsurface affect the conductive railroad rails and railroad operations?

Alternative 8: In Situ Chemical Oxidation

Implementation risk does exist with the potential use of this technology. Potential down gradient ground water changes could include increases in nitrate, sulfate, carbonic acid, sodium and biological oxygen demand. Since this process converts some of the oil from a non-polar to polar state, some of the byproducts would be mobile with water. Bench testing information also suggests that liquids released are of low pH (approximately 3.5 for the bench test). Such low pH liquids are uncomfortably close to being a regulated hazardous waste (WAC 173-303).

Presently, with no known contaminant movement, no offsite expression of contamination has occurred. By supporting mobility of product, Welch Foods environmental liability would be increased, by increasing the possibility of moving chemically impacted contaminant byproducts under offsite properties. Although pumping may be prescribed, it is unusual for a pump not to stop or breakdown; with groundwater flow at approximately one foot per day, some potential contaminant byproduct could escape offsite, increasing implementation risk.

Gaseous product emanations could include sulfur dioxide, nitrous oxide, high oxygen and carbon dioxide. By products of this technology, however, do not seem as toxic as what would be produced as by products of solvent breakdown technologies. A

vapor extraction system could be employed to remove the gaseous products, if necessary.

In light of the common push in today's world to list carbon dioxide as a pollutant, and given the stability and immobility of the product where it is, one wonders why this form of contaminant would not just be left where it is rather than increase the implementability risk using chemical oxidation? An Isotec, Incorporated In Situ Chemical Oxidation scientist indicated that the implementation risk and cost was too great on a stable non-mobile #6 oil contaminant on groundwater to risk attempting cleanup (Stan Haskins, personal communication, July 2009).

Reasonableness of Cost

The relative costs vs. benefits are discussed for each alternative below (contact information in Reference section, following the report).

Alternative 1: No Action

There are no costs associated with implementing this alternative.

Alternative 2: Excavation and Disposal

Further excavation of contaminated soil from within the soil/groundwater smear zone would clean up a great deal of contamination, but costs could be prohibitive. Once the buildings are removed, this alternative would support the excavation of approximately 4,000 cubic yards of clean soil in order to access approximately 225 cubic yards of contaminated soil in the upper water table smear zone. The clean soil would be temporarily stockpiled on site, with the contaminated soil excavated and shipped to a MTCA disposal site. The clean soil would later be used as backfill, with some clean soil brought back onto the site to make up for the shipped contaminated soil. The excavation would need to be brought back up to grade in lifts at optimum moisture percentage and compaction to support future construction. This alternative would require reconstruction of the boiler building and office. Although this method would be effective in removing a significant amount of contaminated soil, groundwater and limited soil contamination would still remain.

Loss of the use of a portion of the site to support food processing would require that the boiler operation be temporarily moved. Food processing could be significantly affected by this expensive alternative. The total cost for implementing this alternative could exceed \$2,000,000.

Alternative 3: Contaminant Monitoring Barrier Wall

Due to the fact that portions of the office and boiler building may need to be removed to install the barrier wall in the deep trench costs for this option will be considerable. If sheet piling could be used, which is in question due to possible cobbles in the soil, the buildings could stay in place and the job could be completed at less cost. Some of the source control that goes with this alternative has already been completed, but onsite paving work and building reconstruction would remain. Removal of the buildings could affect ongoing food processing at the facility and cause income losses. This option could cost well over \$2,000,000 to implement.

Alternative 4: Long Term Monitoring

With lack of flow of the oil contaminant on top of the water table and a year of quarterly monitoring already completed, yearly monitoring should be considered reasonable. Costs would be approximately \$1,200 per year for monitoring once per year or \$4,000 per year for quarterly monitoring.

Alternative 5: Institutional Controls

With no product movement under the site, PBS expects that institutional controls would be a valuable measure for as long as the controls are in place at the site. Legal, business and oversight fees involved in placing an institutional control could be approximately \$5,000. Because it is unlikely institutional controls would be implemented alone, other alternative costs could be applicable.

Alternative 6: Biodegradable Solvent/Oxidant Remedial Action

More wells could be completed at the Welch's facility to provide access for completing biodegradable solvent/oxidant remediation. A considerable amount of testing would be necessary to choose the best surfactant to mobilize the contaminant, with pumping and processing groundwater to remove contaminants. This technology may cost approximately \$700,000 to implement and run for two years.

The cost is very high for a cleanup method that could cause offsite impact and increase Welch Foods environmental liability.

Alternative 7: Thermal Steam Technology

The Thermal Steam Technology method would involve releasing very hot steam in the contaminant zone. More well construction would be necessary for this implementation. Expenditures would be necessary to create an oil/water separator and/or floatation system to remove the released oil from the aquifer. Costs to complete Thermal Steam Technology for two years would be approximately \$800,000, with some of the cost involved in utilities for making heat and steam. Steam technology costs using the resistive heating method would require less wells, but with considerable electricity costs and control of emanating currents, costs would rival the use of direct steam. With the implementability of this alternative in question, even greater costs could be involved.

Alternative 8: In Situ Chemical Oxidation

Cost of this technology is considerable. Well installations could cost \$50,000. Chemicals could cost another \$25,000, with another \$25,000 per year in consultant and monitoring costs.

Discussions with in situ chemical oxidation service providers indicated costs would be at least \$300,000 for implementation, without the required vapor extraction system (another \$50,000).

The cost is high for a cleanup method that could cause offsite impact and increase Welch Foods environmental liability. Projected expenditures however, do not seem as high as the other previously mentioned active remedial action alternatives.

Consideration of Public Concerns

The consideration of public concerns will be completed at a later date after review by the WDOE. This section of the FS cannot be completed without public notification and comment concerning the site. Results of consideration of public concerns will be addressed in the final FS.

6.3 Comparative Analysis of Remedial Action Alternatives

This section includes a more focused comparison of the alternatives to support selection of a preliminary alternative. A review of each of the seven alternatives, including No Action, Excavation and Disposal, Contaminant Monitoring Barrier Wall, Long-Term Monitoring, Bio-Degradable Solvent/Oxidant Remedial Action, Thermal Steam Technology, In Situ Chemical Oxidation and Institutional Controls is provided. Taking into consideration effectiveness, long-term reliability, implementability, implementation risk and cost, each of the alternatives will be considered in this section.

In support of the comparison, Table 3 was prepared to screen the alternatives. In an effort to make the best choice, the comparison may take elements out of several of the alternatives to form a best fit for the preliminary chosen remedial alternative. In accordance with WAC 173-340-360 the preferred order of alternative choices incorporate contaminant recycling, destruction/detoxification, immobilization/solidification, on-site/off-site disposal (in a lined facility), on-site isolation/containment (with engineering controls) and institutional controls, with monitoring.

Table 3 sums each of the alternatives on the basis of protectiveness, permanence, long-term effectiveness, implementability, implementation risk and reasonableness of cost. The sums are provided for the total of all of the components. The results provided are based on the best judgment of PBS.

Based on the results of the evaluation, the long-term monitoring (Alternative #4) and institutional controls (Alternative #5) indicated the highest number of points, respectively. These alternatives appeared to be attractive, in part, because one year of monitoring does not indicate that further contaminant migration is occurring. Additionally, the more aggressive remedial actions have aspects that could chemically or physically change the state of the contaminant to be amenable to movement with water, or mix the contaminant to deeper groundwater zones. These actions could cause downgradient migration of oil or chemically changed oil and increase Welch Foods environmental liability.

The highest point receiver behind long-term monitoring and institutional controls was the contaminant monitoring barrier wall (Alternative #3) isolation and monitoring scenario. Strong issues against this engineering control included reasonableness of cost. Completion of Alternative #3 could require removal of the office and portions of the boiler building from the site, greatly increasing costs and curtailing food processing at the site. Use of sheet piling could make this alternative more attractive, but it is unlikely that sheet piling is implementable.

Other Alternatives including #2, #6, #7 and #8 could have greater implementation risk, cost and cause movement of altered contaminant, with groundwater. Technical Implementability is significant for Alternatives #2, #3, #6, #7 and #8. It is unlikely the required pressure could be maintained to achieve Alternative #7, with high utility costs. Long-term effectiveness appeared to be greatest for Alternatives #2 and #3, with the overall protectiveness greatest for Alternative #2.

Alternative #7 has two implementation scenarios, with either steam injection or electric electrode resistive heating. If this was the chosen alternative, the electrode method (if it could be employed safely) would appear to be superior, because heating would occur throughout the distance between the electrodes, with a better chance of mobilizing a greater amount of oil for subsequent pumping removal.

Alternative #6 and #8 are similar in that the size of the contaminant body is reduced by chemical action. The summary of alternatives suggest that Alternative #8 is superior to #6, in that #8 converts more of the contaminant to a gaseous product, which is not amenable to downgradient groundwater flow and could be effectively removed and scrubbed with vapor extraction. In addition, #6 surfactants would be expected to dissolve contaminant product more permanently (and cause greater groundwater transport) than the oxidant used in Alternative #8. Alternative #8 however is an inefficient process and wastes a significant amount of oxygen as an off-gas rather than providing for oxidation of heavy oil product.

Since none of the active remedial action alternatives (#2, #3, #6, #7 and #8) could be expected to remove all of the contaminant, Alternatives #4 and #5 are our preliminary highest point receivers (see Table #3).

6.4 Preliminary Recommended Remedial Action Alternative

As requested by the WDOE, this study has evaluated the feasibility of the alternatives listed above. Based on the comparative evaluation of the remedial action alternatives, Alternative 4 (Long-Term Monitoring) rates the highest, based on points received. The preliminary recommended alternative is chosen, in part, based on preliminary information that indicates the contaminant is locked at the soil/groundwater interface hydrophobically and is not polar enough to break the water bond and move in the aquifer. A year of monitoring has already tested whether contaminant movement is occurring. Since no contaminant is showing up in the wells, long-term monitoring would not be proposed to occur quarterly. In a preliminary sense, yearly monitoring is proposed with monitoring to then occur on a five-year schedule, if no contamination shows up in the wells after five years of yearly monitoring. The end point for monitoring would be open to consideration.

We believe that Institutional Controls (Alternative #5) could be concurrently implemented in order to add to the protective nature of that action (if they are necessary based on the fact that the contamination is deeper than 15 feet below ground surface). Institutional controls could include deed restrictions to disallow deep excavations or certain types of drilling in the area of the contamination. In addition, we understand the water is tested yearly in the deep artesian water well adjacent to the contamination. Even though no avenue of contaminant entry is projected into the well water petroleum product as NWTPH-Dx should be added to the list of tested constituents. In addition, establishment of new domestic or production wells into or near the contaminated zone should be disallowed.

We also add that an aspect of Alternative #3 (source control) could be borrowed and used in the recommended alternatives as well. Source control, which in this case would call for paving the area above the contamination location, would curtail any surface water infiltration. Stopping any possible water infiltration from irrigation, rain or leaky pipes could add an extra measure of protection that the oil cannot begin moving due to increases in water head above the contaminant.

7.0 RESTORATION TIME FRAME

A further feasibility study evaluation of the site considers restoration time frame (WAC 173-340-360). Factors reviewed in evaluation through this section included: risks to human health and the environment; practicality of achieving a shorter restoration time frame; current use of the site; area resources that could be affected by the release; potential future site use; availability of alternative water supplies; reliability of institutional controls; ability to monitor hazardous substances from the site; toxicity of hazardous substances and natural processes that may reduce site contamination.

We understand that the contaminant, #6 fuel oil is heavy oil and has been shown through previous testing and assessment to contain little or no volatiles. PBS expects that the oil is very stable in its existing state and will either not degrade at all or degrade at a very slow rate. For these reasons the restoration time frame is expected to be very lengthy. We also understand that it appears to be excessively costly to remove or compromise the buildings and to excavate or put in walls to control the contaminant, when the oil does not appear to be migrating. The oil is not strongly toxic and it is buried at depth helping to alleviate risks posed to human health and the environment. Offsite and processing water supplies do not appear to be compromised by the contaminant. Lastly, institutional controls and monitoring are expected to be effective at observations for any future movement of the oil contamination.

If the buildings on the site are ever planned to be removed, it may be prudent at that time to give further consideration to initiating Alternative #2 or #3 and partially remove or further isolate the contaminant.

Limited excavation/disposal, source control and groundwater monitoring measures have already been started at the site and are further prescribed along with the long-term monitoring and institutional controls for control of contamination on the project site. Based on review of the actions already taken (and those prescribed), PBS feels that the restoration time frame should not present a significant issue to the preliminary alternative regime selected.

8.0 CONCLUSIONS

Alternative #4, #5 and portions of Alternative # 3 have been chosen as the preliminary recommended alternatives for the site. We feel that the preliminary selected alternative is the best option for the site and represents a plan for long term control of the contaminant. We understand that the WDOE will make the final determination of environmental cleanup at the site, taking into consideration public comment and their environmental processes review of the site. We understand that the next step for the FS is review by the WDOE.

9.0 LIMITATIONS

PBS has prepared this report for use by Welch Foods. This report is for the exclusive use of the client and is not to be relied upon by other parties. It is not to be photographed, photocopied, or similarly reproduced in total or in part without the expressed written consent of the client and PBS.

This study was limited to the tests, locations, and depths as indicated to determine the absence or presence of certain contaminants. The site as a whole may have other contamination that was not characterized by this study. The findings and conclusions of this report are not scientific certainties but, rather, probabilities based on professional judgment concerning the significance of the data gathered during the course of this investigation.

PBS is not able to represent that the site or adjoining land contain no hazardous waste, oil, or other latent conditions beyond that detected or observed by PBS.

PBS ENGINEERING + ENVIRONMENTAL

Paul Danielson, LEG. Project Manager	Date
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Reviewed by Dulcy Berri, LHG. Senior Reviewer, Principal	Date
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FIGURES

Figure 1 - Site Location Map

Figure 2 – Detailed Site Plan

Figure 3 – Alternative #3 – Contaminant Monitoring Barrier Wall

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Table 2 – Welch Foods RIFS – Four Quarters of Groundwater Monitoring Results 2008 (Summary)

Table 3 – Welch Foods RIFS – Preliminary Alternative Evaluation

Table 4 - Preliminary Graphic Conceptual Model

Table 5 – Simplified Terrestrial Ecological Evaluation

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Site Photographs

APPENDIX B

Limited Pump Test – Hydraulic Conductivity Evaluation

APPENDIX C

Laboratory Reports
Chain-of-Custody Documentation

APPENDIX D

Area Well Logs

APPENDIX E

PBS Bench Testing

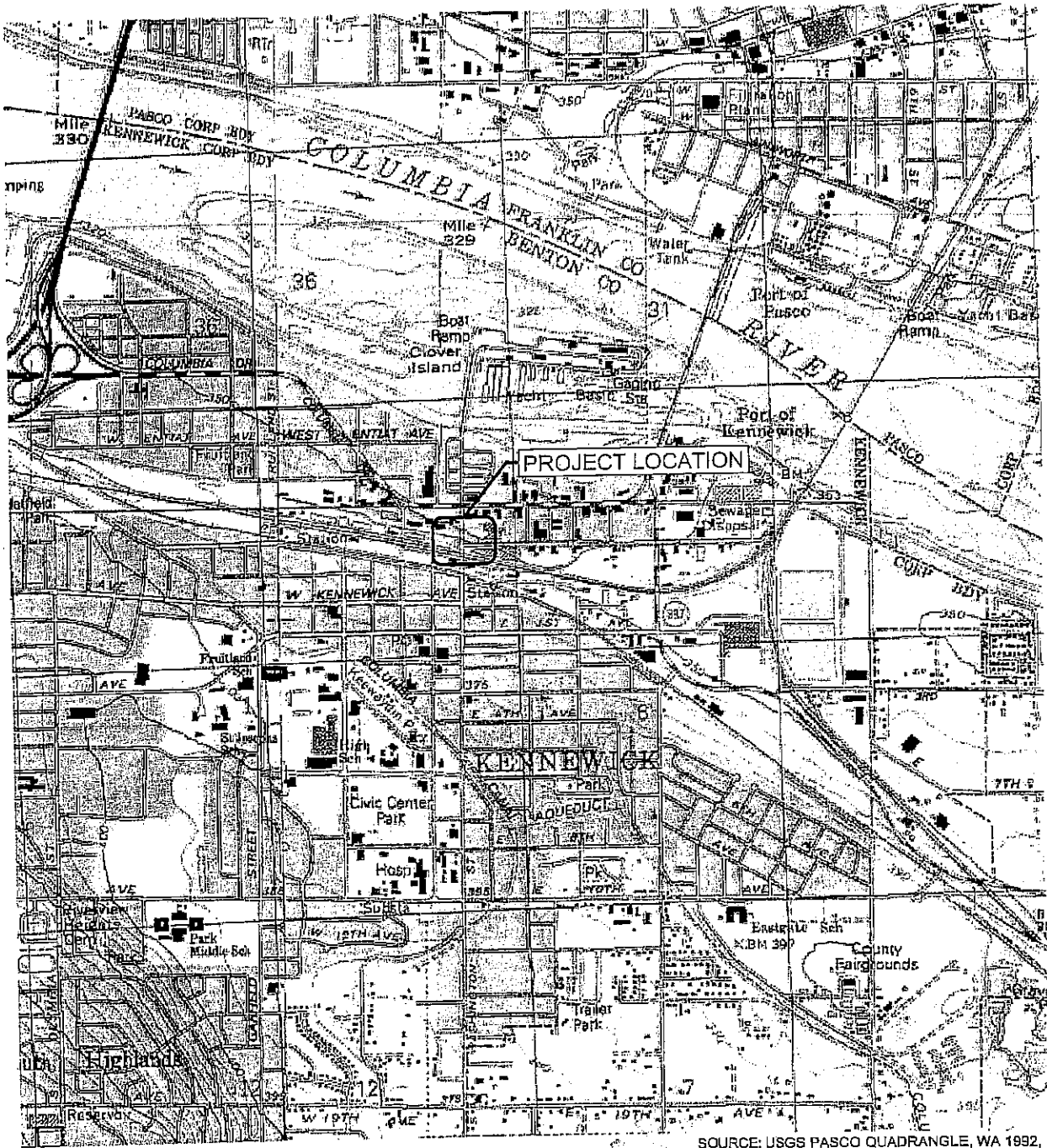
FIGURES

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Figure 2 – Detailed Site Plan

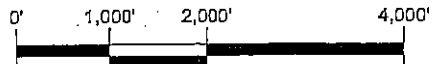
Figure 3 – Alternative #3 – Contaminant Monitoring Barrier Wall

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SOURCE: USGS PASCO QUADRANGLE, WA 1992, PHOTO REVISED 1990.

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SCALE: 1" = 2,000'

PREPARED FOR: WELCH'S FOODS

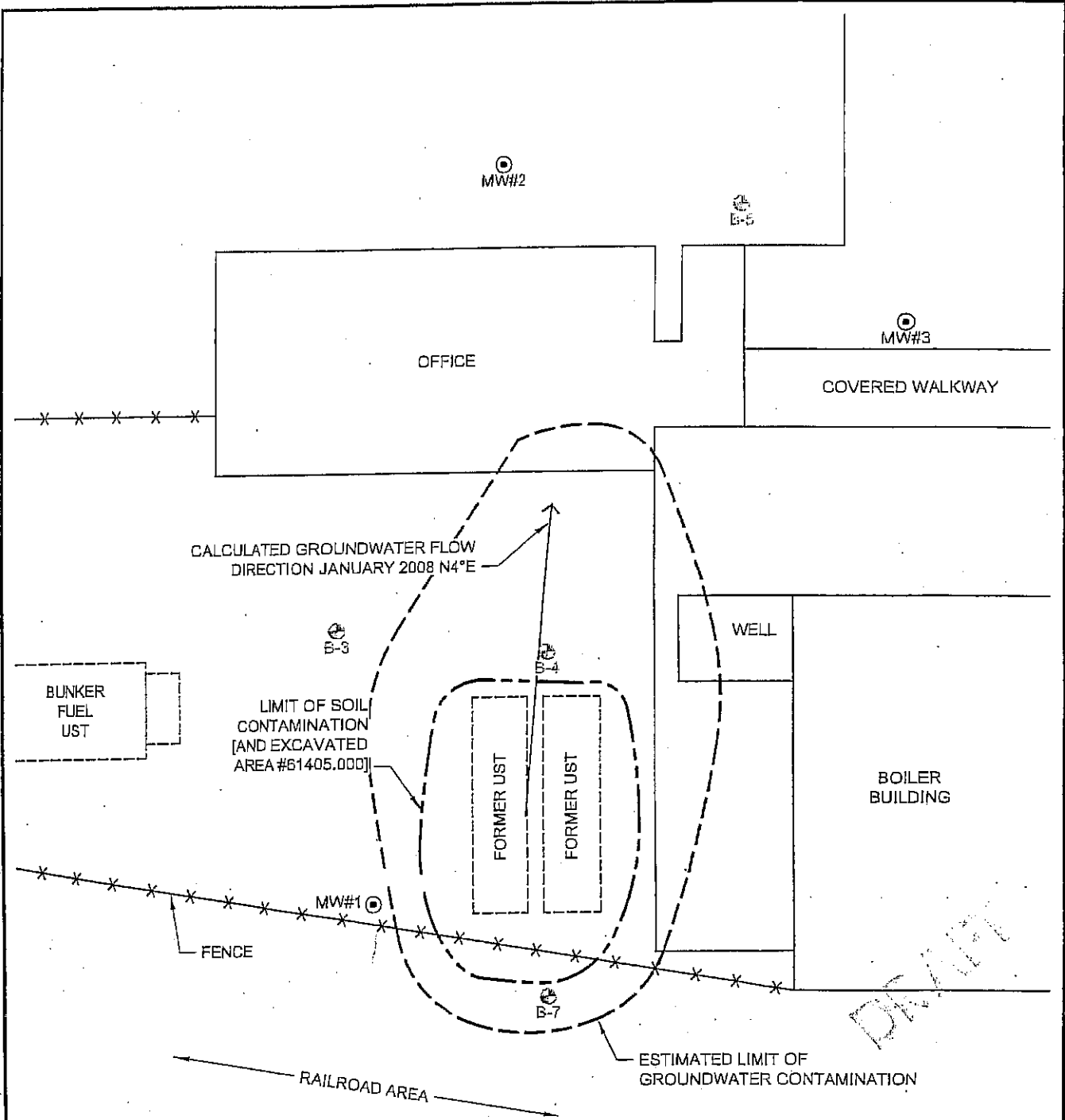


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DATE:
SEPT. 2007



SITE VICINITY MAP
10 EAST BRUNEAU AVENUE
KENNEWICK, WASHINGTON

FIGURE
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LEGEND

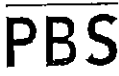
-  BORING LOCATIONS FROM PREVIOUS JOB #61396
-  MONITORING WELL LOCATION



APPROXIMATE SCALE: 1" = 20'

PREPARED FOR: WELCH'S FOODS

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TABLES

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Table 1
Cleanup Levels: Soil, Groundwater and OSHA Air Quality Data

Chemical Constituent	Soil Cleanup Level	Ground Water Cleanup Level	Air Quality
Benzene	0.03 mg/kg ^A	5 ug/liter	1 ppm (3.25 mg/m ³)
Ethylbenzene	6 mg/kg ^A	700 ug/liter	100 ppm
Toluene	7 mg/kg ^A	1,000 ug/liter	0.02 ppm
Xylenes	9 mg/kg ^A	1,000 ug/liter	100 ppm
Acenaphthene	4.8E x 10 ³ T-CLARC	9.6E x 10 ² T-CLARC	NA
Acenaphthylene	NA	NA	NA
Anthracene	2.4E x 10 ⁴ C-CLARC	2.4E x 10 ³ T-CLARC	NA
Benz a anthracene	1.37E x 10 ⁻¹ C-CLARC	1.2E x 10 ² C-CLARC	NA
Benzo b fluoranthene	1.37E x 10 ⁻¹ C-CLARC	1.2E x 10 ² C-CLARC	NA
Benzo g,h,i perylene	NA	NA	NA
Benzo k fluoranthene	1.37E x 10 ⁻¹ C-CLARC	1.2E x 10 ² C-CLARC	NA
Chrysene	1.37E x 10 ⁻¹ C-CLARC	1.2E x 10 ² C-CLARC	NA
Dibenz a,h anthracene	1.37E x 10 ⁻¹ C-CLARC	1.2E x 10 ² C-CLARC	NA
Fluoranthene	3.20E x 10 ³ T-CLARC	6.4E x 10 ² T-CLARC	NA
Fluorene	3.20E x 10 ³ T-CLARC	6.4E x 10 ² T-CLARC	NA
Indeno 1,2,3-cd pyrene	1.37E x 10 ⁻¹ C-CLARC	1.2E x 10 ² C-CLARC	NA
Naphthalene	5 mg/kg ^A	1.6E x 10 ² C-A	10 ppm
Phenanthrene	NA	NA	NA
Pyrene	2.40E x 10 ³ T-CLARC	4.80E x 10 ² T-CLARC	NA
1-Methylnaphthalene	NA	NA	NA
2-Methylnaphthalene	1.63E x 10 ² T-GWC	1.63E x 10 ² T-GWC	NA
NWTPH-Dx	2,000 mg/kg ^A	500 ug/liter ^A	10 ppm
NWTPH-Dx Extended	2,000 mg/kg ^A	500 ug/liter ^A	10 ppm

Note: With data from more than one source, lowest cleanup levels are listed.
 Soil cleanup level results in milligrams/kilogram = mg/kg
 Water cleanup level results in micrograms/liter = ug/liter = 0.001 mg/liter
 T = toxicity pathology – soil or water
 C = carcinogenic pathology – soil or water
 A = Method A Cleanup Level
 CLARC = Cleanup Levels and Risk Calculations under the Model Toxics Control Act Cleanup Regulation
 (Method B Reference Standards – not final cleanup levels)
 GWC = Groundwater Chemicals – Desk Reference; John H. Montgomery, Third Edition, 2000 – toxicity
 guidance not a cleanup level.
 NA = No Cleanup Level or reference air quality information
 Air Quality data from NIOSH Guide of Chemical Hazards, US Department of Health and Human Services and
 the CDC, 1994, using OSHA information.

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TABLE #2
Welch Foods RIFS – Four Quarters of Groundwater Monitoring Results 2008 (Summary)

Well Number	Date	Groundwater Depth	Groundwater Elevation	Groundwater Flow Direction	pH	Conductivity (micromhos/cm)	Temperature	Diesel	BETX	PAHs/Naphthylene 8270 SIM
MW #1	1/24/08	21.35'	79.32'	N 4 ⁰ E	7.48	572	18.0 °C	ND	All ND	All ND
MW #2	1/24/08	20.78'	79.25'	"	7.57	636	17.5 °C	ND	All ND	All ND
MW #3	1/24/08	20.54'	79.26'	"	7.70	629	17.4 °C	ND	All ND	All ND
MW #1	6/27/08	20.01'	80.66'	N 47 ⁰ E	7.32	502	19.6 °C	ND	All ND	All ND
MW #2	6/27/08	19.46'	80.57'	"	7.36	609	20.2 °C	ND	All ND	All ND
MW #3	6/27/08	19.06'	80.54'	"	7.42	585	20.2 °C	ND	All ND	All ND
MW #1	9/5/08	19.68'	80.99'	N 11 ⁰ E	7.34	593	19.7 °C	ND	All ND	All ND
MW #2	9/5/08	19.23'	80.80'	"	7.33	602	20.0 °C	ND	All ND	All ND
MW #3	9/5/08	18.76'	80.83'	"	7.36	586	21.7 °C	ND	All ND	All ND
MW #1	12/2/08	19.24'	81.43	N 47 ⁰ E	7.44	536	20.0 °C	ND	All ND	ND (Pyrene 0.11 ug/l)
MW #2	12/2/08	18.72'	81.31	"	7.31	611	19.9 °C	ND	All ND	All ND
MW #3	12/2/08	18.33'	81.27	"	7.37	601	19.8 °C	ND	All ND	All ND

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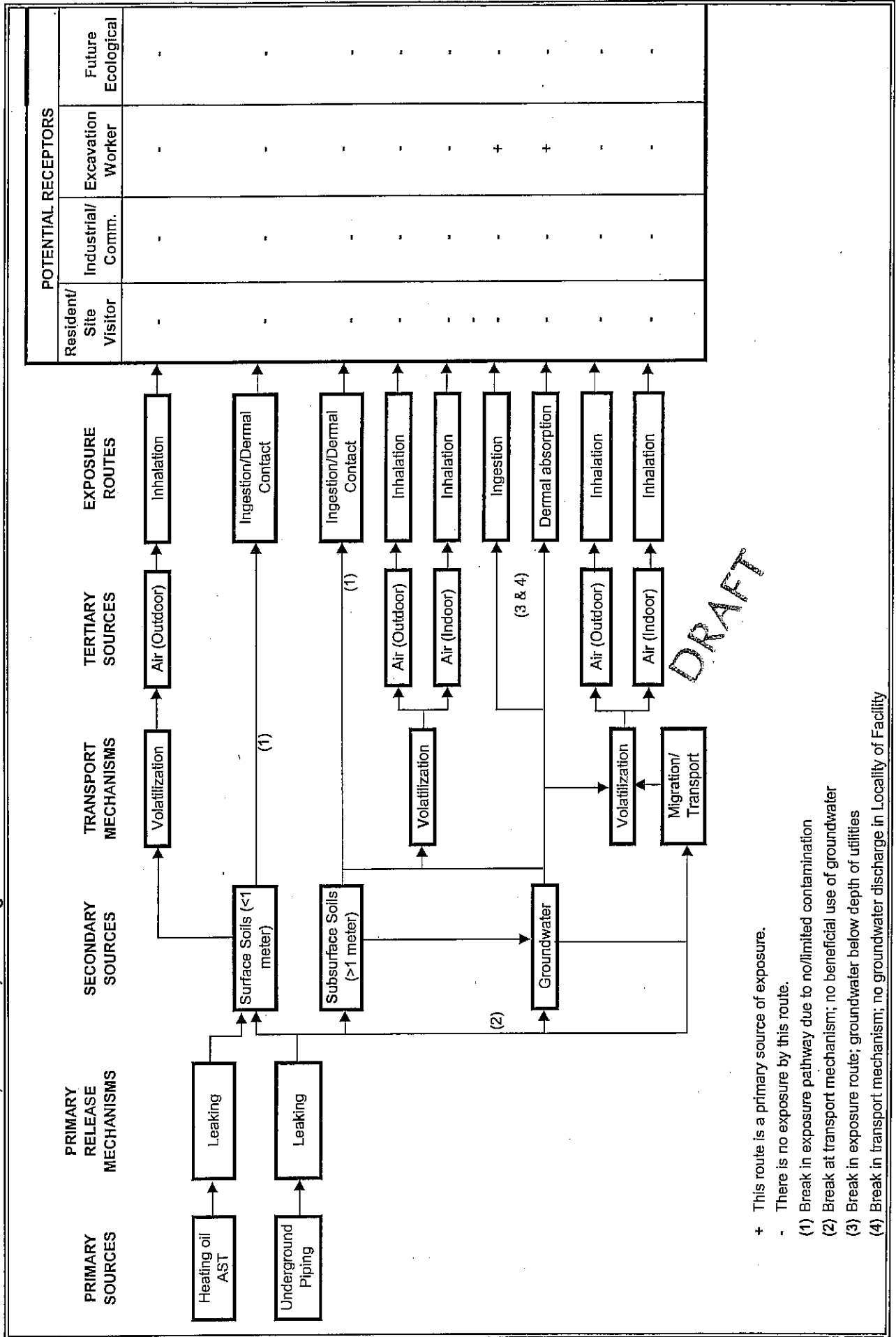
Note: The January monitoring was completed for the Remedial Investigation. Groundwater depth and elevations measurements are in feet. Groundwater elevation is relative and figured to a temporary BM elevation. ND = Non-detected above the minimum detection limit. Temperatures in degrees Centigrade = °C Pyrene detected in groundwater as indicated. Method B Reference Standard is 480 ug/l

Table # 3
Welch Foods RIFS
Preliminary Alternative Evaluation

	Protectiveness	Permanence	Long-Term Effectiveness	Implementability	Implementation Risk	Cost Reasonableness	Total Sum
1) No Action	1	1	1	10	10	10	33
2) Excavation and Disposal	8	8	8	1	5	1	31
3) Monitoring Wall	7	6	7	4	6	3	33
4) Long-term Monitoring	5	2	6	8	10	6	37
5) Institutional Controls	5	2	4	8	10	7	36
6) Solvent/oxidant Remediation	5	7	6	4	5	3	30
7) Thermal Steam Injection	5	5	2	1	5	2	20
8) Chemical Oxidation	5	7	7		7	5	34

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Table #4 - Conceptual Site Model
Welch Foods Former Site, Kennewick, Washington



- + This route is a primary source of exposure.
- There is no exposure by this route.
- (1) Break in exposure pathway due to no/limited contamination
- (2) Break at transport mechanism; no beneficial use of groundwater
- (3) Break in exposure route; groundwater below depth of utilities
- (4) Break in transport mechanism; no groundwater discharge in Locality of Facility

Table 749-1

Simplified Terrestrial Ecological Evaluation – Exposure Analysis Procedure under WAC 173-340-7492(2)(a)(ii).^a

Weldch Foods Facility
10 E BrunEAU
Kennewick WA

Footnotes:

- a It is expected that this habitat evaluation will be undertaken by an experienced field biologist. If this is not the case, enter a conservative score (1) for questions 3 and 4.
- b **Habitat rating system.** Rate the quality of the habitat as high, intermediate or low based on your professional judgment as a field biologist. The following are suggested factors to consider in making this evaluation:
Low: Early successional vegetative stands; vegetation predominantly noxious, nonnative, exotic plant species or weeds. Areas severely disturbed by human activity, including intensively cultivated croplands. Areas isolated from other habitat used by wildlife.
High: Area is ecologically significant for one or more of the following reasons: Late-successional native plant communities present; relatively high species diversity; used by an uncommon or rare species; priority habitat (as defined by the Washington Department of Fish and Wildlife); part of a larger area of habitat where size or fragmentation may be important for the retention of some species.
Intermediate: Area does not rate as either high or low.
- c Indicate "yes" if the area attracts wildlife or is likely to do so. Examples: Birds frequently visit the area to feed; evidence of high use by mammals (tracks, scat, etc.); habitat "island" in an industrial area; unusual features of an area that make it important for feeding animals; heavy use during seasonal migrations.

Estimate the area of contiguous (connected) undeveloped land on the site or within 500 feet of any area of the site to the nearest 1/2 acre (1/4 acre if the area is less than 0.5 acre). "Undeveloped land" means land that is not covered by existing buildings, roads, paved areas or other barriers that will prevent wildlife from feeding on plants, earth-worms, insects or other food in or on the soil.		
1) From the table below, find the number of points corresponding to the area and enter this number in the box to the right.		
<u>Area (acres)</u>	<u>Points</u>	
0.25 or less	4	
0.5	5	
1.0	6	
1.5	7	
2.0	8	
2.5	9	
3.0	10	
3.5	11	
4.0 or more	12	4
2) Is this an industrial or commercial property? See WAC 173-340-7490(3)(c). If yes, enter a score of 3 in the box to the right. If no, enter a score of 1.		3
3) Enter a score in the box to the right for the habitat quality of the site, using the rating system shown below ^b . (High = 1, Intermediate = 2, Low = 3)		1
4) Is the undeveloped land likely to attract wildlife? If yes, enter a score of 1 in the box to the right. If no, enter a score of 2. See footnote c.		1
5) Are there any of the following soil contaminants present: Chlorinated dioxins/furans, PCB mixtures, DDT, DDE, DDD, aldrin, chlordane, dieldrin, endosulfan, endrin, heptachlor, benzene hexachloride, toxaphene, hexachlorobenzene, pentachlorophenol, pentachlorobenzene? If yes, enter a score of 1 in the box to the right. If no, enter a score of 4.		4
6) Add the numbers in the boxes on lines 2 through 5 and enter this number in the box to the right. If this number is larger than the number in the box on line 1, the simplified terrestrial ecological evaluation may be ended under WAC 173-340-7492 (2)(a)(ii).		9

APPENDIX A
Site Photographs





PHOTO 1: LOOKING EAST SHOWING UST SITE, BOILER BUILDING AND OFFICE

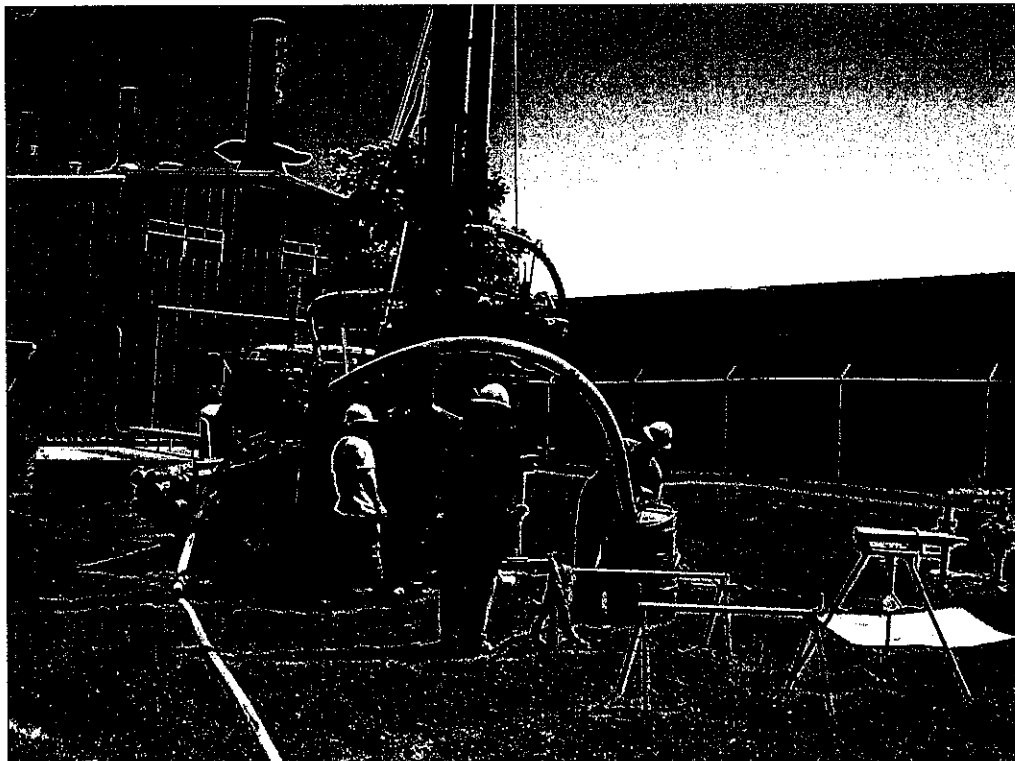


PHOTO 2: DRILLING BORING #4 DURING PHASE II ESA

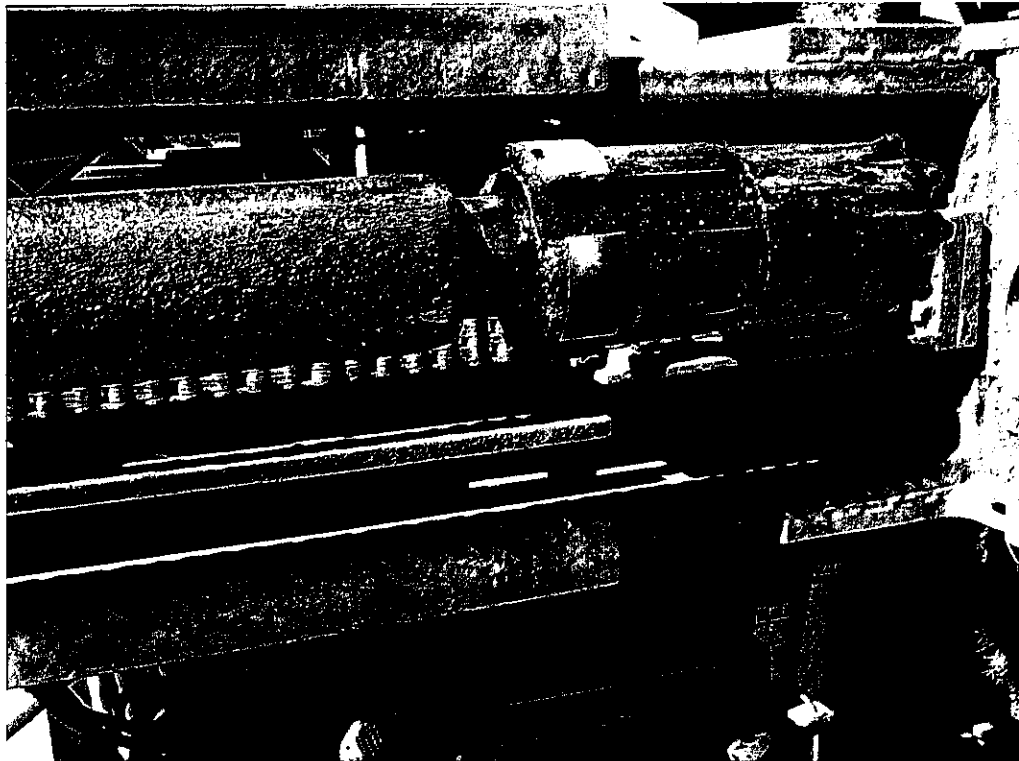


PHOTO 3: OIL ON DRILL BIT, BORING #4



PHOTO 4: LOOKING SOUTHEAST, SHOWING INTERIM REMEDIAL ACTION
CONTAMINATED SOIL REMOVAL EXCAVATION

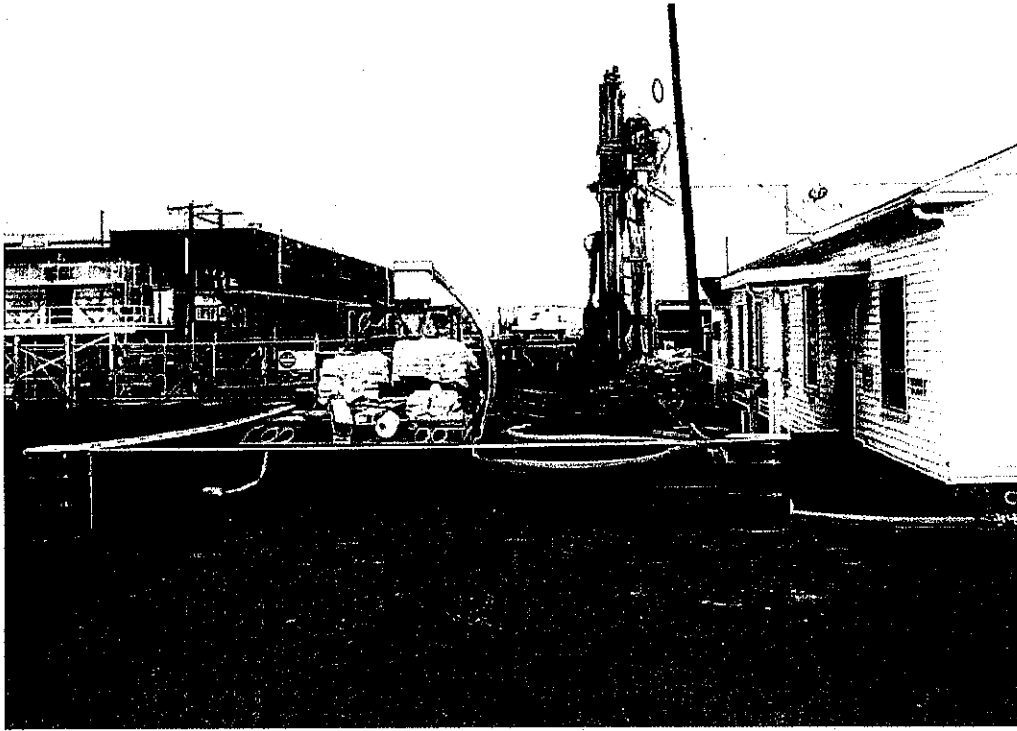


PHOTO 5: DRILLING/INSTALLING MONITORING WELL #2 LOOKING EAST



PHOTO 6: DRILLING MONITORING WELL #3 LOOKING SOUTH

APPENDIX B

Limited Pump Test – Hydraulic Conductivity Evaluation

Project #62121.00

Hydraulic Conductivity and Velocity Estimation through Limited Pump Test

Given: No observation wells.

Effective smallest 10% of grain size = $D_{10} = 0.1$ millimeters

Pump test completed in MW#2, with drawdown of 0.1 feet in long term equilibrium. Pumping equilibrium was 3 gallons per minute or 1.892×10^{-4} meters³/second.

Radius of influence estimated to be 6 feet or 1.827 meters (see attached curve).

Hydraulic conductivity is estimated in the upper portion of the unconfined aquifer.

$$\text{Hydraulic Conductivity} = K = \frac{Q \ln (R/r_w)}{\pi [(H)^2 - (h_w)^2]}$$

$$K = \frac{(1.892 \times 10^{-4} \text{ meters}^3/\text{second}) (100 \text{ cm/meter}) \ln (1.827 \text{ meters}/0.0487 \text{ meter})}{3.14 [(1 \text{ meter})^2 - (0.96954 \text{ meter})^2]}$$

$$K = 3.6 \times 10^{-1} \text{ cm/second}$$

DRAFT

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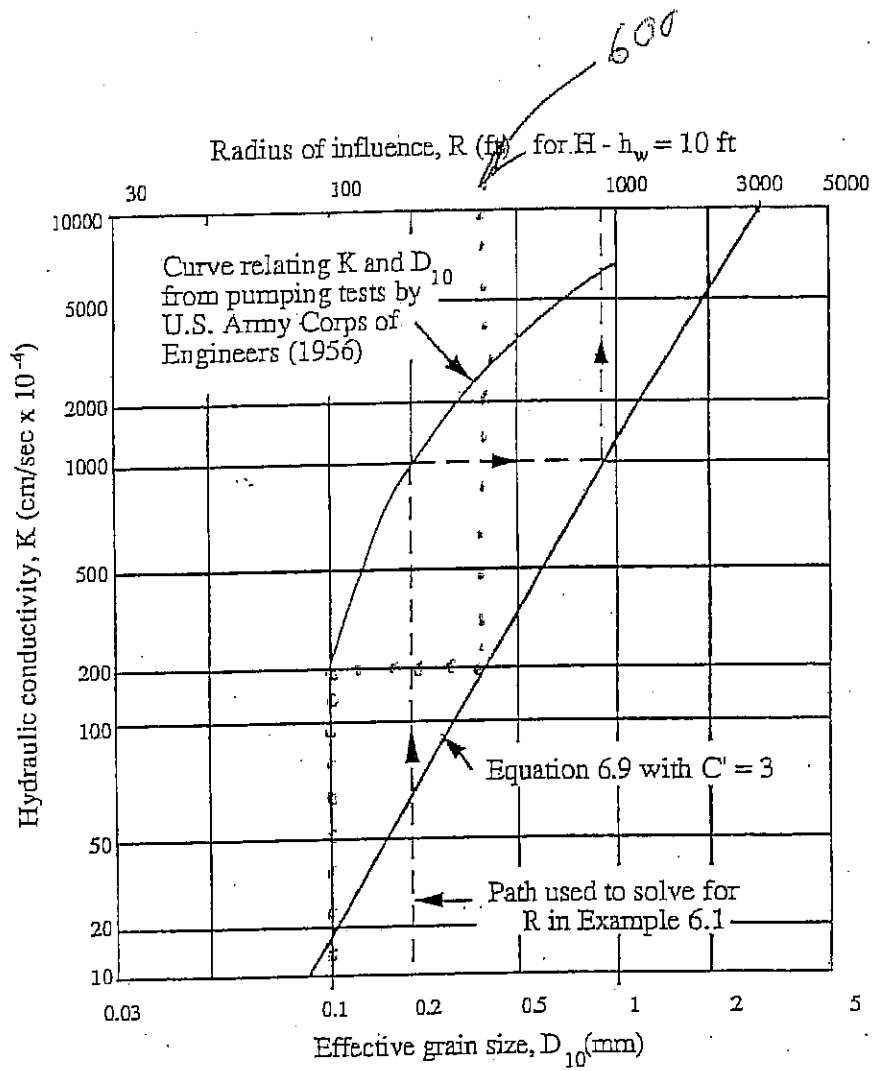


Figure 6.1 Hydraulic conductivity or effective grain size vs. radius of influence for a confined aquifer.

$$\frac{.1}{10} \times 600 = 6 \text{ feet} = 1.827 \text{ meters}$$

Radius.

DRAFT

APPENDIX C

Laboratory Reports
Chain-of-Custody Documentation

6199100



LABORATORY REPORT

RJLeeGroup, Inc. | Center for Laboratory Sciences
2710 North 20th Avenue, Pasco WA 99301
Tel: (509) 545-4989 | Fax: (509) 544-6010

PBS Environmental - Kennewick, WA
320 N. Johnson #100
Kennewick, WA 99336
Attn: Paul Danielson
Phone: (509) 735-2698
Fax: (509) 735-1867

RJ Lee Group Job No.: WA020220080001
Samples Received: 2/1/2008
Report Date: 2/13/2008
Analysis/Prep Date 2/6/2008
Client Project 61499
Purchase Order No.:

Analysis:

Sample ID	Sample Collection	Analytic	Matrix/Method	Units	Result	Qualifier	Reporting Limit
MW-1 WA020220080001-001	2/2/2008	Benzene	EPA 624 Non-Potable Water	µg/L	< 0.50		0.50
MW-1 WA020220080001-001	2/2/2008	Ethylbenzene	EPA 624 Non-Potable Water	µg/L	< 0.50		0.50
MW-1 WA020220080001-001	2/2/2008	Toluene	EPA 624 Non-Potable Water	µg/L	< 0.50		0.50
MW-1 WA020220080001-001	2/2/2008	Xylenes	EPA 624 Non-Potable Water	µg/L	< 0.50		0.50
MW-1 WA020220080001-001	2/2/2008	Acenaphthene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
MW-1 WA020220080001-001	2/2/2008	Acenaphthylene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
MW-1 WA020220080001-001	2/2/2008	Anthracene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
MW-1 WA020220080001-001	2/2/2008	Benz (e) anthracene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
MW-1 WA020220080001-001	2/2/2008	Benzo (b) fluoranthene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
MW-1 WA020220080001-001	2/2/2008	Benzo (g,h,i) perylene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
MW-1 WA020220080001-001	2/2/2008	Benzo (k) fluoranthene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
MW-1 WA020220080001-001	2/2/2008	Chrysene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
MW-1 WA020220080001-001	2/2/2008	Dibenz (a,h) anthracene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
MW-1 WA020220080001-001	2/2/2008	Fluoranthene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
MW-1 WA020220080001-001	2/2/2008	Fluorene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
MW-1 WA020220080001-001	2/2/2008	Indeno (1,2,3-cd) pyrene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50

LABORATORY REPORT

PBS Environmental - Kennewick, WA
 320 N. Johnson #100
 Kennewick, WA 99336
 Attn: Paul Danielson
 Phone: (509) 735-2698
 Fax: (509) 735-1867

RJ Lee Group Job No.: WA020220080001
 Samples Received: 2/1/2008
 Report Date: 2/13/2008
 Analysis/Prep Date: 2/6/2008
 Client Project: 61499
 Purchase Order No.:

Analysis:

Sample ID	Sample Collection	Analyte	Matrix/Method	Units	Result	Qualifier	Reporting Limit
WA020220080001-001	2/2/2008	Naphthalene	EPA 8270 Non-Potable Water	mg/L	< 0.050		0.050
WA020220080001-001	2/2/2008	Phenanthrene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
WA020220080001-001	2/2/2008	Pyrene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
WA020220080001-001	2/2/2008	TPH-Dx	NWTPH-Dx Non-Potable Water	mg/L	< 0.14		0.14
WA020220080001-002	2/2/2008	Benzene	EPA 624 Non-Potable Water	µg/L	< 0.50		0.50
WA020220080001-002	2/2/2008	Ethylbenzene	EPA 624 Non-Potable Water	µg/L	< 0.50		0.50
WA020220080001-002	2/2/2008	Toluene	EPA 624 Non-Potable Water	µg/L	< 0.50		0.50
WA020220080001-002	2/2/2008	Xylenes	EPA 624 Non-Potable Water	µg/L	< 0.50		0.50
WA020220080001-002	2/2/2008	Acenaphthene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
WA020220080001-002	2/2/2008	Acenaphthylene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
WA020220080001-002	2/2/2008	Anthracene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
WA020220080001-002	2/2/2008	Benz (a) anthracene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
WA020220080001-002	2/2/2008	Benzo (b) fluoranthene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
WA020220080001-002	2/2/2008	Benzo (g,h,i) perylene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
WA020220080001-002	2/2/2008	Benzo (k) fluoranthene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
WA020220080001-002	2/2/2008	Chrysene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
WA020220080001-002	2/2/2008	Dibenz (a,h) anthracene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
WA020220080001-002	2/2/2008	Fluoranthene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50

LABORATORY REPORT

RJ Lee Group Job No.: WA020220080001
 Samples Received: 2/1/2008
 Report Date: 2/13/2008
 Analysis/Prep Date: 2/6/2008
 Client Project: 61499
 Purchase Order No.:

PBS Environmental - Kennewick, WA
 320 N. Johnson #100
 Kennewick, WA 99336
 Attn: Paul Danielson
 Phone: (509) 795-2698
 Fax: (509) 735-1867

Analysis:

Sample ID	Sample Collection	Analyte	Matrix/Method	Units	Result	Qualifier	Reporting Limit
MW-2	2/2/2008	Fluorene	EPA 8270	mg/L	< 0.50		0.50
WA020220080001-002			Non-Potable Water				
MW-2	2/2/2008	Indeno (1,2,3-cd) pyrene	EPA 8270	mg/L	< 0.50		0.50
WA020220080001-002			Non-Potable Water				
MW-2	2/2/2008	Naphthalene	EPA 8270	mg/L	< 0.050		0.050
WA020220080001-002			Non-Potable Water				
MW-2	2/2/2008	Phenanthrene	EPA 8270	mg/L	< 0.50		0.50
WA020220080001-002			Non-Potable Water				
MW-2	2/2/2008	Pyrene	EPA 8270	mg/L	< 0.50		0.50
WA020220080001-002			Non-Potable Water				
MW-2	2/2/2008	TPH-Dx	NWTFH-Dx	mg/L	< 0.15		0.15
WA020220080001-002			Non-Potable Water				
MW-3	2/2/2008	Benzene	EPA 624	µg/L	< 0.50		0.50
WA020220080001-003			Non-Potable Water				
MW-3	2/2/2008	Ethylbenzene	EPA 624	µg/L	< 0.50		0.50
WA020220080001-003			Non-Potable Water				
MW-3	2/2/2008	Toluene	EPA 624	µg/L	< 0.50		0.50
WA020220080001-003			Non-Potable Water				
MW-3	2/2/2008	Xylenes	EPA 624	µg/L	< 0.50		0.50
WA020220080001-003			Non-Potable Water				
MW-3	2/2/2008	Acenaphthene	EPA 8270	mg/L	< 0.50		0.50
WA020220080001-003			Non-Potable Water				
MW-3	2/2/2008	Acenaphthylene	EPA 8270	mg/L	< 0.50		0.50
WA020220080001-003			Non-Potable Water				
MW-3	2/2/2008	Anthracene	EPA 8270	mg/L	< 0.50		0.50
WA020220080001-003			Non-Potable Water				
MW-3	2/2/2008	Benzo (a) anthracene	EPA 8270	mg/L	< 0.50		0.50
WA020220080001-003			Non-Potable Water				
MW-3	2/2/2008	Benzo (b) fluoranthene	EPA 8270	mg/L	< 0.50		0.50
WA020220080001-003			Non-Potable Water				
MW-3	2/2/2008	Benzo (g,h,i) perylene	EPA 8270	mg/L	< 0.50		0.50
WA020220080001-003			Non-Potable Water				
MW-3	2/2/2008	Benzo (k) fluoranthene	EPA 8270	mg/L	< 0.50		0.50
WA020220080001-003			Non-Potable Water				
MW-3	2/2/2008	Chrysene	EPA 8270	mg/L	< 0.50		0.50
WA020220080001-003			Non-Potable Water				

LABORATORY REPORT

EPB Environmental - Kennewick, WA
 320 N. Johnson #100
 Kennewick, WA 99336
 Attn: Paul Danielson
 Phone: (509) 735-2698
 Fax: (509) 735-1867

RJ Lee Group Job No.: WA020220080001
 Samples Received: 2/1/2008
 Report Date: 2/13/2008
 Analysis/Prep Date 2/6/2008
 Client Project: 61499
 Purchase Order No.:

Analysis:

Sample ID	Sample Collection	Analyte	Matrix/Method	Units	Result	Qualifier	Reporting Limit
MW-3 WA020220080001-003	2/2/2008	Dibenz (a,h) anthracene	Non-Potable Water EPA 8270	mg/L	< 0.50		0.50
MW-3 WA020220080001-003	2/2/2008	Fluoranthene	Non-Potable Water EPA 8270	mg/L	< 0.50		0.50
MW-3 WA020220080001-003	2/2/2008	Fluorene	Non-Potable Water EPA 8270	mg/L	< 0.50		0.50
MW-3 WA020220080001-003	2/2/2008	Indeno (1,2,3-cd) pyrene	Non-Potable Water EPA 8270	mg/L	< 0.50		0.50
MW-3 WA020220080001-003	2/2/2008	Naphthalene	Non-Potable Water EPA 8270	mg/L	< 0.050		0.050
MW-3 WA020220080001-003	2/2/2008	Phenanthrene	Non-Potable Water EPA 8270	mg/L	< 0.50		0.50
MW-3 WA020220080001-003	2/2/2008	Pyrene	Non-Potable Water EPA 8270	mg/L	< 0.50		0.50
MW-3 WA020220080001-003	2/2/2008	TPH-Dx	Non-Potable Water NWTTH-Dx	mg/L	< 0.15		0.15
MW-23 WA020220080001-004	2/2/2008	Benzene	Non-Potable Water EPA 624	µg/L	< 0.50		0.50
MW-23 WA020220080001-004	2/2/2008	Ethylbenzene	Non-Potable Water EPA 624	µg/L	< 0.50		0.50
MW-23 WA020220080001-004	2/2/2008	Toluene	Non-Potable Water EPA 624	µg/L	< 0.50		0.50
MW-23 WA020220080001-004	2/2/2008	Xylenes	Non-Potable Water EPA 624	µg/L	< 0.50		0.50
MW-23 WA020220080001-004	2/2/2008	Acenaphthene	Non-Potable Water EPA 8270	mg/L	< 0.50		0.50
MW-23 WA020220080001-004	2/2/2008	Acenaphthylene	Non-Potable Water EPA 8270	mg/L	< 0.50		0.50
MW-23 WA020220080001-004	2/2/2008	Anthracene	Non-Potable Water EPA 8270	mg/L	< 0.50		0.50
MW-23 WA020220080001-004	2/2/2008	Benz (a) anthracene	Non-Potable Water EPA 8270	mg/L	< 0.50		0.50
MW-23 WA020220080001-004	2/2/2008	Benzo (b) fluoranthene	Non-Potable Water EPA 8270	mg/L	< 0.50		0.50
MW-23 WA020220080001-004	2/2/2008	Benzo (g,h,i) perylene	Non-Potable Water EPA 8270	mg/L	< 0.50		0.50

LABORATORY REPORT

PBS Environmental - Kennewick, WA
 320 N. Johnson #100
 Kennewick, WA 99536
 Attn: Paul Danielson
 Phone: (509) 735-2698
 Fax: (509) 735-1867

RJ Lee Group Job No.: WA020220080001
 Samples Received: 2/1/2008
 Report Date: 2/13/2008
 Analysis/Prep Date 2/6/2008
 Client Project: 61499
 Purchase Order No.:

Analysis:

Sample ID	Sample Collection	Analyte	Matrix/Method	Units	Result	Qualifier	Reporting Limit
WA020220080001-004	2/2/2008	Benzo (k) fluoranthene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
WA020220080001-004	2/2/2008	Chrysene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
WA020220080001-004	2/2/2008	Dibenz (a,h) anthracene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
WA020220080001-004	2/2/2008	Fluoranthene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
WA020220080001-004	2/2/2008	Fluorene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
WA020220080001-004	2/2/2008	Indeno (1,2,3-cd) pyrene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
WA020220080001-004	2/2/2008	Naphthalene	EPA 8270 Non-Potable Water	mg/L	< 0.050		0.050
WA020220080001-004	2/2/2008	Phenanthrene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
WA020220080001-004	2/2/2008	Pyrene	EPA 8270 Non-Potable Water	mg/L	< 0.50		0.50
WA020220080001-004	2/2/2008	TPH-Dx	NWTPH-Dx Non-Potable Water	mg/L	< 0.15		0.15
WA020220080001-004	1/25/2008	TPH-Dx	NWTPH-Dx Solid	mg/kg	< 33		33

* All solid matrices reported on a dry weight basis unless otherwise noted.

* All values reported without blank correction unless otherwise noted

Analyst Comments:

Report Qualifiers:

- E = Value above quantitation range
- H = Holding time for preparation or analysis exceeded
- N = Analyte not NELAC certified

B = Analyte detected in the associated Method Blank

J = Analyte detected below quantitation limits

L = Sample condition at receipt out of compliance with method defined conditions

S = Spike Recovery outside accepted recovery limits.

R = RPD (relative percent difference) outside accepted recovery limits

NELAC-National Environmental Laboratory Accreditation Conference

LABORATORY REPORT

PBS Environmental - Kennewick, WA
320 N. Johnson #100
Kennewick, WA 99336
Attn: Paul Danielson
Phone: (509) 735-2698
Fax: (509) 735-1867

RJ Lee Group Job No.: WA020220080001
Samples Received: 2/1/2008
Report Date: 2/13/2008
Analysis/Prep Date: 2/6/2008
Client Project: 61499
Purchase Order No.:

Analysis:

Sample ID	Sample Collection	Analyte	Matrix/Method	Units	Result	Qualifier	Reporting Limit
<p><i>These results are submitted pursuant to RJ Lee Group's current terms and conditions of sale, including the company's standard warranty and limitation of liability provisions. No responsibility or liability is assumed for the manner in which the results are used or interpreted. Unless notified in writing to return the samples covered by this report, RJ Lee Group will store the samples for a period of thirty (30) days before discarding. A shipping and handling fee will be assessed for the return of any samples. Unless otherwise noted samples were received in an acceptable condition. This report may not be used to claim product endorsement by any laboratory accrediting agency. The results contained in this report relate only to the items tested or to the sample(s) as received by the laboratory. Any reproduction of this document must be in full for the report to be valid.</i></p> <p>Quality Control data is nonblinded upon request.</p>							
<p>Authorized Signature: <u>Mauro Avila</u> Project Manager: Ms. Marisol Avila</p>							

Request for Laboratory Analytical Services
Chain of Custody

Purchase Order No.: _____ Client Job No.: **6799-00**

Project Name: _____ Client No.: _____
Date Delivered: _____ Logged In By: _____

Name: **Paul Danielson**

Company: **PBS Eng + Env**

Address: **720 N. Johnson Street
Kennebec WA 99336**

City, State, Zip: **Kennebec WA 99336**

Phone: **(509) 735-2698** Fax: **(509) 735-1867**

Call with Verbal Results:

Email Results To: **Paul Danielson**

Company: **PBS**

Name: **Paul Danielson**

Address: **As above**

City, State, Zip: _____

Phone: _____ Fax: _____

Sample Identification	Sample Description	Sample Date	Sample Time		Wipe Area / Air Volume
			Start	Stop	
MW-1	Water	2/1/08			
MW-2	Water	↓			
MW-3	Water	↓			
MW-23	Water	↓			
MW-23	Soil	1/25/08			

Relinquished By (Signature): **Paul Danielson** Date: **2/1/08** Time: **3:30 pm**

Relinquished By (Print Name): **Paul Danielson** Relinquished To: _____

Company Name: _____ Method of Shipment: _____

Relinquished By (Signature): **Manuel Avila** Date: **2/11/08** Time: _____

Relinquished By (Print Name): **Manuel Avila** Relinquished To: _____

Company Name: _____ Method of Shipment: _____

Standard: **Yes** No? IF No, No. of Business Days: **5**

Sample Purpose: Information Regulatory

System ID No.: _____

DOH Source No.: _____

Multiline Sources Nos.: _____

Sample Purpose: A 7 B 7 Other?

Preservation: _____ Matrix: _____ Containers: _____

Umpres: I₂SO₄ _____ WW-Wastewater _____ P-Plastic _____

4°C _____ HCl _____ GW-Groundwater _____ G-Glass _____

JINO, _____ NaOH _____ S-Soil/Sludge _____ W-Wipe _____

Other _____ Na₂SO₄ _____ E-Extract _____ A-Air (Filter or tube) _____

Analysis Requested	Pres. Upon Receipt (Y/N)	Matrix	Container Type	pH	No. Containers
✓	✓	✓	✓	✓	5
✓	✓	✓	✓	✓	7
✓	✓	✓	✓	✓	5
✓	✓	✓	✓	✓	1

Chain of Custody

Received By (Signature): _____ Date: _____ Time: _____

Received By (Print Name): _____ Relinquished To: _____

Company Name: _____ Method of Shipment: _____

Chain of Custody

Received By (Signature): _____ Date: _____ Time: _____

Received By (Print Name): _____ Relinquished To: _____

Company Name: _____ Method of Shipment: _____

Questions? 10503 Battlevue Parkway
Contact Client Services: Manassas, VA 20109
(724) 387-1833 Tel: (703) 368-7880
Fax: (703) 368-7761

350 Hochberg Road
Monroeville, PA 15146
Tel: (724) 325-1776
Fax: (724) 733-1799

530 McCormick Street
San Leandro, CA 94571
Tel: (510) 567-0480
Fax: (510) 567-0488

2710 North 20th Avenue
Pasco, WA 99301
Tel: (509) 545-4989
Fax: (509) 544-6010

Sub-Sample ID	Test	Analyte	Method	Preparation
WA020220080001-002-01	Total Pet Hydrocarbons - Diesel by NWTPH-Dx	TPH-Dx	NWTPH-Dx	Liquid to Liquid Extraction
WA020220080001-002-02	Polynuclear Aromatic Hydrocarbons by EPA 8270	Fluorene	EPA 8270	EPA 3510C
		Chrysene	EPA 8270	EPA 3510C
		Fluoranthene	EPA 8270	EPA 3510C
		Acenaphthylene	EPA 8270	EPA 3510C
		Pyrene	EPA 8270	EPA 3510C
		Benzo (k) fluoranthene	EPA 8270	EPA 3510C
		Phenanthrene	EPA 8270	EPA 3510C
		Benz (a) anthracene	EPA 8270	EPA 3510C
		Naphthalene	EPA 8270	EPA 3510C
	Naphthalene by EPA 8270	Naphthalene	EPA 8270	EPA 3510C
	Polynuclear Aromatic Hydrocarbons by EPA 8270	Anthracene	EPA 8270	EPA 3510C
		do not use	EPA 8270	EPA 3510C
		Dibenz (a,h) anthracene	EPA 8270	EPA 3510C
		Acenaphthene	EPA 8270	EPA 3510C
		Indeno (1,2,3-cd) pyrene	EPA 8270	EPA 3510C
		Benzo (g,h,i) perylene	EPA 8270	EPA 3510C
		Benzo (b) fluoranthene	EPA 8270	EPA 3510C
WA020220080001-002-03	BTEX by EPA 624	Ethylbenzene	EPA 624	Analysis Preparation
		Xylenes	EPA 624	Analysis Preparation
		Toluene	EPA 624	Analysis Preparation
		Benzene	EPA 624	Analysis Preparation

Sample ID: WA020220080001-003	Customer Sample ID: MW-3	Site:
Collector: client	Date/Time Collected: 02/02/2008 12:00 PM Pacific Standard Time	Date/Time Received: 02/01/2008 03:30 PM Pacific Standard Time
Priority: 5 day	Matrix: Non-Potable Water	Quantity: 1120.000000000mL
Preservative: None		
Sample Entered By: Glynnis Bowman		
Comment:		

Sub-Sample ID	Test	Analyte	Method	Preparation
WA020220080001-003-01	Total Pet Hydrocarbons - Diesel by NWTPH-Dx	TPH-Dx	NWTPH-Dx	Liquid to Liquid Extraction
WA020220080001-003-02	Polynuclear Aromatic Hydrocarbons by EPA 8270	Phenanthrene	EPA 8270	EPA 3510C
		Fluorene	EPA 8270	EPA 3510C
		Anthracene	EPA 8270	EPA 3510C
		Benzo (b) fluoranthene	EPA 8270	EPA 3510C
		Dibenz (a,h) anthracene	EPA 8270	EPA 3510C
		Pyrene	EPA 8270	EPA 3510C
		Chrysene	EPA 8270	EPA 3510C
	Naphthalene by EPA 8270	Naphthalene	EPA 8270	EPA 3510C
	Polynuclear Aromatic Hydrocarbons by EPA 8270	Benzo (g,h,i) perylene	EPA 8270	EPA 3510C
		do not use	EPA 8270	EPA 3510C
		Indeno (1,2,3-cd) pyrene	EPA 8270	EPA 3510C

WA020220080001-003-03	BTEX by EPA 624	Acenaphthylene	EPA 8270	EPA 3510C
		Acenaphthene	EPA 8270	EPA 3510C
		Naphthalene	EPA 8270	EPA 3510C
		Benz (a) anthracene	EPA 8270	EPA 3510C
		Benzo (k) fluoranthene	EPA 8270	EPA 3510C
		Fluoranthene	EPA 8270	EPA 3510C
		Toluene	EPA 624	Analysis Preparation
		Ethylbenzene	EPA 624	Analysis Preparation
		Benzene	EPA 624	Analysis Preparation
		Xylenes	EPA 624	Analysis Preparation

Sample ID: WA020220080001-004	Customer Sample ID: MW-23	Site:
Collector: client	Date/Time Collected: 02/02/2008 12:00 PM Pacific Standard Time	Date/Time Received: 02/01/2008 03:30 PM Pacific Standard Time
Priority: 5 day	Matrix: Non-Potable Water	Quantity: 1120.000000000mL
Preservative: None		
Sample Entered By: Glynnis Bowman		
Comment:		

Sub-Sample ID	Test	Analyte	Method	Preparation
WA020220080001-004-01	Total Pet Hydrocarbons - Diesel by NWTPH-Dx	TPH-Dx	NWTPH-Dx	Liquid to Liquid Extraction
WA020220080001-004-02	Polynuclear Aromatic Hydrocarbons by EPA 8270	Benz (a) anthracene	EPA 8270	EPA 3510C
		Benzo (g,h,i) perylene	EPA 8270	EPA 3510C
		Acenaphthylene	EPA 8270	EPA 3510C
		Dibenz (a,h) anthracene	EPA 8270	EPA 3510C
		Chrysene	EPA 8270	EPA 3510C
		do not use	EPA 8270	EPA 3510C
		Indeno (1,2,3-cd) pyrene	EPA 8270	EPA 3510C
	Naphthalene by EPA 8270	Naphthalene	EPA 8270	EPA 3510C
	Polynuclear Aromatic Hydrocarbons by EPA 8270	Fluorene	EPA 8270	EPA 3510C
		Anthracene	EPA 8270	EPA 3510C
		Acenaphthene	EPA 8270	EPA 3510C
		Naphthalene	EPA 8270	EPA 3510C
		Pyrene	EPA 8270	EPA 3510C
		Phenanthrene	EPA 8270	EPA 3510C
		Benzo (k) fluoranthene	EPA 8270	EPA 3510C
		Benzo (b) fluoranthene	EPA 8270	EPA 3510C
		Fluoranthene	EPA 8270	EPA 3510C
WA020220080001-004-03	BTEX by EPA 624	Benzene	EPA 624	Analysis Preparation
		Toluene	EPA 624	Analysis Preparation
		Xylenes	EPA 624	Analysis Preparation
		Ethylbenzene	EPA 624	Analysis Preparation

Sample ID: WA020220080001-005	Customer Sample ID: MW-23	Site:
Collector: client	Date/Time Collected: 01/25/2008 12:00 PM Pacific Standard Time	Date/Time Received: 02/01/2008 03:30 PM Pacific Standard Time
Priority: 5 day	Matrix: Solid	Quantity: 500.000000000g
Preservative: None		

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Charlene Morrow, M.S.
Yelena Aravkina, M.S.
Bradley T. Benson, B.S.
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3012 16th Avenue West
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July 10, 2008

Paul Danielson, Project Manager
PBS Engineering and Environmental, Inc.
320 N. Johnson St., Suite 700
Kennewick, WA 99336

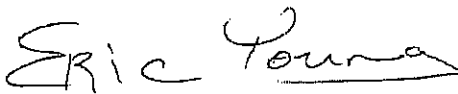
Dear Mr. Danielson:

Included are the results from the testing of material submitted on June 30, 2008 from the 62121.00, F&BI 806347 project. There are 11 pages included in this report. Any samples that may remain are currently scheduled for disposal in 30 days. If you would like us to return your samples or arrange for long term storage at our offices, please contact us as soon as possible.

We appreciate this opportunity to be of service to you and hope you will call if you should have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.



Eric Young
Project Manager

Enclosures
PBS0710R.DOC

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

CASE NARRATIVE

This case narrative encompasses samples received on June 30, 2008 by Friedman & Bruya, Inc. from the PBS Engineering and Environmental 62121.00, F&BI 806347 project. Samples were logged in under the laboratory ID's listed below.

<u>Laboratory ID</u>	<u>PBS Engineering and Environmental</u>
806347-01	MW 1
806347-02	MW 2
806347-03	MW 3

All quality control requirements were acceptable.

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: 07/10/08
Date Received: 06/30/08
Project: 62121.00, F&BI 806347
Date Extracted: 07/03/08
Date Analyzed: 07/03/08

RESULTS FROM THE ANALYSIS OF THE WATER SAMPLES
FOR BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENES
USING EPA METHOD 8021B
Results Reported as ug/L (ppb)

<u>Sample ID</u> Laboratory ID	<u>Benzene</u>	<u>Toluene</u>	<u>Ethyl Benzene</u>	<u>Total Xylenes</u>	<u>Surrogate (% Recovery)</u> Limit (52-124)
MW 1 806347-01	<1	<1	<1	<3	109
MW 2 806347-02	<1	<1	<1	<3	105
MW 3 806347-03	<1	<1	<1	<3	96
Method Blank	<1	<1	<1	<3	104

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: 07/10/08
Date Received: 06/30/08
Project: 62121.00, F&BI 806347
Date Extracted: 07/01/08
Date Analyzed: 07/03/08

RESULTS FROM THE ANALYSIS OF THE WATER SAMPLES
FOR TOTAL PETROLEUM HYDROCARBONS AS
DIESEL AND MOTOR OIL
USING METHOD NWTPH-Dx
Results Reported as ug/L (ppb)

<u>Sample ID</u> Laboratory ID	<u>Diesel Range</u> (C ₁₀ -C ₂₅)	<u>Motor Oil Range</u> (C ₂₅ -C ₃₆)	<u>Surrogate</u> (% Recovery) (Limit 51-132)
MW 1 806347-01	<50	<250	113
MW 2 806347-02	<50	<250	105
MW 3 806347-03	<50	<250	103
Method Blank	<50	<250	100

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Analysis For Semivolatile Compounds By EPA Method 8270C SIM

Client Sample ID: MW 1	Client: PBS Engineering and Environmental
Date Received: 06/30/08	Project: 62121.00, F&BI 806347
Date Extracted: 07/01/08	Lab ID: 806347-01
Date Analyzed: 07/01/08	Data File: 070104.D
Matrix: Water	Instrument: GCMS6
Units: ug/L (ppb)	Operator: YA

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
Anthracene-d10	73	50	150
Benzo(a)anthracene-d12	82	50	129

Compounds:	Concentration ug/L (ppb)
Naphthalene	<0.1
Acenaphthylene	<0.1
Acenaphthene	<0.1
Fluorene	<0.1
Phenanthrene	<0.1
Anthracene	<0.1
Fluoranthene	<0.1
Pyrene	<0.1
Benz(a)anthracene	<0.1
Chrysene	<0.1
Benzo(a)pyrene	<0.1
Benzo(b)fluoranthene	<0.1
Benzo(k)fluoranthene	<0.1
Indeno(1,2,3-cd)pyrene	<0.1
Dibenz(a,h)anthracene	<0.1
Benzo(g,h,i)perylene	<0.1
1-Methylnaphthalene	<0.1
2-Methylnaphthalene	<0.1

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Analysis For Semivolatile Compounds By EPA Method 8270C SIM

Client Sample ID:	MW 2	Client:	PBS Engineering and Environmental
Date Received:	06/30/08	Project:	62121.00, F&BI 806347
Date Extracted:	07/01/08	Lab ID:	806347-02
Date Analyzed:	07/01/08	Data File:	070105.D
Matrix:	Water	Instrument:	GCMS6
Units:	ug/L (ppb)	Operator:	YA

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
Anthracene-d10	73	50	150
Benzo(a)anthracene-d12	81	50	129

Compounds:	Concentration ug/L (ppb)
Naphthalene	<0.1
Acenaphthylene	<0.1
Acenaphthene	<0.1
Fluorene	<0.1
Phenanthrene	<0.1
Anthracene	<0.1
Fluoranthene	<0.1
Pyrene	<0.1
Benz(a)anthracene	<0.1
Chrysene	<0.1
Benzo(a)pyrene	<0.1
Benzo(b)fluoranthene	<0.1
Benzo(k)fluoranthene	<0.1
Indeno(1,2,3-cd)pyrene	<0.1
Dibenz(a,h)anthracene	<0.1
Benzo(g,h,i)perylene	<0.1
1-Methylnaphthalene	<0.1
2-Methylnaphthalene	<0.1

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Analysis For Semivolatile Compounds By EPA Method 8270C SIM

Client Sample ID:	MW 3	Client:	PBS Engineering and Environmental
Date Received:	06/30/08	Project:	62121.00, F&BI 806347
Date Extracted:	07/01/08	Lab ID:	806347-03
Date Analyzed:	07/01/08	Data File:	070106.D
Matrix:	Water	Instrument:	GCMS6
Units:	ug/L (ppb)	Operator:	YA

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
Anthracene-d10	74	50	150
Benzo(a)anthracene-d12	81	50	129

Compounds:	Concentration ug/L (ppb)
Naphthalene	<0.1
Acenaphthylene	<0.1
Acenaphthene	<0.1
Fluorene	<0.1
Phenanthrene	<0.1
Anthracene	<0.1
Fluoranthene	<0.1
Pyrene	<0.1
Benz(a)anthracene	<0.1
Chrysene	<0.1
Benzo(a)pyrene	<0.1
Benzo(b)fluoranthene	<0.1
Benzo(k)fluoranthene	<0.1
Indeno(1,2,3-cd)pyrene	<0.1
Dibenz(a,h)anthracene	<0.1
Benzo(g,h,i)perylene	<0.1
1-Methylnaphthalene	<0.1
2-Methylnaphthalene	<0.1

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Analysis For Semivolatile Compounds By EPA Method 8270C SIM

Client Sample ID:	Method Blank	Client:	PBS Engineering and Environmental
Date Received:	NA	Project:	62121.00, F&BI 806347
Date Extracted:	06/30/08	Lab ID:	081043mb
Date Analyzed:	06/30/08	Data File:	063010.D
Matrix:	Water	Instrument:	GCMS6
Units:	ug/L (ppb)	Operator:	YA

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
Anthracene-d10	75	50	150
Benzo(a)anthracene-d12	81	50	129

Compounds:	Concentration ug/L (ppb)
Naphthalene	<0.1
Acenaphthylene	<0.1
Acenaphthene	<0.1
Fluorene	<0.1
Phenanthrene	<0.1
Anthracene	<0.1
Fluoranthene	<0.1
Pyrene	<0.1
Benz(a)anthracene	<0.1
Chrysene	<0.1
Benzo(a)pyrene	<0.1
Benzo(b)fluoranthene	<0.1
Benzo(k)fluoranthene	<0.1
Indeno(1,2,3-cd)pyrene	<0.1
Dibenz(a,h)anthracene	<0.1
Benzo(g,h,i)perylene	<0.1
1-Methylnaphthalene	<0.1
2-Methylnaphthalene	<0.1

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: 07/10/08
 Date Received: 06/30/08
 Project: 62121.00, F&BI 806347

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER
 SAMPLES FOR BENZENE, TOLUENE,
 ETHYLBENZENE, AND XYLENES
 USING EPA METHOD 8021B

Laboratory Code: 807016-01 (Duplicate)

Analyte	Reporting Units	Sample Result	Duplicate Result	Relative Percent Difference (Limit 20)
Benzene	ug/L (ppb)	54	55	2
Toluene	ug/L (ppb)	8	8	0
Ethylbenzene	ug/L (ppb)	5	5	0
Xylenes	ug/L (ppb)	120	120	0

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Benzene	ug/L (ppb)	50	92	65-118
Toluene	ug/L (ppb)	50	93	72-122
Ethylbenzene	ug/L (ppb)	50	92	73-126
Xylenes	ug/L (ppb)	150	91	74-118

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: 07/10/08
Date Received: 06/30/08
Project: 62121.00, F&BI 806347

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER
SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS
DIESEL EXTENDED USING METHOD NWTPH-Dx

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Diesel Extended	ug/L (ppb)	2,500	116	109	67-141	6

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: 07/10/08
 Date Received: 06/30/08
 Project: 62121.00, F&BI 806347

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER
 SAMPLES FOR PNA'S BY EPA METHOD 8270C SIM

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Naphthalene	ug/L (ppb)	5	77	88	51-118	13
2-Methylnaphthalene	ug/L (ppb)	5	77	88	70-130	13
1-Methylnaphthalene	ug/L (ppb)	5	80	92	70-130	14
Acenaphthylene	ug/L (ppb)	5	77	91	51-120	17
Acenaphthene	ug/L (ppb)	5	78	91	46-122	15
Fluorene	ug/L (ppb)	5	78	93	52-122	18
Phenanthrene	ug/L (ppb)	5	77	91	50-117	17
Anthracene	ug/L (ppb)	5	74	88	50-122	17
Fluoranthene	ug/L (ppb)	5	79	97	49-123	20
Pyrene	ug/L (ppb)	5	79	97	44-125	20
Benz(a)anthracene	ug/L (ppb)	5	73	87	49-118	17
Chrysene	ug/L (ppb)	5	78	92	52-117	16
Benzo(b)fluoranthene	ug/L (ppb)	5	77	96	50-128	22 vo
Benzo(k)fluoranthene	ug/L (ppb)	5	79	92	54-123	15
Benzo(a)pyrene	ug/L (ppb)	5	79	94	52-128	17
Indeno(1,2,3-cd)pyrene	ug/L (ppb)	5	86	106	52-129	21 vo
Dibenz(a,h)anthracene	ug/L (ppb)	5	84	101	53-130	18
Benzo(g,h,i)perylene	ug/L (ppb)	5	81	97	48-128	18

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Data Qualifiers & Definitions

- a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.
- A1 - More than one compound of similar molecule structure was identified with equal probability.
- b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.
- ca - The calibration results for this range fell outside of acceptance criteria. The value reported is an estimate.
- c - The presence of the analyte indicated may be due to carryover from previous sample injections.
- d - The sample was diluted. Detection limits may be raised due to dilution.
- ds - The sample was diluted. Detection limits are raised due to dilution and surrogate recoveries may not be meaningful.
- dv - Insufficient sample was available to achieve normal reporting limits and limits are raised accordingly.
- fb - The analyte indicated was found in the method blank. The result should be considered an estimate.
- fc - The compound is a common laboratory and field contaminant.
- hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. The variability is attributed to sample inhomogeneity.
- ht - The sample was extracted outside of holding time. Results should be considered estimates.
- ip - Recovery fell outside of normal control limits. Compounds in the sample matrix interfered with the quantitation of the analyte.
- j - The result is below normal reporting limits. The value reported is an estimate.
- J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.
- jl - The analyte result in the laboratory control sample is out of control limits. The reported concentration should be considered an estimate.
- jr - The rpd result in laboratory control sample associated with the analyte is out of control limits. The reported concentration should be considered an estimate.
- js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.
- lc - The presence of the compound indicated is likely due to laboratory contamination.
- L - The reported concentration was generated from a library search.
- nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.
- pc - The sample was received in a container not approved by the method. The value reported should be considered an estimate.
- pr - The sample was received with incorrect preservation. The value reported should be considered an estimate.
- ve - The value reported exceeded the calibration range established for the analyte. The reported concentration should be considered an estimate.
- vo - The value reported fell outside the control limits established for this analyte.
- x - The pattern of peaks present is not indicative of diesel.
- y - The pattern of peaks present is not indicative of motor oil.

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Charlene Morrow, M.S.
Yelena Aravkina, M.S.
Bradley T. Benson, B.S.
Kurt Johnson, B.S.

3012 16th Avenue West
Seattle, WA 98119-2029
TEL: (206) 285-8282
FAX: (206) 283-5044
e-mail: fbi@isomedia.com

September 17, 2008

Paul Danielson, Project Manager
PBS Engineering and Environmental, Inc.
320 N. Johnson St., Suite 700
Kennewick, WA 99336

Dear Mr. Danielson:

Included are the results from the testing of material submitted on September 9, 2008 from the 62121.00, F&BI 809063 project. There are 11 pages included in this report. Any samples that may remain are currently scheduled for disposal in 30 days. If you would like us to return your samples or arrange for long term storage at our offices, please contact us as soon as possible.

We appreciate this opportunity to be of service to you and hope you will call if you should have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.



Eric Young
Project Manager

Enclosures
PBS0917R.DOC

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

CASE NARRATIVE

This case narrative encompasses samples received on September 9, 2008 by Friedman & Bruya, Inc. from the PBS Engineering and Environmental, Inc. 62121.00, F&BI 809063 project. Samples were logged in under the laboratory ID's listed below.

<u>Laboratory ID</u>	<u>PBS Engineering and Environmental, Inc.</u>
809063-01	MW-1
809063-02	MW-2
809063-03	MW-3

All quality control requirements were acceptable.

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: 09/17/08
 Date Received: 09/09/08
 Project: 62121.00, F&BI 809063
 Date Extracted: 09/09/08
 Date Analyzed: 09/09/08

RESULTS FROM THE ANALYSIS OF THE WATER SAMPLES
 FOR BENZENE, TOLUENE, ETHYLBENZENE,
 XYLENES AND TPH AS GASOLINE
 USING EPA METHOD 8021B AND NWTPH-Gx
 Results Reported as ug/L (ppb)

<u>Sample ID</u> Laboratory ID	<u>Benzene</u>	<u>Toluene</u>	<u>Ethyl Benzene</u>	<u>Total Xylenes</u>	<u>Gasoline Range</u>	<u>Surrogate (% Recovery)</u> (Limit 52-124)
MW-1 809063-01	<1	<1	<1	<3	<100	70
MW-2 809063-02	<1	<1	<1	<3	<100	93
MW-3 809063-03	<1	<1	<1	<3	<100	91
Method Blank	<1	<1	<1	<3	<100	89

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: 09/17/08
Date Received: 09/09/08
Project: 62121.00, F&BI 809063
Date Extracted: 09/09/08
Date Analyzed: 09/09/08

RESULTS FROM THE ANALYSIS OF THE WATER SAMPLES
FOR TOTAL PETROLEUM HYDROCARBONS AS
DIESEL AND MOTOR OIL
USING METHOD NWTPH-Dx
Results Reported as ug/L (ppb)

<u>Sample ID</u> Laboratory ID	<u>Diesel Range</u> (C ₁₀ -C ₂₅)	<u>Motor Oil Range</u> (C ₂₅ -C ₃₅)	<u>Surrogate</u> <u>(% Recovery)</u> (Limit 51-132)
MW-1 809063-01	<50	<250	98
MW-2 809063-02	<50	<250	89
MW-3 809063-03	<50	<250	98
Method Blank	<50	<250	90

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Analysis For Semivolatile Compounds By EPA Method 8270C SIM

Client Sample ID:	MW-1	Client:	PBS Engineering and Environmental
Date Received:	09/09/08	Project:	62121.00, F&BI 809063
Date Extracted:	09/09/08	Lab ID:	809063-01
Date Analyzed:	09/10/08	Data File:	090925.D
Matrix:	Water	Instrument:	GCMS6
Units:	ug/L (ppb)	Operator:	YA

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
Anthracene-d10	107	50	150
Benzo(a)anthracene-d12	97	50	129

Compounds:	Concentration ug/L (ppb)
Naphthalene	<0.1
Acenaphthylene	<0.1
Acenaphthene	<0.1
Fluorene	<0.1
Phenanthrene	<0.1
Anthracene	<0.1
Fluoranthene	<0.1
Pyrene	<0.1
Benzo(a)anthracene	<0.1
Chrysene	<0.1
Benzo(a)pyrene	<0.1
Benzo(b)fluoranthene	<0.1
Benzo(k)fluoranthene	<0.1
Indeno(1,2,3-cd)pyrene	<0.1
Dibenz(a,h)anthracene	<0.1
Benzo(g,h,i)perylene	<0.1
1-Methylnaphthalene	<0.1
2-Methylnaphthalene	<0.1

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Analysis For Semivolatile Compounds By EPA Method 8270C SIM

Client Sample ID:	MW-2	Client:	PBS Engineering and Environmental
Date Received:	09/09/08	Project:	62121.00, F&BI 809063
Date Extracted:	09/09/08	Lab ID:	809063-02
Date Analyzed:	09/10/08	Data File:	090926.D
Matrix:	Water	Instrument:	GCMS6
Units:	ug/L (ppb)	Operator:	YA

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
Anthracene-d10	100	50	150
Benzo(a)anthracene-d12	95	50	129

Compounds:	Concentration ug/L (ppb)
Naphthalene	<0.1
Acenaphthylene	<0.1
Acenaphthene	<0.1
Fluorene	<0.1
Phenanthrene	<0.1
Anthracene	<0.1
Fluoranthene	<0.1
Pyrene	<0.1
Benzo(a)anthracene	<0.1
Chrysene	<0.1
Benzo(a)pyrene	<0.1
Benzo(b)fluoranthene	<0.1
Benzo(k)fluoranthene	<0.1
Indeno(1,2,3-cd)pyrene	<0.1
Dibenz(a,h)anthracene	<0.1
Benzo(g,h,i)perylene	<0.1
1-Methylnaphthalene	<0.1
2-Methylnaphthalene	<0.1

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Analysis For Semivolatile Compounds By EPA Method 8270C SIM

Client Sample ID:	MW-3	Client:	PBS Engineering and Environmental
Date Received:	09/09/08	Project:	62121.00, F&BI 809063
Date Extracted:	09/09/08	Lab ID:	809063-03
Date Analyzed:	09/10/08	Data File:	090927.D
Matrix:	Water	Instrument:	GCMS6
Units:	ug/L (ppb)	Operator:	YA

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
Anthracene-d10	93	50	150
Benzo(a)anthracene-d12	72	50	129

Compounds:	Concentration ug/L (ppb)
Naphthalene	<0.1
Acenaphthylene	<0.1
Acenaphthene	<0.1
Fluorene	<0.1
Phenanthrene	<0.1
Anthracene	<0.1
Fluoranthene	<0.1
Pyrene	<0.1
Benzo(a)anthracene	<0.1
Chrysene	<0.1
Benzo(a)pyrene	<0.1
Benzo(b)fluoranthene	<0.1
Benzo(k)fluoranthene	<0.1
Indeno(1,2,3-cd)pyrene	<0.1
Dibenz(a,h)anthracene	<0.1
Benzo(g,h,i)perylene	<0.1
1-Methylnaphthalene	<0.1
2-Methylnaphthalene	<0.1

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Analysis For Semivolatile Compounds By EPA Method 8270C SIM

Client Sample ID:	Method Blank	Client:	PBS Engineering and Environmental
Date Received:	NA	Project:	62121.00, F&BI 809063
Date Extracted:	09/09/08	Lab ID:	081454mb2
Date Analyzed:	09/09/08	Data File:	090924.D
Matrix:	Water	Instrument:	GCMS6
Units:	ug/L (ppb)	Operator:	YA

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
Anthracene-d10	100	50	150
Benzo(a)anthracene-d12	93	50	129

Compounds:	Concentration ug/L (ppb)
Naphthalene	<0.1
Acenaphthylene	<0.1
Acenaphthene	<0.1
Fluorene	<0.1
Phenanthrene	<0.1
Anthracene	<0.1
Fluoranthene	<0.1
Pyrene	<0.1
Benz(a)anthracene	<0.1
Chrysene	<0.1
Benzo(a)pyrene	<0.1
Benzo(b)fluoranthene	<0.1
Benzo(k)fluoranthene	<0.1
Indeno(1,2,3-cd)pyrene	<0.1
Dibenz(a,h)anthracene	<0.1
Benzo(g,h,i)perylene	<0.1
1-Methylnaphthalene	<0.1
2-Methylnaphthalene	<0.1

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: 09/17/08
 Date Received: 09/09/08
 Project: 62121.00, F&BI 809063

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER
 SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE,
 XYLENES, AND TPH AS GASOLINE
 USING EPA METHOD 8021B AND NWTPH-Gx

Laboratory Code: 809059-01 (Duplicate)

Analyte	Reporting Units	Sample Result	Duplicate Result	Relative Percent Difference (Limit 20)
Benzene	ug/L (ppb)	<1	<1	nm
Toluene	ug/L (ppb)	<1	<1	nm
Ethylbenzene	ug/L (ppb)	<1	<1	nm
Xylenes	ug/L (ppb)	<3	<3	nm
Gasoline	ug/L (ppb)	<100	<100	nm

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Benzene	ug/L (ppb)	50	91	65-118
Toluene	ug/L (ppb)	50	93	72-122
Ethylbenzene	ug/L (ppb)	50	98	73-126
Xylenes	ug/L (ppb)	150	94	74-118
Gasoline	ug/L (ppb)	1,000	94	69-134

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: 09/17/08
Date Received: 09/09/08
Project: 62121.00, F&BI 809063

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER
SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS
DIESEL EXTENDED USING METHOD NWTPH-Dx

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Diesel Extended	ug/L (ppb)	2,500	101	106	67-141	5

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: 09/17/08

Date Received: 09/09/08

Project: 62121.00, F&BI 809068

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER
 SAMPLES FOR PNA'S BY EPA METHOD 8270C SIM

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Naphthalene	ug/L (ppb)	5	84	81	68-101	4
2-Methylnaphthalene	ug/L (ppb)	5	86	84	59-111	2
1-Methylnaphthalene	ug/L (ppb)	5	85	82	69-105	4
Acenaphthylene	ug/L (ppb)	5	82	79	70-109	4
Acenaphthene	ug/L (ppb)	5	84	81	69-104	4
Fluorene	ug/L (ppb)	5	87	83	68-111	5
Phenanthrene	ug/L (ppb)	5	84	81	66-106	4
Anthracene	ug/L (ppb)	5	83	80	67-112	4
Fluoranthene	ug/L (ppb)	5	88	82	69-116	7
Pyrene	ug/L (ppb)	5	88	82	68-115	7
Benz(a)anthracene	ug/L (ppb)	5	81	79	65-102	2
Chrysene	ug/L (ppb)	5	82	80	66-103	2
Benzo(b)fluoranthene	ug/L (ppb)	5	89	86	70-117	3
Benzo(k)fluoranthene	ug/L (ppb)	5	87	83	64-116	5
Benzo(a)pyrene	ug/L (ppb)	5	87	83	68-116	5
Indeno(1,2,3-cd)pyrene	ug/L (ppb)	5	84	82	63-122	2
Dibenz(a,h)anthracene	ug/L (ppb)	5	88	84	66-116	5
Benzo(g,h,i)perylene	ug/L (ppb)	5	85	82	66-114	4

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Data Qualifiers & Definitions

- a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.
- A1 - More than one compound of similar molecule structure was identified with equal probability.
- b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.
- ca - The calibration results for this range fell outside of acceptance criteria. The value reported is an estimate.
- c - The presence of the analyte indicated may be due to carryover from previous sample injections.
- d - The sample was diluted. Detection limits may be raised due to dilution.
- ds - The sample was diluted. Detection limits are raised due to dilution and surrogate recoveries may not be meaningful.
- dv - Insufficient sample was available to achieve normal reporting limits and limits are raised accordingly.
- fb - The analyte indicated was found in the method blank. The result should be considered an estimate.
- fc - The compound is a common laboratory and field contaminant.
- hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. The variability is attributed to sample inhomogeneity.
- ht - The sample was extracted outside of holding time. Results should be considered estimates.
- ip - Recovery fell outside of normal control limits. Compounds in the sample matrix interfered with the quantitation of the analyte.
- j - The result is below normal reporting limits. The value reported is an estimate.
- J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.
- jl - The analyte result in the laboratory control sample is out of control limits. The reported concentration should be considered an estimate.
- jr - The rpd result in laboratory control sample associated with the analyte is out of control limits. The reported concentration should be considered an estimate.
- js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.
- lc - The presence of the compound indicated is likely due to laboratory contamination.
- L - The reported concentration was generated from a library search.
- nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.
- pc - The sample was received in a container not approved by the method. The value reported should be considered an estimate.
- pr - The sample was received with incorrect preservation. The value reported should be considered an estimate.
- ve - The value reported exceeded the calibration range established for the analyte. The reported concentration should be considered an estimate.
- vo - The value reported fell outside the control limits established for this analyte.
- x - The pattern of peaks present is not indicative of diesel.
- y - The pattern of peaks present is not indicative of motor oil.

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

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December 18, 2008

Dana Ertel, Project Manager
PBS Engineering and Environmental, Inc.
320 N. Johnson St. Suite 100
Kennewick, WA 99336

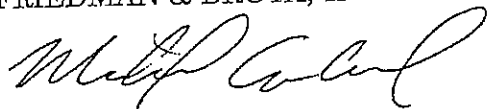
Dear Mr. Ertel:

Included are the results from the testing of material submitted on December 3, 2008 from the 62121.000, F&BI 812027 project. There are 11 pages included in this report. Any samples that may remain are currently scheduled for disposal in 30 days. If you would like us to return your samples or arrange for long term storage at our offices, please contact us as soon as possible.

We appreciate this opportunity to be of service to you and hope you will call if you should have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.



Michael Erdahl
Project Manager

Enclosures
PBS1218R.DOC

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

CASE NARRATIVE

This case narrative encompasses samples received on December 3, 2008 by Friedman & Bruya, Inc. from the PBS Engineering and Environmental 62121.000, F&BI 812027 project. Samples were logged in under the laboratory ID's listed below.

<u>Laboratory ID</u>	<u>PBS Engineering and Environmental</u>
812027-01	MW-1
812027-02	MW-2
812027-03	MW-3

The 8270D laboratory control sample failed below the acceptance criteria for several compounds. The data was flagged accordingly. All other quality control requirements were acceptable.

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: 12/18/08
 Date Received: 12/03/08
 Project: 62121.000, F&BI 812027
 Date Extracted: 12/03/08
 Date Analyzed: 12/04/08

RESULTS FROM THE ANALYSIS OF THE WATER SAMPLES
 FOR BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENES
 USING EPA METHOD 8021B

Results Reported as ug/L (ppb)

<u>Sample ID</u> Laboratory ID	<u>Benzene</u>	<u>Toluene</u>	<u>Ethyl Benzene</u>	<u>Total Xylenes</u>	<u>Surrogate (% Recovery)</u> Limit (52-124)
MW-1 812027-01	<1	<1	<1	<3	74
MW-2 812027-02	<1	<1	<1	<3	71
MW-3 812027-03	<1	<1	<1	<3	69
Method Blank	<1	<1	<1	<3	74

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: 12/18/08
 Date Received: 12/03/08
 Project: 62121.000, F&BI 812027
 Date Extracted: 12/04/08
 Date Analyzed: 12/04/08

RESULTS FROM THE ANALYSIS OF THE WATER SAMPLES
 FOR TOTAL PETROLEUM HYDROCARBONS AS
 DIESEL AND MOTOR OIL
 USING METHOD NWTPH-Dx
 Results Reported as ug/L (ppb)

<u>Sample ID</u> Laboratory ID	<u>Diesel Range</u> (C ₁₀ -C ₂₅)	<u>Motor Oil Range</u> (C ₂₅ -C ₃₆)	<u>Surrogate</u> <u>(% Recovery)</u> (Limit 51-137)
MW-1 812027-01	<50	<250	88
MW-2 812027-02	<50	<250	91
MW-3 812027-03	<50	<250	80
Method Blank	<50	<250	82

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Analysis For Semivolatile Compounds By EPA Method 8270D SIM

Client Sample ID:	MW-1	Client:	PBS Engineering and Environmental
Date Received:	12/03/08	Project:	62121.000, F&BI 812027
Date Extracted:	12/04/08	Lab ID:	812027-01
Date Analyzed:	12/05/08	Data File:	120508.D
Matrix:	Water	Instrument:	GCMS6
Units:	ug/L (ppb)	Operator:	YA

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
Anthracene-d10	88	50	150
Benzo(a)anthracene-d12	85	50	129

Compounds:	Concentration ug/L (ppb)
Naphthalene	<0.1
Acenaphthylene	<0.1
Acenaphthene	<0.1
Fluorene	<0.1
Phenanthrene	<0.1
Anthracene	<0.1
Fluoranthene	<0.1
Pyrene	0.11
Benz(a)anthracene	<0.1
Chrysene	<0.1
Benzo(a)pyrene	<0.1
Benzo(b)fluoranthene	<0.1
Benzo(k)fluoranthene	<0.1
Indeno(1,2,3-cd)pyrene	<0.1
Dibenz(a,h)anthracene	<0.1 jl
Benzo(g,h,i)perylene	<0.1 jl

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Analysis For Semivolatile Compounds By EPA Method 8270D SIM

Client Sample ID:	MW-2	Client:	PBS Engineering and Environmental
Date Received:	12/03/08	Project:	62121.000, F&BI 812027
Date Extracted:	12/04/08	Lab ID:	812027-02
Date Analyzed:	12/05/08	Data File:	120506.D
Matrix:	Water	Instrument:	GCMS6
Units:	ug/L (ppb)	Operator:	YA

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
Anthracene-d10	93	50	150
Benzo(a)anthracene-d12	88	50	129

Compounds:	Concentration ug/L (ppb)
Naphthalene	<0.1
Acenaphthylene	<0.1
Acenaphthene	<0.1
Fluorene	<0.1
Phenanthrene	<0.1
Anthracene	<0.1
Fluoranthene	<0.1
Pyrene	<0.1
Benzo(a)anthracene	<0.1
Chrysene	<0.1
Benzo(a)pyrene	<0.1
Benzo(b)fluoranthene	<0.1
Benzo(k)fluoranthene	<0.1
Indeno(1,2,3-cd)pyrene	<0.1
Dibenz(a,h)anthracene	<0.1 jl
Benzo(g,h,i)perylene	<0.1 jl

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Analysis For Semivolatile Compounds By EPA Method 8270D SIM

Client Sample ID:	MW-3	Client:	PBS Engineering and Environmental
Date Received:	12/03/08	Project:	62121.000, F&BI 812027
Date Extracted:	12/04/08	Lab ID:	812027-03
Date Analyzed:	12/05/08	Data File:	120507.D
Matrix:	Water	Instrument:	GCMS6
Units:	ug/L (ppb)	Operator:	YA

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
Anthracene-d10	91	50	150
Benzo(a)anthracene-d12	85	50	129

Compounds:	Concentration ug/L (ppb)
Naphthalene	<0.1
Acenaphthylene	<0.1
Acenaphthene	<0.1
Fluorene	<0.1
Phenanthrene	<0.1
Anthracene	<0.1
Fluoranthene	<0.1
Pyrene	<0.1
Benz(a)anthracene	<0.1
Chrysene	<0.1
Benzo(a)pyrene	<0.1
Benzo(b)fluoranthene	<0.1
Benzo(k)fluoranthene	<0.1
Indeno(1,2,3-cd)pyrene	<0.1
Dibenz(a,h)anthracene	<0.1 j1
Benzo(g,h,i)perylene	<0.1 j1

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Analysis For Semivolatile Compounds By EPA Method 8270D SIM

Client Sample ID: Method Blank
 Date Received: NA
 Date Extracted: 12/04/08
 Date Analyzed: 12/05/08
 Matrix: Water
 Units: ug/L (ppb)

Client: PBS Engineering and Environmental
 Project: 62121.000, F&BI 812027
 Lab ID: 081915mb
 Data File: 120505.D
 Instrument: GCMS6
 Operator: YA

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
Anthracene-d10	74	50	150
Benzo(a)anthracene-d12	72	50	129

Compounds:	Concentration ug/L (ppb)
Naphthalene	<0.1
Acenaphthylene	<0.1
Acenaphthene	<0.1
Fluorene	<0.1
Phenanthrene	<0.1
Anthracene	<0.1
Fluoranthene	<0.1
Pyrene	<0.1
Benzo(a)anthracene	<0.1
Chrysene	<0.1
Benzo(a)pyrene	<0.1
Benzo(b)fluoranthene	<0.1
Benzo(k)fluoranthene	<0.1
Indeno(1,2,3-cd)pyrene	<0.1
Dibenz(a,h)anthracene	<0.1 jl
Benzo(g,h,i)perylene	<0.1 jl

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: 12/18/08
 Date Received: 12/03/08
 Project: 62121.000, F&BI 812027

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER
 SAMPLES FOR BENZENE, TOLUENE,
 ETHYLBENZENE, AND XYLENES
 USING EPA METHOD 8021B

Laboratory Code: 811308-01 (Duplicate)

Analyte	Reporting Units	Sample Result	Duplicate Result	Relative Percent Difference (Limit 20)
Benzene	ug/L (ppb)	<1	<1	nm
Toluene	ug/L (ppb)	<1	<1	nm
Ethylbenzene	ug/L (ppb)	<1	<1	nm
Xylenes	ug/L (ppb)	<3	<3	nm

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Benzene	ug/L (ppb)	50	95	65-118
Toluene	ug/L (ppb)	50	99	72-122
Ethylbenzene	ug/L (ppb)	50	98	73-126
Xylenes	ug/L (ppb)	150	97	74-118

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: 12/18/08

Date Received: 12/03/08

Project: 62121.000, F&BI 812027

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER
SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS
DIESEL EXTENDED USING METHOD NWTPH-Dx

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Diesel Extended	ug/L (ppb)	2,500	92	81	71-131	13

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: 12/18/08
 Date Received: 12/03/08
 Project: 62121.000, F&BI 812027

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER
 SAMPLES FOR PNA'S BY EPA METHOD 8270D SIM

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Naphthalene	ug/L (ppb)	5	78	87	68-101	11
2-Methylnaphthalene	ug/L (ppb)	5	82	90	59-111	9
1-Methylnaphthalene	ug/L (ppb)	5	81	89	69-105	9
Acenaphthylene	ug/L (ppb)	5	81	90	70-109	11
Acenaphthene	ug/L (ppb)	5	78	87	69-104	11
Fluorene	ug/L (ppb)	5	71	79	68-111	11
Phenanthrene	ug/L (ppb)	5	77	87	66-106	12
Anthracene	ug/L (ppb)	5	77	87	67-112	12
Fluoranthene	ug/L (ppb)	5	80	88	69-116	10
Pyrene	ug/L (ppb)	5	80	88	68-115	10
Benz(a)anthracene	ug/L (ppb)	5	75	84	65-102	11
Chrysene	ug/L (ppb)	5	77	85	66-103	10
Benzo(b)fluoranthene	ug/L (ppb)	5	78	92	70-117	16
Benzo(k)fluoranthene	ug/L (ppb)	5	81	90	64-116	11
Benzo(a)pyrene	ug/L (ppb)	5	76	86	68-116	12
Indeno(1,2,3-cd)pyrene	ug/L (ppb)	5	63	78	63-122	21 vo
Dibenz(a,h)anthracene	ug/L (ppb)	5	64 vo	78	66-116	20
Benzo(g,h,i)perylene	ug/L (ppb)	5	62 vo	76	66-114	20

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Data Qualifiers & Definitions

- a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.
- A1 - More than one compound of similar molecule structure was identified with equal probability.
- b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.
- ca - The calibration results for this range fell outside of acceptance criteria. The value reported is an estimate.
- c - The presence of the analyte indicated may be due to carryover from previous sample injections.
- d - The sample was diluted. Detection limits may be raised due to dilution.
- ds - The sample was diluted. Detection limits are raised due to dilution and surrogate recoveries may not be meaningful.
- dv - Insufficient sample was available to achieve normal reporting limits and limits are raised accordingly.
- fb - The analyte indicated was found in the method blank. The result should be considered an estimate.
- fc - The compound is a common laboratory and field contaminant.
- hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. The variability is attributed to sample inhomogeneity.
- ht - The sample was extracted outside of holding time. Results should be considered estimates.
- ip - Recovery fell outside of normal control limits. Compounds in the sample matrix interfered with the quantitation of the analyte.
- j - The result is below normal reporting limits. The value reported is an estimate.
- J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.
- jl - The analyte result in the laboratory control sample is out of control limits. The reported concentration should be considered an estimate.
- jr - The rpd result in laboratory control sample associated with the analyte is out of control limits. The reported concentration should be considered an estimate.
- js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.
- lc - The presence of the compound indicated is likely due to laboratory contamination.
- L - The reported concentration was generated from a library search.
- nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.
- pc - The sample was received in a container not approved by the method. The value reported should be considered an estimate.
- pr - The sample was received with incorrect preservation. The value reported should be considered an estimate.
- ve - The value reported exceeded the calibration range established for the analyte. The reported concentration should be considered an estimate.
- vo - The value reported fell outside the control limits established for this analyte.
- x - The pattern of peaks present is not indicative of diesel.
- y - The pattern of peaks present is not indicative of motor oil.

APPENDIX D

Area Well Logs

WATER WELL REPORT

STATE OF WASHINGTON

Application No. 64-2734
Permit No.

OWNER: Name Welch's Inc. Address _____
LOCATION OF WELL: County Benton - NW 1/4 NW 1/4 Sec 6 T. 8 N. R. 28E W. 30E

Distance and direction from section or subdivision corner _____

PROPOSED USE: Domestic Industrial Municipal
Irrigation Test Well Other

TYPE OF WORK: Owner's number of well _____
(if more than one) _____
New well Method: Dug Bored
Deepened Cable Driven
Reconditioned Rotary Jetted

DIMENSIONS: Diameter of well 12 10 inches.
Drilled 548' 6" ft. Depth of completed well 548' 6" ft.

CONSTRUCTION DETAILS:
Casing installed: 12" Diam. from +6" ft. to 122 ft.
Threaded 10" Diam. from +1' ft. to 365 ft.
Welded _____ " Diam. from _____ ft. to _____ ft.

Perforations: Yes No
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: Yes No
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes No Size of gravel: _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes No To what depth? 122 ft.
Material used in seal: Cement
Did any strata contain unusable water? Yes No
Type of water? _____ Depth of strata 109
Method of sealing strata off: Pressure grate

PUMP: Manufacturer's Name _____
Type _____ HP _____

WATER LEVELS: Land-surface elevation _____ ft.
above mean sea level. _____ ft.
level _____ ft. below top of well Date 6-25-81
Static pressure 6 lbs. per square inch Date 6-25-81
Artesian water is controlled by flange and cap
(Cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
pump test made? Yes No If yes, by whom Layne & Bowler
_____ gal./min. with _____ ft. drawdown after _____ hrs.
500 " 27 " " " " "
1390 " 100 " " " " " "

every data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Rate of test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Direction flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes No

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Sand, Boulders, Gravel	0	27
Gravel sand black water	27	42
Gravel sand tan	42	43
Clay tan	43	47
Clay blue	47	96
Clay dark green	96	109
Sand black	109	109'6"
Basalt black scoria water	109'6"	116
Basalt black mh	116	128
Basalt black, blue clay	128	136
Basalt red scoria	136	145
Basalt black mh	145	212
Basalt black blue claystone	212	214
Basalt black firm	214	219
Basalt red scoria H2O	219	224
Basalt black scoria	224	232
Basalt black, red, blue clay	232	235
Basalt gray hard	235	340
Clay blue	340	348
Sand blue	348	362
Basalt black scoria	362	365
Basalt black hard	365	447
Basalt black scoria H2O	447	452
Basalt black hard	452	456
Basalt black scoria H2O	456	458
Basalt black fractured hard	458	480
Basalt water bearing	480	497
Basalt black scoria	497	548'6"
Basalt black	548'6"	

RECEIVED AUG 10 1981
AUG 31 1981
DEPARTMENT OF ELECTRICITY

DEPARTMENT OF ELECTRICITY
GENERAL REGIONAL OFFICE
Completed June 15, 1981

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Nelson Well Drilling Inc.
NAME _____ (Person, firm, or corporation) (Type or print)

Address 10036 West Argent Pasco Wa.

(Signed) James Nelson Well Driller

License No. 361 Date 6-26-81, 19__

(USE ADDITIONAL SHEETS IF NECESSARY) OK EP 9-16-81

The Department of Ecology does NOT Warrant the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. RE02129

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission ("x" in box)

- Construction
- Decommission

ORIGINAL INSTALLATION Notice of Intent Number: RE02129

Consulting Firm PBS Engineering and Environmental
 Unique Ecology Well ID Tag No. BAR002

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller Engineer Trainee
 Name (Print Last, First Name) Mickelson, Toby
 Driller/Engineer /Trainee Signature [Signature]
 Driller or Trainee License No: 2870

If trainee, licensed driller's Signature and License Number:

Type of Well ("x" in box)

- Resource Protection
- Geotech Soil Boring

Property Owner Lieb Properties
 Site Address 10 East BrunEAU
 City Kennewick County Benton

Location NW1/4-1/4 NW1/4 Sec 06 Twn 8NR 30E
 EWM or WWM

Lat/Long (s, t, r) Lat Deg _____ Min _____ Sec _____
 still REQUIRED) Long Deg _____ Min _____ Sec _____

Tax Parcel No. 106802030001022

Cased or Uncased Diameter: 2" / 6" Static Level 21'

Work/Decommission Start Date January 24, 2008

Work/Decommission Completed Date January 25, 2008

Construction Design	Well Data	Formation Description
	<p>BAR002</p> <ul style="list-style-type: none"> - Flush MANT. SURFACE SEAL - 3' permanent casing w/locking cap - Soil samples taken @ 15' and 19' (PISS) STATIC WATER LEVEL 21' 	<p>BAR002</p> <ul style="list-style-type: none"> FINE SAND 3' cemented BASALT GRAVELS 14" COARSE SAND 19' cemented BASALT GRAVELS TD: 30' 2"

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Please print, sign and return by mail to Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. 526714

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission (select one)

Construction

Decommission ORIGINAL INSTALLATION Notice

210450 of Intent Number _____

Consulting Firm P.B.S. Engineering

Unique Ecology Well ID _____

Tag No. (B-1)-2-3-4-5-6-7

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller Engineer Trainee Name (Print) Randall E. Wilder

Driller/Engineer/Trainee Signature [Signature]

Driller or Trainee License No. 2578

If trainee, licensed driller's Signature and License No. _____

Type of Well (select one)

Resource Protection

Geotech Soil Boring D

Property Owner Welch & Food

Site Address 10 E. Broadway

City Kennelworth County Barton

Location N6/14-14 N1/4 Sec 6 Twn 8N R 30 EWM WWM

Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

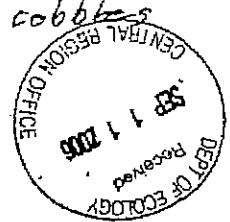
Tax Parcel No. _____

Cased or Uncased Diameter _____ Static Level 20

~~Work/Decommission~~ Start Date 7-31-06

~~Work/Decommission~~ Completed Date 8-1-06

Construction/Design	Well Data	Formation Description	
		Silty Sand	7
Abandoned with Bentonite			10
6" Borehole		sand Gravel cobbles	20
			24



The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Please print, sign and return by mail to Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. 526714

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission (select one)

Construction

Decommission ORIGINAL INSTALLATION Notice

210453 of Intent Number
Consulting Firm PBS Engineering

Unique Ecology Well ID
Tag No. B-1-2-3-4-5-6-7

Type of Well (select one)

Resource Protection

Geotech Soil Boring

Property Owner Welch's Food

Site Address 10 E Briarwood

City Kennebec County Barton

Location N/1/4-1/4 N/2/4 Sec 6 Twn 8N R 30 EIVM WWW

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller Engineer Trainee Name (Print) Randall E. Wilder

Driller/Engineer/Trainee Signature [Signature]

Driller or Trainee License No. 2578

If trainee, licensed driller's
Signature and License No. _____

Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Lat Min/Sec _____
Long Deg _____ Long Min/Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter _____ Static Level 20

Work/Decommission Start Date 7-31-06

Work/Decommission Completed Date 8-1-06

Construction/Design

Well Data

Formation Description

			silty sand	7
10	Abandoned with bentonite			10
20	6" Borehole		sand Gravel cobbles	20
24				24



The Department of Ecology does NOT warranty the Data and/or Information on this Well Report

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. A130291

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission ("x" in box)

Construction 292348

Decommission

ORIGINAL INSTALLATION Notice of Intent Number:

E007937

Consulting Firm _____

Unique Ecology Well ID Tag No. Tetra Tech

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller Engineer Trainee

Name (Print Last, First Name) Knopf, Noel

Driller/Engineer /Trainee Signature _____

Driller or Trainee License No. T2872

If trainee, licensed driller's Signature and License Number:

Amie Husula 2508

Type of Well ("x" in box)

Resource Protection

Geotech Soil Boring d

Property Owner John Micheal & Barbara Bond

Site Address 110 N Washington Street

City Kennewick

County Benton

Location NW1/4-1/4 NW1/4 Sec 06 Twn 8N R 30

EWM or WWM

Lat/Long (s, t, r) Lat Deg _____ Min _____ Sec _____

still REQUIRED) Long Deg _____ Min _____ Sec _____

Tax Parcel No. 106802040001000

Cased or Uncased Diameter 1" Static Level 27'

Work/Decommission Start Date 2-6-08

Work/Decommission Completed Date 2-6-08

Construction Design

Well Data

Formation Description

Drove a 1. stainless steel point down to depth and collected a water sample.

Boring Depth: 40'

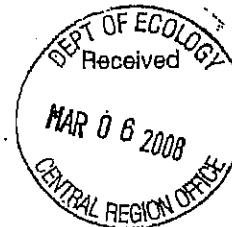
Screen: @ 38'

Slot Size: open point

Type: _____

Removed all rods and casing from boring and backfilled with bentonite.

N/A



WATER WELL REPORT

Original & 1st copy Ecology 2nd copy owner 3rd copy driller

Construction/Decommission (circle)

Construction
 Decommission ORIGINAL CONSTRUCTION Notice
 147322 of Intent Number AKH-820

CURRENT

Notice of Intent No W-171060

Unique Ecology Well ID Tag No AKH-820

Water Right Permit No H

Property Owner Name Branwood Homes

Well Street Address 1622 S Sharp rd

City Kenn. County Benton

Location SE 1/4 1/4 NE 1/4 Sec 1 Twn 29 R 29 circle or one WWM

Lat/Long (still) Lat Deg _____ Lat Min/Sec _____

REQUIRED) Long Deg _____ Long Min/Sec _____

Tax Parcel No 1-0189-101-2694-002

PROPOSED USE Domestic Industrial Municipal
 DeWater Irrigation Test Well Other _____

TYPE OF WORK Owners number of well (if more than one) _____
 New Well Reconditioned Method Dug Bored Driven
 Deepened Cable Rotary Jetted

DIMENSIONS Diameter of well 6 inches drilled 120 ft
 Depth of completed well 120 ft

CONSTRUCTION DETAILS
 Casing Welded 6 Diam from 0 ft to 120 ft
 Installed Liner installed _____ Diam from _____ ft to _____ ft
 Threaded _____ Diam from _____ ft to _____ ft

Perforations Yes No
 Type of perforator used _____
 SIZE of perms in by in and no. of perms _____ from _____ ft to _____ ft

Screens Yes No K Pac Location _____
 Manufacturer's Name _____
 Type _____ Model No _____
 Diam _____ Slot Size _____ from _____ ft to _____ ft
 Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed Yes No Size of gravel/sand _____
 Materials placed from _____ ft to _____ ft

Surface Seal Yes No To what depth? 20 ft
 Materials used in seal Bentonite
 Did any strata contain unusable water? Yes No
 Type of water? _____ Depth of strata _____
 Method of sealing strata off _____

PUMP Manufacturer's Name _____
 Type _____ H P _____

WATER LEVELS Land surface elevation above mean sea level _____ ft
 Static level 100 ft below top of well Date 7-31-03
 Artesian pressure _____ lbs per square inch Date _____
 Artesian water is controlled by _____ (cap valve etc)

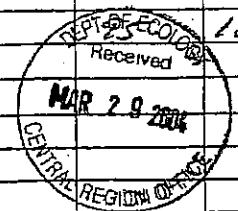
WELL TESTS Drawdown is amount water level is lowered below static level
 Was a pump test made? Yes No If yes by whom? _____
 Yield _____ gal/min with _____ ft drawdown after _____ hrs
 Yield _____ gal/min with _____ ft drawdown after _____ hrs
 Yield _____ gal/min with _____ ft drawdown after _____ hrs
 Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

 Date of test _____
 Bailer test _____ gal/min with _____ ft drawdown after _____ hrs
 Arrest 15 gal/min with stem set at 115 ft for 4 hrs
 Artesian flow _____ g p m Date _____
 Temperature of water _____ Was a chemical analysis made? Yes No

CONSTRUCTION OR DECOMMISSION PROCEDURE
 Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information. Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Silty Topsoil	0	35
Sand & Gravel	35	52
Basalt	52	60
Fractured Basalt & clay	60	65
Fractured Basalt	65	95
Free Bas. Sand & Gravel	95	115
Fractured Basalt	115	120
Water Bearing zone		120



Start Date 7-31-03 Completed Date 7-31-03

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller Engineer Trainee Name (Print) TOON HANEY
 Driller/Engineer/Trainee Signature [Signature]
 Driller or Trainee License No 2343
 Drilling Company Statewide Well Drilling
 Address 101 KAG Trail rd
 City State Zip Pasco WA 99301
 Contractor's Registration No Statewide Date 4/04

If trainee, licensed driller's Signature and License no _____

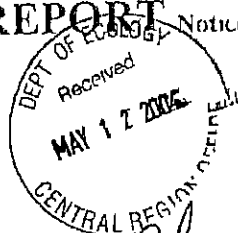
Ecology is an Equal Opportunity Employer ECY 050 1 20 (Rev 4/01)

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RESOURCE PROTECTION WELL REPORT

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Notice of Intent No 5 28612



Construction/Decommission (*x* in circle)

- Construction 149313
- Decommission Original Construction Notice of Intent Number _____

Type of Well (*x* in circle)

- Resource Protection
- Geotech Soil Boring *N*

Property Owner Port of Kennewick

Site Address Clover Island Drive

Unique Ecology Well ID Tag No Soil borings 4,3,2

City Kennewick County Benton

Consulting Firm Shannon & Wilson

Location SW 1/4 1/4 SW 1/4 Sec 31 Twn 9 R 30 EWM circle or one WWM

Driller or Trainee Name Dan Claassen

Lat/Long (s t r Lat Deg _____ Lat Min/Sec _____)

Driller or Trainee Signature Dan Claassen

still REQUIRED) Long Deg _____ Long Min/Sec _____

Driller or Trainee License No. 1827

Tax Parcel No _____

If trainee, licensed driller's Signature and License no _____

Cased or Uncased Diameter 6" Static Level 15'

Work/Decommission Start Date 5-5-04

Work/Decommission Completed Date 5-5-04

Construction/Design

Well Data

Formation Description

	<p>drilled to 20' sampling every 2 1/2', backfilled with bentonite chips</p>	<p>0-7 1/2' dark brown, silty gravels</p> <p>7 1/2'-20 silty sands</p>
--	--	--

Scale 1" = 10'

The Department of Ecology does NOT Warrant the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

RESOURCE PROTECTION WELL REPORT CURRENT

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Notice of Intent No. E004918

Construction/Decommission ("x" in circle)

Type of Well ("x" in circle)

- Construction 286831
- Decommission ORIGINAL INSTALLATION Notice of Intent Number _____

- Resource Protection
- Geotech. Soil Boring P

Consulting Firm P.B.S. Environmental

Property Owner Dennis Schliener

Unique Ecology Well ID _____

Site Address 316 E. Braineau Ave

Tag No: _____

City Kirkland County: Benton

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Location SE 1/4 SW 1/4 Sec 31 Twp 9N R3E EW or WW circle or one

Lat/Long (s. l. r still REQUIRED) Lat Deg _____ Lat Min/Sec _____

Long Deg _____ Long Min/Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter 2" Static Level 9.5'

Work/Decommission Start Date 11/14/03

Work/Decommission Completed Date 11/14/03

Driller Engineer Trainee Name (Print) Eric Nassau

Driller/Engineer/Trainee Signature [Signature]

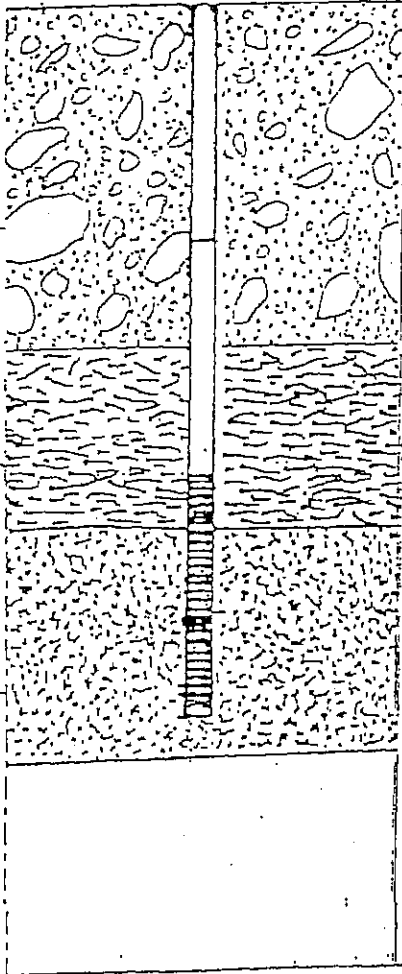
Driller or Trainee License No. 2482

If trainee, licensed driller's Signature and License no. _____

Construction/Design

Well Data

Formation Description



Inserted PVC screen down to depth and collected a water sample

Boring depth: 12'

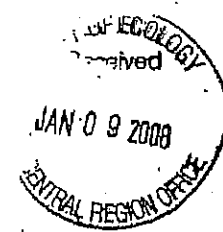
PVC Screen: 9'-12'

Slot Size: 10s/64"

Type: 3/4" slot 90

Removed PVC from boring and backfilled with bentonite.

Sand & gravel



Scale 1" = _____

Page 1 of 6

ECY 030-12 (Rev 2/01)

APPENDIX E

PBS Bench Testing

DRAFT

LIMITED CHEMICAL OXIDATION BENCH TESTING

Chemical oxidation bench testing was completed by PBS to help determine whether Alternative #8 is practicable at the 10 East Bruneau site. The advantage of the bench test is that it was completed in a matrix of indigenous soil for the project area (a mixture of basalt and Ice Age unit sand and fine gravel). The carbonate content of the sand is similar to what would be expected at the subject property, with the unit sample collected along the Columbia River less than two miles upstream from the former Welch site.

Some of the reasoning behind the testing involved the need to estimate whether a significant component of the altered heavy oil would volatilize to soil gas or whether a liquid product would be the main decomposition material.

The bench test was completed in a closed loop system to keep track of decomposition byproducts.

A weighed eight ounce heat proof canning jar was used to begin the project. Local washed sand was weighed and used to mimic the natural soil formation that the #6 fuel from the Welch Foods site. The weighed sand was added to the jar, with the weighed #6 semi-solid oil sample derived from the Welch site to make sure as many variables as possible were relevant to the test and Welch site. Weighed de-ionized water was added to the jar up to the elevation of the oil (similar to the situation at the Welch site). An upper layer of weighed sand (above the oil) was added to near the top of the jar, again similar to the Welch site.

An exit pipe was plumbed into the top of the lid (and stabilized with exterior epoxy putty) which was designed to fit the inlet of a ½ liter Tedlar bag, to facilitate gaseous analytical analysis and volume computation of any off gasses formed.

With the oxidation test prepared measured amounts of 3% hydrogen peroxide (H₂O₂), a proprietary mixture of Fenton's Reagent (Fe +3) and an 8% solution of sodium persulfate (Na₂S₂O₈) were added simultaneously. The test amounts were three parts hydrogen peroxide, and one part each of Fenton's Reagent and persulfate.

Weights and measures:

Jar only:	188.2 grams
Jar + initial sand	386.7 grams
Jar + initial sand + bunker oil	412.8 grams
Jar + initial sand + bunker oil + final sand to cover	469.8 grams
Jar + initial sand + bunker oil + final sand + DI water	523.6 grams

Reagents added simultaneously and capped shut immediately:

- 10 grams Isotec Catalyst (Fe +3) solution
- 10 grams of sodium persulfate (4 grams/50 milliliter)
- 40 grams of 3% hydrogen peroxide

Test started at 1:45 pm on 7/29/09

The time required for chemical travel through the upper sand layer allowed time to attach the cap and Tedlar bag connection to collect any gas or vapors leaving the chemical system.

A limited amount of bubbling and chemical oxidation reaction behavior was observed during the test (less reaction than during a qualitative pretest when the oil and reagents were mixed without the sand and excess water to see how quickly the reaction would take place). A possible desired result would have been the production of a significant amount of vapor (which could be easily removed and scrubbed by a vapor extraction system and scrubber).

Test was ended on 7/31/09 at 8 AM (31.5 hours total)

TEST RESULTS:

Vapor test results:

Test results showed that approximately 0.104 cubic liters of vapor accumulated in the Tedlar Bag after 31.5 hours. The bag was submitted for lab testing with the following results:

- Nitrogen 34.1%
- Oxygen 60.4%
- Carbon Dioxide 5.5%

Liquid test results:

Jar + initial sand + bunker oil + final sand + DI water	523.6 grams
Jar + initial sand + bunker oil + final sand to cover	<u>469.8</u> grams
Grams of water at start	53.8 grams
Other Liquids = liquid reagents	60 grams
Water	<u>53.8</u> grams
Total initial liquids	113.8 grams

Liquid removed from the jar was 29.2 milliliters, which was submitted for lab testing. DI water was added to the VOCs vial to make 40 milliliters.

DRAFT

The decanted liquid was expected to weigh more than one gram per milliliter (approximate DI water weight). Results suggest however that a significant amount of liquid was converted to a gas form or remained as liquid attached to solids. The estimated moisture percentage of the remaining sand was 8% moisture. With the total weight of the sand at the test start was $198.5 + 57 = 255.5$ grams. $255.5 \times 0.08 = 20.4$ grams of moisture estimated remaining in the soil after the test which would not decant or drain.

Total estimated moisture remaining after the test is $29.2 + 20.4 = 49.6$ grams of moisture.

So approximately $49.6/113.8 = 43.6\%$ of the initial liquid remained after the test; a large reduction, which we assume was converted to a gas form.

With the great amount of oxygen present in the liquids/reagents, we can assume some of the liquid ended up as oxygen gas.

Test results concerning oil:

Jar + initial sand + oil =	412.8 grams
Jar + initial sand =	<u>386.7</u> grams
Initial oil weight =	26.1 grams

Before test jar + initial sand + bunker oil + final sand to cover	469.8 grams
After test same parameters with soil dried and oil remaining	<u>466.4</u> grams
Final weight of oil missing after test	3.4 grams

Results suggest that $3.4/26.1$ or 6% of the oil was oxidized and apparently removed from jar as a liquid or gas during the test.

TEST LIMITATIONS:

A test limitation was observed in that a small amount of total mixed liquid was released through the top of the jar lid (approximately 3 milliliters) during the test.

We could have weighed the jar + initial and final sand + remaining water and bunker oil before decanting the water from the system to find out how much water and liquid reagent was converted to gas form during the test.

We could have weighed the moist soil ahead of drying to calculate the apparent moisture percentage of the remaining sand after the test – this would have allowed better computation of liquids in the system after the test.

WELCH SITE #6 FUEL HEAT TESTING

With the understanding that, especially in the heavy grade fuels, some variation in volatile hydrocarbons is common, this testing was completed. The testing was important because one of the alternatives (Steam Remedial Action) depends on removing the volatile product, though concurrent vapor extraction. If volatiles were not present in the fuel then steam use remediation is limited or less necessary.

To support the test a closed loop system was formed. A heat proof four ounce jar was cleaned and prepared. A pipe that could be affixed to a ½ liter Tedlar Bag was prepared. Epoxy putty was used on the exterior of the system to seal and stabilize the pipe to the jar lid. The three foot long pipe was a copper ¼ line, with the length used to reduce the amount of heat arriving at the Tedlar bag and potentially melting the plastic. A loop and low area was formed in the copper pipe to form an area where liquid condensate could collect ahead of the Tedlar vapor trap. An external water bath was present at the copper pipe loop to support cooling and encourage vapor condensation. Heat was provided through a gas barbeque system.

Oil from the Welch facility (5.8 grams) was placed in the jar as a semi-solid material. Heating was begun and it was noted that at approximately 200⁰ F, the semi-solid fuel became a thin liquid. At approximately 370⁰ F some smoke formed within the jar. The smoke appeared to originate from heating of the interior of the metal jar lid coating. Heating continued slowly. The epoxy putty stabilizer on the pipe exterior darkened at approximately 400⁰ F.

Interestingly no boiling occurred in the oil. Material Safety Data Sheet (MSDS) information indicates that #6 fuel oil boils at >392⁰ F. The oil from the Welch site is undoubtedly older, with some potential lost volatiles, supporting a significantly higher boiling point and fewer volatiles.

Heating continued up to 520⁰ F with no change in the oil, indication of line condensation or vapor collection in the Tedlar bag. No obvious indications of self ignition occurred within the jar during the test.

The test qualitatively suggested that very little if any lower temperature volatiles were present in the oil and that the oil would need to be at near 200⁰ F before sufficient thinning of the material would allow pumping. Few lower density hydrocarbons that may be subject to self ignition were suspected of being present based on test observations.