SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

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May 10, 1999

Abide International, Inc.
401 Parkplace, Suite 203
Kirkland, WA 98033

Attn: Mr. Craig Frantz

RE: PETROLEUM RISK ASSESSMENT, CLOSED UNDERGROUND STORAGE TANK (UST), FEDERAL BUILDING, RICHLAND, WASHINGTON

Attached is the report "Petroleum Risk Assessment, Closed Underground Storage Tank, Federal Building, Richland, Washington." The risk assessment was conducted in accordance with our proposal dated July 30, 1998.

Please contact us if you have any questions about the report. Upon your approval, we will submit this report to Ecology.

Sincerely,

SHANNON & WILSON, INC.

Dawn Birkner

Dawn Birkner
Senior Risk Assessor

ALV:PDB/alv

Enclosure: Petroleum Risk Assessment, Closed UST at Federal Building, Richland, Washington

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ABBREVIATIONS AND ACRONYMS

bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
cPAH	carcinogenic polycyclic aromatic hydrocarbon
COPC	chemical of potential concern
CSM	conceptual site model
DCA	dichloroethane
DCE	dichloroethene
DRO	diesel-range organics
EC	equivalent carbon number
EHI	estimated hazard index
Ecology	Department of Ecology
EPC	exposure point concentration
EPH	extractable petroleum hydrocarbons
HI	hazard index
HQ	hazard quotient
MCL	maximum contaminant level
µg/L	micrograms per liter
mg/L	milligrams per liter
mg/kg	milligrams per kilogram
MTBE	methyl tertiary butyl ether
MTCA	Model Toxics Control Act
NWTPH-DX	northwest total petroleum hydrocarbons as diesel
PAH	polycyclic aromatic hydrocarbon
PCE	tetrachloroethene
RBCL	risk-based cleanup level
RfD	reference dose
RI	remedial investigation
TCE	trichloroethene
TCR	target cancer risk
TEF	toxicity equivalency factor
THI	target hazard index
TPH	total petroleum hydrocarbon
TPHCWG	Total Petroleum Hydrocarbon Criteria Working Group
UST	underground Storage Tank
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbons

PETROLEUM RISK ASSESSMENT
CLOSED UST AT FEDERAL BUILDING
RICHLAND, WASHINGTON

1.0 INTRODUCTION

This petroleum risk assessment was conducted by Shannon & Wilson, Inc., in accordance with our proposal dated July 30, 1998 and Ecology's Washington State Interim Interpretive and Policy Statement for Cleanup of Total Petroleum Hydrocarbons [TPH]) (Interim Policy) (Ecology, 1997; 1998). The objective was to evaluate the potential risks under current and anticipated future conditions posed by fuel-related chemicals released from a closed-in-place underground storage tank (UST) at the Federal Building located at 825 Jadwin Avenue in Richland, Washington. The UST formerly contained diesel fuel for an emergency generator. A vicinity map is presented in Figure 1 .

1.1 Site Background and Setting

The site is located in a commercial district with retail establishments, office buildings, and medical facilities in the surrounding area. The Federal Building is in the northeast quarter of the southwest quarter of Section 11, Township 9 North, Range 28 East of the Willamette Meridian (EWM), Benton County, Washington. The site is located approximately one-quarter mile west of the Columbia River, which flows southward in this vicinity. Groundwater flow direction at the site is generally toward the east-northeast, and depth to groundwater ranges from 13 to 17 feet below ground surface (bgs).

A 1,000-gallon underground storage tank (UST) that formerly was used to store diesel fuel for an emergency generator at the Federal Building is present at the site. Reportedly, the UST was installed during the original building construction. The UST is located at the northwest corner of the main Federal Building structure (see Figure 2), below an irrigated grassy area that is about 12 feet by 20 feet in size and is surrounded by sidewalks and pavements on three sides and by the Federal Building on the fourth (south) side.

The UST was closed in place by Roar Tech, Inc., in 1998. The closure involved cleaning the interior of the UST and filling it with an inert material. Removal of the UST was deemed impractical because of the many sensitive underground utilities (primarily fiber optic and other communications cables) in the vicinity of the UST. Furthermore, leakage from the UST was not

suspected because the UST had passed tightness testing within the past year, and product inventory records did not indicate loss of product.

However, during a site assessment performed by Shannon & Wilson following UST closure (see Section 1.2.1), a soil sample collected from approximately 8.5 feet bgs contained diesel range TPH at a concentration of 2,600 milligrams per kilogram (mg/kg). The Model Toxics Control Act (MTCA) Method A criterion for diesel range TPH in the soil is 200 mg/kg.

1.2 Previous Investigations

This section describes previous investigations conducted at the Federal Building site and provides a discussion of the suspected source of volatile organic compounds (VOCs) detected in groundwater. The VOC results are discussed in this section because they were not considered to be site-related and were not carried further through the risk assessment. The sampling results and sampling locations are presented in Table 1 and Figure 3 for soil and in Table 2 and Figure 2 for groundwater, respectively.

1.2.1 Description of Previous Investigations

A subsurface investigation consisting of excavation of and sampling soil from four hand auger borings in the vicinity of the diesel UST was conducted in July 1998 (Shannon & Wilson, 1998a). Four soil samples were collected at depths ranging from 4 to 8.5 feet below ground surface (bgs) for laboratory analysis (using Northwest Total Petroleum Hydrocarbon – Diesel, Extended Range [NWTPH-DX]). The bottom of the UST is located at approximately 8 feet bgs. Sample depths were selected based on visual observation and olfactory observations of subsurface soils. Diesel-range organics (DRO) were detected in two of the samples: TP2-8.5 (test pit 2, 8.5 feet bgs) at a concentration of 2,600 mg/kg and TP3-4 at a concentration of 38 mg/kg. Petroleum hydrocarbons in the heavy oil range were also detected in TP2-8.5 at a concentration of 92 mg/kg, but the laboratory report indicated that diesel range hydrocarbons in the sample elevated the oil result. Petroleum hydrocarbons were not detected in the other two soil samples. The sample with the highest petroleum concentration, TP2-8.5, was also analyzed for extractable petroleum hydrocarbon (EPH) fractions and polycylic aromatic hydrocarbons (PAHs). The EPH concentration was 1,350 mg/kg. Low levels of three noncarcinogenic polycylic aromatic hydrocarbons (PAHs) were detected, but no carcinogenic PAHs (cPAHs) were detected.

In September 1998, a boring was drilled at the UST location, sampled, and completed as a monitoring well as part of the Preliminary Phase 2 Environmental Site Assessment (Shannon & Wilson, 1998b). The boring location and soil sampling depths were selected to target the area of suspected contamination, based on the results of the July 1998 investigation and field screening. The soil samples from the boring were collected below the bottom elevation of the UST, between 8 and 14 feet bgs. The groundwater sample was collected from this newly installed well (MW-01), which has a screen depth of 9.5 to 20 feet bgs, bridging the water table. All three soil samples and the groundwater sample were analyzed for EPH and PAHs. The groundwater sample and the soil sample with the highest concentration of TPH (based on field screening) was also analyzed for volatile petroleum hydrocarbons (VPH), benzene, toluene, ethylbenzene, and xylenes (BTEX), and methyl-t-butyl ether (MTBE) because the age of the diesel release is not known and fresh or partially weathered diesel can contain lighter fractions than EPH. Concentrations of VPH + EPH in site soil samples ranged from 340 to 3,100 mg/kg. No BTEX or cPAHs were detected in site soils, but low levels of noncarcinogenic PAHs were detected. In the groundwater sample collected in September 1998, the concentration of VPH +EPH was 4,600 micrograms per liter (µg/L). No BTEX was detected, but low levels of one cPAH (chrysene) and several noncarcinogenic PAHs were detected.

In December 1998, two additional monitoring wells were installed near the property boundary (MW-02 and MW-03), and groundwater samples were collected from these new wells and from the existing MW-01, as part of the Supplemental Phase 2 Environmental Site Assessment (Shannon &Wilson, 1999). Each groundwater sample was analyzed for EPH, VPH, PAHs, and VOCs (by EPA Method 8260B). No PAHs, BTEX, or VPH were detected in any of the groundwater samples. EPH was detected in only one monitoring well (MW-01), at a much lower concentration (100 µg/L) than was detected in the September 1998 sampling event (4,600 µg/L). Four halogenated organic compounds were also detected in the groundwater samples: tetrachloroethene (PCE), chloroform, trichloroethene (TCE), and (cis)1,2-dichloroethene (1,2-DCE).

In March 1999, the three monitoring wells on site (MW-01, MW-02, and MW-03) were resampled as part of quarterly groundwater monitoring. Each groundwater sample was analyzed for EPH, VPH, PAHs, and VOCs. No BTEX or PAHs were detected in any sample. VPH was detected only slightly above the detection limit (56 µg/L) in the C8-C10 aromatic fraction in MW-03. VPH was not detected in MW-01 or MW-02. Low levels of EPH (aliphatic fraction) were detected in MW-01, but no EPH was detected in MW-02 or MW-03. The same four VOCs detected in the December 1998 sampling round (PCE, TCE, chloroform, and 1,2-DCE) were

detected in the March 1999 sampling round. Concentrations of (cis)1,2-DCE increased from 4.5 µg/L to 28 µg/L in MW-02, while concentrations of TCE decreased from 130 µg/L to 82 µg/L in MW-03.

1.2.2 Discussion of VOC Results

The VOC results in on-site groundwater are described in Section 1.2.2.1. The potential on-site and off-site sources of the VOCs are discussed in Section 1.2.2.2. Conclusions about the source of the VOCs and the implications for the risk assessment are presented in Section 1.2.2.3.

1.2.2.1 VOC Concentrations in On-site Groundwater

Maximum concentrations of two of the four VOCs (PCE and chloroform) detected in the groundwater samples exceeded MTCA Method B risk-based formula values for groundwater (see Table 2). PCE was detected in all three monitoring wells in both the December 1998 and the March 1999 sampling rounds. The detected PCE concentrations ranged from 1.9 µg/L to 130 µg/L. The MTCA Method B formula value for PCE (as a carcinogen) is 0.858 µg/L, and the EPA Maximum Contaminant Level (MCL) is 5 µg/L (EPA, 1996). Chloroform was detected in two of the wells (MW-01 and MW-03) in both sampling rounds. The detected chloroform concentrations ranged from 9.9 µg/L to 24 µg/L. The MTCA Method B formula value for chloroform is 7.17 µg/L. Establishment of actual MTCA Method B cleanup levels requires consideration of applicable laws, site-specific information, cross-media impacts, cumulative effects, and other factors in addition to formula risk-based calculations.

The highest concentration of PCE detected was in the sample from MW-03, located closest to former solvent USTs at the site. However, PCE was also detected in samples from MW-01 and MW-02. MW-03 is crossgradient of MW-02, and crossgradient as well as downgradient of MW-01. It is possible that contamination, if any, originating from the location of the former solvent USTs could impact MW-02, but it is unlikely that it could impact MW-01.

1.2.2.2 Potential Sources of the VOCs in On-site Groundwater

In an attempt to identify the source or sources of solvent constituents that were detected in groundwater samples from the site, information regarding former solvent USTs at the site, and potential off-site contaminant sources was reviewed (see Section 3.0 in the Supplemental Phase 2 Environmental Site Assessment Report [Shannon & Wilson, 1999] for additional detail).

Three USTs formerly located to the east of the Federal Building reportedly contained solvents that were used in the maintenance of printing equipment. These three USTs were removed in July 1997. A liquid sample collected in 1995 from UST No. 6, the waste solvent tank, indicated the presence of TCE and acetone at concentrations of 36 µg/L and 22 µg/L, respectively, but no PCE, chloroform, or 1,2,-DCE were detected. No VOCs were detected in EPA Method 8240 analyses of the four subsurface soil samples that were collected from below the former solvent USTs during tank excavation. In addition, the UST closure report for the former solvent tanks, which was prepared by PBS Environmental (see Appendix D of the Supplemental Phase 2 Environmental Site Assessment Report [Shannon & Wilson, 1999]), indicated that the USTs and piping appeared to be in very good condition, and that no visual or olfactory evidence of leakage from the UST system was apparent during closure activities. A copy of these soil and tank water sampling results is presented in Appendix A.3.

Information used to evaluate potential off-site source(s) of halogenated organic compounds in the groundwater was obtained from the State of Washington Department of Ecology (Ecology) and from the City of Richland. New City Cleaners and the City of Richland Wellsian Way Well Field are included on Ecology's Hazardous Sites List as locations where halogenated organic compounds (typically solvents) have been detected in the groundwater. New City Cleaners at 747 Stevens Drive is located approximately 1,500 feet southwest of the Federal Building property. The Wellsian Way Well Field, along the west side of Wellsian Way, is between 3,200 and 6,000 feet southwest of the Federal Building. The locations of the well field and the dry cleaner are shown on Figure 1. Other potential off-site sources of solvents are also discussed below.

New City Cleaners: Reportedly, this dry cleaner began using PCE in 1974. PCE was stored outside in 55-gallon drums until 1975 when vandalism caused a release; after that, the drums were stored inside the facility. In late 1991, a groundwater assessment was conducted at a site adjacent to the south side of the dry cleaners' property. Groundwater samples collected from wells located along the north side of the property contained PCE and TCE at maximum concentrations of 1,900 µg/L and 12 µg/L, respectively. In April 1992 when four USTs (containing Bunker C oil, kerosene, and stoddard solvents) were removed from the dry cleaner's site, halogenated organic compounds were detected in soil and groundwater samples collected during the UST closure site assessment. Maximum concentrations of PCE, TCE, cis-1,2 DCE, and cis-1,2 dichloroethane (DCA) detected in groundwater were 23,200 µg/L, 982 µg/L, 3 µg/L, and 842 µg/L, respectively. Additional sampling in June 1992 confirmed the earlier results. In July 1996, Ecology issued an enforcement order to the owners of New City

Cleaners requiring that a remedial investigation (RI) be performed at the site. The RI was conducted by EMCON, and the final RI report, dated June 11, 1998, was reviewed by Ecology. The agency's review letter dated January 4, 1999, indicated that the owners will be required to perform additional work to determine if groundwater contamination has migrated off-site, specifically to the north of the dry cleaner property. The letter also indicated that Ecology is in the process of preparing an enforcement order requiring the completion of a feasibility study to support the selection of a cleanup action for the site.

EMCON's RI report (June 1998) presented the results of four groundwater sampling events in 1997. One set of groundwater samples was collected in March using a Geoprobe™. The other three sets of samples were collected from monitoring wells. The report indicated that the depth to groundwater is approximately 8 to 9 feet bgs, and the flow gradient is toward the northeast under both high and low groundwater elevation conditions. Maximum groundwater concentrations of PCE, TCE and cis-1,2 DCE detected in the Geoprobe™ samples were 4,300 µg/L, 3,500 µg/L and 2,300 µg/L, respectively. Maximum groundwater concentrations of PCE, TCE, and cis-1,2 DCE detected in the monitoring well samples were 210 µg/L, 7.9 µg/L, and 2.5 µg/L, respectively.

EMCON performed slug tests at two monitoring wells at the site and estimated the hydraulic conductivity to be 1×10^{-2} centimeters per second (cm/sec). With an average horizontal hydraulic gradient of 0.0033 foot per foot, the average horizontal groundwater velocity was calculated to be 0.3 foot per day. Based on the assumed average velocity, the time of travel for groundwater between the New City Cleaners site and monitoring wells at the Federal Building site (a distance of approximately 1,500 feet) is between 15 and 17 years. A release of PCE from New City Cleaners was documented in 1975 (24 years ago). The presence of organic material in the soil can retard the movement of organic contaminants, such as PCE, that are dissolved in groundwater. Soils that formed in the arid climate of this region are typically very low in organic matter, and organic materials are primarily restricted to the upper 0.4 to 0.8 inch of the soil profile (DOE, 1995; Washington Soil Conservation Service, 1971). Therefore, it is assumed that the soils comprising the upper unconfined aquifer underlying the downtown Richland area would have a minimal retardation effect on the movement of PCE. If PCE contamination moved at approximately the same rate as the horizontal movement of groundwater, PCE-contaminated groundwater originating at the dry cleaner facility could have reached the Federal Building site by the time of the December 1998 groundwater sampling. Therefore, the New City Cleaners is a potential source of the halogenated organic solvent contamination detected at the Federal Building site. The New City Cleaners is also a potential

source of the solvent contamination detected at another site in the vicinity of the Federal Building. Chloroform, TCE, and PCE were detected in groundwater samples from monitoring wells located south of the former city shop facility at 1300 Mansfield Street (see Figure 1). The former city shop site is located approximately 800 feet northeast of the New City Cleaners site and approximately 900 feet west-northwest of the Federal Building. Water level measurements at the former city shop site indicated a northeasterly flow gradient at that location. Therefore, the former city shop facility is not a likely source of contaminants to the Federal Building site, but is likely downgradient (e.g., receiving contaminants) from the New City Cleaners site.

Wellsian Way Well Field: Mr. Roger Wright, City of Richland Engineering Manager, provided information regarding the city's municipal water supply well field. He indicated that there are four wells in the system, but they are not being used for to supply water because of the presence of PCE and TCE contamination. A treatment system has been operating since 1996 in an effort to decontaminate the aquifer. Mr. Wright indicated that the groundwater flow gradient in the vicinity of the well field is predominantly from north to south, and that the most likely source of the contamination is believed to be a former repair shop that operated at the present location of Budget Rent-A-Car on Wellsian Way near Elliot Street. The suspect site is located approximately 2,500 feet southwest of the Federal Building property. Therefore, the Wellsian Way well field is not a likely source of the halogenated organic solvent contamination detected at the Federal Building site.

Other Potential Off-Site Sources: Historical information obtained from an undated Kroll Atlas indicates that there have been multiple service stations along Stevens Drive and Lee Boulevard west, southwest, and south of the Federal Building property. Some of the facilities are still operating as gasoline stations or automotive repair shops, but others have been converted to other uses. The map indicated that there were ten service stations in an area from 1,600 feet west, 1,200 to 2,200 feet southwest, and 600 feet south of the site. Another dry cleaner (Richland Laundry and Dry Cleaners, 1106 Harding Street) that has been in operation for many years is located about 1,100 feet southwest of the Federal Building. Facilities and operations such as these that used, stored, or disposed of solvents represent potential sources of VOCs in the subsurface environment in the vicinity of the Federal Building. Not enough information is available to determine if these facilities are sources of contaminants at the Federal Building site.

1.2.2.3 Conclusions and Implications for the Risk Assessment

The pattern of halogenated organic compounds detected in soil, tank water, and groundwater samples collected at the site is not consistent with the former, on-site solvent USTs being the source of halogenated chemicals in groundwater. If the groundwater flow gradient has been consistently toward the east-northeast, a potential release from the former solvent USTs would not account for the presence of chloroform and PCE in the sample from MW-01. In addition, the compounds detected in the liquid sample collected in 1995 from the former waste solvent UST (acetone and TCE) did not correlate with the results of the monitoring well sample detections (PCE in all three wells, TCE in one well, and acetone in none). The absence of soil contamination and good condition of the tanks, as documented in the solvent UST site assessment report prepared by PBS Environmental (see Appendix D of the Supplemental Phase 2 Environmental Site Assessment Report [Shannon & Wilson, 1999]), is also indicative that the former solvent USTs are not the likely source of the groundwater contamination.

Acetone is a common laboratory contaminant, so the detection of this compound in the sample collected from the former solvent UST is not conclusive evidence that acetone was used in the printing equipment maintenance. However, acetone was not detected in the laboratory blank. Furthermore, according to an employee in the printing department at the local newspaper, acetone was commonly used as a de-inking solvent in the past.

The halogenated organic compounds detected in groundwater samples collected at the Federal Building site are similar to those detected at the New City Cleaners site (i.e., PCE and its typical breakdown products), with the exception of chloroform. The same group of organic compounds (including chloroform) has also been detected in wells located upgradient of the former Richland City Shop facility at 1300 Mansfield Street. Additional potential sources of solvents are also present in the vicinity. Therefore, it is probable that the VOCs detected at the Federal Building site are indicative of the presence of contamination that originated from one or more off-site source(s).

Halogenated VOCs are present in site groundwater at concentrations that would pose a threat if groundwater was used as a source of drinking water. However, the Federal Building's water supply is city water. Ecology has stated that "an exemption from liability exists for owners and operators of property that overlies a contaminated groundwater plume if the property is not the source of the contamination and the owners did not contribute to the release of the contamination." Because the VOCs detected in the on-site monitoring wells appear to be from an upgradient source, they were not evaluated further in this risk assessment. However,

groundwater samples will be collected from the site monitoring wells quarterly to evaluate whether solvent concentrations are increasing or decreasing over time.

1.3 Scope of Work

The scope of this risk assessment is limited to the evaluation of risks from diesel in the vicinity of the former diesel UST. The potential for other sources or types of chemicals at the facility was not evaluated. As described in Section 1.2, halogenated volatiles in groundwater were not considered in the risk assessment. The methods used in this risk assessment are consistent with MTCA Method B (including application of Ecology's Washington State Interim Interpretive and Policy Statement for Cleanup of Total Petroleum Hydrocarbons [TPH]) (Interim Policy) (Ecology, 1997; 1998).

1.4 Report Organization

The remainder of this report is organized into the following subsections:

- Section 2 presents the Conceptual Site Model which describes potential pathways of exposure to site contaminants.
- Section 3 presents the Data Evaluation and Identification of Chemicals of Potential Concern.
- Section 4 presents the risk assessment, including the exposure assessment, toxicity assessment, risk characterization, and uncertainty analysis.
- Section 5 presents the conclusions and recommendations.
- Section 6 describes limitations of the use of this report.
- Section 7 contains the cited references.
- Appendix A contains the analytical data for the site.
- Appendix B contains Important Information About Your Environmental Report.

2.0 CONCEPTUAL SITE MODEL

A complete exposure pathway must exist before any risk to human or ecological receptors is possible. A conceptual site model (CSM) defines the exposure pathways for a site.

The components of an exposure pathway include:

- Primary contaminant source(s) and release mechanism(s);
- Secondary sources;
- Mechanisms of contaminant retention in, or transport to, exposure media;
- Receptors that may contact contaminants in exposure media; and
- Routes of intake of contaminated media by receptors.

If any one of these elements is missing, a given exposure pathway is incomplete.

The Interim Policy directly addresses only two of many possible human exposure pathways: incidental ingestion of soil and a soil-to-drinking water pathway. It does not directly address ecological exposure pathways. However, in accordance with MTCA, appropriate policies and guidance, and professional judgement (Ecology, 1997; 1998), ecological exposure pathways and additional human exposure pathways do need to be evaluated. Because it is important to evaluate all reasonable complete and potentially significant human and ecological exposure pathways, a CSM was developed to describe the components of the primary exposure pathways at the site. The CSM for this site is presented below and depicted graphically in Figure 4.

2.1 Primary Sources and Release Mechanisms

Based on our scope, the only former primary source at the Federal Building site considered in this risk assessment is the closed-in-place diesel UST. The tank location is shown on Figure 2. Diesel was potentially released to the environment as a result of spills or leaks prior to the tank's closure. Types of chemicals likely to be associated with a diesel release are lower molecular weight PAHs and other fuel constituents such as aliphatic (e.g., dodecane) and aromatic (e.g., fluorene or naphthalene) hydrocarbons comprised of varying numbers of carbons. Low levels of more volatile hydrocarbons also may be associated with fresh diesel releases. The age of the diesel release is not known.

2.2 Secondary Sources

Subsurface soils adjacent to the UST have been impacted by the release of contaminants from the former UST. Contamination was found at depths between 8.5 and 14 feet (the deepest sample); however, shallower soil (4 to 7 feet bgs) did not contain concentrations above MTCA Method A levels (Table 1). Relatively low concentrations of VPH were detected (e.g., those overlapping with the diesel range) but EPH fractions were predominant in site soils. No BTEX, MTBE, or higher molecular weight PAHs were detected. This is consistent with site history, which indicates that diesel was used in the former UST. In addition to serving as an exposure

medium, soils are a secondary source from which chemicals may potentially be released to other media such as groundwater.

2.3 Mechanisms of Retention in or Transport to Exposure Media

The mechanisms of retention in or transport of site chemicals are based on the general geology and hydrogeology of a site and chemical properties of the contaminants. A typical profile of soil observed during site sampling has about one foot of very dark grayish-brown fine sandy loam over about one foot of very gravelly loam. Soils below two feet bgs are sandy gravel and cobbles. Brief discussions of potential transport mechanisms are provided in the following subsections.

2.3.1 Retention

Soil is a retention medium at the site based on the detection of up to 3,100 mg/kg of EPH +VPH in site soils. It is also considered a potential secondary source from which chemicals may migrate to other media. Brief discussions of potential transport mechanisms are provided in the following subsections.

2.3.2 Particulate Emissions and Volatilization

Particulate emissions to the outdoor air are minimized by the limited size of the source area, the depth of the source, and the presence of vegetation (grass) over most of the source area. Because BTEX compounds were not detected and only low levels of aliphatic and aromatic VPH were detected in site soils, volatilization to outdoor air is unlikely. The detections were primarily of the heavier VPHs, which generally volatilize more slowly than lighter VPHs. Although slow volatilization to outdoor air may occur, it is unlikely to be significant given the small size of the source area and the rapid mixing that would occur.

Based on the soil sampling results, BTEX was not detected, and the majority of the petroleum detected was in the less volatile extractable range. Therefore, volatilization from soil to indoor air does not appear to be of concern. Similarly, volatilization of diesel constituents from groundwater via the vadose zone to indoor air is not of concern. Although some groundwater contamination may be present beneath the building, only two volatiles were detected in groundwater. One was C8-C10 aromatics at a concentration of 56 µg/L which is barely above the detection limit of 50 µg/L. The other, C10-C12 aliphatics, was detected at 88 µg/L in MW-01 during the initial sampling round, but was not detected in two subsequent sampling rounds.

2.3.3 Erosion/Runoff

Because the site is generally flat and covered by structures, pavement and vegetation (grass), erosion, runoff, or overland flow is not expected to be significant. No drainages or surface water flow pathways were observed at the site. The nearest water body is the Columbia River, located approximately one-quarter mile east of the site.

2.3.4 Leaching and Groundwater Transport

Infiltrating rainwater or irrigation water may be dissolving chemicals, resulting in their transfer from soils downward to groundwater. Infiltration over part of the source area is effectively eliminated by presence of a concrete slab (see Figure 3). Groundwater flow direction is generally toward the east-northeast based on the relative elevations of the groundwater surface in the three monitoring wells on site, and depth to groundwater ranges from 13 to 17 feet bgs. Although chemical concentrations in soil decrease markedly with depth (see Table 1), EPH may be seasonally in contact with the water table. Chemicals dissolving in groundwater could potentially be transported downgradient to drinking water wells, if they exist or are ever installed. However, the source of drinking water for the site and the residents in the area is the municipal water supply. Although a formal well survey was not conducted, it appears that there are no drinking water wells downgradient of the site (between the site and the Columbia River) based on a review of registered well logs furnished by Ecology. Although future well installation downgradient of the site is unlikely, it can not be ruled out based on available information. Therefore, it was assumed that chemicals reaching groundwater could be transported to future wells.

2.3.5 Product

Product was not observed on groundwater, and soil concentrations are below levels likely to be indicative of product.

2.3.6 Discharge to Surface Water

Once chemicals reach groundwater, they can also potentially be transported to surface water. Because the site is approximately one-quarter of a mile from the Columbia River, the likelihood is low that site-related petroleum constituents would reach aquatic receptors at significant concentrations, especially in light of the relatively low concentrations beneath the source and in the perimeter wells, and the absence of the more mobile fuel constituents like BTEX.

2.3.7 Biotic Uptake

Biotic uptake by terrestrial organisms is unlikely because:

- The extent of the impacted soils is limited and at depth.
- The surface above the source consists of a concrete slab and a small area of regularly mowed grass which provides low value habitat due to its limited size, the lack of cover, and the limited diversity of vegetation.
- The commercial setting of the area lacks suitable habitat for most wildlife species.
- The limited biomagnification potential of most petroleum constituents.

Gardening and agriculture are unlikely to occur on site because of its anticipated continued use by the Federal Building. Therefore, current and future uptake by human food sources (e.g., vegetables or beef) or other biota (plants or animals) is not expected, and foodchain pathways are incomplete.

2.4 Receptors and Exposure Routes

2.4.1 Human Receptors and Exposure Routes

Current human receptors identified for the site include site workers and trespassers. Future site use is not expected to change. However, a more conservative hypothetical residential receptor was evaluated in accordance with MTCA Method B and to reduce the likeliness that deed restrictions may be required under MTCA. Protection of a hypothetical resident should ensure protection of the identified receptors. Although there are no current plans to sell the site, this approach also ensures that future residents would be protected if the site were to be sold and converted to residential use.

The following exposure routes were determined to be complete and potentially significant:

- Incidental ingestion of soil.
- Dermal contact with soil.
- Ingestion of groundwater, dermal contact with groundwater, and inhalation of volatiles released during household water use. This route is currently incomplete on site and unlikely to become complete in the future because the Federal Building is supplied with city water. However, it is possible that these routes could become complete for

downgradient offsite receptors if wells are installed in the future, therefore it was conservatively assumed to be a complete exposure pathway.

In accordance with MTCA, dermal contact was not evaluated quantitatively.

The following exposure routes are potentially complete, but were considered insignificant and therefore not evaluated:

- Inhalation of particulates in outdoor air. This pathway is rarely significant relative to soil ingestion, and particulate emissions to outdoor air are expected to be minimal as previously described. For these reasons, this route is unlikely to be significant under current or expected site conditions.
- Inhalation of volatiles in outdoor air. BTEX compounds were not detected, but some predominantly heavier aliphatic and aromatic VPH constituents (largely overlapping with the EPH range) were detected. Although this pathway is potentially complete, it is unlikely to be significant because of the likely slow rate of volatilization, small size of the source, and likely rapid mixing in outdoor air.
- Inhalation of volatiles from groundwater via the vadose zone to indoor air. Only low levels of two heavier VPH fractions were detected.

The following exposure routes were considered to be incomplete and unlikely to become complete because no complete transport mechanisms were identified:

- Inhalation of volatile chemicals released from soil to indoor air.
- Incidental ingestion of and dermal contact with surface water and sediment and ingestion of fish.
- Ingestion of garden produce, domestic animal products, and game.

2.4.2 Ecological Receptors and Intake Routes

The potential for exposure of terrestrial ecological receptors is minimal because of the small extent of the contamination and its depth. Impacts, if any, on lower trophic level receptors would be negligible given the small number of organisms likely to be affected. The value of the habitat above the source area is very limited due to its small size and nature (mowed grass and concrete). It provides no cover and a very limited diversity of vegetation. The commercial setting of the general area also affects the type and quality of available nearby habitat (e.g., pavement and grass lawns rather than natural vegetation, disturbances, and noise by humans) which reduces the number and types of terrestrial ecological receptors that may be present at or

in the vicinity of the site. These factors greatly reduce the possibility of significant terrestrial wildlife exposure. Therefore, terrestrial receptors were not assessed.

Because the site is approximately one-quarter of a mile from the Columbia River the likelihood is low that site contaminants would reach aquatic receptors at significant concentrations; therefore, aquatic receptors were not assessed.

3.0 DATA EVALUATION AND IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

Before risks associated with the exposure pathways identified for quantification in the CSM were estimated, the quality and usefulness of the available data were evaluated to select the risk assessment data set. Then, the chemicals of potential concern (COPCs) to be quantitatively evaluated in the risk assessment were identified.

3.1 Data Quality and Usefulness for Risk Assessment

The field sampling and laboratory analysis are discussed in Section 1.2. The analytical data are summarized in Tables 1 and 2 for soil and groundwater, respectively, and presented in detail in Appendix A. Section A.1 contains the NWTPH-DX data; Section A.2 presents the risk assessment data set (EPH, VPH, PAHs, BTEX); and Section A.3 presents the VOC data for groundwater. No data gaps were identified with respect to the types of analyses. Because the number of samples was limited, particularly with respect to sample depth, there is some uncertainty as to whether the area of maximum site contamination was sampled. However, the soil samples analyzed were collected from immediately below the bottom of the former UST and are likely to be represent maximum contaminant concentrations. Groundwater samples were collected from underneath the source area (MW-01) as well as downgradient and cross-gradient of the source area (MW-02 and MW-03).

NWTPH-DX data were not used directly in the risk assessment because VPH and EPH data provide more specific information for risk assessment purposes. VOC data (other than BTEX) were not used in the risk assessment because they are not considered to be a site-derived contaminant. Data for noncarcinogenic PAHs were not used directly in the calculation of risks for petroleum because these chemicals are already included in the aromatic fraction of EPH. However, to ensure compliance with regulatory standards for individual chemicals, maximum site concentrations of individual noncarcinogenic PAHs in soil and groundwater were compared with MTCA Method B formula values from the Cleanup Levels and Risk Calculations

(CLARC II) Database (Ecology, 1996b). Concentrations of noncarcinogenic PAHs were several orders of magnitude lower than MTCA Method B formula values for both soil and groundwater (See Tables 3 and 4, respectively). Therefore, individual noncarcinogenic PAHs were not considered further.

A limited data review was performed on the EPH, VPH, and cPAH analyses in several soil and groundwater samples. Sample data reviewed include one soil sample collected on July 13, 1998 and submitted for EPH and PAH analyses, three soil samples and one water sample collected on September 9 and September 10, 1998 and submitted for PAH, EPH, VPH analyses, and three water samples collected on December 9, 1998 and submitted for PAH, EPH, VPH, and VOC analyses. All data reviewed were considered usable for the risk assessment. All sample hold times were met. All method blank samples were non-detect for target analytes. All quality control samples were performed at the required frequency. All surrogate recoveries and spike/spike duplicate recoveries were within control limits with the following exceptions. Soil sample TP2-8.5, collected on July 13 and analyzed by the EPH method, had no surrogate recovery due to the high amount of coeluting compounds present in the sample. Results for this sample should be considered estimated but still useable for this project. In addition, difficulty was experienced with surrogate compounds in some of the other samples for all methods. Some of the samples had surrogate recoveries high and outside the control limits; however, no data were qualified based on surrogate recoveries. One water sample (MW03), collected on December 9, 1998, had surrogate recoveries for EPH analysis low and outside the control limits. When the sample was reextracted and reanalyzed, the same low surrogate recovery was obtained. The laboratory attributed this noncompliance to possible matrix interference. All results for the sample were non-detect; however, the results may be potentially biased low and; therefore, should be used with caution.

3.2 Identification of Chemicals of Potential Concern

All petroleum chemicals detected by analysis for VPH, EPH, BTEX, MTBE, or cPAHs were identified as COPCs for the risk assessment. MTBE, BTEX, and six of the seven cPAHs were not detected in any samples and thus were eliminated as COPCs.

The COPCs include VPH/EPH fractions in soil and groundwater and chrysene in groundwater.

4.0 HUMAN HEALTH RISK ASSESSMENT

4.1 Exposure Assessment

A typical human health exposure assessment describes the exposure setting, identifies the exposure pathways, and discusses how exposures were quantified. The exposure setting and pathways are defined in the CSM (Section 2.0) and are not reiterated here. In summary, a hypothetical residential scenario was assumed, and the only human exposure pathways that were determined to be complete and potentially significant were:

- Ingestion of soil
- Dermal contact with soil
- Ingestion of groundwater
- Dermal contact with groundwater
- Inhalation of volatiles released during household use of groundwater.

Under MTCA, dermal exposure is not quantitatively evaluated. Therefore, dermal exposure to soil or groundwater was not considered further in the risk assessment.

Soil and groundwater exposures were evaluated separately. Exposure to site soils is discussed in Section 4.1.1, and exposure to site groundwater is discussed in Section 4.1.2.

4.1.1 Soil Exposure

For noncarcinogens in soil, exposure was quantitatively estimated using exposure point concentrations (EPCs) and MTCA default residential exposure parameters (Table 5) (Ecology, 1996a) in standard MTCA intake equations (Ecology, 1996a).

EPCs were not statistically derived. Rather, the sum of the aliphatic fractions and the aromatic fractions were calculated for each sample (see Table 6). In accordance with Ecology's Interim Policy (Ecology 1997; 1998), the aliphatic fraction was calculated by summing each of the detected aliphatic fractions and subtracting the C21-C36 fraction. The aromatic fraction was calculated by summing all of the detected fractions. For one of the soil samples, RFB-01, both VPH and EPH were analyzed. Because most of the fractions (e.g., C10-C12) reported by VPH are also reported by EPH, only the higher of the VPH and EPH fractions that were reported by both methods were used in calculating the total aliphatic and total aromatic fractions used in the risk assessment. This was done to avoid "double counting" those fractions that were analyzed by both methods.

The sample with the maximum sum (3,060 mg/kg; RFB-02) was then conservatively used as the basis of the aliphatic and aromatic EPCs (see Tables 6 and 7). This sample (RFB-02) was also selected because it contained the highest percentage of aromatic hydrocarbons of any of the samples; 56% aromatic hydrocarbons and 44% aliphatic hydrocarbons (Table 6). The aromatic and aliphatic EPCs used in the risk assessment were 1,700 mg/kg and 1,360 mg/kg, respectively (Table 7).

The VPH results for soil were not used quantitatively because all of the VPH fractions detected, except for the aromatic C8-C10 fraction, were also included in the EPH analysis and therefore are "double counted." Also, the concentration of the only VPH fraction (C8-C10 aromatics) that was detected and not "double counted" was very low (36 mg/kg). Although VPH was analyzed in only one of the four samples (RFB-01), no BTEX was detected in any of the samples and the VPH fractions detected in RFB-01 were in the diesel range. Therefore, it is unlikely that VPH is present in site soils at concentrations that would contribute significantly to the risk.

No cPAHs were detected in soil; therefore carcinogenic exposure and risks were not calculated in soil.

4.1.2 Groundwater Exposures

EPH/VPH fractions are the only COPCs identified for groundwater. Risks were not calculated for noncarcinogens in groundwater because total EPH + VPH concentrations in groundwater samples collected in December 1998 and March 1999 were well below the regulatory criterion (1,000 µg/L) in all three of the wells (see Table 2). In MW-01, the total EPH + VPH concentrations were 100 µg/L and 120 µg/L in December 1998 and March 1999, respectively. In MW-02, no petroleum constituents were detected in either sampling event. In MW-03, no petroleum constituents were detected in December 1998, and only 56 µg/L (the reporting limit was 50 µg/L) was detected in the March 1999 sampling event. In addition, no BTEX or PAHs were detected in any monitoring well during the either the December 1998 or March 1999 sampling events.

PAH, EPH, and VPH were, however, detected in a groundwater sample collected from MW-01 during the September 1998 sampling event (see Table 2). At that time VPH + EPH was detected at 4,900 µg/L, which was greater than the MTCA cleanup level of 1,000 µg/L. However, the September groundwater sample from MW-01 was collected one day after the well was drilled and developed, and it is likely that disturbances caused by the drilling and by

suspended sediment in the sample may have resulted in an elevated EPH + VPH concentration in the initial sample.

In addition, the September sampling event occurred during the irrigation season, when the sprinkler system was likely in use. This irrigation system is used during the period from about April to October each year and was not in use during the December and March sampling events. A significant quantity of irrigation water may be applied to the area during operation, based on the fact that several feet of standing water have been observed to accumulate in the telecommunications vault adjacent to the diesel UST site.

Relatively minor water table fluctuations may mobilize contaminants in a thin smear zone during periods of high water. The groundwater elevation in MW-01 was 0.28 foot (3.4 inches) lower in December and 0.11 foot (1.3 inches) lower in March than it was in September 1998. Based on the detection of EPH in soil at a depth of 12.5 to 14 feet bgs (depth to water table varies from 11 to 13 feet bgs at this location), it is possible that a "smear zone" exists at the top of the water table at the location of the closed UST. When the groundwater elevation rises, petroleum hydrocarbon constituents may be picked up by the groundwater from the soil.

The application of irrigation water at the site may be accelerating the flushing of petroleum hydrocarbons, by leaching from the vadose zone. Groundwater table fluctuations on an area-wide basis may also raise the water table, thereby mobilizing chemicals in the smear zone. Because the September 1998 EPH concentration in groundwater was unacceptable, some ongoing monitoring is needed to ensure concentrations do not again rise to unacceptable levels (>1 milligrams per liter [mg/L]).

Although measured groundwater concentrations exist for the site, the soil-to-groundwater pathway was evaluated using Raoult's law in order to determine if site soils remain a source of potential unacceptable concentrations of petroleum constituents into groundwater (Ecology, 1997; 1998). Raoult's Law states that the equilibrium concentration of a chemical in the moisture phase (e.g., pore water) is dependent on the mole fraction and the solubility of the chemical in water. That is, the composition and solubility of the fractions determine pore water concentrations for chemical mixtures present above the chemical saturation point. For noncarcinogens, the soil concentrations and molecular weights of each fraction were used to determine mole fractions. Then, using Raoult's Law, the mole fraction and solubility were used to estimate pore water concentrations. Estimated pore water concentrations were then divided by the default dilution attenuation factor (e.g., 20 for soil in the vadose zone and 1 for soil in the

saturated zone) to estimate groundwater EPCs for each fraction. Because analytical results for site soil samples were available for both the vadose zone and the saturated zone, the Raoult's Law calculations were performed for both scenarios using maximum soil concentrations in each zone. For the vadose zone, soil sample RFB-02 (collected at 10 to 11.5 feet bgs) was used in the calculation, and soil sample RFB-03 (collected at 12.5 to 14 feet bgs) was used for the saturated zone calculation. The EPCs for each detected fraction in the vadose zone were then summed to obtain a total EPC of 0.16 mg/L for hydrocarbons in groundwater, which is well below the MTCA cleanup level of 1 mg/L. The EPCs for each detected fraction in the saturated zone sample were also summed, and a total EPC of 1.2 mg/L for hydrocarbons in groundwater was calculated. Because the concentration predicted from vadose zone sample was less than the 1 mg/L MTCA cleanup level for TPH in groundwater (Ecology, 1996a), it is unlikely that soil in the vadose zone will leach unacceptable concentrations of petroleum constituents into groundwater. However, since the concentration predicted from the saturated zone sample was only slightly above the 1 mg/L MTCA cleanup level, there is some potential for petroleum constituents in the saturated zone to leach to groundwater beneath the source area at a level that could pose a threat if a drinking water well was ever installed within the source area. The model input and results are shown in Tables 8 and 9 for the vadose and saturated zones, respectively.

Chrysene is the only cPAH that was detected in groundwater. Chrysene was detected in MW-01 during the September 1998 sampling event but was not detected in subsequent sampling rounds. Because chrysene was the only carcinogenic COPC in groundwater, chrysene intake was not estimated separately. Rather, risk from groundwater exposure was calculated as the product of the ratio of the EPC for chrysene to an adjusted MTCA Method B groundwater formula value for benzo(a)pyrene from the CLARC II database (Ecology, 1996b) and the target cancer risk of 10^{-6} on which the cleanup level was based. The MTCA groundwater formula value for benzo(a)pyrene was multiplied by a factor of 100 to account for the relative toxicity of chrysene compared to that of benzo(a)pyrene, using the toxicity equivalency factor (TEF) approach (Cal EPA, 1994). The adjusted MTCA Method B formula value for chrysene is 1.2 µg/L. The detected chrysene concentration of 0.092 µg/L was used as the EPC in the risk calculation (Table 10).

4.2 Toxicity Assessment

A toxicity assessment defines the link between exposure and adverse effects. For petroleum constituents, a combined indicator/surrogate approach was used to assess toxicity in accordance with Ecology's Interim Policy (Ecology, 1997; 1998), which was adapted from the Total

Petroleum Hydrocarbon Criteria Working Group (TPHCWG) methodology (TPHCWG, 1997). For purposes of the risk assessment, indicator chemicals are the individual carcinogenic compounds within the chemical mixture that comprise petroleum hydrocarbons. Indicator chemicals used for petroleum under the Interim Policy include benzene and seven cPAHs. No benzene or cPAHs were detected in soil; chrysene (a cPAH) was the only carcinogen detected in groundwater. Therefore, only chrysene was evaluated as an indicator compound. Because ratios to default risk-based cleanup levels (Ecology, 1996b) were used to assess risk from carcinogens, a separate toxicity assessment was not performed for chrysene. However, the slope factor (cancer toxicity value) used in developing the default risk-based cleanup levels is shown in Table 11.

"Surrogate" compounds are chemicals of known toxicity that are used to assess the noncarcinogenic threat from the entire mass of a wide range of petroleum constituents of unknown toxicity. Petroleum mixtures are separated into distinct carbon ranges and into aliphatic and aromatic fractions, and "surrogate" compounds are used to represent the toxicity of each petroleum fraction. Under the Interim Policy (Ecology, 1997; 1998), available toxicity information is considered insufficient to allow different surrogates to be used for various equivalent carbon ranges. Therefore, one surrogate (hexane) is used for the aliphatic VPH + EPH fraction (excluding the > C21 fraction), and one surrogate (pyrene) is used for the aromatic VPH + EPH fraction (including alkenes). Quantitative estimates of toxic response developed by the EPA (1999) (known as reference doses [RfDs]) for hexane and pyrene were used to evaluate potential noncancer toxicity for the aliphatic and aromatic fractions of VPH + EPH, respectively (EPA, 1999). The chronic RfD is an estimate of lifetime daily exposure for humans (including sensitive subpopulations) that is likely to be without risk of adverse effect. RfDs are expressed in units of mg/kg/day. Estimated intakes of COPCs from environmental media (e.g., soil) can be compared to the RfD. Chronic RfDs were used in the noncancer risk calculations. This risk assessment uses only oral RfDs because soil ingestion is the only exposure route that was quantified. RfDs for pyrene and hexane are presented in Table 11.

4.3 Risk Characterization

Risk characterization integrates the results of the exposure and toxicity assessments to estimate the potential for adverse effects.

4.3.1 Methodology for Quantifying Risks

Risks are typically characterized separately for noncarcinogenic and carcinogenic chemicals. For noncarcinogens, toxicologists currently recognize the existence of a threshold of exposure below which there is virtually no likelihood of adverse health impacts in an exposed individual. In contrast, any amount of exposure to a carcinogen above background concentrations is believed to contribute to excess lifetime cancer risk.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified period of time with an RfD derived for a similar (e.g., chronic) exposure duration. The ratio of exposure to toxicity is the hazard quotient (HQ). HQs are calculated by dividing the chronic daily intake of a COPC in mg/kg/day by the route-specific RfD (mg/kg/day) (in this case, the oral RfD). Hazard indexes (HIs) are the sum of HQs across multiple chemicals or pathways. The HI for aliphatic and aromatic fractions is shown in the equation below:

$$HI = \frac{Intake_{aliphatics}}{RfD_{alipatics}} + \frac{Intake_{aromatics}}{RfD_{aromatics}}$$

An HI less than one indicates that adverse effects should not occur.

Carcinogenic risk for chrysene was calculated using the following formula:

$$Risk = \frac{EPC}{RBCL} \; x \; TCR$$

Where:

EPC = exposure point concentration (mg/L for water);
RBCL = Risk-Based Cleanup Level (TEF-adjusted MTCA Method B groundwater formula value in mg/L)
TCR = Target Cancer Risk on which the RBCL is based (1×10^{-6}).

Based on MTCA (Ecology, 1996a), excess cancer risks of $1x10^{-6}$ for each COPC (and $1x10^{-5}$ across all COPCs) are considered to be acceptable.

4.3.2 Results

Unacceptable carcinogenic risks are not posed by site contaminants under current or anticipated future conditions. Under a hypothetical future residential scenario, the chemical-specific cancer risk calculated using the maximum concentration of chrysene in groundwater was

estimated to be 7.7×10^{-8} (Table 9). Because chrysene was the only carcinogen detected in groundwater, the cumulative cancer risk is also 7.7×10^{-8}, which is considered to be acceptable.

Noncancer risks for petroleum were not calculated for groundwater because the maximum EPH +VPH concentrations detected in the December 1998 and March 1999 groundwater sampling events were well below the MTCA Method A cleanup level of 1 mg/L. Petroleum concentrations in groundwater during the September 1998 sampling event were above 1 mg/L, but the data from this sampling event do not appear to be representative of site conditions. It is likely that this result is biased because the monitoring well was newly constructed, so suspended sediments may have been present in the sample.

The noncancer risk or HQ for the soil ingestion pathway using the maximum detected concentration was estimated to be 0.71 for aromatic VPH + EPH fractions and 0.28 for aliphatic VPH + EPH fractions; the cumulative HI is 0.99 (Table 5). Thus, noncarcinogenic risks were below levels of concern (HI less than 1).

Although VPH + EPH in soil appears to pose no risk at this site, a risk-based cleanup level (RBCL) was calculated as follows:

$$RBCL = \frac{EPC \; x \; THI}{EHI}$$

Where

RBCL = Risk-Based Cleanup Level (mg/kg)
EPC = Exposure Point Concentration (mg/kg)
THI = Acceptable Target Hazard Index = 1 (Ecology, 1996a)
EHI = Estimated Hazard Index (0.99)

The acceptable target HI across chemicals under MTCA is 1 (Ecology, 1996a). Therefore, the sum of the EPCs for aliphatic and aromatic VPH + EPH was divided by the HI across both aliphatic and aromatic hydrocarbons (0.99), resulting in a final RBCL for VPH + EPH of 3,086 mg/kg. The method used is valid for a 56:44 apportionment of aromatic and aliphatic hydrocarbons. This cleanup level will be protective as long as the VPH + EPH is comprised of 56 percent aromatics or less. It is unlikely that the percentage of aromatics in VPH + EPH would substantially exceed 56% given that this is above the range of aromatic percentages typical for fresh diesel fuel and that this was the highest measured percentage of aromatics in site samples (see Table 6). The RBCL for EPH can also be calculated independently of concentration using the assumed apportionment of aromatic and aliphatic

hydrocarbons (56:44) and the known relationship of the toxicity data for each fraction. The derivation of this calculation is shown below:

$$EPC_{aliphatic} = F_{aliphatic} \times C_{VPH+EPH} \; ; \quad EPC_{aromatic} = F_{aromatic} \times C_{VPH+EPH}$$

Therefore,

$$HI = \frac{F_{aliphatic} \times C_{VPH+EPH} \times {}^{IR}/_{BW}}{RfD_{aliphatic}} + \frac{F_{aromatic} \times C_{VPH+EPH} \times {}^{IR}/_{BW}}{RfD_{aromatic}} = (C_{VPH+EPH} \times {}^{IR}/_{BW}) \times ({}^{F_{aliphatic}}/_{RfD_{aliphatic}} + {}^{F_{aromatic}}/_{RfD_{aromatic}})$$

If this equation is rearranged to solve for a concentration of $C_{VPH+EPH}$ that corresponds to a target HI of 1 (e.g., to solve for a cleanup level), then

$$C_{VPH\,/\,EPH} = \frac{THI \times {}^{BW}/_{IR}}{{}^{F_{aliphatic}}/_{RfD_{aliphatic}} + {}^{F_{aromatic}}/_{RfD_{aromatic}}} = \frac{1 \times {}^{16}/_{0.0002}}{{}^{0.56}/_{0.06} + {}^{0.44}/_{0.03}} = 3{,}086 \text{ mg/kg}$$

Where:

$HQ_{Aliphatic}$ = Hazard quotient for aliphatic hydrocarbons
$HQ_{Aromatic}$ = Hazard quotient for aromatic hydrocarbons
$EPC_{Aliphatic}$ = Exposure point concentration of aliphatic hydrocarbons
$EPC_{Aromatic}$ = Exposure point concentration of aromatic hydrocarbons
BW = Body weight = 16 kg (child)
IR = Soil Ingestion Rate = 0.0002 kg/day (200 mg/day x $1x10^{-6}$ kg/mg)
$RfD_{Aliphatic}$ = Oral reference dose for aliphatic hydrocarbons (hexane surrogate)
$RFD_{Aromatic}$ = Oral reference dose for aromatic hydrocarbons (pyrene surrogate)
$C_{VPH+EPH}$ = Concentration of VPH and EPH (solving for combined VPH + EPH cleanup level)
$F_{Aliphatic}$ = Fraction of $C_{VPH+EPH}$ comprised of aliphatic hydrocarbons (0.44 assumed)
$F_{Aromatic}$ = Fraction of $C_{VPH+EPH}$ comprised of aromatic hydrocarbons (0.56 assumed)
THI = Acceptable Target Hazard Index = 1

Some historical site data was analyzed by NWTPH-DX. Because the NWTPH-DX concentration (2,600 mg/kg) was higher than the sum of the VPH and EPH concentrations (1,350 mg/kg) in the sample analyzed by both methods (TP2), a cleanup level based on VPH + EPH concentrations should be conservative for NWTPH-DX (e.g., the equivalent VPH + EPH concentrations is roughly one-half as the measured NWTPH-DX concentration. The highest

NWTPH-DX concentration detected was 2,600 mg/kg, which is below the VPH + EPH RBCL of 3,086 mg/kg. Because the RBCL was calculated excluding the C21-C36 aliphatic fraction (per Ecology, 1997; 1998: see Section 4.1.1), this RBCL should only be compared to VPH + EPH results that also exclude this aliphatic fraction. Hence, the maximum detected VPH + EPH concentration (excluding the C21 to C36 aliphatic fraction) is 3,060 mg/kg, which is below the RBCL of 3,086 mg/kg.

4.4 Uncertainty Analysis

Because uncertainty is inherent in every stage of the risk assessment process, risk assessments generally use a number of very conservative assumptions in an effort to err on the side of the protection of human health. A detailed uncertainty analysis is beyond the scope of this assessment. However, some of the common uncertainties associated with each step in a risk assessment are summarized below.

4.4.1 Data Collection and Evaluation

Sources of uncertainty may be associated with the assumptions and procedures used during site sampling, laboratory analysis, or data evaluation. For example, regardless of the number of samples collected and types of analyses conducted, some uncertainty will always remain about the nature, magnitude, and extent of contamination. The full extent of contamination was not determined, but the sample locations were selected to represent areas where contamination was most likely to occur. Within the physical restraints that affected sampling, an attempt was made to collect samples in the areas likely to be the most contaminated. The risk assessment samples analyzed for petroleum fractions were for the samples with the highest NWTPH-DX concentrations. Field and laboratory procedures allow for the potential introduction of artifacts to samples and the potential for data quality to be impacted. Generally, uncertainties associated with data collection and evaluation were minimized but could result in over- or underestimation of risk.

4.4.2 Exposure Assessment

Use of the maximum aromatic/aliphatic apportionment of VPH + EPH to represent the apportionment site-wide may have overestimated the actual aromatic/aliphatic apportionment. The maximum values (56:44 aromatic: aliphatic) are conservative relative to reported literature values for fresh and weathered diesel fuel.

The exposure assumptions used in this risk assessment are conservative, in accordance with MTCA, and most likely resulted in an overestimate of actual risk. The residential default parameters under MTCA do not reflect actual behavior expected at the site, which is likely to remain a commercial property. Use of these parameters overestimates risk. However, the dermal pathway is not evaluated under MTCA, which may underestimate risks.

Use of simple soil to groundwater models tends to overestimate (but can underestimate) actual concentrations in groundwater. Measured groundwater concentrations are generally more useful if contaminant migration to groundwater has already occurred.

4.4.3 Toxicity Assessment

The use of toxicity data from "surrogate" chemicals for the petroleum risk assessment contributed uncertainty to the toxicity assessment. Because the toxicity of these compounds may be greater than or less than that of their surrogates, the risks estimated using these surrogates may have been under- or overestimated. However, because the most conservative available toxicity factors for aliphatic and aromatic compounds were used (hexane and pyrene, respectively), it is likely that risk was overestimated.

4.4.4 Risk Characterization

The uncertainties in each component of the risk assessment process are compounded in the overall calculation of final risk estimates. Thus, quantitative risk estimates presented are very likely to be substantial overestimates because of the conservative assumptions used in assessing exposure and toxicity. In particular, use of residential exposure assumptions where a future exposure is expected to remain commercial, and application of Ecology's very conservative approach to assessing the toxicity of petroleum fractions likely resulted in an overestimate of risks.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The results of the human health risk assessment indicate an estimated cancer risk of 7.7×10^{-8} (acceptable risk) and an estimated HI of 0.99 (no noncancer threat) from exposure to site soils. Because all measured groundwater concentrations on site were below the MTCA cleanup level of 1 mg/L (with the exception of the September 1998 results for MW-01, which may not be representative of site conditions), no current or future human health risks are expected from exposure to groundwater. However, to verify that the September 1998 result is not

representative and because the soil-to-groundwater modeling results for soil in the saturated zone indicate that concentrations of VPH + EPH in groundwater could reach 1.2 mg/L (essential at or just above the MTCA cleanup level), it is recommended that groundwater samples be collected from the site monitoring wells quarterly through September 1999. If the ongoing quarterly monitoring results from MW-01 instead suggest that irrigation may be impacting the transfer of petroleum products to the groundwater, an approach to reducing this effect would be to hard-surface (pave) the area over the closed UST and discontinue irrigation.

Although the halogenated VOCs in groundwater were not evaluated in this risk assessment and do not appear to be site-related, they are present on site at concentrations that would present an unacceptable risk if a drinking water well were installed. The source appears to be from an upgradient site. Under Ecology policy, "an exemption for liability exists for owners and operators of property that overlies a contaminated groundwater plume if the property is not the source of the contamination and the owners did not contribute to the release of the contamination." Until the source is identified and adequately addressed by the appropriate party, site groundwater should not be used. Because the current water supply for the Federal Building is city water and there are no anticipated land use changes, installation of an onsite drinking water supply well is very unlikely.

If, after a period of quarterly monitoring, EPH + VPH concentrations in groundwater rise to greater to 1 mg/L beneath the closed in place diesel UST, but remain below that level in the downgradient perimeter well, an alternative point of compliance for groundwater at the downgradient perimeter wells MW-02 may be appropriate for several reasons:

- There is no current use of onsite groundwater.
- There is no anticipated use of site groundwater.
- City water is the source of water for the Federal Building.
- Site groundwater is not currently suitable for use because of the halogenated VOC contamination that appears to be migrating to the site from an upgradient source.
- Therefore, remediation of site soil or groundwater for diesel constituents would not make the site groundwater usable. Further, natural attenuation will likely decrease concentrations in groundwater compared to current levels before upgradient solvent issues are addressed (if they are).
- Remediation is impracticable and would not reduce any current or reasonable likely future risks. The presence of multiple fiber optic and telecommunication cables in the

area of the UST and gravel and cobble subsurface soil place practical constraints on remedial options.

- Diesel constituents are not present at unacceptable levels in the downgradient perimeter well.

6.0 LIMITATIONS AND CLOSURE

The scope of our risk assessment was limited to diesel constituents associated with a single closed-in-place diesel UST. The potential for other source areas to be present elsewhere on the property was not evaluated. Halogenated volatiles in groundwater were not evaluated because their source is unrelated to the closed-in-place diesel UST. The data presented in this report are based on limited testing at the site and should be considered representative at the time of our observation. Some information was obtained from reports prepared by others; this information was not independently verified but was assumed to be accurate. Shannon & Wilson, Inc., performed this work within its best judgement and scope limitations to adequately describe conditions at the diesel UST area. Changes in the conditions of the property could occur over time from both natural processes and human activities. In addition, changes in governmental codes, regulations, policies, or law could occur. Because of these changes beyond our control, our observations and recommendations applicable to this facility may need to be revised wholly or in part.

This report was prepared for the exclusive use of Abide International, General Services Administration, and their representatives and in no way guarantees that an agency or its staff will reach the same conclusions as Shannon & Wilson, Inc. We have prepared Appendix B, "Important Information About Your Environmental Report" to assist you and others in understanding the use and limitations of our reports.

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REFERENCES

California Environmental Protection Agency (Cal EPA). 1994. Benzo(a)pyrene as a Toxic Air Contaminant. Part B. Health Assessment. Office of Environmental Health Hazard Assessment. July.

Department of Energy (DOE). 1995. Hanford Site Background, Part 1 Soil Background for Non-Radioactive Analytes. Revision 3. October.

Shannon & Wilson, Inc., 1998a. Underground Storage Tank Site Assessment, Federal Building, Richland, Washington. April.

Shannon & Wilson, Inc., 1998b. Preliminary Phase 2 Environmental Site Assessment, Closed UST at Federal Building, Richland, Washington. October.

Shannon & Wilson, Inc., 1999. Supplemental Phase 2 Environmental Site Assessment, Closed UST at Federal Building, Richland, Washington. March.

Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG), 1997, Volume 3: Selection of representative TPH fractions based on fate and transport considerations, and Volume 6: Development of fraction-specific reference doses (RfDs) and reference concentrations (RfCs) for total petroleum hydrocarbons (TPH). June.

U.S. Environmental Protection Agency (EPA), 1996. Drinking Water Regulations and Health Advisories. Office of Water. EPA 822-R-96-001.

_____. Integrated risk information system (IRIS) [Online]; Available; National Library of Medicine TOXNET System.

Washington Department of Ecology (Ecology), 1996a. Model Toxics Control Act cleanup regulation, Chapter 173-340 WAC: Olympia, Wash., Publication No. 94-06, amended January 1996.

_____, 1996b. Model Toxics Control Act, cleanup levels and risk calculations (CLARC II) update: Olympia, Wash., Chapter 173-162. Washington Administrative Code (WAC).

_____, 1997. Interim Interpretive and Policy Statement: Cleanup of Total Petroleum Hydrocarbons (TPH). Publication No. ECY97-600. January.

_____, 1998. Interim TPH Policy Update. Memo from Carol Kraege, Toxics Cleanup Program. November 17.

Washington Soil Conservation Service. 1971. Soil Survey Benton County Area, Washington.

TABLE 1
RESULTS OF SOIL ANALYTICAL TESTING

Parameter	Soil, mg/kg (sample depth, feet bgs)						
	9/9/98			7/13/98			
	RFB-01 (8-9.5)	RFB-02 (10-11.5)	RFB-03 (12.5-14)	TP1 (4.5)	TP2 (8.5)	TP3 (4)	TP4 (7)
PAHs				NT		NT	NT
Naphthalene	<0.072	<0.036	<0.035		<0.036		
2-Methylnaphthalene	1.0	0.15	0.062		0.79		
Acenaphthylene	<0.072	<0.036	<0.035		<0.036		
Acenaphthene	<0.072	<0.036	<0.035		<0.036		
Fluorene	<0.072	<0.036	<0.035		<0.036		
Phenanthrene	<0.072	<0.036	<0.035		<0.036		
Anthracene	1.9	1.6	0.18		1.1		
Fluoranthene	0.1	0.064	<0.035		<0.036		
Pyrene	0.4	0.24	0.056		0.19		
Benzo(a)anthracene	<0.072	<0.036	<0.035		<0.036		
Chrysene	<0.072	<0.036	<0.035		<0.036		
Benzo(b)fluoranthene	<0.072	<0.036	<0.035		<0.036		
Benzo(k)fluoranthene	<0.072	<0.036	<0.035		<0.036		
Benzo(a)pyrene	<0.072	<0.036	<0.035		<0.036		
Indeno(1,2,3-cd)pyrene	<0.072	<0.036	<0.035		<0.036		
Dibenzo(a,h)pyrene	<0.072	<0.036	<0.035		<0.036		
Benzo(g,h,i)pyrene	<0.072	<0.036	<0.035		<0.036		
	<0.072	<0.036	<0.035		<0.036		
EPH				NT		NT	NT
Aliphatic Fractions							
C10-C12	230	230	7.3		99		
C12-C16	700	660	85		420		
C16-C18	290	270	47		200		
C18-C21	250	200	35		140		
C21-C28	98	90	17		56		
C28-C36	<10	<10	<10		<5.4		
Total Aliphatic	1,600	1,400	190		910		
Aromatic Fractions							
C10-C12	92	140	<5.2		26		
C12-C16	460	650	44		110		
C16-C18	330	430	41		140		
C18-C21	320	410	40		74		
C21-C28	75	96	16		84		

TABLE 1 (cont.)
RESULTS OF SOIL ANALYTICAL TESTING

Parameter	Soil, mg/kg (sample depth, feet bgs)						
	9/9/98			7/13/98			
	RFB-01 (8-9.5)	RFB-02 (10-11.5)	RFB-03 (12.5-14)	TP1 (4.5)	TP2 (8.5)	TP3 (4)	TP4 (7)
C28-C36	<5.4	7.8	8.5		<5.4		
Total Aromatic	1,300	1,700	150		440		
VPH		NT	NT	NT	NT	NT	NT
Aliphatic Fractions							
C5-C6	<5.0						
C6-C8	<5.0						
C8-C10	<5.0						
C10-C12	250						
Total Aliphatic	250						
Aromatic Fractions							
C8-C10	36						
C10-C12	190						
C12-C13	210						
Total Aromatic	440						
Target Analytes:							
Methyl t-butyl ether	<0.50						
Benzene	<0.50						
Toluene	<0.50						
Ethylbenzene	<0.50						
Xylenes	<0.50						
TPH	NT	NT					
Diesel Range			300	<29	2,600	38	<27
Heavy Oil Range			<52	<58	92	<53	<54

Notes:
bgs = below ground surface
EPH = extractable petroleum hydrocarbons
mg/kg = milligrams per kilogram
NT = not tested
PAH = polycyclic aromatic hydrocarbons
TP = test pit
TPH = total petroleum hydrocarbons
VPH = volatile petroleum hydrocarbons

TABLE 2
RESULTS OF ANALYTICAL TESTING OF GROUNDWATER SAMPLES, µg/L

Parameter	9/10/98	12/9/98			3/31/99		
	MW-01	MW-01	MW-02	MW-03	MW-01	MW-02	MW-03
PAHs							
Naphthalene	0.19	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2-Methylnaphthalene	1.4	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Acenaphthylene	0.11	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Acenaphthene	0.41	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluorene	1	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Phenanthrene	3.4	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Anthracene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoranthene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Pyrene	0.13	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(a)anthracene	<0.050	<0.050	<0.050	<0.050	<0.025	<0.025	<0.025
Chrysene	0.092	<0.050	<0.050	<0.050	<0.025	<0.025	<0.025
Benzo(b)fluoranthene	<0.050	<0.050	<0.050	<0.050	<0.025	<0.025	<0.025
Benzo(k)fluoranthene	<0.050	<0.050	<0.050	<0.050	<0.025	<0.025	<0.025
Benzo(a)pyrene	<0.050	<0.050	<0.050	<0.050	<0.025	<0.025	<0.025
Indeno(1,2,3-cd)pyrene	<0.050	<0.050	<0.050	<0.050	<0.025	<0.025	<0.025
Dibenzo(a,h)anthracene	<0.050	<0.050	<0.050	<0.050	<0.025	<0.025	<0.025
Benzo(g,h,i)perylene	<0.050	<0.050	<0.050	<0.050	<0.025	<0.025	<0.025
EPH							
Aliphatic Fractions							
C10-C12	310	<50	<50	<50	<50	<50	<50
C12-C16	1,200	100	<50	<50	64	<50	<50
C16-C18	520	<50	<50	<50	<50	<50	<50
C18-C21	400	<50	<50	<50	<50	<50	<50
C21-C28	220	<50	<50	<50	56	<50	<50
C28-C36	<200	<50	<50	<50	<50	<50	<50
Total Aliphatic	2,900	100			120		
Aromatic Fractions							
C10-C12	140	<50	<50	<50	<50	<50	<50
C12-C16	640	<50	<50	<50	<50	<50	<50
C16-C18	430	<50	<50	<50	<50	<50	<50
C18-C21	360	<50	<50	<50	<50	<50	<50
C21-C28	90	<50	<50	<50	<50	<50	<50
C28-C36	<150	<50	<50	<50	<50	<50	<50
Total Aromatic	1,700						

TABLE 2 (cont.)
RESULTS OF ANALYTICAL TESTING OF GROUNDWATER SAMPLES, µg/L

Parameter	9/10/98	12/9/98			3/31/99		
	MW-01	MW-01	MW-02	MW-03	MW-01	MW-02	MW-03
VPH							
Aliphatic Fractions							
C5-C6	<50	<50	<50	<50	<50	<50	<50
C6-C8	<50	<50	<50	<50	<50	<50	<50
C8-C10	<50	<50	<50	<50	<50	<50	<50
C10-C12	88	<50	<50	<50	<50	<50	<50
Total Aliphatic	88						
Aromatic Fractions							
C8-C10	<50	<50	<50	<50	<50	<50	56
C10-C12	81	<50	<50	<50	<50	<50	<50
C12-C13	130	<50	<50	<50	<50	<50	<50
Total Aromatic	210						56
Target Analytes:							
Methyl t-butylether	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Benzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Toluene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Ethylbenzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Xylenes	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Volatiles (EPA 8260B)	NT						
Cis 1,2-Dichloroethene		<1.0	4.5	<1.0	<1.0	28	<1.0
Chloroform		24	<1.0	9.9	23	<1.0	13
Trichloroethene		<1.0	3.1	<1.0	<1.0	1.9	<1.0
Tetrachloroethene		3.9	22	130	1.9	28	82
Other Volatiles		ND	ND	ND	ND	ND	ND

Notes:
EPA = Environmental Protection Agency
EPH = extractable petroleum hydrocarbons
µg/L = micrograms per liter
MW = monitoring well
NT = not tested
PAHs = polycyclic aromatic hydrocarbons
TPH = total petroleum hydrocarbons
VPH = volatile petroleum hydrocarbons

TABLE 3
COMPARISON OF CONCENTRATIONS OF INDIVIDUAL DETECTED NONCARCINOGENIC POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL WITH MTCA METHOD B FORMULA VALUES

Chemical	Maximum Concentrations (mg/kg)	MTCA Method B Soil RBCL (mg/kg)	Ratio of Max. to MTCA Method B Soil RBCL (unitless)	MTCA Method B Soil-to-GW RBCL (b) (mg/kg)	Ratio of Max. to MTCA Method B Soil-to-GW RBCL (unitless)
Anthracene	1	24,000	7.92E-05	480	3.96E-03
Fluoranthene	1.9	3,200	3.13E-05	64	1.56E-03
2-Methylnaphthalene	0.1	3,200 (c)	3.13E-04	32 (c)	3.13E-02
Pyrene	0.4	2,400	1.67E-05	48	8.33E-03
Total Hazard Index (a)			0.00044		0.045

Notes:
(a) Product of the sum of the ratios and the target hazard quotient of one on which the MTCA Method B RBCLs are based.
(b) Ecology, 1996b, soil-to-groundwater value is based on the "100 times" rule.
(c) Value for naphthalene used as a surrogate.

GW = groundwater
mg/kg = milligrams per kilogram
Max. = maximum concentration
MTCA = Washington State Model Toxics Control Act
PAHs = polycyclic aromatic hydrocarbons
RBCL = Risk-Based Cleanup Level (default MTCA Method B Formula Values)

TABLE 4
COMPARISON OF CONCENTRATIONS OF INDIVIDUAL NONCARCINOGENIC POLYCYCLIC AROMATIC HYDROCARBONS IN GROUNDWATER WITH MTCA METHOD B FORMULA VALUES

Chemical	Maximum Concentrations (µg/L)	MTCA Method B GW RBCL (µg/L)	Ratio of Max. to MTCA Method B GW RBCL (unitless)
Acenaphthylene	0.11	NA	NE
Acenaphthene	0.41	960	4.27E-04
Fluorene	1	640	1.56E-03
2-Methylnaphthalene	1.4	320 (b)	4.34E-03
Naphthalene	0.19	320	5.94E-04
Pyrene	0.13	480	2.71E-04
Total Hazard Index (a)			0.0072

Notes:
(a) Product of the sum of the ratios and the target hazard quotient of one on which the MTCA Method B RBCLs are based.
(b) Value for naphthalene used as a surrogate.
GW = groundwater
ug/kg = micrograms per kilogram
Max. = maximum concentration
MTCA = Washington State Model Toxics Control Act
PAHs = polycyclic aromatic hydrocarbons
RBCL = Risk-Based Cleanup Level (default MTCA Method B Formula Values)

TABLE 5
DEFAULT RESIDENTIAL EXPOSURE PARAMETERS FOR SOIL INGESTION

Parameter	Value	Units	Source
Ingestion Rate	0.0002	kg/day	MTCA—Child
Frequency of Contact	365	days/year	MTCA—Child
Exposure Duration	6	years	MTCA—Child
Body Weight	16	kg	MTCA—Child
Noncarcinogenic Averaging Time	2,190	days	MTCA—ED x 365 days/year

Notes:
Ecology = Washington State Department of Ecology
ED = exposure duration
kg/day = kilograms per day
MTCA = Model Toxics Control Act (Ecology, 1996a)

TABLE 6
SOIL APPORTIONMENT RESULTS

Sample Number	Aromatic Fraction (mg/kg)	Aliphatic Fraction [a] (mg/kg)	Sum of Fractions (mg/kg)	% Aromatic	% Aliphatic
RFB-01	1,411 [b,c]	1,490 [c]	2,901	48.6	51.4
RFB-02	1,700	1,360	3,060	56	44
RFB-03	150	174	324	46.3	53.7
TP2	434	859	1293	33.6	66.4

Notes:
a- Aliphatic fraction adjusted by subtracting the C21-C36 fraction (Ecology 1997;1998).
b- Includes the VPH aromatic C8-C10 fraction.
c- Includes the higher of the VPH and EPH fractions where the same fraction was analyzed by both methods.
EPH = extractable petroleum hydrocarbons
mg/kg = milligrams per kilogram
RFB = Richland Federal Building
TP = test pit
VPH = volatile petroleum hydrocarbons

TABLE 7
INTAKE AND ESTIMATED RISKS FOR A HYPOTHETICAL RESIDENT EXPOSED TO NONCARCINOGENS VIA INCIDENTAL INGESTION OF PETROLEUM HYDROCARBONS IN SOIL (SURROGATE APPROACH)

Chemical of Potential Concern	EPC in Soil (mg/kg)	Noncancer Intake (mg/kg/day)	Chronic Oral RfD (mg/kg/day)	Noncancer HQ (unitless)	Surrogate Used
Aromatic VPH+EPH	1,700	2.13E-02	0.03	7.08E-01	Pyrene
Aliphatic VPH+EPH	1,360	1.70E-02	0.06	2.83E-01	Hexane
Hazard Index				**0.99**	

Notes:
EPC = exposure point concentration
EPH = extractable petroleum hydrocarbons
HQ = hazard quotient
mg/kg = milligrams per kilogram
mg/kg/day = milligrams per kilogram per day
RfD = reference dose
VPH = volatile petroleum hydrocarbons

TABLE 8
ESTIMATED PETROLEUM HYDROCARBON CONCENTRATIONS LEACHING TO GROUNDWATER FROM SOIL IN THE VADOSE ZONE (RAOULT'S LAW METHOD)

Petroleum Fraction (a)	EPC for Soil (b) (mg/kg)	Molecular Weight (c) (g/mg)	Moles (mmol/kg)	Mole Fraction	Solubility (c) (mg/L)	Effective Solubility/ Pore Water Concentration (mg/L)	Dilution Factor (unitless)	EPC in GW at Hypothetical Well (mg/L)
Aliphatic Hydrocarbons								
EC > 10-12	230	160	1.4	0.09	2.6E-02	2.2E-03	20	1.1E-04
EC > 12-16	660	200	3.3	0.20	5.9E-04	1.2E-04	20	5.8E-06
EC > 16-21	470	270	1.7	0.10	1.0E-06	1.0E-07	20	5.2E-09
Aromatic Hydrocarbons								
EC > 10-12	140	130	1.1	0.06	2.5E+01	1.6E+00	20	8.0E-02
EC > 12-16	650	150	4.3	0.26	5.8E+00	1.5E+00	20	7.5E-02
EC > 16-21	840	190	4.4	0.26	5.1E-01	1.3E-01	20	6.7E-03
EC > 21-35	104	240	0.4	0.03	6.6E-03	1.7E-04	20	8.5E-06
Total Aliphatic and Aromatic Hydrocarbons			16.7	1.00				0.16

Notes:
(a) Petroleum fractions not detected are not shown.
(b) Based on sample RFB-02.
(c) The source of the molecular weights and solubilities is the Interim Policy (Ecology, 1997) unless otherwise stated.
EC = equivalent carbon number
EPC = exposure point concentration
g/mg = grams per milligram
mg/kg = milligrams per kilogram
mg/L = milligrams per liter
mmol/kg = millimoles per kilogram

TABLE 9
ESTIMATED PETROLEUM HYDROCARBON CONCENTRATIONS LEACHING TO GROUNDWATER FROM SOIL IN THE SATURATED ZONE (RAOULT'S LAW METHOD)

Petroleum Fraction (a)	EPC for Soil (b) (mg/kg)	Molecular Weight (c) (g/mg)	Moles (mmol/kg)	Mole Fraction	Solubility (c) (mg/L)	Effective Solubility/ Pore Water Concentration (mg/L)	Dilution Factor (unitless)	EPC in GW at Hypothetical Well (mg/L)
Aliphatic Hydrocarbons								
EC > 10-12	7.3	160	0.05	0.03	2.6E-02	4.4E-04	1	7.4E-04
EC > 12-16	85	200	0.4	0.27	5.9E-04	1.6E-04	1	1.6E-04
EC > 16-21	82	270	0.3	0.19	1.0E-06	1.9E-07	1	1.9E-07
Aromatic Hydrocarbons								
EC > 12-16	44	150	0.3	0.18	5.8E+00	1.1E+00	1	1.1E+00
EC > 16-21	81	190	0.4	0.27	5.1E-01	1.4E-01	1	1.4E-01
EC > 21-35	24.5	240	0.1	0.06	6.6E-03	4.2E-04	1	4.2E-04
Total Aliphatic and Aromatic Hydrocarbons			1.6	1.00				1.20

Notes:
(a) Petroleum fractions not detected are not shown.
(b) Based on sample RFB-03.
(c) The source of the molecular weights and solubilities is the Interim Policy (Ecology, 1997) unless otherwise stated.
EC = equivalent carbon number
EPC = exposure point concentration
g/mg = grams per milligram
mg/kg = milligrams per kilogram
mg/L = milligrams per liter
mmol/kg = millimoles per kilogram

TABLE 10
CANCER RISK ESTIMATES FOR CARCINOGENS IN A HYPOTHETICAL FUTURE DRINKING WATER WELL

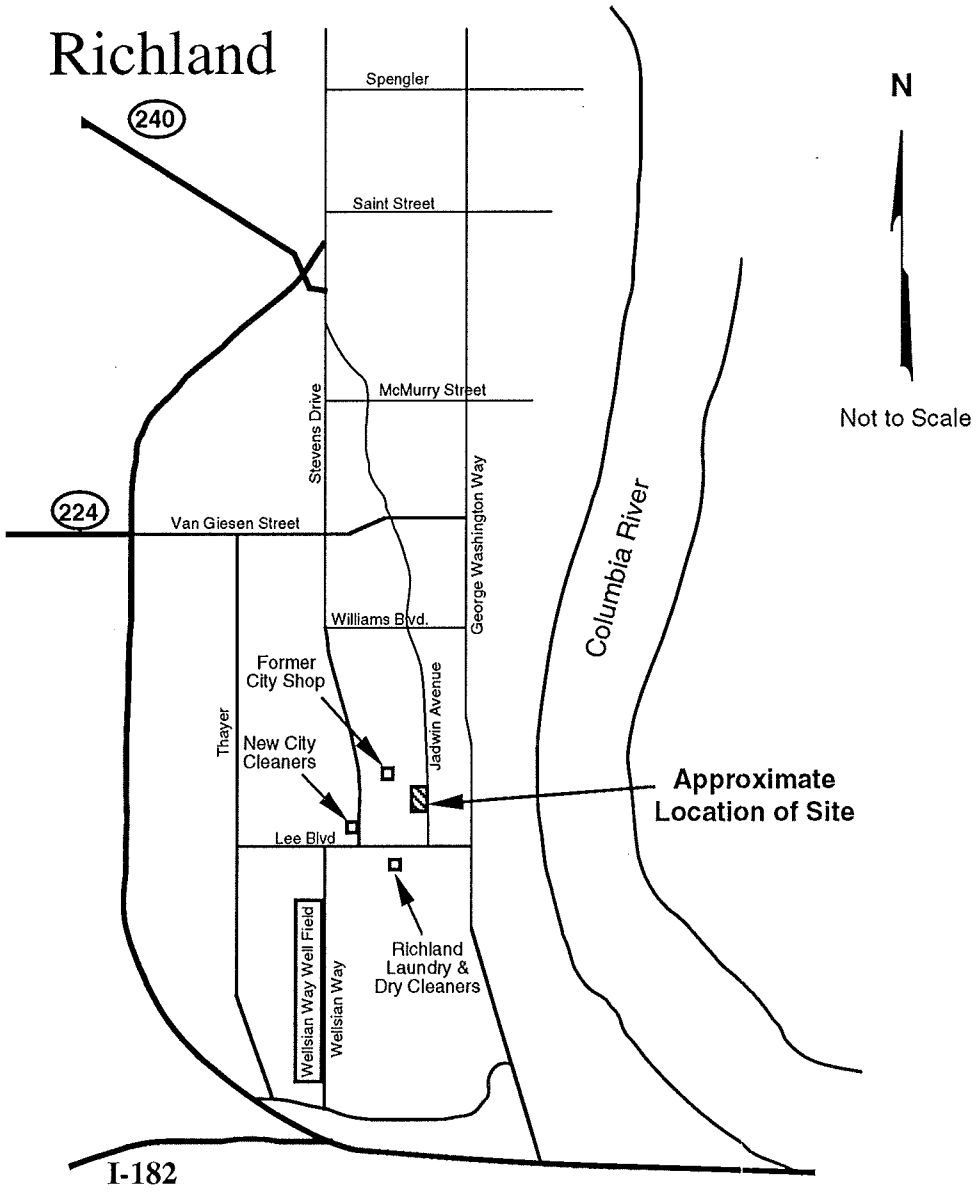
Chemicals of Potential Concern	EPC (µg/L)	MTCA B Groundwater Ingestion (µg/L) (a)	Ratio
Chrysene	0.092	1.2	0.0767
Cancer Risk (b)			7.7E-08

Notes:
(a) MTCA B value adjusted using the toxicity equivalency factor (TEF) approach (Cal EPA, 1994).
(b) Calculated by multiplying the ratio of exceedance by the target cancer risk of 1E-06.
EPA = U.S. Environmental Protection Agency
µg/L = micrograms per liter
MTCA = Model Toxics Control Act

TABLE 11
TOXICITY FACTORS FOR CHEMICALS OF POTENTIAL CONCERN

Chemical of Potential Concern	Carcinogenic Effects	Noncarcinogenic Effects
	Oral Slope Factor $(mg/kg/day)^{-1}$	Oral Reference Dose (mg/kg/day)
Chrysene	0.073 (a)	NA
Pyrene (b)	NA	0.03 (a)
Hexane (c)	NA	0.06 (a)

Notes:
a From Integrated Risk Information System (IRIS) (EPA, 1999), adjusted using the toxicity equivalency factor (TEF) approach (Cal EPA, 1994).
b Represents aromatic fraction of VPH + EPH (Ecology, 1997).
c Represents aliphatic fraction of VPH + EPH (Ecology, 1997).
Ecology = Washington State Department of Ecology
EPA = U.S. Environmental Protection Agency
EPH = extractable petroleum hydrocarbons
NA = not applicable
VPH = volatile petroleum hydrocarbons



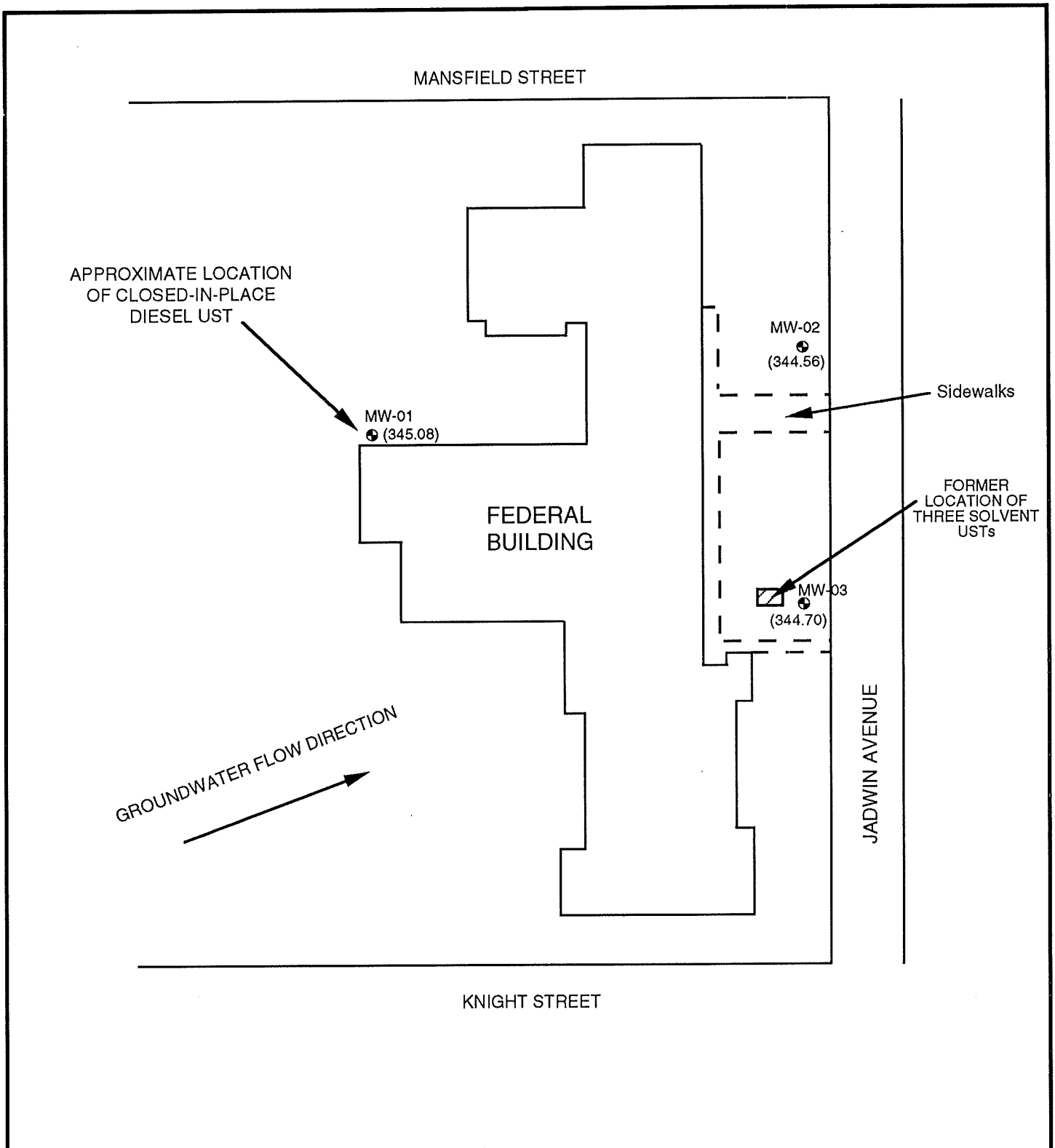
Federal Building Diesel Fuel UST Site
Richland, Washington

SITE VICINITY MAP

May 1999 V-1075-02

SHANNON & WILSON, INC.
Geotechnical & Environmental Consultants

FIG. 1



MW-01 (344.57) Monitoring well: approximate location, designation, and groundwater elevation on 12-5-98

0 100 200

Approximate Scale in Feet

N

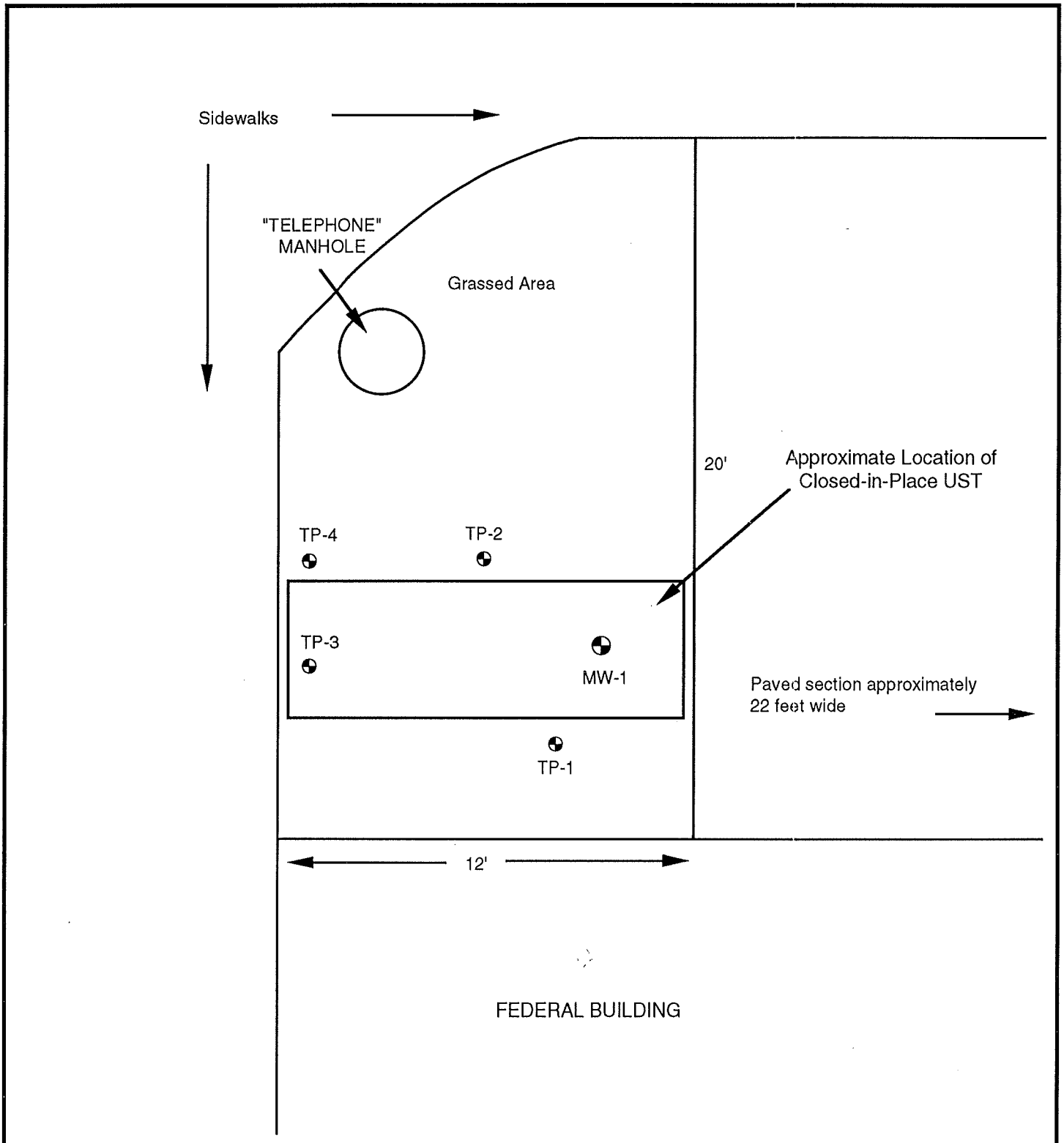
Federal Building Diesel Fuel UST Site
Richland, Washington

SITE MAP AND MONITORING WELL LOCATIONS

May 1999 V-1075-02

SHANNON & WILSON, INC.
Geotechnical & Environmental Consultants

FIG. 2



LEGEND

MW-1 Exploration designation and approximate location

0 4 8

Approximate Scale in Feet

N

Federal Building Diesel Fuel UST Site
Richland, Washington

SITE PLAN AND SOIL SAMPLING LOCATIONS

May 1999 V-1075-02

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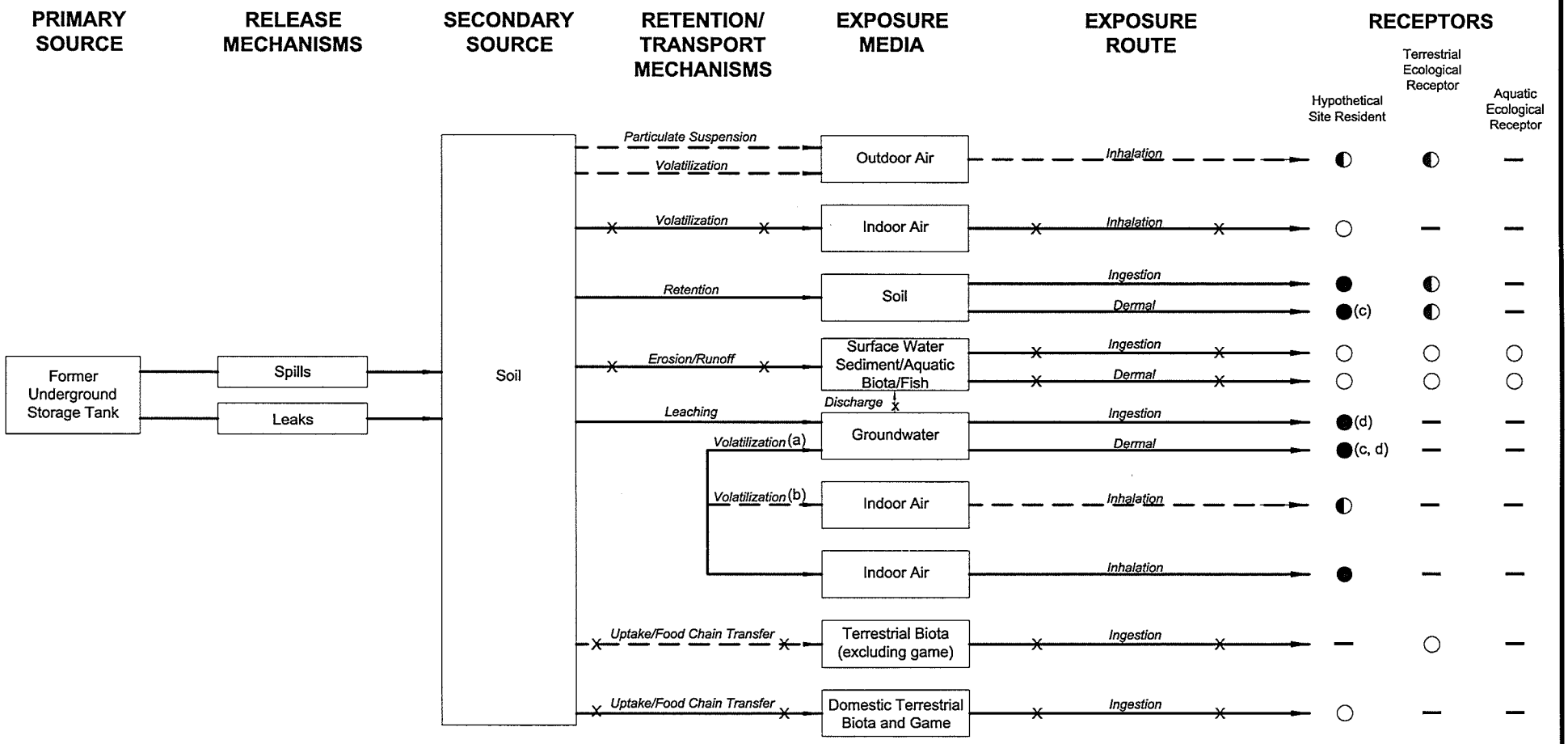
FIG. 3

File: V-1075-02 Fig. 4 Date: 4/26/99



LEGEND

- Complete; quantified unless otherwise noted
- Complete but insignificant and not quantified
- Incomplete or negligible and not quantified
- Not applicable
- (a) During household water use
- (b) Via the vadose zone
- (c) Not quantified under the Model Toxics Control Act
- (d) Only these pathways apply to an off site resident

FIG. 4

Federal Building
Richland, Washington

CONCEPTUAL SITE MODEL

May 1999 V-1075-02

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 4

APPENDIX A

ANALYTICAL DATA

APPENDIX A

ANALYTICAL DATA

TABLE OF CONTENTS

ATTACHMENTS

Section

ABBREVIATIONS AND ACRONYMS

BTEX	benzene, toluene, ethylbenzene, and xylenes
EC	equivalent carbon number
EPH	extractable petroleum hydrocarbons
µg/kg	micrograms per kilogram
mg/kg	milligrams per kilogram
MTBE	methyl tertiary butyl ether
NWTPH-DX	Northwest Total Petroleum Hydrocarbon as Diesel, extended range
PAHs	polycyclic aromatic hydrocarbons
TPH	total petroleum hydrocarbons
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbons
WDOE	Washington Department of Ecology

APPENDIX A

ANALYTICAL DATA

This appendix provides the laboratory analytical data from the field investigation. Section A.1 contains the laboratory data sheets for soil samples analyzed by Northwest Total Petroleum Hydrocarbons-Diesel (NWTPH-DX). Section A.2 contains the risk assessment data set, including both soil and groundwater data analyzed for benzene, toluene, ethylbenzene, xylenes (BTEX), methyl tertiary butyl ether (MTBE), polycyclic aromatic hydrocarbons (PAHs), fractions of volatile petroleum hydrocarbons (VPH), and fractions of extractable petroleum hydrocarbons (EPH). Section A.3 contains the volatile organic compound (VOC) data for soil and groundwater.

SECTION A.1

NWTPH-DX DATA

OnSite Environmental Inc.
Analytical Testing and Mobile Laboratory Services

July 15, 1998

Donna Parkes
Shannon & Wilson, Inc.
303 Wellsian Way
Richland, WA 99352

Re: Analytical Data for Project V-1075-01
Laboratory Reference No. 9807-064

Dear Donna:

Enclosed are the analytical results and associated quality control data for samples submitted on July 14, 1998.

The standard policy of OnSite Environmental Inc., is to store your samples for 30 days from the date of receipt. If you require longer storage, please contact the laboratory.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the data, or need additional information, please feel free to call me.

Sincerely,

David Baumeister
Project Chemist

Enclosures

20 1998

14924 NE 31st Circle • Redmond, WA 98052 • (425) 883-3881 • Fax (425) 885-4603

Date of Report: July 15, 1998
Samples Submitted: July 14, 1998
Lab Traveler: 07-064
Project: V-1075-01

NWTPH-Dx

Date Extracted:	7-14-98
Date Analyzed:	7-14-98
Matrix:	Soil
Units:	mg/Kg (ppm)

Client ID:	TP1-4.5	TP2-8.5	TP3-4
Lab ID:	07-064-01	07-064-02	07-064-03
Diesel Fuel:	ND	2600	38
PQL:	29	27	27
Heavy Oil:	ND	92	ND
PQL:	58	54	53
Surrogate Recovery:			
o-Terphenyl	83%	---	86%
Flags:		F,P	

Date of Report: July 15, 1998
Samples Submitted: July 14, 1998
Lab Traveler: 07-064
Project: V-1075-01

NWTPH-Dx

Date Extracted:	7-14-98
Date Analyzed:	7-14-98
Matrix:	Soil
Units:	mg/Kg (ppm)
Client ID:	TP4-7
Lab ID:	07-064-04
Diesel Fuel:	ND
PQL:	27
Heavy Oil:	ND
PQL:	54
Surrogate Recovery:	
o-Terphenyl	88%

Flags:

Date of Report: July 15, 1998
Samples Submitted: July 14, 1998
Lab Traveler: 07-064
Project: V-1075-01

NWTPH-Dx
METHOD BLANK QUALITY CONTROL

Date Extracted:	7-14-98
Date Analyzed:	7-14-98
Matrix:	Soil
Units:	mg/Kg (ppm)
Lab ID:	MB0714S1
Diesel Fuel:	ND
PQL:	25
Heavy Oil:	ND
PQL:	50
Surrogate Recovery:	
o-Terphenyl	88%

Flags:

Date of Report: July 15, 1998
Samples Submitted: July 14, 1998
Lab Traveler: 07-064
Project: V-1075-01

NWTPH-Dx
DUPLICATE QUALITY CONTROL

Date Extracted:	7-13-98
Date Analyzed:	7-13-98
Matrix:	Soil
Units:	mg/Kg (ppm)

Lab ID:	07-062-04	07-062-04 DUP
Diesel Fuel C12-C24:	ND	ND
PQL:	25	25
RPD:	N/A	
Surrogate Recovery:		
o-Terphenyl	80%	92%

Flags:

Date of Report: July 15, 1998
Samples Submitted: July 14, 1998
Lab Traveler: 07-064
Project: V-1075-01

NWTPH-Dx
SB/SBD QUALITY CONTROL

Date Extracted:	7-13-98
Date Analyzed:	7-13-98
Matrix:	Soil
Units:	mg/Kg (ppm)
Spike Level:	100 ppm

Lab ID:	SB0713S1	SB0713S1 DUP
Diesel Fuel C12-C24:	79.9	77.1
PQL:	25	25
Percent Recovery:	80	77
RPD:	3.6	
Surrogate Recovery:		
o-Terphenyl	104%	105%

Flags:

Date of Report: July 15, 1998
Samples Submitted: July 14, 1998
Lab Traveler: 07-064
Project: V-1075-01

NWTPH-Dx
DUPLICATE QUALITY CONTROL

Date Extracted: 7-14-98
Date Analyzed: 7-14-98

Matrix: Soil
Units: mg/Kg (ppm)

Lab ID:	07-064-03	07-064-03 DUP
Diesel Fuel:	35.6	43.4
PQL:	25	25
RPD:	20	
Surrogate Recovery:		
o-Terphenyl	86%	93%

Flags:

Date of Report: July 15, 1998
Samples Submitted: July 14, 1998
Lab Traveler: 07-064
Project: V-1075-01

Date Analyzed: 7-14-98

% MOISTURE

Client ID	Lab ID	% Moisture
TP1-4.5	07-064-01	14
TP2-8.5	07-064-02	8.0
TP3-4	07-064-03	6.0
TP4-7	07-064-04	8.0

OnSite Environmental Inc.

DATA QUALIFIERS AND ABBREVIATIONS

A - Due to high sample concentration, the amount spiked is insufficient for meaningful MS/MSD recovery data.

B - The analyte indicated was also found in the blank sample.

C - The duplicate RPD is outside control limits due to high result variability when analyte concentrations are within five times the quantitation limit.

D - Data from 1:____ dilution.

E - The value reported exceeds the quantitation range, and is an estimate.

F - Surrogate recovery data is not available due to the high concentration of coeluting target compounds.

G - Insufficient sample quantity for duplicate analysis.

J - The value reported was below the practical quantitation limit. The value is an estimate.

K - Sample duplicate RPD is outside control limits due to sample inhomogeniety. The sample was re-extracted and re-analyzed with similar results.

L - Quantitated from C7-C34 as diesel fuel #2.

M - Predominantly _____ range hydrocarbons present in the sample.

N - Hydrocarbons in the gasoline range (C7-toluene) are present in the sample which are elevating the diesel result.

O - Hydrocarbons in the heavy oil range (>C24) are present in the sample which are elevating the diesel result.

P - Hydrocarbons in the diesel range (C12-C24) are present in the sample which are elevating the oil result.

Q - The RPD of the results between the two columns is greater than 25.

R - Hydrocarbons outside the defined gasoline range are present in the sample and are elevating the gasoline result.

S - Surrogate recovery data is not available due to the necessary dilution of the sample.

T - The sample chromatogram is not similar to a typical _____.

U - Matrix Spike/Matrix Spike Duplicate RPD are outside control limits due to matrix effects.

V - Matrix Spike/Matrix Spike Duplicate recoveries are outside control limits due to matrix effects.

Y - Acid Cleaned.

Z - Interferences were present which prevented the quantitation of the analyte below the detection limit reported.

ND - Not Detected
MRL - Method Reporting Limit
PQL - Practical Quantitation

Chain of Custody Record

Shannon & Wilson, Inc.

400 N. 34th Street, Suite 100
Seattle, WA 98103
(206) 632-8020

11500 Olive Blvd., Suite 276
St. Louis, MO 63141
(314) 872-8170

2055 Hill Road
Fairbanks, AK 99707
(907) 479-0600

5430 Fairbanks Street, Suite 3
Anchorage, AK 99518
(907) 561-2120

303 Wellsian Way
Richland WA 99352
(509) 946-6309

Page 1 of 1
Laboratory [illegible]
Attn: D. P.

Analysis Parameters/Sample Container Description
(include preservative if used)

Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab	NWTPH-Dx					BTEX	Total Number of Containers	Remarks/Matrix
TP1-4.5	1	10:45	7/13/98			X					X		Soil
TP2-8.5	2	11:10	7/13/98			X					X		"
TP3-4	3	12:20	7/13/98			X					X		"
TP4-7	4	1:45	7/13/98			X					X		"

Project Information		Sample Receipt	
Project Number:	V-1075-01	Total Number of Containers	
Project Name:	Federal Bldg	COC Seals/Intact? Y/N/NA	
Contact:	Donna Parkes	Received Good Cond./Cold	
Ongoing Project?	Yes ☐ No ☑	Delivery Method:	UPS overnight
Sampler:	D. Parkes	(attach shipping bill, if any)	

Instructions	
Requested Turn Around Time:	Standard
Special Instructions:	

Relinquished By: 1.	Relinquished By: 2.	Relinquished By: 3.
Signature: Donna Parkes	Signature:	Signature:
Time: 3:30	Time:	Time:
Printed Name: Donna Parkes	Printed Name:	Printed Name:
Date: 7/13/98	Date:	Date:
Company: Shannon & Wilson	Company:	Company:

Received By: 1.	Received By: 2.	Received By: 3.
Signature: Kristen Koch	Signature:	Signature:
Time: 9:00	Time:	Time:
Printed Name: KRISTEN KOCH	Printed Name:	Printed Name:
Date: 7/14/98	Date:	Date:
Company: OSE	Company:	Company:

Distribution: White - w/shipment - returned to Shannon & Wilson w/ Laboratory report
Yellow - w/shipment - for consignee files
Pink - Shannon & Wilson - Job File

F-19-91/UR

No. [illegible]

SECTION A.2

RISK ASSESSMENT DATA SET

OnSite Environmental Inc.
Analytical Testing and Mobile Laboratory Services

August 6, 1998

Donna Parkes
Shannon & Wilson, Inc.
303 Wellsian Way
Richland, WA 99352

Re: Analytical Data for Project V-1075-01
Laboratory Reference No. 9807-064

Dear Donna:

Enclosed are the analytical results and associated quality control data for samples submitted on July 14, 1998.

The standard policy of OnSite Environmental Inc., is to store your samples for 30 days from the date of receipt. If you require longer storage, please contact the laboratory.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the data, or need additional information, please feel free to call me.

Sincerely,

David Baumeister
Project Chemist

Enclosures

Date of Report: August 6, 1998
Samples Submitted: July 14, 1998
Lab Traveler: 07-064
Project: V-1075-01

EXTRACTABLE PETROLEUM HYDROCARBONS

Date Extracted: 07-24-98
Date Analyzed: 07-28-98

Matrix: Soil
Units: mg/Kg (ppm)

Lab ID: 07-064-02
Client ID: TP2-8.5

		PQL
Aliphatic C10-C12:	99	5.4
Aliphatic C12-C16:	420	5.4
Aliphatic C16-C18:	200	5.4
Aliphatic C18-C21:	140	5.4
Aliphatic C21-C28:	56	5.4
Aliphatic C28-C36:	ND	5.4
Total Aliphatic:	910	
Aromatic C10-C12:	26	5.4
Aromatic C12-C16:	110	5.4
Aromatic C16-C18:	140	5.4
Aromatic C18-C21:	74	5.4
Aromatic C21-C28:	84	5.4
Aromatic C28-C36:	ND	5.4
Total Aromatic:	440	
Surrogate Recovery:		Control Limits
o-Terphenyl	---	50%-150%
Flags:	F	

Date of Report: August 6, 1998
Samples Submitted: July 14, 1998
Lab Traveler: 07-064
Project: V-1075-01

EXTRACTABLE PETROLEUM HYDROCARBONS
METHOD BLANK QUALITY CONTROL

Date Extracted: 07-24-98
Date Analyzed: 07-28-98

Matrix: Soil
Units: mg/Kg (ppm)

Lab ID: MB0724S1

		PQL
Aliphatic C10-C12:	ND	5.0
Aliphatic C12-C16:	ND	5.0
Aliphatic C16-C18:	ND	5.0
Aliphatic C18-C21:	ND	5.0
Aliphatic C21-C28:	ND	5.0
Aliphatic C28-C36:	ND	5.0
Total Aliphatic:	NA	
Aromatic C10-C12:	ND	5.0
Aromatic C12-C16:	ND	5.0
Aromatic C16-C18:	ND	5.0
Aromatic C18-C21:	ND	5.0
Aromatic C21-C28:	ND	5.0
Aromatic C28-C36:	ND	5.0
Total Aromatic:	NA	

Surrogate Recovery:		Control Limits
o-Terphenyl	116%	50%-150%

Flags:

Date of Report: August 6, 1998
Samples Submitted: July 14, 1998
Lab Traveler: 07-064
Project: V-1075-01

EXTRACTABLE PETROLEUM HYDROCARBONS
DUPLICATE QUALITY CONTROL

Date Extracted: 07-24-98
Date Analyzed: 7-28&31-98

Matrix: Soil
Units: mg/Kg (ppm)

Lab ID:	07-139-01	07-139-01 DUP		
			PQL	RPD
Aliphatic C10-C12:	ND	ND	5.0	N/A
Aliphatic C12-C16:	ND	ND	5.0	N/A
Aliphatic C16-C18:	ND	ND	5.0	N/A
Aliphatic C18-C21:	ND	ND	5.0	N/A
Aliphatic C21-C28:	ND	ND	5.0	N/A
Aliphatic C28-C36:	ND	ND	5.0	N/A
Total Aliphatic:				
Aromatic C10-C12:	ND	ND	5.0	N/A
Aromatic C12-C16:	ND	ND	5.0	N/A
Aromatic C16-C18:	ND	ND	5.0	N/A
Aromatic C18-C21:	ND	ND	5.0	N/A
Aromatic C21-C28:	ND	ND	5.0	N/A
Aromatic C28-C36:	ND	ND	5.0	N/A
Total Aromatic:				
Surrogate Recovery:				
o-Terphenyl	122%	122%		

Flags:

Date of Report: August 6, 1998
Samples Submitted: July 14, 1998
Lab Traveler: 07-064
Project: V-1075-01

EXTRACTABLE PETROLEUM HYDROCARBONS
SB/SBD QUALITY CONTROL

Date Extracted: 07-24-98
Date Analyzed: 7-28&8-3-98

Matrix: Soil
Units: mg/Kg (ppm)

Spike Level: 100 ppm

Lab ID: SB0724S1

	SB	Percent Recovery	SBD	Percent Recovery	PQL	RPD
Aliphatic C10-C12:	3.14	3.1	3.11	3.1	2.5	0.9
Aliphatic C12-C16:	11.8	12	11.8	12	2.5	N
Aliphatic C16-C18:	9.94	9.9	9.88	9.9	2.5	NA
Aliphatic C18-C21:	7.45	7.5	7.35	7.4	2.5	1.4
Aliphatic C21-C28:	ND	NA	ND	NA	2.5	NA
Aliphatic C28-C36:	ND	NA	ND	NA	2.5	NA
Total Aliphatic:		32.3		32.3		
Aromatic C10-C12:	5.34	5.3	4.97	5.0	2.5	7.3
Aromatic C12-C16:	5.41	5.4	5.84	5.8	2.5	7.6
Aromatic C16-C18:	6.9	6.9	7.94	7.9	2.5	14
Aromatic C18-C21:	4.03	4.0	4.73	4.7	2.5	16
Aromatic C21-C28:	3.18	3.2	4.01	4.0	2.5	22
Aromatic C28-C36:	ND	NA	2.73	NA	2.5	NA
Total Aromatic:		24.9		27.5		
Total Spike:		57%		60%		
Surrogate Recovery:						
o-Terphenyl		108%		113%		

Flags:

Date of Report: August 6, 1998
Samples Submitted: July 14, 1998
Lab Traveler: 07-064
Project: V-1075-01

PAH's by EPA 8270C

Date Extracted:	07-24-98
Date Analyzed:	07-29-98
Matrix:	Soil
Units:	mg/kg (ppm)
Lab ID:	07-064-2
Client ID:	TP2-8.5

Compound:	Results	Flags	PQL
Naphthalene	ND		0.036
2-Methylnaphthalene	0.79		0.036
Acenaphthylene	ND		0.036
Acenaphthene	ND		0.036
Fluorene	ND		0.036
Phenanthrene	ND		0.036
Anthracene	1.1		0.036
Fluoranthene	ND		0.036
Pyrene	0.19		0.036
Benzo[a]anthracene	ND		0.036
Chrysene	ND		0.036
Benzo[b]fluoranthene	ND		0.036
Benzo[k]fluoranthene	ND		0.036
Benzo[a]pyrene	ND		0.036
Indeno[1,2,3-cd]pyrene	ND		0.036
Dibenz[a,h]anthracene	ND		0.036
Benzo[g,h,i]perylene	ND		0.036

Surrogate :	Percent Recovery	Flags	Control Limits
Nitrobenzene-d5	129	*	23 - 120
2-Fluorobiphenyl	89		30 - 115
Terphenyl-d14	77		18 - 137

* - Surrogate recovery outside control limits.

Date of Report: August 6, 1998
Samples Submitted: July 14, 1998
Lab Traveler: 07-064
Project: V-1075-01

PAH's by EPA 8270C
METHOD BLANK QUALITY CONTROL

Date Extracted:	07-24-98
Date Analyzed:	07-29-98
Matrix:	Soil
Units:	mg/kg (ppm)
Lab ID:	MB0724S1

Compound:	Results	Flags	PQL
Naphthalene	ND		0.033
2-Methylnaphthalene	ND		0.033
Acenaphthylene	ND		0.033
Acenaphthene	ND		0.033
Fluorene	ND		0.033
Phenanthrene	ND		0.033
Anthracene	ND		0.033
Fluoranthene	ND		0.033
Pyrene	ND		0.033
Benzo[a]anthracene	ND		0.033
Chrysene	ND		0.033
Benzo[b]fluoranthene	ND		0.033
Benzo[k]fluoranthene	ND		0.033
Benzo[a]pyrene	ND		0.033
Indeno[1,2,3-cd]pyrene	ND		0.033
Dibenz[a,h]anthracene	ND		0.033
Benzo[g,h,i]perylene	ND		0.033

Surrogate :	Percent Recovery	Flags	Control Limits
Nitrobenzene-d5	57		23 - 120
2-Fluorobiphenyl	69		30 - 115
Terphenyl-d14	92		18 - 137

Date of Report: August 6, 1998
Samples Submitted: July 14, 1998
Lab Traveler: 07-064
Project: V-1075-01

PAH's by EPA 8270C
MS/MSD QUALITY CONTROL

Date Extracted: 07-20-98
Date Analyzed: 07-23-98

Matrix: Soil
Units: mg/kg(ppm)

Lab ID: 07-083-8 MSD

Compound:	Spike Amount	MS	Percent Recovery	MSD	Percent Recovery	RPD
Phenol	3.30	2.00	60	1.962	59	1.7
2-Chlorophenol	3.30	1.92	58	1.88	57	2.3
1,4-Dichlorobenzene	1.65	0.83	51	0.81	49	3.1
N-Nitroso-di-n-propylamine	1.65	1.15	70	1.12	68	3.2
1,2,4-Trichlorobenzene	1.65	1.06	64	1.05	64	0.57
4-Chloro-3-methylphenol	3.30	2.56	77	2.53	77	1.1
Acenaphthene	1.65	1.33	79	1.46	87	9.4
2,4-Dinitrotoluene	1.65	1.27	77	1.25	75	1.6
4-Nitrophenol	3.30	2.27	69	2.32	70	1.8
Pentachlorophenol	3.30	4.22	71	4.72	86	19
Pyrene	1.65	1.71	89	1.83	96	7.4

OnSite Environmental Inc.

DATA QUALIFIERS AND ABBREVIATIONS

A - Due to high sample concentration, the amount spiked is insufficient for meaningful MS/MSD recovery data.

B - The analyte indicated was also found in the blank sample.

C - The duplicate RPD is outside control limits due to high result variability when analyte concentrations are within five times the quantitation limit.

D - Data from 1:____ dilution.

E - The value reported exceeds the quantitation range, and is an estimate.

F - Surrogate recovery data is not available due to the high concentration of coeluting target compounds.

G - Insufficient sample quantity for duplicate analysis.

J - The value reported was below the practical quantitation limit. The value is an estimate.

K - Sample duplicate RPD is outside control limits due to sample inhomogeniety. The sample was re-extracted and re-analyzed with similar results.

L - Quantitated from C7-C34 as diesel fuel #2.

M - Predominantly _____ range hydrocarbons present in the sample.

N - Hydrocarbons in the gasoline range (C7-toluene) are present in the sample which are elevating the diesel result.

O - Hydrocarbons in the heavy oil range (>C24) are present in the sample which are elevating the diesel result.

P - Hydrocarbons in the diesel range (C12-C24) are present in the sample which are elevating the oil result.

Q - The RPD of the results between the two columns is greater than 25.

R - Hydrocarbons outside the defined gasoline range are present in the sample; NWTPH-Dx recommended.

S - Surrogate recovery data is not available due to the necessary dilution of the sample.

T - The sample chromatogram is not similar to a typical _____.

U - Matrix Spike/Matrix Spike Duplicate RPD are outside control limits due to matrix effects.

V - Matrix Spike/Matrix Spike Duplicate recoveries are outside control limits due to matrix effects.

Y - Acid Cleaned.

Z - Interferences were present which prevented the quantitation of the analyte below the detection limit reported.

ND - Not Detected
MRL - Method Reporting Limit
PQL - Practical Quantitation

Shannon & Wilson, Inc.

Chain of Custody Record

07-064

Page 1 of 1
Laboratory On Site
Attn: D. B.

400 N. 34th Street, Suite 100
Seattle, WA 98103
(206) 632-8020

11500 Olive Blvd., Suite 276
St. Louis, MO 63141
(314) 872-8170

303 Wellsian Way
Richland WA 99352
(509) 946-6309

2055 Hill Road
Fairbanks, AK 99707
(907) 479-0600

5430 Fairbanks Street, Suite 3
Anchorage, AK 99518
(907) 561-2120

Analysis Parameters/Sample Container Description
(include preservative if used)

Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab	NWTPH-Dx	EPH	PAH's	Dry Weight	Total Number of Containers	Remarks/Matrix
TP1-4.5	1	10:45	7/13/98			X			X		Soil
TP2-8.5	2	11:10	7/13/98			X	(X)	(X)	X		↓
TP3-4	3	12:20	7/13/98			X			X		
TP4-7	4	1:45	7/13/98			X			X		

Project Information		Sample Receipt	
Project Number:	V-1075-01	Total Number of Containers	
Project Name:	Federal Bldg	COC Seals/Intact? Y/N/NA	
Contact:	Donna Parkes	Received Good Cond./Cold	
Ongoing Project?	Yes ☐ No ☒	Delivery Method:	UPS overnight
Sampler:	D. Parkes	(attach shipping bill, if any)	

Instructions	
Requested Turn Around Time:	Standard
Special Instructions:	(X) Added by Donna Parkes 7/23/98

Relinquished By: 1.	Relinquished By: 2.	Relinquished By: 3.
Signature: Donna Parkes	Signature:	Signature:
Time: 3:30	Time:	Time:
Printed Name: Donna Parkes	Printed Name:	Printed Name:
Date: 7/13/98	Date:	Date:
Company: Shannon + Wilson	Company:	Company:

Received By: 1.	Received By: 2.	Received By: 3.
Signature: Kristen Koch	Signature:	Signature:
Time: 9:00	Time:	Time:
Printed Name: KRISTEN KOCH	Printed Name:	Printed Name:
Date: 7/14/98	Date:	Date:
Company: OSE	Company:	Company:

Distribution: White - w/shipment - returned to Shannon & Wilson w/ Laboratory report
Yellow - w/shipment - for consignee files
Pink - Shannon & Wilson - Job File

F-19-91/UR

No. 11712

OnSite
Environmental Inc.
Analytical Testing and Mobile Laboratory Services

September 22, 1998

Donna Parkes
Shannon & Wilson, Inc.
400 N 34th Street, Suite 100
Seattle, WA 98103

Re: Analytical Data for Project V-1075-02
Laboratory Reference No. 9809-056

Dear Donna:

Enclosed are the analytical results and associated quality control data for samples submitted on September 11, 1998.

The standard policy of OnSite Environmental Inc., is to store your samples for 30 days from the date of receipt. If you require longer storage, please contact the laboratory.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the data, or need additional information, please feel free to call me.

Sincerely,

David Baumeister for
Project Chemist

Enclosures

14924 NE 31st Circle • Redmond, WA 98052 • (425) 883-3881 • Fax (425) 885-4603

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

PAH's by EPA 8270C

Date Extracted:	9-11-98
Date Analyzed:	9-14-98
Matrix:	Soil
Units:	mg/kg (ppm)
Lab ID:	09-056-01
Client ID:	RFB-01-SL

Compound:	Results	Flags	PQL
Naphthalene	ND		0.072
2-Methylnaphthalene	1.0		0.072
Acenaphthylene	ND		0.072
Acenaphthene	ND		0.072
Fluorene	ND		0.072
Phenanthrene	ND		0.072
Anthracene	1.9		0.072
Fluoranthene	0.1		0.072
Pyrene	0.4		0.072
Benzo[a]anthracene	ND		0.072
Chrysene	ND		0.072
Benzo[b]fluoranthene	ND		0.072
Benzo[k]fluoranthene	ND		0.072
Benzo[a]pyrene	ND		0.072
Indeno[1,2,3-cd]pyrene	ND		0.072
Dibenz[a,h]anthracene	ND		0.072
Benzo[g,h,i]perylene	ND		0.072

Surrogate :	Percent Recovery	Flags	Control Limits
Nitrobenzene-d5	98		23 - 120
2-Fluorobiphenyl	138	*	30 - 115
Terphenyl-d14	99		18 - 137

* Outside control limit

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

PAH's by EPA 8270C

Date Extracted:	9-11-98
Date Analyzed:	9-14-98
Matrix:	Soil
Units:	mg/kg (ppm)
Lab ID:	09-056-02
Client ID:	RFB-02-SL

Compound:	Results	Flags	PQL
Naphthalene	ND		0.036
2-Methylnaphthalene	0.15		0.036
Acenaphthylene	ND		0.036
Acenaphthene	ND		0.036
Fluorene	ND		0.036
Phenanthrene	ND		0.036
Anthracene	1.6		0.036
Fluoranthene	0.064		0.036
Pyrene	0.24		0.036
Benzo[a]anthracene	ND		0.036
Chrysene	ND		0.036
Benzo[b]fluoranthene	ND		0.036
Benzo[k]fluoranthene	ND		0.036
Benzo[a]pyrene	ND		0.036
Indeno[1,2,3-cd]pyrene	ND		0.036
Dibenz[a,h]anthracene	ND		0.036
Benzo[g,h,i]perylene	ND		0.036

Surrogate :	Percent Recovery	Flags	Control Limits
Nitrobenzene-d5	92		23 - 120
2-Fluorobiphenyl	145	*	30 - 115
Terphenyl-d14	91		18 - 137

* Outside control limit

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

PAH's by EPA 8270C

Date Extracted:	9-11-98
Date Analyzed:	9-14-98
Matrix:	Soil
Units:	mg/kg (ppm)
Lab ID:	09-056-03
Client ID:	RFB-03-SL

Compound:	Results	Flags	PQL
Naphthalene	ND		0.035
2-Methylnaphthalene	0.062		0.035
Acenaphthylene	ND		0.035
Acenaphthene	ND		0.035
Fluorene	ND		0.035
Phenanthrene	ND		0.035
Anthracene	0.18		0.035
Fluoranthene	ND		0.035
Pyrene	0.056		0.035
Benzo[a]anthracene	ND		0.035
Chrysene	ND		0.035
Benzo[b]fluoranthene	ND		0.035
Benzo[k]fluoranthene	ND		0.035
Benzo[a]pyrene	ND		0.035
Indeno[1,2,3-cd]pyrene	ND		0.035
Dibenz[a,h]anthracene	ND		0.035
Benzo[g,h,i]perylene	ND		0.035

Surrogate :	Percent Recovery	Flags	Control Limits
Nitrobenzene-d5	61		23 - 120
2-Fluorobiphenyl	81		30 - 115
Terphenyl-d14	98		18 - 137

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

PAH's by EPA 8270C
METHOD BLANK QUALITY CONTROL

Date Extracted:	9-11-98
Date Analyzed:	9-14-98
Matrix:	Soil
Units:	mg/kg (ppm)
Lab ID:	MB0911S1

Compound:	Results	Flags	PQL
Naphthalene	ND		0.033
2-Methylnaphthalene	ND		0.033
Acenaphthylene	ND		0.033
Acenaphthene	ND		0.033
Fluorene	ND		0.033
Phenanthrene	ND		0.033
Anthracene	ND		0.033
Fluoranthene	ND		0.033
Pyrene	ND		0.033
Benzo[a]anthracene	ND		0.033
Chrysene	ND		0.033
Benzo[b]fluoranthene	ND		0.033
Benzo[k]fluoranthene	ND		0.033
Benzo[a]pyrene	ND		0.033
Indeno[1,2,3-cd]pyrene	ND		0.033
Dibenz[a,h]anthracene	ND		0.033
Benzo[g,h,i]perylene	ND		0.033

Surrogate :	Percent Recovery	Flags	Control Limits
Nitrobenzene-d5	56		23 - 120
2-Fluorobiphenyl	70		30 - 115
Terphenyl-d14	97		18 - 137

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

PAH's by EPA 8270C
MS/MSD QUALITY CONTROL

Date Extracted: 9-04-98
Date Analyzed: 9-09-98

Matrix: Soil
Units: mg/Kg (ppm)

Lab ID: 02101SMSD

Compound:	Spike Amount	MS	Percent Recovery	MSD	Percent Recovery	RPD
Phenol	3.30	2.74	83	3.19	97	15
2-Chlorophenol	3.30	2.64	80	3.03	92	14
1,4-Dichlorobenzene	1.65	1.22	74	1.41	85	14
N-Nitroso-di-n-propylamine	1.65	1.53	93	1.70	103	10
1,2,4-Trichlorobenzene	1.65	1.53	93	1.65	100	7.4
4-Chloro-3-methylphenol	3.30	3.58	108	3.79	115	5.8
Acenaphthene	1.65	2.00	102	2.17	113	9.6
2,4-Dinitrotoluene	1.65	1.48	89	1.63	99	10
4-Nitrophenol	3.30	3.04	92	3.38	102	10
Pentachlorophenol	3.30	2.84	86	3.31	100	15
Pyrene	1.65	3.43	92	3.81	115	22

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

PAH's by SIM

Date Extracted:	9-17-98
Date Analyzed:	9-21-98
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	09-056-04
Client ID:	**RFB-06-GW**

Compound:	**Results**	**Flags**	**PQL**
Naphthalene	0.19		0.050
2-Methylnaphthalene	1.4		0.050
Acenaphthylene	0.11		0.050
Acenathphene	0.41		0.050
Fluorene	1		0.050
Phenanthrene	3.4		0.050
Anthracene	ND		0.050
Fluoranthene	ND		0.050
Pyrene	0.13		0.050
Benzo[a]anthracene	ND		0.050
Chrysene	0.092		0.050
Benzo[b]fluoranthene	ND		0.050
Benzo[k]fluoranthene	ND		0.050
Benzo[a]pyrene	ND		0.050
Indeno[1,2,3-cd]pyrene	ND		0.050
Dibenz[a,h]anthracene	ND		0.050
Benzo[g,h,i]perylene	ND		0.050

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

PAH's by SIM
METHOD BLANK QUALITY CONTROL

Date Extracted:	9-17-98
Date Analyzed:	9-21-98
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	MB0917W1

Compound:	Results	Flags	PQL
Naphthalene	ND		0.050
2-Methylnaphthalene	ND		0.050
Acenaphthylene	ND		0.050
Acenathphene	ND		0.050
Fluorene	ND		0.050
Pentachloropehenol	ND		0.050
Phenanthrene	ND		0.050
Anthracene	ND		0.050
Fluoranthene	ND		0.050
Benzo[a]anthracene	ND		0.050
Chrysene	ND		0.050
Benzo[b]fluoranthene	ND		0.050
Benzo[k]fluoranthene	ND		0.050
Benzo[a]pyrene	ND		0.050
Indeno[1,2,3-cd]pyrene	ND		0.050
Dibenz[a,h]anthracene	ND		0.050
Benzo[g,h,i]perylene	ND		0.050

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

PAH's by EPA 8270

Date Extracted:	9-17-98
Date Analyzed:	9-18-98
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	09-056-04
Client ID:	**RFB-06-GW**

Compound:	Results	Flags	PQL
Naphthalene	ND		1.0
2-Methylnaphthalene	1.6		1.0
Acenaphthylene	ND		1.0
Acenaphthene	ND		1.0
Fluorene	ND		1.0
Phenanthrene	2.5		1.0
Anthracene	ND		1.0
Fluoranthene	ND		1.0
Pyrene	ND		1.0
Benzo[a]anthracene	ND		1.0
Chrysene	ND		1.0
Benzo[b]fluoranthene	ND		1.0
Benzo[k]fluoranthene	ND		1.0
Benzo[a]pyrene	ND		1.0
Indeno[1,2,3-cd]pyrene	ND		1.0
Dibenz[a,h]anthracene	ND		1.0
Benzo[g,h,i]perylene	ND		1.0

Surrogate	Percent Recovery	Control Limits
Nitrobenzene-d5	66	35 - 114
2-Fluorobiphenyl	74	43 - 116
Terphenyl-d14	78	33 - 144

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

PAH's by EPA 8270
METHOD BLANK QUALITY CONTROL

Date Extracted:	9-17-98
Date Analyzed:	9-18-98
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	MB0917W1

Compound:	Results	Flags	PQL
Naphthalene	ND		1.0
2-Methylnaphthalene	ND		1.0
Acenaphthylene	ND		1.0
Acenaphthene	ND		1.0
Fluorene	ND		1.0
Phenanthrene	ND		1.0
Anthracene	ND		1.0
Fluoranthene	ND		1.0
Pyrene	ND		1.0
Benzo[a]anthracene	ND		1.0
Chrysene	ND		1.0
Benzo[b]fluoranthene	ND		1.0
Benzo[k]fluoranthene	ND		1.0
Benzo[a]pyrene	ND		1.0
Indeno[1,2,3-cd]pyrene	ND		1.0
Dibenz[a,h]anthracene	ND		1.0
Benzo[g,h,i]perylene	ND		1.0

Surrogate	Percent Recovery	Control Limits
Nitrobenzene-d5	74	35 - 114
2-Fluorobiphenyl	86	43 - 116
Terphenyl-d14	84	33 - 144

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

PAH's by EPA 8270
SB/SBD QUALITY CONTROL

Date Extracted: 9-17-98
Date Analyzed: 9-17-98

Matrix: Water
Units: ug/L (ppb)

Lab ID: SB0915W1

Compound:	Spike Amount	SB	Percent Recovery	SBD	Percent Recovery		RPD
Phenol	100	25.0	25	28.1	28		12
2-Chlorophenol	100	71.9	72	78.4	78		8.6
1,4-Dichlorobenzene	50	35.7	71	41.3	83		15
N-Nitroso-di-n-propylamine	50	37.2	74	41.8	84		12
1,2,4-Trichlorobenzene	50	37.0	74	43.9	88		17
4-Chloro-3-methylphenol	100	83.9	84	101	101		18
Acenaphthene	50	43.5	87	50.2	100		14
2,4-Dinitrotoluene	50	49.2	98	57.7	115	**	16
4-Nitrophenol	100	32.0	32	38.6	39		19
Pentachlorophenol	100	89.6	90	102	102		13
Pyrene	50	53.6	107	61.0	122		13

** Compound recovery outside control limits.

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

EXTRACTABLE PETROLEUM HYDROCARBONS

Date Extracted: 9-15-98
Date Analyzed: 9-17&18-98

Matrix: Soil
Units: mg/Kg (ppm)

Lab ID: 09-056-01
Client ID: RFB-01-SL

		PQL
Aliphatic C10-C12:	230	5.4
Aliphatic C12-C16:	700	5.4
Aliphatic C16-C18:	290	5.4
Aliphatic C18-C21:	250	5.4
Aliphatic C21-C28:	98	5.4
Aliphatic C28-C36:	ND	10
Total Aliphatic:	1600	
Aromatic C10-C12:	92	5.4
Aromatic C12-C16:	460	5.4
Aromatic C16-C18:	330	5.4
Aromatic C18-C21:	320	5.4
Aromatic C21-C28:	75	5.4
Aromatic C28-C36:	ND	5.4
Total Aromatic:	1300	

Surrogate Recovery:		Control Limits
o-Terphenyl	118%	50%-150%

Flags:

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

EXTRACTABLE PETROLEUM HYDROCARBONS

Date Extracted: 9-15-98
Date Analyzed: 9-17&18-98

Matrix: Soil
Units: mg/Kg (ppm)

Lab ID: 09-056-02
Client ID: RFB-02-SL

		PQL
Aliphatic C10-C12:	230	5.2
Aliphatic C12-C16:	660	5.2
Aliphatic C16-C18:	270	5.2
Aliphatic C18-C21:	200	5.2
Aliphatic C21-C28:	90	5.2
Aliphatic C28-C36:	ND	10
Total Aliphatic:	1400	
Aromatic C10-C12:	140	5.2
Aromatic C12-C16:	650	5.2
Aromatic C16-C18:	430	5.2
Aromatic C18-C21:	410	5.2
Aromatic C21-C28:	96	5.2
Aromatic C28-C36:	7.8	5.2
Total Aromatic:	1700	
Surrogate Recovery:		Control Limits
o-Terphenyl	168%	50%-150%
Flags:	F	

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

EXTRACTABLE PETROLEUM HYDROCARBONS

Date Extracted: 9-15-98
Date Analyzed: 9-23-98

Matrix: Soil
Units: mg/Kg (ppm)

Lab ID: 09-056-03
Client ID: RFB-03-SL

		PQL
Aliphatic C10-C12:	7.3	5.2
Aliphatic C12-C16:	85	5.2
Aliphatic C16-C18:	47	5.2
Aliphatic C18-C21:	35	5.2
Aliphatic C21-C28:	17	5.2
Aliphatic C28-C36:	ND	10
Total Aliphatic:	190	
Aromatic C10-C12:	ND	5.2
Aromatic C12-C16:	44	5.2
Aromatic C16-C18:	41	5.2
Aromatic C18-C21:	40	5.2
Aromatic C21-C28:	16	5.2
Aromatic C28-C36:	8.5	5.2
Total Aromatic:	150	

Surrogate Recovery:		Control Limits
o-Terphenyl	113%	50%-150%

Flags:

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

EXTRACTABLE PETROLEUM HYDROCARBONS
METHOD BLANK QUALITY CONTROL

Date Extracted: 9-15-98
Date Analyzed: 9-18-98

Matrix: Soil
Units: mg/Kg (ppm)

Lab ID: MB0915S1

		PQL
Aliphatic C10-C12:	ND	5.0
Aliphatic C12-C16:	ND	5.0
Aliphatic C16-C18:	ND	5.0
Aliphatic C18-C21:	ND	5.0
Aliphatic C21-C28:	ND	5.0
Aliphatic C28-C36:	ND	10
Total Aliphatic:	NA	
Aromatic C10-C12:	ND	5.0
Aromatic C12-C16:	ND	5.0
Aromatic C16-C18:	ND	5.0
Aromatic C18-C21:	ND	5.0
Aromatic C21-C28:	ND	5.0
Aromatic C28-C36:	ND	5.0
Total Aromatic:	NA	

Surrogate Recovery:		Control Limits
o-Terphenyl	107%	50%-150%

Flags:

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

EXTRACTABLE PETROLEUM HYDROCARBONS
DUPLICATE QUALITY CONTROL

Date Extracted: 9-15-98
Date Analyzed: 9-22&23-98

Matrix: Soil
Units: mg/Kg (ppm)

Lab ID:	09-056-03	09-056-03 DUP		
			PQL	RPD
Aliphatic C10-C12:	7.3	7.4	5.0	1.4
Aliphatic C12-C16:	85	90	5.0	5.7
Aliphatic C16-C18:	47	51	5.0	8.2
Aliphatic C18-C21:	35	44	5.0	23
Aliphatic C21-C28:	17	20	5.0	16
Aliphatic C28-C36:	ND	8.7	5.0	N/A
Aromatic C10-C12:	ND	ND	5.0	N/A
Aromatic C12-C16:	44	42	5.0	4.7
Aromatic C16-C18:	41	39	5.0	5.0
Aromatic C18-C21:	40	37	5.0	7.8
Aromatic C21-C28:	16	14	5.0	13
Aromatic C28-C36:	8.5	11	5.0	26
Surrogate Recovery:		Control Limits		
o-Terphenyl	113%	113%		

Flags:

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

EXTRACTABLE PETROLEUM HYDROCARBONS
SB/SBD QUALITY CONTROL

Date Extracted: 9-15-98
Date Analyzed: 9-22-98

Matrix: Soil
Units: mg/Kg (ppm)

Spike level: 100 ppm

Lab ID:	SB0915S1		SB0915S1 DUP			
		Percent Recovery		Percent Recovery	PQL	RPD
Aliphatic C10-C12:	ND	N/A	ND	N/A	5.0	N/A
Aliphatic C12-C16:	17.8	18	17.9	18	5.0	0.56
Aliphatic C16-C18:	11.9	12	11.8	12	5.0	0.84
Aliphatic C18-C21:	11.5	12	11.4	11	5.0	0.87
Aliphatic C21-C28:	5.88	6	5.56	6	5.0	5.5
Aliphatic C28-C36:	6.96	7	6.47	6	5.0	7.2
Total Aliphatic:	54.0		53.1			
Aromatic C10-C12:	ND	N/A	ND	N/A	5.0	N/A
Aromatic C12-C16:	10.0	10	9.92	10	5.0	0.80
Aromatic C16-C18:	8.96	9	8.72	9	5.0	2.7
Aromatic C18-C21:	9.73	10	9.50	10	5.0	2.4
Aromatic C21-C28:	ND	N/A	ND	N/A	5.0	N/A
Aromatic C28-C36:	9.59	10	7.50	8	5.0	24
Total Aromatic:	38.3		35.6			
Surrogate Recovery:				Control Limits		
o-Terphenyl	74%		74%	50%-150%		

Flags:

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

EXTRACTABLE PETROLEUM HYDROCARBONS

Date Extracted: 9-17-98
Date Analyzed: 9-18-98

Matrix: Water
Units: mg/L (ppm)

Lab ID: 09-056-04
Client ID: RFB-06-GW

		PQL
Aliphatic C10-C12:	0.31	0.05
Aliphatic C12-C16:	1.2	0.05
Aliphatic C16-C18:	0.52	0.05
Aliphatic C18-C21:	0.40	0.05
Aliphatic C21-C28:	0.22	0.05
Aliphatic C28-C36:	ND	0.20
Total Aliphatic:	2.9	
Aromatic C10-C12:	0.14	0.05
Aromatic C12-C16:	0.64	0.05
Aromatic C16-C18:	0.43	0.05
Aromatic C18-C21:	0.36	0.05
Aromatic C21-C28:	0.09	0.05
Aromatic C28-C36:	ND	0.15
Total Aromatic:	1.7	

Surrogate Recovery:		Control Limits
o-Terphenyl	72%	50%-150%

Flags:

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

EXTRACTABLE PETROLEUM HYDROCARBONS
METHOD BLANK QUALITY CONTROL

Date Extracted: 9-17-98
Date Analyzed: 9-18-98

Matrix: Water
Units: mg/L (ppm)

Lab ID: MB0917W2

		PQL
Aliphatic C10-C12:	ND	0.05
Aliphatic C12-C16:	ND	0.05
Aliphatic C16-C18:	ND	0.05
Aliphatic C18-C21:	ND	0.05
Aliphatic C21-C28:	ND	0.05
Aliphatic C28-C36:	ND	0.05
Total Aliphatic:	NA	0.20
Aromatic C10-C12:	ND	0.05
Aromatic C12-C16:	ND	0.05
Aromatic C16-C18:	ND	0.05
Aromatic C18-C21:	ND	0.05
Aromatic C21-C28:	ND	0.05
Aromatic C28-C36:	ND	0.05
Total Aromatic:	NA	0.15
Surrogate Recovery:		Control Limits
o-Terphenyl	86%	50%-150%
Flags:	G	

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

EXTRACTABLE PETROLEUM HYDROCARBONS
SB/SBD QUALITY CONTROL

Date Extracted: 9-17-98
Date Analyzed: 9-18-98

Matrix: Water
Units: mg/L (ppm)

Spike Level: 1.00 ppm

Lab ID: SB0917W1 SB0917W2 DUP

	SB	Percent Recovery	SBD	Percent Recovery	PQL	RPD
Aliphatic C10-C12:	ND	N/A	ND	N/A	0.05	N/A
Aliphatic C12-C16:	0.169	17	0.156	16	0.05	7.9
Aliphatic C16-C18:	0.120	12	0.105	10	0.05	13
Aliphatic C18-C21:	0.114	11	0.104	10	0.05	9.0
Aliphatic C21-C28:	0.0782	8	0.0829	8.0	0.05	9.0
Aliphatic C28-C36:	0.177	18	0.175	18	0.05	1.1
Total Aliphatic:	0.658		0.623			
Aromatic C10-C12:	ND	N/A	ND	N/A	0.05	N/A
Aromatic C12-C16:	0.121	12	0.120	12	0.05	0.83
Aromatic C16-C18:	0.113	11	0.109	11	0.05	3.6
	0.108	11	0.105	10	0.05	2.8
Aromatic C21-C28:	ND	N/A	ND	5.0	0.05	N/A
Aromatic C28-C36:	0.0538	5	ND	N/A	0.05	N/A
Total Aromatic:	0.396		0.334			
Surrogate Recovery:						
o-Terphenyl	87%		70%			

Flags:

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

VOLATILE PETROLEUM HYDROCARBONS

Date Extracted:	9-16-98
Date Analyzed:	9-16-98
Matrix:	Soil
Units:	mg/Kg (ppm)
Lab ID:	09-056-1
Client ID:	RFB-01-SL

VPH:	Results	PQL
Aliphatic C5-C6	ND	5.0
Aliphatic C6-C8	ND	5.0
Aliphatic C8-C10	ND	5.0
Aliphatic C10-C12	250	5.0
Total Aliphatic:	250	
Aromatic C8-C10	36	5.0
Aromatic C10-C12	190	5.0
Aromatic C12-C13	210	5.0
Total Aromatic:	440	
Target Analytes:		
Methyl t-butylether	ND	0.50
Benzene	ND	0.50
Toluene	ND	0.50
Ethylbenzene	ND	0.50
m , p - Xylene	ND	0.50
o -Xylene	ND	0.50

Surrogate:	Percent Recovery	Control Limits
Fluorobenzene	---	70%-130%

Flags: S

	Result
VPH	690

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

VOLATILE PETROLEUM HYDROCARBONS
METHOD BLANK QUALITY CONTROL

Date Extracted:	9-16-98
Date Analyzed:	9-16-98
Matrix:	Soil
Units:	mg/Kg (ppm)
Lab ID:	MB0916S1

VPH:	Results	PQL
Aliphatic C5-C6	ND	5.0
Aliphatic C6-C8	ND	5.0
Aliphatic C8-C10	ND	5.0
Aliphatic C10-C12	ND	5.0
Total Aliphatic:	NA	
Aromatic C8-C10	ND	5.0
Aromatic C10-C12	ND	5.0
Aromatic C12-C13	ND	5.0
Total Aromatic:	NA	
Target Analytes:		
Methyl t-butylether	ND	0.50
Benzene	ND	0.50
Toluene	ND	0.50
Ethylbenzene	ND	0.50
m , p - Xylene	ND	0.50
o -Xylene	ND	0.50

Surrogate:	Percent Recovery	Control Limits
Fluorobenzene	120	70%-130%

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

VOLATILE PETROLEUM HYDROCARBONS
DUPLICATE QUALITY CONTROL

Date Extracted:	9-16-98
Date Analyzed:	9-17-98
Matrix:	Soil
Units:	mg/Kg (ppm)

Lab ID:	09-080-03	Duplicate		
VPH:	Results	Results	PQL	RPD
Aliphatic C5-C6	ND	ND	5.0	NA
Aliphatic C6-C8	ND	ND	5.0	NA
Aliphatic C8-C10	ND	ND	5.0	NA
Aliphatic C10-C12	ND	ND	5.0	NA
Aromatic C8-C10	ND	ND	5.0	NA
Aromatic C10-C12	ND	ND	5.0	NA
Aromatic C12-C13	ND	ND	5.0	NA
Target Analytes:				
Methyl t-butylether	ND	ND	0.50	NA
Benzene	ND	ND	0.50	NA
Toluene	ND	ND	0.50	NA
Ethylbenzene	ND	ND	0.50	NA
m , p - Xylene	ND	ND	0.50	NA
o -Xylene	ND	ND	0.50	NA
Surrogate:	Percent Recovery	Percent Recovery	Control Limits	
Fluorobenzene	110	110	70%-130%	

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

VOLATILE PETROLEUM HYDROCARBONS
MS/MSD QUALITY CONTROL

Date Extracted: 9-16-98
Date Analyzed: 9-16-98

Matrix: Soil
Units: mg/Kg (ppm)
Spike Level: 1.00 ppm

Lab ID: SB0916S1

	SB	Percent Recovery	SBD	Percent Recovery	PQL	RPD
Benzene:	0.933	93	0.935	94	0.50	0.22
Toluene:	0.977	98	0.998	100	0.50	2.2
Ethylbenzene:	1.01	101	1.02	102	0.50	1.0
m , p - Xylene:	1.01	101	1.03	103	0.50	2.0
o -Xylene:	0.979	98	0.986	99	0.50	0.80
Surrogate:					Control Limits	
Fluorobenzene		96		96	70%-130%	

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

VOLATILE PETROLEUM HYDROCARBONS

Date Extracted:	9-16-98
Date Analyzed:	9-16-98
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	09-056-04
Client ID:	RFB-06-GW

VPH:	Results	PQL
Aliphatic C5-C6	ND	50
Aliphatic C6-C8	ND	50
Aliphatic C8-C10	ND	50
Aliphatic C10-C12	88	50
Total Aliphatic:	88	
Aromatic C8-C10	ND	50
Aromatic C10-C12	81	50
Aromatic C12-C13	130	50
Total Aromatic:	210	
Target Analytes:		
Methyl t-butylether	ND	5.0
Benzene	ND	5.0
Toluene	ND	5.0
Ethylbenzene	ND	5.0
m , p - Xylene	ND	5.0
o -Xylene	ND	5.0

Surrogate:	Percent Recovery	Control Limits
Fluorobenzene	79	70%-130%

Flags:

	Result
VPH	298

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

VOLATILE PETROLEUM HYDROCARBONS
METHOD BLANK QUALITY CONTROL

Date Extracted:	9-16-98
Date Analyzed:	9-16-98
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	MB0916W1

VPH:	Results	PQL
Aliphatic C5-C6	ND	50
Aliphatic C6-C8	ND	50
Aliphatic C8-C10	ND	50
Aliphatic C10-C12	ND	50
Total Aliphatic:	NA	
Aromatic C8-C10	ND	50
Aromatic C10-C12	ND	50
Aromatic C12-C13	ND	50
Total Aromatic:	NA	
Target Analytes:		
Methyl t-butylether	ND	5.0
Benzene	ND	5.0
Toluene	ND	5.0
Ethylbenzene	ND	5.0
m , p - Xylene	ND	5.0
o -Xylene	ND	5.0

Surrogate:	Percent Recovery	Control Limits
Fluorobenzene	79	70%-130%

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

VOLATILE PETROLEUM HYDROCARBONS
DUPLICATE QUALITY CONTROL

Date Extracted:	9-16-98
Date Analyzed:	9-16-98
Matrix:	Water
Units:	ug/L (ppb)

Lab ID:	09-056-04	Duplicate		
VPH:	Results	Results	PQL	RPD
Aliphatic C5-C6	ND	ND	50	NA
Aliphatic C6-C8	ND	ND	50	NA
Aliphatic C8-C10	ND	ND	50	NA
Aliphatic C10-C12	ND	ND	50	NA
Aromatic C8-C10	ND	ND	50	NA
Aromatic C10-C12	80.8	75.8	50	6.4
Aromatic C12-C13	130	128	50	1.6
Target Analytes:				
Methyl t-butylether	ND	ND	5.0	NA
Benzene	ND	ND	5.0	NA
Toluene	ND	ND	5.0	NA
Ethylbenzene	ND	ND	5.0	NA
m , p - Xylene	ND	ND	5.0	NA
o -Xylene	ND	ND	5.0	NA
Surrogate:	Percent Recovery	Percent Recovery	Control Limits	
Fluorobenzene	79	83	70%-130%	

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

VOLATILE PETROLEUM HYDROCARBONS
SB/SBD QUALITY CONTROL

Date Extracted: 9-16-98
Date Analyzed: 9-16-98

Matrix: Water
Units: ug/L (ppb)
Spiking Level: 50.0 ppb

Lab ID: SB0916W1

	SB	Percent Recovery	SBD	Percent Recovery	PQL	RPD
Benzene:	49.8	100	51.0	102	5.0	2.4
Toluene:	51.6	103	52.9	106	5.0	2.4
Ethylbenzene:	53.3	107	54.8	110	5.0	2.8
m,p 0- Xylene:	52.7	105	54.2	108	5.0	2.8
o -Xylene:	51.1	102	52.5	105	5.0	2.8
Surrogate:					Control Limits	
Fluorobenzene		80		83	70%-130%	

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

NWTPH-Dx

Date Extracted:	9-15-98
Date Analyzed:	9-15-98
Matrix:	Soil
Units:	mg/Kg (ppm)
Client ID:	RFB-03-SL
Lab ID:	09-056-03
Diesel Fuel:	300
PQL:	26
Heavy Oil:	ND
PQL:	52
Surrogate Recovery:	
o-Terphenyl	113%

Flags:

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

NWTPH-Dx
METHOD BLANK QUALITY CONTROL

Date Extracted:	9-15-98
Date Analyzed:	9-15-98
Matrix:	Soil
Units:	mg/Kg (ppm)
Lab ID:	MB0915S1
Diesel Fuel:	ND
PQL:	25
Heavy Oil:	ND
PQL:	50
Surrogate Recovery:	
o-Terphenyl	90%

Flags:

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

NWTPH-Dx
DUPLICATE QUALITY CONTROL

Date Extracted:	9-15-98
Date Analyzed:	9-15-98
Matrix:	Soil
Units:	mg/Kg (ppm)

Lab ID:	09-056-03	09-056-03 DUP
Diesel Fuel:	287	254
PQL:	25	25
RPD:	12	
Surrogate Recovery:		
o-Terphenyl	113%	108%

Flags:

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

NWTPH-Dx
SB/SBD QUALITY CONTROL

Date Extracted:	9-15-98
Date Analyzed:	9-15&16-98
Matrix:	Soil
Units:	mg/Kg (ppm)
Spike Level:	100 ppm

Lab ID:	SB0915S1	SB0915S1 DUP
Diesel Fuel:	108	112
PQL:	25	25
Percent Recovery:	108	112
RPD:	3.6	
Surrogate Recovery:		
o-Terphenyl	106%	112%

Flags:

Date of Report: September 22, 1998
Samples Submitted: September 11, 1998
Lab Traveler: 09-056
Project: V-1075-02

Date Analyzed: 9-11-98

% MOISTURE

Client ID	Lab ID	% Moisture
RFB-01-SL	09-056-01	8.0
RFB-02-SL	09-056-02	4.0
RFB-03-SL	09-056-03	4.0

OnSite Environmental Inc.

DATA QUALIFIERS AND ABBREVIATIONS

A - Due to high sample concentration, the amount spiked is insufficient for meaningful MS/MSD recovery data.

B - The analyte indicated was also found in the blank sample.

C - The duplicate RPD is outside control limits due to high result variability when analyte concentrations are within five times the quantitation limit.

D - Data from 1:____ dilution.

E - The value reported exceeds the quantitation range, and is an estimate.

F - Surrogate recovery data is not available due to the high concentration of coeluting target compounds.

G - Insufficient sample quantity for duplicate analysis.

J - The value reported was below the practical quantitation limit. The value is an estimate.

K - Sample duplicate RPD is outside control limits due to sample inhomogeniety. The sample was re-extracted and re-analyzed with similar results.

M - Predominantly _____ range hydrocarbons present in the sample.

N - Hydrocarbons in the gasoline range (C7-toluene) are present in the sample which are elevating the diesel result.

O - Hydrocarbons in the heavy oil range (>C24) are present in the sample which are elevating the diesel result.

P - Hydrocarbons in the diesel range (C12-C24) are present in the sample which are elevating the oil result.

Q - The RPD of the results between the two columns is greater than 25.

R - Hydrocarbons outside the defined gasoline range are present in the sample; NWTPH-Dx recommended.

S - Surrogate recovery data is not available due to the necessary dilution of the sample.

T - The sample chromatogram is not similar to a typical _____.

U - Matrix Spike/Matrix Spike Duplicate RPD are outside control limits due to matrix effects.

V - Matrix Spike/Matrix Spike Duplicate recoveries are outside control limits due to matrix effects.

X - Sample underwent silica gel cleanup procedures.

Y - Sample underwent acid cleanup procedures.

Z - Interferences were present which prevented the quantitation of the analyte below the detection limit reported.

ND - Not Detected
MRL - Method Reporting Limit
PQL - Practical Quantitation

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CHAIN OF CUSTODY RECORD

Page 1 of 1
Laboratory Onsite
Attn: [illegible]

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Seattle, WA 98103
(206) 632-8020

11500 Olive Blvd., Suite 276
St. Louis, MO 63141
(314) 872-8170

1354 N. Grandridge Blvd. 303 Wellsian Way
Kennewick, WA 99336 Richland WA
~~(509)~~ 735-1280 (509)946-6309

2055 Hill Road
Fairbanks, AK 99709
(907) 479-0600

5430 Fairbanks Street, Suite 3
Anchorage, AK 99518
(907) 561-2120

2412 N. 30th St., Suite 201
Tacoma, WA 98407
(206) 759-0156

Analysis Parameters/Sample Container Description
(include preservative if used)

Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab	PAH 8270C	PAH 625 (SIM)	EPH	VPH	NWTPH-Dx	NWTPH-Gx	Total Number of Containers	Remarks/Matrix
RFB-01-SL	1	5:00P	9-9			X		X	X		x	2	soil
RFB-02-SL	2	5:15	9-9-98			X		X			x	2	soil
RFB-03-SL	3	5:30	9-9			X		X		X	x	2	soil
RFB-06-GW	4	7:30A	9-10				X	X	X			5	water- samples for EPH + VPH preserved w/ HCl

Project Information	Sample Receipt
Project Number: V-1075-02	Total Number of Containers
Project Name: Federal Bldg UST	COC Seals/Intact? Y/N/NA
Contact: Donna Parkes	Received Good Cond./Cold
Ongoing Project? Yes ☐ No ☐	Delivery Method: UPS overnight
Sampler: D. Parkes	(attach shipping bill, if any)

Instructions

Requested Turn Around Time: Standard

Special Instructions: Fax results to SAW at (509)946-6580

Relinquished By: 1.	Relinquished By: 2.	Relinquished By: 3.
Signature: Donna Parkes Time: 4:15	Signature: Time:	Signature: Time:
Printed Name: Donna Parkes Date: 9-10-98	Printed Name: Date:	Printed Name: Date:
Company: Shannon & Wilson	Company:	Company:
Received By: 1.	**Received By: 2.**	**Received By: 3.**
Signature: [illegible] Time: 7:30	Signature: Time:	Signature: Time:
Printed Name: [illegible] Date: 9/11	Printed Name: Date:	Printed Name: Date:
Company: [illegible]	Company:	Company:

Distribution: White - w/shipment - returned to Shannon & Wilson w/ Laboratory report
Yellow - w/shipment - for consignee files
Pink - Shannon & Wilson - Job File

F-19-91/UR

No _____

OnSite Environmental Inc.
Analytical Testing and Mobile Laboratory Services

December 30, 1998

Donna Parkes
Shannon & Wilson, Inc.
303 Wellsian Way
Richland, WA 99352

Re: Analytical Data for Project V-1075-03
Laboratory Reference No. 9812-086

Dear Donna:

Enclosed are the analytical results and associated quality control data for samples submitted on December 10, 1998.

The standard policy of OnSite Environmental Inc. is to store your samples for 30 days from the date of receipt. If you require longer storage, please contact the laboratory.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the data, or need additional information, please feel free to call me.

Sincerely,

David Baumeister
Project Chemist

Enclosures

14924 NE 31st Circle • Redmond, WA 98052 • (425) 883-3881 • Fax (425) 885-4603

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

PAH's by EPA 8270C (SIM)
Selective Ion Monitoring

Date Extracted:	12-15-98
Date Analyzed:	12-16-98
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	12-086-01
Client ID:	**RFB-MW02-002**

Compound:	**Results**	**Flags**	**PQL**
Naphthalene	ND		0.050
2-Methylnaphthalene	ND		0.050
Acenaphthylene	ND		0.050
Acenathphene	ND		0.050
Fluorene	ND		0.050
Pentachloropehenol	ND		0.050
Phenanthrene	ND		0.050
Anthracene	ND		0.050
Fluoranthene	ND		0.050
Benzo[a]anthracene	ND		0.050
Chrysene	ND		0.050
Benzo[b]fluoranthene	ND		0.050
Benzo[k]fluoranthene	ND		0.050
Benzo[a]pyrene	ND		0.050
Indeno[1,2,3-cd]pyrene	ND		0.050
Dibenz[a,h]anthracene	ND		0.050
Benzo[g,h,i]perylene	ND		0.050

Surrogate	**Percent Recovery**	**Control Limits**
Nitrobenzene-d5	62	35 - 114
2-Fluorobiphenyl	69	43 - 116
Terphenyl-d14	80	33 - 144

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

PAH's by EPA 8270C (SIM)
Selective Ion Monitoring

Date Extracted:	12-15-98
Date Analyzed:	12-16-98
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	12-086-02
Client ID:	**RFB-MW03-002**

Compound:	**Results**	**Flags**	**PQL**
Naphthalene	ND		0.050
2-Methylnaphthalene	ND		0.050
Acenaphthylene	ND		0.050
Acenathphene	ND		0.050
Fluorene	ND		0.050
Pentachloropehenol	ND		0.050
Phenanthrene	ND		0.050
Anthracene	ND		0.050
Fluoranthene	ND		0.050
Benzo[a]anthracene	ND		0.050
Chrysene	ND		0.050
Benzo[b]fluoranthene	ND		0.050
Benzo[k]fluoranthene	ND		0.050
Benzo[a]pyrene	ND		0.050
Indeno[1,2,3-cd]pyrene	ND		0.050
Dibenz[a,h]anthracene	ND		0.050
Benzo[g,h,i]perylene	ND		0.050

Surrogate	**Percent Recovery**	**Control Limits**
Nitrobenzene-d5	61	35 - 114
2-Fluorobiphenyl	80	43 - 116
Terphenyl-d14	85	33 - 144

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

PAH's by EPA 8270C (SIM)
Selective Ion Monitoring

Date Extracted:	12-15-98
Date Analyzed:	12-16-98
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	12-086-03
Client ID:	**RFB-MW01-002**

Compound:	**Results**	**Flags**	**PQL**
Naphthalene	ND		0.050
2-Methylnaphthalene	ND		0.050
Acenaphthylene	ND		0.050
Acenathphene	ND		0.050
Fluorene	ND		0.050
Pentachloropehenol	ND		0.050
Phenanthrene	ND		0.050
Anthracene	ND		0.050
Fluoranthene	ND		0.050
Benzo[a]anthracene	ND		0.050
Chrysene	ND		0.050
Benzo[b]fluoranthene	ND		0.050
Benzo[k]fluoranthene	ND		0.050
Benzo[a]pyrene	ND		0.050
Indeno[1,2,3-cd]pyrene	ND		0.050
Dibenz[a,h]anthracene	ND		0.050
Benzo[g,h,i]perylene	ND		0.050

Surrogate	**Percent Recovery**	**Control Limits**
Nitrobenzene-d5	64	35 - 114
2-Fluorobiphenyl	74	43 - 116
Terphenyl-d14	81	33 - 144

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

PAH's by EPA 8270C (SIM)
Selective Ion Monitoring
METHOD BLANK QUALITY CONTROL

Date Extracted:	12-15-98
Date Analyzed:	12-16-98
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	MB1215W1

Compound:	Results	Flags	PQL
Naphthalene	ND		0.050
2-Methylnaphthalene	ND		0.050
Acenaphthylene	ND		0.050
Acenathphene	ND		0.050
Fluorene	ND		0.050
Pentachloropehenol	ND		0.050
Phenanthrene	ND		0.050
Anthracene	ND		0.050
Fluoranthene	ND		0.050
Benzo[a]anthracene	ND		0.050
Chrysene	ND		0.050
Benzo[b]fluoranthene	ND		0.050
Benzo[k]fluoranthene	ND		0.050
Benzo[a]pyrene	ND		0.050
Indeno[1,2,3-cd]pyrene	ND		0.050
Dibenz[a,h]anthracene	ND		0.050
Benzo[g,h,i]perylene	ND		0.050

Surrogate	Percent Recovery	Control Limits
Nitrobenzene-d5	72	35 - 114
2-Fluorobiphenyl	86	43 - 116
Terphenyl-d14	90	33 - 144

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

PAH's by EPA 8270C
MS/MSD QUALITY CONTROL

Date Extracted: 12-03-98
Date Analyzed: 12-03-98

Matrix: Water
Units: ug/L (ppb)

Lab ID: 11-130-02MS

Compound:	Spike Amount	MS	Percent Recovery	MSD	Percent Recovery	RPD
Phenol	100	31.2	31	30.1	30	3.6
2-Chlorophenol	100	45.9	46	47.6	48	3.6
1,4-Dichlorobenzene	50.0	19.6	39	21.7	43	10
N-Nitroso-di-n-propylamine	50.0	21.2	42	23.9	48	12
1,2,4-Trichlorobenzene	50.0	22.9	46	25.1	50	9.2
4-Chloro-3-methylphenol	100	59.8	60	64.4	64	7.4
Acenaphthene	50.0	27.7	55	32.2	64	15
2,4-Dinitrotoluene	50.0	28.3	57	30.0	60	5.8
4-Nitrophenol	100	46.0	46	40.2	40	13
Pentachlorophenol	100	76.1	74	76.1	74	0.0
Pyrene	50.0	36.8	74	37.2	74	1.1

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

EXTRACTABLE PETROLEUM HYDROCARBONS

Date Extracted: 12-15-98
Date Analyzed: 12-21-98

Matrix: Water
Units: mg/L (ppm)

Lab ID: 12-086-01
Client ID: RFB-MW02-002

		PQL
Aliphatic C10-C12:	ND	0.050
Aliphatic C12-C16:	ND	0.050
Aliphatic C16-C18:	ND	0.050
Aliphatic C18-C21:	ND	0.050
Aliphatic C21-C28:	ND	0.050
Aliphatic C28-C36:	ND	0.050
Total Aliphatic:	N/A	
Aromatic C10-C12:	ND	0.050
Aromatic C12-C16:	ND	0.050
Aromatic C16-C18:	ND	0.050
Aromatic C18-C21:	ND	0.050
Aromatic C21-C28:	ND	0.050
Aromatic C28-C36:	ND	0.050
Total Aromatic:	N/A	
Surrogate Recovery:		Control Limits
o-Terphenyl	82%	50%-150%

Flags:

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

EXTRACTABLE PETROLEUM HYDROCARBONS

Date Extracted: 12-15-98
Date Analyzed: 12-21-98

Matrix: Water
Units: mg/L (ppm)

Lab ID: 12-086-02
Client ID: RFB-MW03-002

		PQL
Aliphatic C10-C12:	ND	0.050
Aliphatic C12-C16:	ND	0.050
Aliphatic C16-C18:	ND	0.050
Aliphatic C18-C21:	ND	0.050
Aliphatic C21-C28:	ND	0.050
Aliphatic C28-C36:	ND	0.050
Total Aliphatic:	N/A	
Aromatic C10-C12:	ND	0.050
Aromatic C12-C16:	ND	0.050
Aromatic C16-C18:	ND	0.050
Aromatic C18-C21:	ND	0.050
Aromatic C21-C28:	ND	0.050
Aromatic C28-C36:	ND	0.050
Total Aromatic:	N/A	
Surrogate Recovery:		Control Limits
o-Terphenyl	37%	50%-150%
Flags:	Z	

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

EXTRACTABLE PETROLEUM HYDROCARBONS

Date Extracted: 12-15-98
Date Analyzed: 12-21-98

Matrix: Water
Units: mg/L (ppm)

Lab ID: 12-086-03
Client ID: RFB-MW01-002

		PQL
Aliphatic C10-C12:	ND	0.050
Aliphatic C12-C16:	0.10	0.050
Aliphatic C16-C18:	ND	0.050
Aliphatic C18-C21:	ND	0.050
Aliphatic C21-C28:	ND	0.050
Aliphatic C28-C36:	ND	0.050
Total Aliphatic:	0.10	
Aromatic C10-C12:	ND	0.050
Aromatic C12-C16:	ND	0.050
Aromatic C16-C18:	ND	0.050
Aromatic C18-C21:	ND	0.050
Aromatic C21-C28:	ND	0.050
Aromatic C28-C36:	ND	0.050
Total Aromatic:	N/A	
Surrogate Recovery:		Control Limits
o-Terphenyl	72%	50%-150%

Flags:

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

EXTRACTABLE PETROLEUM HYDROCARBONS
METHOD BLANK QUALITY CONTROL

Date Extracted: 12-15-98
Date Analyzed: 12-21-98

Matrix: Water
Units: mg/L (ppm)

Lab ID: MB1215W1

		PQL
Aliphatic C10-C12:	ND	0.050
Aliphatic C12-C16:	ND	0.050
Aliphatic C16-C18:	ND	0.050
Aliphatic C18-C21:	ND	0.050
Aliphatic C21-C28:	ND	0.050
Aliphatic C28-C36:	ND	0.050
Total Aliphatic:	NA	
Aromatic C10-C12:	ND	0.050
Aromatic C12-C16:	ND	0.050
Aromatic C16-C18:	ND	0.050
Aromatic C18-C21:	ND	0.050
Aromatic C21-C28:	ND	0.050
Aromatic C28-C36:	ND	0.050
Total Aromatic:	NA	

Surrogate Recovery:		Control Limits
o-Terphenyl	87%	50%-150%

Flags:

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

EXTRACTABLE PETROLEUM HYDROCARBONS
SB/SBD QUALITY CONTROL

Date Extracted: 12-15-98
Date Analyzed: 12-21-98

Matrix: Water
Units: mg/L (ppm)

Spike Level: 1.00 ppm

Lab ID:	SB1215W1	SB1215W1 DUP		
			PQL	RPD
Aliphatic C10-C12:	0.0914	0.0862	0.050	5.9
Aliphatic C12-C16:	0.328	0.280	0.050	16
Aliphatic C16-C18:	0.193	0.181	0.050	6.4
Aliphatic C18-C21:	0.157	0.147	0.050	6.3
Aliphatic C21-C28:	0.0793	ND	0.050	NA
Aliphatic C28-C36:	ND	ND	0.050	NA
Aromatic C10-C12:	0.0524	ND	0.050	NA
Aromatic C12-C16:	0.151	0.102	0.050	39
Aromatic C16-C18:	0.137	0.105	0.050	27
Aromatic C18-C21:	0.119	0.0818	0.050	37
Aromatic C21-C28:	ND	ND	0.050	NA
Aromatic C28-C36:	ND	ND	0.050	NA
Percent Recovery:	131	98		28
Surrogate Recovery:			Control Limits	
o-Terphenyl	76%	76%	50-150%	

Flags:

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

VOLATILE PETROLEUM HYDROCARBONS

Date Extracted:	12-15-98
Date Analyzed:	12-15-98
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	12-086-01
Client ID:	RFB-MW02-002

VPH:	Results	PQL
Aliphatic C5-C6	ND	50
Aliphatic C6-C8	ND	50
Aliphatic C8-C10	ND	50
Aliphatic C10-C12	ND	50
Total Aliphatic:	NA	
Aromatic C8-C10	ND	50
Aromatic C10-C12	ND	50
Aromatic C12-C13	ND	50
Total Aromatic:	NA	
Target Analytes:		
Methyl t-butylether	ND	5.0
Benzene	ND	5.0
Toluene	ND	5.0
Ethylbenzene	ND	5.0
m , p - Xylene	ND	5.0
o -Xylene	ND	5.0

Surrogate:	Percent Recovery	Control Limits
Fluorobenzene	92	70%-130%

Flags:

	Result
VPH	NA

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

VOLATILE PETROLEUM HYDROCARBONS

Date Extracted:	12-15-98
Date Analyzed:	12-15-98
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	12-086-02
Client ID:	RFB-MW03-002

VPH:	Results	PQL
Aliphatic C5-C6	ND	50
Aliphatic C6-C8	ND	50
Aliphatic C8-C10	ND	50
Aliphatic C10-C12	ND	50
Total Aliphatic:	NA	
Aromatic C8-C10	ND	50
Aromatic C10-C12	ND	50
Aromatic C12-C13	ND	50
Total Aromatic:	NA	
Target Analytes:		
Methyl t-butylether	ND	5.0
Benzene	ND	5.0
Toluene	ND	5.0
Ethylbenzene	ND	5.0
m , p - Xylene	ND	5.0
o -Xylene	ND	5.0

Surrogate:	Percent Recovery	Control Limits
Fluorobenzene	91	70%-130%

Flags:

	Result
VPH	NA

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

VOLATILE PETROLEUM HYDROCARBONS

Date Extracted:	12-15-98
Date Analyzed:	12-15-98
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	12-086-03
Client ID:	RFB-MW01-002

VPH:	Results	PQL
Aliphatic C5-C6	ND	50
Aliphatic C6-C8	ND	50
Aliphatic C8-C10	ND	50
Aliphatic C10-C12	ND	50
Total Aliphatic:	NA	
Aromatic C8-C10	ND	50
Aromatic C10-C12	ND	50
Aromatic C12-C13	ND	50
Total Aromatic:	NA	
Target Analytes:		
Methyl t-butylether	ND	5.0
Benzene	ND	5.0
Toluene	ND	5.0
Ethylbenzene	ND	5.0
m , p - Xylene	ND	5.0
o -Xylene	ND	5.0

Surrogate:	Percent Recovery	Control Limits
Fluorobenzene	90	70%-130%

Flags:

	Result
VPH	NA

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

VOLATILE PETROLEUM HYDROCARBONS
METHOD BLANK QUALITY CONTROL

Date Extracted:	12-15-98
Date Analyzed:	12-15-98
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	MB1215W1

VPH:	Results	PQL
Aliphatic C5-C6	ND	50
Aliphatic C6-C8	ND	50
Aliphatic C8-C10	ND	50
Aliphatic C10-C12	ND	50
Total Aliphatic:	NA	
Aromatic C8-C10	ND	50
Aromatic C10-C12	ND	50
Aromatic C12-C13	ND	50
Total Aromatic:	NA	
Target Analytes:		
Methyl t-butylether	ND	5.0
Benzene	ND	5.0
Toluene	ND	5.0
Ethylbenzene	ND	5.0
m , p - Xylene	ND	5.0
o -Xylene	ND	5.0

Surrogate:	Percent Recovery	Control Limits
Fluorobenzene	90	70%-130%

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

VOLATILE PETROLEUM HYDROCARBONS
DUPLICATE QUALITY CONTROL

Date Extracted: 12-15-98
Date Analyzed: 12-15-98

Matrix: Water
Units: ug/L (ppb)

Lab ID: 12-086-01

VPH:	Sample	Duplicate	PQL	RPD
Aliphatic C5-C6	ND	ND	50	NA
Aliphatic C6-C8	ND	ND	50	NA
Aliphatic C8-C10	ND	ND	50	NA
Aliphatic C10-C12	ND	ND	50	NA
Aromatic C8-C10	ND	ND	50	NA
Aromatic C10-C12	ND	ND	50	NA
Aromatic C12-C13	ND	ND	50	NA
Target Analytes:				
Methyl t-butylether	ND	ND	5.0	NA
Benzene	ND	ND	5.0	NA
Toluene	ND	ND	5.0	NA
Ethylbenzene	ND	ND	5.0	NA
m , p - Xylene	ND	ND	5.0	NA
o -Xylene	ND	ND	5.0	NA
Surrogate:	Percent Recovery	Percent Recovery	Control Limits	
Fluorobenzene	92	90	70%-130%	

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

VOLATILE PETROLEUM HYDROCARBONS
SB/SBD QUALITY CONTROL

Date Extracted: 12-15-98
Date Analyzed: 12-15-98

Matrix: Water
Units: ug/L (ppb)

Spike Level: 50.0 (ppb)

Lab ID: SB1215W1

	SB	Percent Recovery	SBD	Percent Recovery	PQL	RPD
Methyl t-butylether:	42.4	85	41.6	83	5.0	1.9
Benzene:	47.1	94	46.1	92	5.0	2.1
Toluene:	47.6	95	46.5	93	5.0	2.3
Ethylbenzene:	47.7	95	46.7	93	5.0	2.1
m , p - Xylene:	47.6	95	46.6	93	5.0	2.1
o -Xylene:	47.3	95	46.1	92	5.0	2.6
Surrogate:					Control Limits	
Fluorobenzene		96		93	70%-130%	

OnSite Environmental Inc.

DATA QUALIFIERS AND ABBREVIATIONS

A - Due to high sample concentration, the amount spiked is insufficient for meaningful MS/MSD recovery data.

B - The analyte indicated was also found in the blank sample.

C - The duplicate RPD is outside control limits due to high result variability when analyte concentrations are within five times the quantitation limit.

D - Data from 1:____ dilution.

E - The value reported exceeds the quantitation range, and is an estimate.

F - Surrogate recovery data is not available due to the high concentration of coeluting target compounds.

G - Insufficient sample quantity for duplicate analysis.

J - The value reported was below the practical quantitation limit. The value is an estimate.

K - Sample duplicate RPD is outside control limits due to sample inhomogeniety. The sample was re-extracted and re-analyzed with similar results.

M - Predominantly _____ range hydrocarbons present in the sample.

N - Hydrocarbons in the gasoline range (C7-toluene) are present in the sample.

O - Hydrocarbons in the heavy oil range (>C24) are present in the sample.

P - Hydrocarbons in the diesel range (C12-C24) are present in the sample which are elevating the oil result.

Q - The RPD of the results between the two columns is greater than 25.

R - Hydrocarbons outside the defined gasoline range are present in the sample; NWTPH-Dx recommended.

S - Surrogate recovery data is not available due to the necessary dilution of the sample.

T - The sample chromatogram is not similar to a typical _____.

U - Matrix Spike/Matrix Spike Duplicate RPD are outside control limits due to matrix effects.

V - Matrix Spike/Matrix Spike Duplicate recoveries are outside control limits due to matrix effects.

X - Sample underwent silica gel cleanup procedures.

Y - Sample underwent acid cleanup procedures.

Z - Sample re-fractionated and re-analyzed with similar results. Suspected matrix interference.

ND - Not Detected
MRL - Method Reporting Limit
PQL - Practical Quantitation

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

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CHAIN OF CUSTODY RECORD

Page 1 of 1
Laboratory
Attn:

Analysis Parameters/Sample Container Description
(include preservative if used)

Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab							Total Number of Containers	Remarks/Matrix

Project Information	
Project Number:	
Project Name:	
Contact:	
Ongoing Project? Yes ☑ No ☐	
Sampler:	

Sample Receipt	
Total Number of Containers	
COC Seals/Intact? Y/N/NA	
Received Good Cond./Cold	
Delivery Method: (attach shipping bill, if any)	

Instructions
Requested Turn Around Time:
Special Instructions:

Relinquished By: 1.	Relinquished By: 2.	Relinquished By: 3.
Signature: Time: 4:00	Signature: Time:	Signature: Time:
Printed Name: Donna Parkes Date: 12/9/98	Printed Name: Date:	Printed Name: Date:
Company: Shannon Wilson Inc	Company:	Company:

Received By: 1.	Received By: 2.	Received By: 3.
Signature: Time:	Signature: Time:	Signature: Time:
Printed Name: Date:	Printed Name: Date:	Printed Name: Date:
Company:	Company:	Company:

Distribution: White - w/shipment - returned to Shannon & Wilson w/ Laboratory report
Yellow - w/shipment - for consignee files
Pink - Shannon & Wilson - Job File

F-19-91/UR

No.

OnSite Environmental Inc.
Analytical Testing and Mobile Laboratory Services

April 13, 1999

Donna Parkes
Shannon & Wilson, Inc.
303 Wellsian Way
Richland, WA 99352

Re: Analytical Data for Project V-1075-03
Laboratory Reference No. 9904-003

Dear Donna:

Enclosed are the analytical results and associated quality control data for samples submitted on April 1, 1999.

The standard policy of OnSite Environmental Inc. is to store your samples for 30 days from the date of receipt. If you require longer storage, please contact the laboratory.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the data, or need additional information, please feel free to call me.

Sincerely,

David Baumeister
Project Chemist

Enclosures

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

VOLATILES by EPA 8260B
page 1 of 2

Date Extracted: 4-4-99
Date Analyzed: 4-4-99

Matrix: Water
Units: ug/L (ppb)

Lab ID: 04-003-01
Client ID: RFB-MW02-003

Compound	Results	Flags	PQL
Dichlorodifluoromethane	ND		1.0
Chloromethane	ND		1.0
Vinyl Chloride	ND		1.0
Bromomethane	ND		1.0
Chloroethane	ND		1.0
Trichlorofluoromethane	ND		1.0
1,1-Dichloroethene	ND		1.0
Acetone	ND		50
Carbon Disulfide	ND		1.0
Methylene Chloride	ND		5.0
(trans) 1,2-Dichloroethene	ND		1.0
1,1-Dichloroethane	ND		1.0
Vinyl Acetate	ND		20
2,2-Dichloropropane	ND		1.0
(cis) 1,2-Dichloroethene	28		1.0
2-Butanone	ND		100
Chloroform	ND		1.0
1,1,1-Trichloroethane	ND		5.0
Carbon Tetrachloride	ND		1.0
1,1-Dichloropropene	ND		1.0
Benzene	ND		1.0
1,2-Dichloroethane	ND		1.0
Trichloroethene	1.9		1.0
1,2-Dichloropropane	ND		1.0
Dibromomethane	ND		1.0
Bromodichloromethane	ND		5.0
2-Chloroethyl Vinyl Ether	ND		20
(cis) 1,3-Dichloropropene	ND		1.0
Toluene	ND		1.0
(trans) 1,3-Dichloropropene	ND		1.0
1,1,2-Trichloroethane	ND		1.0
Tetrachloroethene	28		1.0
1,3-Dichloropropane	ND		1.0

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

VOLATILES by EPA 8260B
page 2 of 2

Lab ID: 04-003-01
Client ID: RFB-MW02-003

Compound	Results	Flags	PQL
Methyl Isobutyl Ketone	ND		20
Dibromochloromethane	ND		1.0
1,2-Dibromoethane	ND		1.0
Chlorobenzene	ND		1.0
1,1,1,2-Tetrachloroethane	ND		1.0
Ethylbenzene	ND		1.0
m,p-Xylene	ND		2.0
o-Xylene	ND		1.0
Styrene	ND		1.0
Bromoform	ND		1.0
Isopropylbenzene	ND		1.0
Bromobenzene	ND		1.0
1,1,2,2-Tetrachloroethane	ND		5.0
1,2,3-Trichloropropane	ND		5.0
n-Propylbenzene	ND		1.0
2-Chlorotoluene	ND		1.0
4-Chlorotoluene	ND		1.0
1,3,5-Trimethylbenzene	ND		1.0
tert-Butylbenzene	ND		1.0
1,2,4-Trimethylbenzene	ND		1.0
sec-Butylbenzene	ND		1.0
1,3-Dichlorobenzene	ND		1.0
p-Isopropyltoluene	ND		1.0
1,4-Dichlorobenzene	ND		1.0
1,2-Dichlorobenzene	ND		1.0
n-Butylbenzene	ND		1.0
1,2-Dibromo-3-chloropropane	ND		5.0
1,2,4-Trichlorobenzene	ND		5.0
Hexachlorobutadiene	ND		1.0
Naphthalene	ND		5.0
1,2,3-Trichlorobenzene	ND		5.0

Surrogate	Percent Recovery		Control Limits
Dibromofluoromethane	146	*	71-133
Toluene-d8	139		80-151
4-Bromofluorobenzene	86		75-139

* Surrogate recovery outside control limits.

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

VOLATILES by EPA 8260B
page 1 of 2

Date Extracted:	4-4-99
Date Analyzed:	4-4-99
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	04-003-02
Client ID:	**RFB-MW01-003**

Compound	Results	Flags	PQL
Dichlorodifluoromethane	ND		1.0
Chloromethane	ND		1.0
Vinyl Chloride	ND		1.0
Bromomethane	ND		1.0
Chloroethane	ND		1.0
Trichlorofluoromethane	ND		1.0
1,1-Dichloroethene	ND		1.0
Acetone	ND		50
Carbon Disulfide	ND		1.0
Methylene Chloride	ND		5.0
(trans) 1,2-Dichloroethene	ND		1.0
1,1-Dichloroethane	ND		1.0
Vinyl Acetate	ND		20
2,2-Dichloropropane	ND		1.0
(cis) 1,2-Dichloroethene	ND		1.0
2-Butanone	ND		100
Chloroform	23		1.0
1,1,1-Trichloroethane	ND		5.0
Carbon Tetrachloride	ND		1.0
1,1-Dichloropropene	ND		1.0
Benzene	ND		1.0
1,2-Dichloroethane	ND		1.0
Trichloroethene	ND		1.0
1,2-Dichloropropane	ND		1.0
Dibromomethane	ND		1.0
Bromodichloromethane	ND		5.0
2-Chloroethyl Vinyl Ether	ND		20
(cis) 1,3-Dichloropropene	ND		1.0
Toluene	ND		1.0
(trans) 1,3-Dichloropropene	ND		1.0
1,1,2-Trichloroethane	ND		1.0
Tetrachloroethene	1.9		1.0
1,3-Dichloropropane	ND		1.0

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

VOLATILES by EPA 8260B
page 2 of 2

Lab ID: 04-003-02
Client ID: RFB-MW01-003

Compound	Results	Flags	PQL
Methyl Isobutyl Ketone	ND		20
Dibromochloromethane	ND		1.0
1,2-Dibromoethane	ND		1.0
Chlorobenzene	ND		1.0
1,1,1,2-Tetrachloroethane	ND		1.0
Ethylbenzene	ND		1.0
m,p-Xylene	ND		2.0
o-Xylene	ND		1.0
Styrene	ND		1.0
Bromoform	ND		1.0
Isopropylbenzene	ND		1.0
Bromobenzene	ND		1.0
1,1,2,2-Tetrachloroethane	ND		5.0
1,2,3-Trichloropropane	ND		5.0
n-Propylbenzene	ND		1.0
2-Chlorotoluene	ND		1.0
4-Chlorotoluene	ND		1.0
1,3,5-Trimethylbenzene	ND		1.0
tert-Butylbenzene	ND		1.0
1,2,4-Trimethylbenzene	ND		1.0
sec-Butylbenzene	ND		1.0
1,3-Dichlorobenzene	ND		1.0
p-Isopropyltoluene	ND		1.0
1,4-Dichlorobenzene	ND		1.0
1,2-Dichlorobenzene	ND		1.0
n-Butylbenzene	ND		1.0
1,2-Dibromo-3-chloropropane	ND		5.0
1,2,4-Trichlorobenzene	ND		5.0
Hexachlorobutadiene	ND		1.0
Naphthalene	ND		5.0
1,2,3-Trichlorobenzene	ND		5.0

Surrogate	Percent Recovery		Control Limits
Dibromofluoromethane	129		71-133
Toluene-d8	136		80-151
4-Bromofluorobenzene	143	*	75-139

* Surrogate recovery outside control limits.

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

VOLATILES by EPA 8260B
page 1 of 2

Date Extracted: 4-4-99
Date Analyzed: 4-4-99

Matrix: Water
Units: ug/L (ppb)

Lab ID: 04-003-03
Client ID: RFB-MW03-003

Compound	Results	Flags	PQL
Dichlorodifluoromethane	ND		1.0
Chloromethane	ND		1.0
Vinyl Chloride	ND		1.0
Bromomethane	ND		1.0
Chloroethane	ND		1.0
Trichlorofluoromethane	ND		1.0
1,1-Dichloroethene	ND		1.0
Acetone	ND		50
Carbon Disulfide	ND		1.0
Methylene Chloride	ND		5.0
(trans) 1,2-Dichloroethene	ND		1.0
1,1-Dichloroethane	ND		1.0
Vinyl Acetate	ND		20
2,2-Dichloropropane	ND		1.0
(cis) 1,2-Dichloroethene	ND		1.0
2-Butanone	ND		100
Chloroform	13		1.0
1,1,1-Trichloroethane	ND		5.0
Carbon Tetrachloride	ND		1.0
1,1-Dichloropropene	ND		1.0
Benzene	ND		1.0
1,2-Dichloroethane	ND		1.0
Trichloroethene	ND		1.0
1,2-Dichloropropane	ND		1.0
Dibromomethane	ND		1.0
Bromodichloromethane	ND		5.0
2-Chloroethyl Vinyl Ether	ND		20
(cis) 1,3-Dichloropropene	ND		1.0
Toluene	ND		1.0
(trans) 1,3-Dichloropropene	ND		1.0
1,1,2-Trichloroethane	ND		1.0
Tetrachloroethene	82		1.0
1,3-Dichloropropane	ND		1.0

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

VOLATILES by EPA 8260B
page 2 of 2

Lab ID: 04-003-03
Client ID: RFB-MW03-003

Compound	Results	Flags	PQL
Methyl Isobutyl Ketone	ND		20
Dibromochloromethane	ND		1.0
1,2-Dibromoethane	ND		1.0
Chlorobenzene	ND		1.0
1,1,1,2-Tetrachloroethane	ND		1.0
Ethylbenzene	ND		1.0
m,p-Xylene	ND		2.0
o-Xylene	ND		1.0
Styrene	ND		1.0
Bromoform	ND		1.0
Isopropylbenzene	ND		1.0
Bromobenzene	ND		1.0
1,1,2,2-Tetrachloroethane	ND		5.0
1,2,3-Trichloropropane	ND		5.0
n-Propylbenzene	ND		1.0
2-Chlorotoluene	ND		1.0
4-Chlorotoluene	ND		1.0
1,3,5-Trimethylbenzene	ND		1.0
tert-Butylbenzene	ND		1.0
1,2,4-Trimethylbenzene	ND		1.0
sec-Butylbenzene	ND		1.0
1,3-Dichlorobenzene	ND		1.0
p-Isopropyltoluene	ND		1.0
1,4-Dichlorobenzene	ND		1.0
1,2-Dichlorobenzene	ND		1.0
n-Butylbenzene	ND		1.0
1,2-Dibromo-3-chloropropane	ND		5.0
1,2,4-Trichlorobenzene	ND		5.0
Hexachlorobutadiene	ND		1.0
Naphthalene	ND		5.0
1,2,3-Trichlorobenzene	ND		5.0

Surrogate	Percent Recovery		Control Limits
Dibromofluoromethane	139	*	71-133
Toluene-d8	151		80-151
4-Bromofluorobenzene	111		75-139

* Surrogate recovery outside control limits.

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

VOLATILES by EPA 8260B
page 1 of 2

Date Extracted:	4-3-99
Date Analyzed:	4-3-99
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	04-003-04
Client ID:	**TRIP BLANK**

Compound	Results	Flags	PQL
Dichlorodifluoromethane	ND		1.0
Chloromethane	ND		1.0
Vinyl Chloride	ND		1.0
Bromomethane	ND		1.0
Chloroethane	ND		1.0
Trichlorofluoromethane	ND		1.0
1,1-Dichloroethene	ND		1.0
Acetone	ND		50
Carbon Disulfide	ND		1.0
Methylene Chloride	ND		5.0
(trans) 1,2-Dichloroethene	ND		1.0
1,1-Dichloroethane	ND		1.0
Vinyl Acetate	ND		20
2,2-Dichloropropane	ND		1.0
(cis) 1,2-Dichloroethene	ND		1.0
2-Butanone	ND		100
Chloroform	ND		1.0
1,1,1-Trichloroethane	ND		5.0
Carbon Tetrachloride	ND		1.0
1,1-Dichloropropene	ND		1.0
Benzene	ND		1.0
1,2-Dichloroethane	ND		1.0
Trichloroethene	ND		1.0
1,2-Dichloropropane	ND		1.0
Dibromomethane	ND		1.0
Bromodichloromethane	ND		5.0
2-Chloroethyl Vinyl Ether	ND		20
(cis) 1,3-Dichloropropene	ND		1.0
Toluene	ND		1.0
(trans) 1,3-Dichloropropene	ND		1.0
1,1,2-Trichloroethane	ND		1.0
Tetrachloroethene	ND		1.0
1,3-Dichloropropane	ND		1.0

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

VOLATILES by EPA 8260B
page 2 of 2

Lab ID: 04-003-04
Client ID: TRIP BLANK

Compound	Results	Flags	PQL
Methyl Isobutyl Ketone	ND		20
Dibromochloromethane	ND		1.0
1,2-Dibromoethane	ND		1.0
Chlorobenzene	ND		1.0
1,1,1,2-Tetrachloroethane	ND		1.0
Ethylbenzene	ND		1.0
m,p-Xylene	ND		2.0
o-Xylene	ND		1.0
Styrene	ND		1.0
Bromoform	ND		1.0
Isopropylbenzene	ND		1.0
Bromobenzene	ND		1.0
1,1,2,2-Tetrachloroethane	ND		5.0
1,2,3-Trichloropropane	ND		5.0
n-Propylbenzene	ND		1.0
2-Chlorotoluene	ND		1.0
4-Chlorotoluene	ND		1.0
1,3,5-Trimethylbenzene	ND		1.0
tert-Butylbenzene	ND		1.0
1,2,4-Trimethylbenzene	ND		1.0
sec-Butylbenzene	ND		1.0
1,3-Dichlorobenzene	ND		1.0
p-Isopropyltoluene	ND		1.0
1,4-Dichlorobenzene	ND		1.0
1,2-Dichlorobenzene	ND		1.0
n-Butylbenzene	ND		1.0
1,2-Dibromo-3-chloropropane	ND		5.0
1,2,4-Trichlorobenzene	ND		5.0
Hexachlorobutadiene	ND		1.0
Naphthalene	ND		5.0
1,2,3-Trichlorobenzene	ND		5.0

Surrogate	Percent Recovery		Control Limits
Dibromofluoromethane	116		71-133
Toluene-d8	124		80-151
4-Bromofluorobenzene	166	*	75-139

* Surrogate recovery outside control limits.

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

VOLATILES by EPA 8260B
METHOD BLANK QUALITY CONTROL
page 1 of 2

Date Extracted: 4-4-99
Date Analyzed: 4-4-99

Matrix: Water
Units: ug/L (ppb)

Lab ID: MB0404W1

Compound	Results	Flags	PQL
Dichlorodifluoromethane	ND		1.0
Chloromethane	ND		1.0
Vinyl Chloride	ND		1.0
Bromomethane	ND		1.0
Chloroethane	ND		1.0
Trichlorofluoromethane	ND		1.0
1,1-Dichloroethene	ND		1.0
Acetone	ND		50
Carbon Disulfide	ND		1.0
Methylene Chloride	ND		5.0
(trans) 1,2-Dichloroethene	ND		1.0
1,1-Dichloroethane	ND		1.0
Vinyl Acetate	ND		20
2,2-Dichloropropane	ND		1.0
(cis) 1,2-Dichloroethene	ND		1.0
2-Butanone	ND		100
Chloroform	ND		1.0
1,1,1-Trichloroethane	ND		5.0
Carbon Tetrachloride	ND		1.0
1,1-Dichloropropene	ND		1.0
Benzene	ND		1.0
1,2-Dichloroethane	ND		1.0
Trichloroethene	ND		1.0
1,2-Dichloropropane	ND		1.0
Dibromomethane	ND		1.0
Bromodichloromethane	ND		5.0
2-Chloroethyl Vinyl Ether	ND		20
(cis) 1,3-Dichloropropene	ND		1.0
Toluene	ND		1.0
(trans) 1,3-Dichloropropene	ND		1.0
1,1,2-Trichloroethane	ND		1.0
Tetrachloroethene	ND		1.0
1,3-Dichloropropane	ND		1.0

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

VOLATILES by EPA 8260B
METHOD BLANK QUALITY CONTROL
page 2 of 2

Lab ID: MB0404W1

Compound	Results	Flags	PQL
Methyl Isobutyl Ketone	ND		20
Dibromochloromethane	ND		1.0
1,2-Dibromoethane	ND		1.0
Chlorobenzene	ND		1.0
1,1,1,2-Tetrachloroethane	ND		1.0
Ethylbenzene	ND		1.0
m,p-Xylene	ND		2.0
o-Xylene	ND		1.0
Styrene	ND		1.0
Bromoform	ND		1.0
Isopropylbenzene	ND		1.0
Bromobenzene	ND		1.0
1,1,2,2-Tetrachloroethane	ND		5.0
1,2,3-Trichloropropane	ND		5.0
n-Propylbenzene	ND		1.0
2-Chlorotoluene	ND		1.0
4-Chlorotoluene	ND		1.0
1,3,5-Trimethylbenzene	ND		1.0
tert-Butylbenzene	ND		1.0
1,2,4-Trimethylbenzene	ND		1.0
sec-Butylbenzene	ND		1.0
1,3-Dichlorobenzene	ND		1.0
p-Isopropyltoluene	ND		1.0
1,4-Dichlorobenzene	ND		1.0
1,2-Dichlorobenzene	ND		1.0
n-Butylbenzene	ND		1.0
1,2-Dibromo-3-chloropropane	ND		5.0
1,2,4-Trichlorobenzene	ND		5.0
Hexachlorobutadiene	ND		1.0
Naphthalene	ND		5.0
1,2,3-Trichlorobenzene	ND		5.0

Surrogate	Percent Recovery		Control Limits
Dibromofluoromethane	143	*	71-133
Toluene-d8	145		80-151
4-Bromofluorobenzene	89		75-139

* Surrogate recovery outside control limits.

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

VOLATILES by EPA 8260B
METHOD BLANK QUALITY CONTROL
page 1 of 2

Date Extracted: 4-3-99
Date Analyzed: 4-3-99

Matrix: Water
Units: ug/L (ppb)

Lab ID: MB0402W1

Compound	Results	Flags	PQL
Dichlorodifluoromethane	ND		1.0
Chloromethane	ND		1.0
Vinyl Chloride	ND		1.0
Bromomethane	ND		1.0
Chloroethane	ND		1.0
Trichlorofluoromethane	ND		1.0
1,1-Dichloroethene	ND		1.0
Acetone	ND		50
Carbon Disulfide	ND		1.0
Methylene Chloride	ND		5.0
(trans) 1,2-Dichloroethene	ND		1.0
1,1-Dichloroethane	ND		1.0
Vinyl Acetate	ND		20
2,2-Dichloropropane	ND		1.0
(cis) 1,2-Dichloroethene	ND		1.0
2-Butanone	ND		100
Chloroform	ND		1.0
1,1,1-Trichloroethane	ND		5.0
Carbon Tetrachloride	ND		1.0
1,1-Dichloropropene	ND		1.0
Benzene	ND		1.0
1,2-Dichloroethane	ND		1.0
Trichloroethene	ND		1.0
1,2-Dichloropropane	ND		1.0
Dibromomethane	ND		1.0
Bromodichloromethane	ND		5.0
2-Chloroethyl Vinyl Ether	ND		20
(cis) 1,3-Dichloropropene	ND		1.0
Toluene	ND		1.0
(trans) 1,3-Dichloropropene	ND		1.0
1,1,2-Trichloroethane	ND		1.0
Tetrachloroethene	ND		1.0
1,3-Dichloropropane	ND		1.0

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

VOLATILES by EPA 8260B
METHOD BLANK QUALITY CONTROL
page 2 of 2

Lab ID: MB0402W1

Compound	Results	Flags	PQL
Methyl Isobutyl Ketone	ND		20
Dibromochloromethane	ND		1.0
1,2-Dibromoethane	ND		1.0
Chlorobenzene	ND		1.0
1,1,1,2-Tetrachloroethane	ND		1.0
Ethylbenzene	ND		1.0
m,p-Xylene	ND		2.0
o-Xylene	ND		1.0
Styrene	ND		1.0
Bromoform	ND		1.0
Isopropylbenzene	ND		1.0
Bromobenzene	ND		1.0
1,1,2,2-Tetrachloroethane	ND		5.0
1,2,3-Trichloropropane	ND		5.0
n-Propylbenzene	ND		1.0
2-Chlorotoluene	ND		1.0
4-Chlorotoluene	ND		1.0
1,3,5-Trimethylbenzene	ND		1.0
tert-Butylbenzene	ND		1.0
1,2,4-Trimethylbenzene	ND		1.0
sec-Butylbenzene	ND		1.0
1,3-Dichlorobenzene	ND		1.0
p-Isopropyltoluene	ND		1.0
1,4-Dichlorobenzene	ND		1.0
1,2-Dichlorobenzene	ND		1.0
n-Butylbenzene	ND		1.0
1,2-Dibromo-3-chloropropane	ND		5.0
1,2,4-Trichlorobenzene	ND		5.0
Hexachlorobutadiene	ND		1.0
Naphthalene	ND		5.0
1,2,3-Trichlorobenzene	ND		5.0

Surrogate	Percent Recovery		Control Limits
Dibromofluoromethane	115		71-133
Toluene-d8	120		80-151
4-Bromofluorobenzene	158	*	75-139

* Surrogate recovery outside control limits.

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

VOLATILES by EPA 8260B
SB/SBD QUALITY CONTROL

Date Extracted: 4-5-99
Date Analyzed: 4-5-99

Matrix: Water
Units: ug/L (ppb)

Lab ID: SB0404W1

Compound	Spike Amount	SB	Percent Recovery	SBD	Percent Recovery	RPD
1,1-Dichloroethene	50.0	48.5	97	46.0	92	5.3
Benzene	50.0	44.2	88	46.0	92	4.2
Trichloroethene	50.0	50.9	102	48.0	96	5.9
Toluene	50.0	48.3	97	49.1	98	1.5
Chlorobenzene	50.0	48.3	97	51.0	102	5.5

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

VOLATILE PETROLEUM HYDROCARBONS

Date Extracted:	4-05-99
Date Analyzed:	4-05-99
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	04-003-01
Client ID:	RFB-MW02-003

VPH:	Results	PQL
Aliphatic C5-C6	ND	50
Aliphatic C6-C8	ND	50
Aliphatic C8-C10	ND	50
Aliphatic C10-C12	ND	50
Total Aliphatic:	NA	
Aromatic C8-C10	ND	50
Aromatic C10-C12	ND	50
Aromatic C12-C13	ND	50
Total Aromatic:	NA	
Target Analytes:		
Methyl t-butylether	ND	5.0
Benzene	ND	5.0
Toluene	ND	5.0
Ethylbenzene	ND	5.0
m , p - Xylene	ND	5.0
o -Xylene	ND	5.0

Surrogate:	Percent Recovery	Control Limits
Fluorobenzene	83	70%-130%

Flags:

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

VOLATILE PETROLEUM HYDROCARBONS

Date Extracted:	4-05-99
Date Analyzed:	4-05-99
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	04-003-02
Client ID:	RFB-MW01-003

VPH:	Results	PQL
Aliphatic C5-C6	ND	50
Aliphatic C6-C8	ND	50
Aliphatic C8-C10	ND	50
Aliphatic C10-C12	ND	50
Total Aliphatic:	NA	
Aromatic C8-C10	ND	50
Aromatic C10-C12	ND	50
Aromatic C12-C13	ND	50
Total Aromatic:	NA	
Target Analytes:		
Methyl t-butylether	ND	5.0
Benzene	ND	5.0
Toluene	ND	5.0
Ethylbenzene	ND	5.0
m , p - Xylene	ND	5.0
o -Xylene	ND	5.0

Surrogate:	Percent Recovery	Control Limits
Fluorobenzene	86	70%-130%

Flags:

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

VOLATILE PETROLEUM HYDROCARBONS

Date Extracted:	4-05-99
Date Analyzed:	4-05-99
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	04-003-03
Client ID:	RFB-MW03-003

VPH:	Results	PQL
Aliphatic C5-C6	ND	50
Aliphatic C6-C8	ND	50
Aliphatic C8-C10	ND	50
Aliphatic C10-C12	ND	50
Total Aliphatic:	NA	
Aromatic C8-C10	56	50
Aromatic C10-C12	ND	50
Aromatic C12-C13	ND	50
Total Aromatic:	56	
Target Analytes:		
Methyl t-butylether	ND	5.0
Benzene	ND	5.0
Toluene	ND	5.0
Ethylbenzene	ND	5.0
m , p - Xylene	ND	5.0
o -Xylene	ND	5.0

Surrogate:	Percent Recovery	Control Limits
Fluorobenzene	83	70%-130%

Flags:

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

VOLATILE PETROLEUM HYDROCARBONS
METHOD BLANK QUALITY CONTROL

Date Extracted:	4-05-99
Date Analyzed:	4-05-99
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	MB0405W1

VPH:	Results	PQL
Aliphatic C5-C6	ND	50
Aliphatic C6-C8	ND	50
Aliphatic C8-C10	ND	50
Aliphatic C10-C12	ND	50
Total Aliphatic:	NA	
Aromatic C8-C10	ND	50
Aromatic C10-C12	ND	50
Aromatic C12-C13	ND	50
Total Aromatic:	NA	
Target Analytes:		
Methyl t-butylether	ND	5.0
Benzene	ND	5.0
Toluene	ND	5.0
Ethylbenzene	ND	5.0
m , p - Xylene	ND	5.0
o -Xylene	ND	5.0

Surrogate:	Percent Recovery	Control Limits
Fluorobenzene	75	70%-130%

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

VOLATILE PETROLEUM HYDROCARBONS
DUPLICATE QUALITY CONTROL

Date Extracted: 4-05-99
Date Analyzed: 4-05-99

Matrix: Water
Units: ug/L (ppb)

Lab ID: 04-003-01

VPH:	Sample	Duplicate	PQL	RPD
Aliphatic C5-C6	ND	ND	50	NA
Aliphatic C6-C8	ND	ND	50	NA
Aliphatic C8-C10	ND	ND	50	NA
Aliphatic C10-C12	ND	ND	50	NA
Aromatic C8-C10	ND	ND	50	NA
Aromatic C10-C12	ND	ND	50	NA
Aromatic C12-C13	ND	ND	50	NA
Target Analytes:				
Methyl t-butylether	ND	ND	5.0	NA
Benzene	ND	ND	5.0	NA
Toluene	ND	ND	5.0	NA
Ethylbenzene	ND	ND	5.0	NA
m , p - Xylene	ND	ND	5.0	NA
o -Xylene	ND	ND	5.0	NA

Surrogate:	Percent Recovery	Percent Recovery	Control Limits
Fluorobenzene	83	86	70%-130%

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

VOLATILE PETROLEUM HYDROCARBONS
SB/SBD QUALITY CONTROL

Date Extracted: 4-05-99
Date Analyzed: 4-05-99

Matrix: Water
Units: ug/L
Spiking Level: 50.0 ppb

Lab ID: SB0405W1

	SB	Percent Recovery	SBD	Percent Recovery	PQL	RPD
Methyl t-butylether:	44.0	88	48.9	98	5.0	11
Benzene:	46.5	93	49.8	100	5.0	6.8
Toluene:	47.2	94	50.7	101	5.0	7.2
Ethylbenzene:	47.6	95	51.1	102	5.0	7.0
m , p - Xylene:	47.6	95	51.1	102	5.0	7.0
o -Xylene:	47.5	95	50.8	102	5.0	6.8
Surrogate:					Control Limits	
Fluorobenzene		91		96	70%-130%	

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

EXTRACTABLE PETROLEUM HYDROCARBONS

Date Extracted: 4-2-99
Date Analyzed: 4-13-99

Matrix: Water
Units: mg/L (ppm)

Lab ID: 04-003-01
Client ID: RFB-MW02-003

		PQL
Aliphatic C10-C12:	ND	0.050
Aliphatic C12-C16:	ND	0.050
Aliphatic C16-C18:	ND	0.050
Aliphatic C18-C21:	ND	0.050
Aliphatic C21-C28:	ND	0.050
Aliphatic C28-C36:	ND	0.050
Total Aliphatic:	NA	
Aromatic C10-C12:	ND	0.050
Aromatic C12-C16:	ND	0.050
Aromatic C16-C18:	ND	0.050
Aromatic C18-C21:	ND	0.050
Aromatic C21-C28:	ND	0.050
Aromatic C28-C36:	ND	0.050
Total Aromatic:	NA	

Surrogate Recovery:		Control Limits
o-Terphenyl	88%	50%-150%
1-Chlorooctadecane	51%	50%-150%

Flags:

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

EXTRACTABLE PETROLEUM HYDROCARBONS

Date Extracted: 4-2-99
Date Analyzed: 4-13-99

Matrix: Water
Units: mg/L (ppm)

Lab ID: 04-003-02
Client ID: RFB-MW01-003

		PQL
Aliphatic C10-C12:	ND	0.050
Aliphatic C12-C16:	0.064	0.050
Aliphatic C16-C18:	ND	0.050
Aliphatic C18-C21:	ND	0.050
Aliphatic C21-C28:	0.056	0.050
Aliphatic C28-C36:	ND	0.050
Total Aliphatic:	0.12	
Aromatic C10-C12:	ND	0.050
Aromatic C12-C16:	ND	0.050
Aromatic C16-C18:	ND	0.050
Aromatic C18-C21:	ND	0.050
Aromatic C21-C28:	ND	0.050
Aromatic C28-C36:	ND	0.050
Total Aromatic:	NA	

Surrogate Recovery:		Control Limits
o-Terphenyl	90%	50%-150%
1-Chlorooctadecane	67%	50%-150%

Flags:

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

EXTRACTABLE PETROLEUM HYDROCARBONS

Date Extracted: 4-2-99
Date Analyzed: 4-13-99

Matrix: Water
Units: mg/L (ppm)

Lab ID: 04-003-03
Client ID: RFB-MW03-003

		PQL
Aliphatic C10-C12:	ND	0.050
Aliphatic C12-C16:	ND	0.050
Aliphatic C16-C18:	ND	0.050
Aliphatic C18-C21:	ND	0.050
Aliphatic C21-C28:	ND	0.050
Aliphatic C28-C36:	ND	0.050
Total Aliphatic:	NA	
Aromatic C10-C12:	ND	0.050
Aromatic C12-C16:	ND	0.050
Aromatic C16-C18:	ND	0.050
Aromatic C18-C21:	ND	0.050
Aromatic C21-C28:	ND	0.050
Aromatic C28-C36:	ND	0.050
Total Aromatic:	NA	

Surrogate Recovery:		Control Limits
o-Terphenyl	98%	50%-150%
1-Chlorooctadecane	70%	50%-150%

Flags:

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

EXTRACTABLE PETROLEUM HYDROCARBONS
METHOD BLANK QUALITY CONTROL

Date Extracted: 4-2-99
Date Analyzed: 4-13-99

Matrix: Water
Units: mg/L (ppm)

Lab ID: MB0402W1

		PQL
Aliphatic C10-C12:	ND	0.050
Aliphatic C12-C16:	ND	0.050
Aliphatic C16-C18:	ND	0.050
Aliphatic C18-C21:	ND	0.050
Aliphatic C21-C28:	ND	0.050
Aliphatic C28-C36:	ND	0.050
Total Aliphatic:	NA	
Aromatic C10-C12:	ND	0.050
Aromatic C12-C16:	ND	0.050
Aromatic C16-C18:	ND	0.050
Aromatic C18-C21:	ND	0.050
Aromatic C21-C28:	ND	0.050
Aromatic C28-C36:	ND	0.050
Total Aromatic:	NA	

Surrogate Recovery:		Control Limits
o-Terphenyl	92%	50%-150%
1-Chlorooctadecane	65%	50%-150%

Flags:

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

EXTRACTABLE PETROLEUM HYDROCARBONS
SB/SBD QUALITY CONTROL

Date Extracted: 4-2-99
Date Analyzed: 4-13-99

Matrix: Water
Units: mg/L (ppm)

Spike Level: 100 ppm

Lab ID:	SB0402W1	SB0402W1 DUP		
			PQL	RPD
Aliphatic C10-C12:	0.0660	0.0676	0.050	2.4
Aliphatic C12-C16:	0.259	0.270	0.050	4.1
Aliphatic C16-C18:	0.187	0.199	0.050	6.2
Aliphatic C18-C21:	0.171	0.183	0.050	6.6
Aliphatic C21-C28:	0.0966	0.103	0.050	6.4
Aliphatic C28-C36:	ND	ND	0.050	NA
Aromatic C10-C12:	ND	ND	0.050	NA
Aromatic C12-C16:	0.0548	0.0738	0.050	30
Aromatic C16-C18:	ND	0.0527	0.050	NA
Aromatic C18-C21:	0.126	0.169	0.050	29
Aromatic C21-C28:	ND	ND	0.050	NA
Aromatic C28-C36:	ND	ND	0.050	NA

Surrogate Recovery:			Control Limits
o-Terphenyl	77%	96%	50%-150%
1-Chlorooctadecane	50%	56%	50%-150%

Flags:

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

PAH's by EPA 8270C Mod.
(Selective Ion Monitoring)

Date Extracted:	04-05-99
Date Analyzed:	04-06-99
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	04-003-01
Client ID:	**RFB-MW02-003**

Compound:	**Results**	**Flags**	**PQL**
Naphthalene	ND		0.050
2-Methylnaphthalene	ND		0.050
Acenaphthylene	ND		0.050
Acenathphene	ND		0.050
Fluorene	ND		0.050
Phenanthrene	ND		0.050
Anthracene	ND		0.050
Fluoranthene	ND		0.050
Pyrene	ND		0.050
Benzo[a]anthracene	ND		0.025
Chrysene	ND		0.025
Benzo[b]fluoranthene	ND		0.025
Benzo[k]fluoranthene	ND		0.025
Benzo[a]pyrene	ND		0.025
Indeno[1,2,3-cd]pyrene	ND		0.025
Dibenz[a,h]anthracene	ND		0.025
Benzo[g,h,i]perylene	ND		0.025

Surrogate	**Percent Recovery**	**Control Limits**
Nitrobenzene-d5	70	35 - 114
2-Fluorobiphenyl	80	43 - 116
Terphenyl-d14	76	33 - 144

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

PAH's by EPA 8270C Mod.
(Selective Ion Monitoring)

Date Extracted:	04-05-99
Date Analyzed:	04-06-99
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	04-003-02
Client ID:	**RFB-MW01-003**

Compound:	Results	Flags	PQL
Naphthalene	ND		0.050
2-Methylnaphthalene	ND		0.050
Acenaphthylene	ND		0.050
Acenathphene	ND		0.050
Fluorene	ND		0.050
Phenanthrene	ND		0.050
Anthracene	ND		0.050
Fluoranthene	ND		0.050
Pyrene	ND		0.050
Benzo[a]anthracene	ND		0.025
Chrysene	ND		0.025
Benzo[b]fluoranthene	ND		0.025
Benzo[k]fluoranthene	ND		0.025
Benzo[a]pyrene	ND		0.025
Indeno[1,2,3-cd]pyrene	ND		0.025
Dibenz[a,h]anthracene	ND		0.025
Benzo[g,h,i]perylene	ND		0.025

Surrogate	Percent Recovery	Control Limits
Nitrobenzene-d5	64	35 - 114
2-Fluorobiphenyl	86	43 - 116
Terphenyl-d14	80	33 - 144

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

PAH's by EPA 8270C Mod.
(Selective Ion Monitoring)

Date Extracted:	04-05-99
Date Analyzed:	04-06-99
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	04-003-03
Client ID:	**RFB-MW03-003**

Compound:	**Results**	**Flags**	**PQL**
Naphthalene	ND		0.050
2-Methylnaphthalene	ND		0.050
Acenaphthylene	ND		0.050
Acenathphene	ND		0.050
Fluorene	ND		0.050
Phenanthrene	ND		0.050
Anthracene	ND		0.050
Fluoranthene	ND		0.050
Pyrene	ND		0.050
Benzo[a]anthracene	ND		0.025
Chrysene	ND		0.025
Benzo[b]fluoranthene	ND		0.025
Benzo[k]fluoranthene	ND		0.025
Benzo[a]pyrene	ND		0.025
Indeno[1,2,3-cd]pyrene	ND		0.025
Dibenz[a,h]anthracene	ND		0.025
Benzo[g,h,i]perylene	ND		0.025

Surrogate	**Percent Recovery**	**Control Limits**
Nitrobenzene-d5	67	35 - 114
2-Fluorobiphenyl	86	43 - 116
Terphenyl-d14	80	33 - 144

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

PAH's by EPA 8270C Mod.
METHOD BLANK QUALITY CONTROL
(Selective Ion Monitoring)

Date Extracted:	04-05-99
Date Analyzed:	04-06-99
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	MB0405W1
Client ID:	

Compound:	Results	Flags	PQL
Naphthalene	ND		0.050
2-Methylnaphthalene	ND		0.050
Acenaphthylene	ND		0.050
Acenathphene	ND		0.050
Fluorene	ND		0.050
Phenanthrene	ND		0.050
Anthracene	ND		0.050
Fluoranthene	ND		0.050
Pyrene	ND		0.050
Benzo[a]anthracene	ND		0.025
Chrysene	ND		0.025
Benzo[b]fluoranthene	ND		0.025
Benzo[k]fluoranthene	ND		0.025
Benzo[a]pyrene	ND		0.025
Indeno[1,2,3-cd]pyrene	ND		0.025
Dibenz[a,h]anthracene	ND		0.025
Benzo[g,h,i]perylene	ND		0.025

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

PAH's by EPA 8270C Mod.
(Selective Ion Monitoring)

Date Extracted:	04-05-99
Date Analyzed:	04-06-99
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	04-003-03
Client ID:	**RFB-MW03-003**

Compound:	**Results**	**Flags**	**PQL**
Naphthalene	ND		0.050
2-Methylnaphthalene	ND		0.050
Acenaphthylene	ND		0.050
Acenathphene	ND		0.050
Fluorene	ND		0.050
Phenanthrene	ND		0.050
Anthracene	ND		0.050
Fluoranthene	ND		0.050
Pyrene	ND		0.050
Benzo[a]anthracene	ND		0.025
Chrysene	ND		0.025
Benzo[b]fluoranthene	ND		0.025
Benzo[k]fluoranthene	ND		0.025
Benzo[a]pyrene	ND		0.025
Indeno[1,2,3-cd]pyrene	ND		0.025
Dibenz[a,h]anthracene	ND		0.025
Benzo[g,h,i]perylene	ND		0.025

Surrogate	**Percent Recovery**	**Control Limits**
Nitrobenzene-d5	67	35 - 114
2-Fluorobiphenyl	86	43 - 116
Terphenyl-d14	80	33 - 144

Date of Report: April 13, 1999
Samples Submitted: April 1, 1999
Lab Traveler: 04-003
Project: V-1075-03

PAH's by EPA 8270C Mod.
SB/SBD QUALITY CONTROL
(Selective Ion Monitoring)

Date Extracted: 04-05-99
Date Analyzed: 04-07-99

Matrix: Water
Units: ug/L (ppb)

Lab ID: SB0405W1

Compound:	Spike Amount	SB	Percent Recovery	SBD	Percent Recovery	RPD
Phenol	100	27.6	28	29.9	30	8.0
2-Chlorophenol	100	65.8	66	76.8	77	15
1,4-Dichlorobenzene	50	37.1	74	41.8	84	12
N-Nitroso-di-n-propylamine	50	48.2	96	51.8	104	7.2
1,2,4-Trichlorobenzene	50	39.8	80	44.3	89	11
4-Chloro-3-methylphenol	100	72.9	73	76.6	77	4.9
Acenaphthene	50	39.1	78	42.1	84	7.4
2,4-Dinitrotoluene	50	40.2	80	42.7	85	6.0
4-Nitrophenol	100	29.8	30	32.0	32	7.1
Pentachlorophenol	100	45.6	46	55.9	56	20
Pyrene	50	40.1	80	42.3	85	5.3

OnSite Environmental Inc.

DATA QUALIFIERS AND ABBREVIATIONS

A - Due to high sample concentration, the amount spiked is insufficient for meaningful MS/MSD recovery data.

B - The analyte indicated was also found in the blank sample.

C - The duplicate RPD is outside control limits due to high result variability when analyte concentrations are within five times the quantitation limit.

D - Data from 1:____ dilution.

E - The value reported exceeds the quantitation range, and is an estimate.

F - Surrogate recovery data is not available due to the high concentration of coeluting target compounds.

G - Insufficient sample quantity for duplicate analysis.

J - The value reported was below the practical quantitation limit. The value is an estimate.

K - Sample duplicate RPD is outside control limits due to sample inhomogeniety. The sample was re-extracted and re-analyzed with similar results.

M - Predominantly _____ range hydrocarbons present in the sample.

N - Hydrocarbons in the gasoline range (C7-toluene) are present in the sample.

O - Hydrocarbons in the heavy oil range (>C24) are present in the sample.

P - Hydrocarbons in the diesel range (C12-C24) are present in the sample which are elevating the oil result.

Q - The RPD of the results between the two columns is greater than 25.

R - Hydrocarbons outside the defined gasoline range are present in the sample; NWTPH-Dx recommended.

S - Surrogate recovery data is not available due to the necessary dilution of the sample.

T - The sample chromatogram is not similar to a typical _____.

U - Matrix Spike/Matrix Spike Duplicate RPD are outside control limits due to matrix effects.

V - Matrix Spike/Matrix Spike Duplicate recoveries are outside control limits due to matrix effects.

X - Sample underwent silica gel cleanup procedures.

Y - Sample underwent acid cleanup procedures.

Z - Interferences were present which prevented the quantitation of the analyte below the detection limit reported.

ND - Not Detected
MRL - Method Reporting Limit
PQL - Practical Quantitation

DB

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CHAIN OF CUSTODY RECORD

Page 1 of 1
Laboratory On Site
Attn: D. Baumeister

400 N. 34th Street, Suite 100
Seattle, WA 98103
(206) 632-8020

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St. Louis, MO 63141
(314) 872-8170

1354 N. Grandridge Blvd.
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303 Wellsian Way
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2055 Hill Road
Fairbanks, AK 99709
(907) 479-0600

5430 Fairbanks Street, Suite 3
Anchorage, AK 99518
(907) 561-2120

2412 N. 30th St., Suite 201
Tacoma, WA 98407
(206) 759-0156

Analysis Parameters/Sample Container Description
(include preservative if used)

Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab	VOC (8260) incl. acetone	VPH	EPH	PAH 625 (SIM)			Total Number of Containers	Remarks/Matrix
RFB-mw02-003	1	11:15	3/31/99			X	X	X	X			8	groundwater
RFB-mw01-003	2	12:30	↓			X	X	X	X			8	↓
RFB-mw03-003	3	1:45	↓			X	X	X	X			8	↓
Trip Blank	4					X						2	water

Project Information		Sample Receipt	
Project Number:	V-1075-03	Total Number of Containers	
Project Name:	Federal Bldg	COC Seals/Intact? Y/N/NA	
Contact:	D. Parkes	Received Good Cond./Cold	
Ongoing Project?	Yes ☑ No ☐	Delivery Method:	UPS O/N
Sampler:	D. Parkes	(attach shipping bill, if any)	

Instructions

Requested Turn Around Time: Standard

Special Instructions:

Relinquished By: 1.	Relinquished By: 2.	Relinquished By: 3.
Signature: Donna Parkes Time: 4:00	Signature: Time:	Signature: Time:
Printed Name: Donna Parkes Date: 3-31-99	Printed Name: Date:	Printed Name: Date:
Company: Shannon & Wilson	Company:	Company:
Received By: 1.	**Received By: 2.**	**Received By: 3.**
Signature: Time:	Signature: Time:	Signature: Time:
Printed Name: Date: 4/1/99	Printed Name: Date:	Printed Name: Date:
Company:	Company:	Company:

Distribution: White - w/shipment - returned to Shannon & Wilson w/ Laboratory report
Yellow - w/shipment - for consignee files
Pink - Shannon & Wilson - Job File

F-19-91/UR

No.

SECTION A.3

VOLATILE ORGANIC COMPOUND (VOC) DATA

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

VOLATILES by EPA 8260B
page 1 of 2

Date Extracted:	12-11-98
Date Analyzed:	12-11-98
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	12-086-01
Client ID:	**RFB-MW02-002**

Compound	Results	Flags	PQL
Dichlorodifluoromethane	ND		1.0
Chloromethane	ND		1.0
Vinyl Chloride	ND		1.0
Bromomethane	ND		1.0
Chloroethane	ND		1.0
Trichlorofluoromethane	ND		1.0
1,1-Dichloroethene	ND		1.0
Methylene Chloride	ND		5.0
(trans) 1,2-Dichloroethene	ND		1.0
1,1-Dichloroethane	ND		1.0
2,2-Dichloropropane	ND		1.0
(cis) 1,2-Dichloroethene	4.5		1.0
Chloroform	ND		1.0
1,1,1-Trichloroethane	ND		1.0
Carbon Tetrachloride	ND		5.0
1,1-Dichloropropene	ND		1.0
Benzene	ND		1.0
1,2-Dichloroethane	ND		1.0
Trichloroethene	3.1		1.0
1,2-Dichloropropane	ND		1.0
Dibromomethane	ND		1.0
Bromodichloromethane	ND		1.0
(cis) 1,3-Dichloropropene	ND		1.0
Toluene	ND		1.0
(trans) 1,3-Dichloropropene	ND		1.0
1,1,2-Trichloroethane	ND		1.0
Tetrachloroethene	22		1.0
1,3-Dichloropropane	ND		1.0

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

VOLATILES by EPA 8260B
page 2 of 2

Lab ID: 12-086-01
Client ID: RFB-MW02-002

Compound	Results	Flags	PQL
Dibromochloromethane	ND		1.0
1,2-Dibromoethane	ND		1.0
Chlorobenzene	ND		1.0
1,1,1,2-Tetrachloroethane	ND		1.0
Ethylbenzene	ND		1.0
m,p-Xylene	ND		2.0
o-Xylene	ND		1.0
Styrene	ND		1.0
Bromoform	ND		1.0
Isopropylbenzene	ND		1.0
Bromobenzene	ND		1.0
1,1,2,2-Tetrachloroethane	ND		1.0
1,2,3-Trichloropropane	ND		5.0
n-Propylbenzene	ND		1.0
2-Chlorotoluene	ND		1.0
4-Chlorotoluene	ND		1.0
1,3,5-Trimethylbenzene	ND		1.0
tert-Butylbenzene	ND		1.0
1,2,4-Trimethylbenzene	ND		1.0
sec-Butylbenzene	ND		1.0
1,3-Dichlorobenzene	ND		1.0
p-Isopropyltoluene	ND		1.0
1,4-Dichlorobenzene	ND		1.0
1,2-Dichlorobenzene	ND		1.0
n-Butylbenzene	ND		1.0
1,2-Dibromo-3-chloropropane	ND		5.0
1,2,4-Trichlorobenzene	ND		1.0
Hexachlorobutadiene	ND		5.0
Naphthalene	ND		5.0
1,2,3-Trichlorobenzene	ND		1.0

Surrogate	Percent Recovery	Control Limits
Dibromofluoromethane	98	71-133
Toluene-d8	119	80-151
4-Bromofluorobenzene	131	75-139

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

VOLATILES by EPA 8260B
page 1 of 2

Date Extracted:	12-11-98
Date Analyzed:	12-11-98
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	12-086-02
Client ID:	**RFB-MW03-002**

Compound	Results	Flags	PQL
Dichlorodifluoromethane	ND		1.0
Chloromethane	ND		1.0
Vinyl Chloride	ND		1.0
Bromomethane	ND		1.0
Chloroethane	ND		1.0
Trichlorofluoromethane	ND		1.0
1,1-Dichloroethene	ND		1.0
Methylene Chloride	ND		5.0
(trans) 1,2-Dichloroethene	ND		1.0
1,1-Dichloroethane	ND		1.0
2,2-Dichloropropane	ND		1.0
(cis) 1,2-Dichloroethene	ND		1.0
Chloroform	9.9		1.0
1,1,1-Trichloroethane	ND		1.0
Carbon Tetrachloride	ND		5.0
1,1-Dichloropropene	ND		1.0
Benzene	ND		1.0
1,2-Dichloroethane	ND		1.0
Trichloroethene	ND		1.0
1,2-Dichloropropane	ND		1.0
Dibromomethane	ND		1.0
Bromodichloromethane	ND		1.0
(cis) 1,3-Dichloropropene	ND		1.0
Toluene	ND		1.0
(trans) 1,3-Dichloropropene	ND		1.0
1,1,2-Trichloroethane	ND		1.0
Tetrachloroethene	130		1.0
1,3-Dichloropropane	ND		1.0

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

VOLATILES by EPA 8260B
page 2 of 2

Lab ID: 12-086-02
Client ID: RFB-MW03-002

Compound	Results	Flags	PQL
Dibromochloromethane	ND		1.0
1,2-Dibromoethane	ND		1.0
Chlorobenzene	ND		1.0
1,1,1,2-Tetrachloroethane	ND		1.0
Ethylbenzene	ND		1.0
m,p-Xylene	ND		2.0
o-Xylene	ND		1.0
Styrene	ND		1.0
Bromoform	ND		1.0
Isopropylbenzene	ND		1.0
Bromobenzene	ND		1.0
1,1,2,2-Tetrachloroethane	ND		1.0
1,2,3-Trichloropropane	ND		5.0
n-Propylbenzene	ND		1.0
2-Chlorotoluene	ND		1.0
4-Chlorotoluene	ND		1.0
1,3,5-Trimethylbenzene	ND		1.0
tert-Butylbenzene	ND		1.0
1,2,4-Trimethylbenzene	ND		1.0
sec-Butylbenzene	ND		1.0
1,3-Dichlorobenzene	ND		1.0
p-Isopropyltoluene	ND		1.0
1,4-Dichlorobenzene	ND		1.0
1,2-Dichlorobenzene	ND		1.0
n-Butylbenzene	ND		1.0
1,2-Dibromo-3-chloropropane	ND		5.0
1,2,4-Trichlorobenzene	ND		1.0
Hexachlorobutadiene	ND		1.0
Naphthalene	ND		5.0
1,2,3-Trichlorobenzene	ND		1.0

Surrogate	Percent Recovery		Control Limits
Dibromofluoromethane	91		71-133
Toluene-d8	115		80-151
4-Bromofluorobenzene	144	*	75-139

* - Surrogate recovery is outside control limits.

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

VOLATILES by EPA 8260B
page 1 of 2

Date Extracted:	12-11-98
Date Analyzed:	12-11-98
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	12-086-03
Client ID:	**RFB-MW01-002**

Compound	Results	Flags	PQL
Dichlorodifluoromethane	ND		1.0
Chloromethane	ND		1.0
Vinyl Chloride	ND		1.0
Bromomethane	ND		1.0
Chloroethane	ND		1.0
Trichlorofluoromethane	ND		1.0
1,1-Dichloroethene	ND		1.0
Methylene Chloride	ND		5.0
(trans) 1,2-Dichloroethene	ND		1.0
1,1-Dichloroethane	ND		1.0
2,2-Dichloropropane	ND		1.0
(cis) 1,2-Dichloroethene	ND		1.0
Chloroform	24		1.0
1,1,1-Trichloroethane	ND		1.0
Carbon Tetrachloride	ND		5.0
1,1-Dichloropropene	ND		1.0
Benzene	ND		1.0
1,2-Dichloroethane	ND		1.0
Trichloroethene	ND		1.0
1,2-Dichloropropane	ND		1.0
Dibromomethane	ND		1.0
Bromodichloromethane	ND		1.0
(cis) 1,3-Dichloropropene	ND		1.0
Toluene	ND		1.0
(trans) 1,3-Dichloropropene	ND		1.0
1,1,2-Trichloroethane	ND		1.0
Tetrachloroethene	3.9		1.0
1,3-Dichloropropane	ND		1.0

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

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page 2 of 2

Lab ID: 12-086-03
Client ID: RFB-MW01-002

Compound	Results	Flags	PQL
Dibromochloromethane	ND		1.0
1,2-Dibromoethane	ND		1.0
Chlorobenzene	ND		1.0
1,1,1,2-Tetrachloroethane	ND		1.0
Ethylbenzene	ND		1.0
m,p-Xylene	ND		2.0
o-Xylene	ND		1.0
Styrene	ND		1.0
Bromoform	ND		1.0
Isopropylbenzene	ND		1.0
Bromobenzene	ND		1.0
1,1,2,2-Tetrachloroethane	ND		1.0
1,2,3-Trichloropropane	ND		5.0
n-Propylbenzene	ND		1.0
2-Chlorotoluene	ND		1.0
4-Chlorotoluene	ND		1.0
1,3,5-Trimethylbenzene	ND		1.0
tert-Butylbenzene	ND		1.0
1,2,4-Trimethylbenzene	ND		1.0
sec-Butylbenzene	ND		1.0
1,3-Dichlorobenzene	ND		1.0
p-Isopropyltoluene	ND		1.0
1,4-Dichlorobenzene	ND		1.0
1,2-Dichlorobenzene	ND		1.0
n-Butylbenzene	ND		1.0
1,2-Dibromo-3-chloropropane	ND		5.0
1,2,4-Trichlorobenzene	ND		1.0
Hexachlorobutadiene	ND		1.0
Naphthalene	ND		5.0
1,2,3-Trichlorobenzene	ND		1.0

Surrogate	Percent Recovery	Control Limits
Dibromofluoromethane	98	71-133
Toluene-d8	120	80-151
4-Bromofluorobenzene	135	75-139

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

VOLATILES by EPA 8260B
page 1 of 2

Date Extracted:	12-11-98
Date Analyzed:	12-11-98
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	12-086-04
Client ID:	**TRIP BLANK**

Compound	Results	Flags	PQL
Dichlorodifluoromethane	ND		1.0
Chloromethane	ND		1.0
Vinyl Chloride	ND		1.0
Bromomethane	ND		1.0
Chloroethane	ND		1.0
Trichlorofluoromethane	ND		1.0
1,1-Dichloroethene	ND		1.0
Methylene Chloride	6.6		5.0
(trans) 1,2-Dichloroethene	ND		1.0
1,1-Dichloroethane	ND		1.0
2,2-Dichloropropane	ND		1.0
(cis) 1,2-Dichloroethene	ND		1.0
Chloroform	ND		1.0
1,1,1-Trichloroethane	ND		1.0
Carbon Tetrachloride	ND		5.0
1,1-Dichloropropene	ND		1.0
Benzene	ND		1.0
1,2-Dichloroethane	ND		1.0
Trichloroethene	ND		1.0
1,2-Dichloropropane	ND		1.0
Dibromomethane	ND		1.0
Bromodichloromethane	ND		1.0
(cis) 1,3-Dichloropropene	ND		1.0
Toluene	2.7		1.0
(trans) 1,3-Dichloropropene	ND		1.0
1,1,2-Trichloroethane	ND		1.0
Tetrachloroethene	ND		1.0
1,3-Dichloropropane	ND		1.0

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

VOLATILES by EPA 8260B
page 2 of 2

Lab ID: 12-086-04
Client ID: TRIP BLANK

Compound	Results	Flags	PQL
Dibromochloromethane	ND		1.0
1,2-Dibromoethane	ND		1.0
Chlorobenzene	ND		1.0
1,1,1,2-Tetrachloroethane	ND		1.0
Ethylbenzene	ND		1.0
m,p-Xylene	ND		2.0
o-Xylene	ND		1.0
Styrene	ND		1.0
Bromoform	ND		1.0
Isopropylbenzene	ND		1.0
Bromobenzene	ND		1.0
1,1,2,2-Tetrachloroethane	ND		1.0
1,2,3-Trichloropropane	ND		5.0
n-Propylbenzene	ND		1.0
2-Chlorotoluene	ND		1.0
4-Chlorotoluene	ND		1.0
1,3,5-Trimethylbenzene	ND		1.0
tert-Butylbenzene	ND		1.0
1,2,4-Trimethylbenzene	ND		1.0
sec-Butylbenzene	ND		1.0
1,3-Dichlorobenzene	ND		1.0
p-Isopropyltoluene	ND		1.0
1,4-Dichlorobenzene	ND		1.0
1,2-Dichlorobenzene	ND		1.0
n-Butylbenzene	ND		1.0
1,2-Dibromo-3-chloropropane	ND		5.0
1,2,4-Trichlorobenzene	ND		1.0
Hexachlorobutadiene	ND		1.0
Naphthalene	ND		5.0
1,2,3-Trichlorobenzene	ND		1.0

Surrogate	Percent Recovery	Control Limits
Dibromofluoromethane	94	71-133
Toluene-d8	116	80-151
4-Bromofluorobenzene	138	75-139

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

VOLATILES by EPA 8260B
METHOD BLANK QUALITY CONTROL
page 1 of 2

Date Extracted:	12-11-98
Date Analyzed:	12-11-98
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	MB1211W1

Compound	Results	Flags	PQL
Dichlorodifluoromethane	ND		1.0
Chloromethane	ND		1.0
Vinyl Chloride	ND		1.0
Bromomethane	ND		1.0
Chloroethane	ND		1.0
Trichlorofluoromethane	ND		1.0
1,1-Dichloroethene	ND		1.0
Methylene Chloride	ND		5.0
(trans) 1,2-Dichloroethene	ND		1.0
1,1-Dichloroethane	ND		1.0
2,2-Dichloropropane	ND		1.0
(cis) 1,2-Dichloroethene	ND		1.0
Chloroform	ND		1.0
1,1,1-Trichloroethane	ND		1.0
Carbon Tetrachloride	ND		5.0
1,1-Dichloropropene	ND		1.0
Benzene	ND		1.0
1,2-Dichloroethane	ND		1.0
Trichloroethene	ND		1.0
1,2-Dichloropropane	ND		1.0
Dibromomethane	ND		1.0
Bromodichloromethane	ND		1.0
(cis) 1,3-Dichloropropene	ND		1.0
Toluene	ND		1.0
(trans) 1,3-Dichloropropene	ND		1.0
1,1,2-Trichloroethane	ND		1.0
Tetrachloroethene	ND		1.0
1,3-Dichloropropane	ND		1.0

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

VOLATILES by EPA 8260B
METHOD BLANK QUALITY CONTROL
page 2 of 2

Lab ID: MB1211W1

Compound	Results	Flags	PQL
Dibromochloromethane	ND		1.0
1,2-Dibromoethane	ND		1.0
Chlorobenzene	ND		1.0
1,1,1,2-Tetrachloroethane	ND		1.0
Ethylbenzene	ND		1.0
m,p-Xylene	ND		2.0
o-Xylene	ND		1.0
Styrene	ND		1.0
Bromoform	ND		1.0
Isopropylbenzene	ND		1.0
Bromobenzene	ND		1.0
1,1,2,2-Tetrachloroethane	ND		1.0
1,2,3-Trichloropropane	ND		5.0
n-Propylbenzene	ND		1.0
2-Chlorotoluene	ND		1.0
4-Chlorotoluene	ND		1.0
1,3,5-Trimethylbenzene	ND		1.0
tert-Butylbenzene	ND		1.0
1,2,4-Trimethylbenzene	ND		1.0
sec-Butylbenzene	ND		1.0
1,3-Dichlorobenzene	ND		1.0
p-Isopropyltoluene	ND		1.0
1,4-Dichlorobenzene	ND		1.0
1,2-Dichlorobenzene	ND		1.0
n-Butylbenzene	ND		1.0
1,2-Dibromo-3-chloropropane	ND		5.0
1,2,4-Trichlorobenzene	ND		1.0
Hexachlorobutadiene	ND		5.0
Naphthalene	ND		5.0
1,2,3-Trichlorobenzene	ND		1.0

Surrogate	Percent Recovery		Control Limits
Dibromofluoromethane	97		71-133
Toluene-d8	115		80-151
4-Bromofluorobenzene	140	*	75-139

* - Surrogate recovery is outside control limits.

Date of Report: December 30, 1998
Samples Submitted: December 10, 1998
Lab Traveler: 12-086
Project: V-1075-03

VOLATILES by EPA 8260B
SB/SBD QUALITY CONTROL

Date Extracted: 12-11-98
Date Analyzed: 12-12-98

Matrix: Water
Units: ug/L (ppb)

Lab ID: SB1211W1

Compound	Spike Amount	SB	Percent Recovery	SBD	Percent Recovery	RPD	
1,1-Dichloroethene	250	218	87	233	93	6.4	
Benzene	250	206	82	203	81	1.3	
Trichloroethene	250	247	99	252	101	2.1	
Toluene	250	237	95	252	101	6.0	**
Chlorobenzene	250	236	95	242	97	2.2	

** RPD is outside control limits.

PBS
ENVIRONMENTAL

5 August 1997

Henry Ong
Project Manager - Richland Federal Building
Abide International Inc.
P.O. Box 1631
Richland, Washington 99352

Re: Analytical Results of Soil Samples Collected From Beneath Chemical USTs

Dear Mr. Ong:

On July 17, 1997 PBS monitored the excavation of three chemical underground storage tanks USTs. The three tanks were located in the front of the Richland Federal Building (east side) and were installed in a row in an east-west orientation. Excavation of the tanks began at approximately 12:30 pm and by 3:30 pm, all three tanks were out of the ground and blocked-up on plastic sheeting. No visual or olfactory evidence of leakage was observed during the excavation of these tanks. The tanks and piping were coated with a heavy asphaltic material and appeared to be in very good condition. Supply piping to the tanks appeared to be welded at the joints. Due to the presence of structures preventing the excavation of the supply piping, the supply piping was abandoned in place. All fill and vent piping was excavated and disposed of with the three USTs.

PBS collected three soil samples from the bottom of the finished excavation (one sample from beneath each tank). As a quality control measure, one of the samples was split in the field and submitted for analysis as a sample duplicate. Each sample was collected from a depth of approximately 1 foot beneath the bottoms of each tank which correlated with a total depth of approximately 9.5 feet below ground surface. The soil in the vicinity of the tanks consisted of a course sandy gravel mixed with river cobbles. No evidence of ground water was observed during the excavation activities. Samples STX 1 and STX 2 were collected from beneath the west tank, sample STX-3 was collected from beneath the center tank and sample STX-4 was collected from beneath the west tank. These samples were transported under chain of custody to North Creek Analytical in Portland, Oregon. The tanks formerly stored solvents for use in the maintenance of printing equipment.

Each of the four samples was analyzed for volatile organic compounds by EPA Method 8260. This analysis tests for 63 different organic compounds. No detectable levels of any of these

compounds were identified in any of the four samples submitted for analysis. These findings provide additional evidence supporting PBS' earlier observations that indicated that these tanks had not leaked.

Attached to this letter is a copy of the final analytical report and the chain of custody form. If you have any questions regarding this information, please contact me at your convenience.

Sincerely,

Douglas Hancock
Project Manager

PBS Environmental	Project: Federal Building	Sampled: 7/17/97
1220 SW Morrison	Project Number: 5950.01	Received: 7/18/97
Portland, OR 97205	Project Manager: Doug Hancock	Reported: 8/1/97 13:55

ANALYTICAL REPORT FOR SAMPLES:

Sample Description	Laboratory Sample Number	Sample Matrix	Date Sampled
STX-1	P707335-01	Soil	7/17/97
STX-2	P707335-02	Soil	7/17/97
STX-3	P707335-03	Soil	7/17/97
STX-4	P707335-04	Soil	7/17/97

The results in this report apply to the samples analyzed in accordance with the chain of custody docume
This analytical report must be reproduced in its entire

Howard Holmes, Project Manager

PBS Environmental	Project: Federal Building	Sampled: 7/17/97
1220 SW Morrison	Project Number: 5950.01	Received: 7/18/97
Portland, OR 97205	Project Manager: Doug Hancock	Reported: 8/1/97 13:55

Volatile Organic Compounds per EPA Method 8260A
North Creek Analytical - Portland

Analyte	Batch Number	Date Prepared	Date Analyzed	Surrogate Limits	Reporting Limit	Result	Units	Notes*
STX-1			P707335-01				Soil	
Acetone	0870017	7/31/97	7/31/97		1250	ND	ug/kg dry	
Benzene	"	"	"		50.0	ND	"	
Bromobenzene	"	"	"		50.0	ND	"	
Bromochloromethane	"	"	"		50.0	ND	"	
Bromodichloromethane	"	"	"		50.0	ND	"	
Bromoform	"	"	"		100	ND	"	
Bromomethane	"	"	"		500	ND	"	
2-Butanone	"	"	"		1250	ND	"	
n-Butylbenzene	"	"	"		50.0	ND	"	
sec-Butylbenzene	"	"	"		50.0	ND	"	
tert-Butylbenzene	"	"	"		50.0	ND	"	
Carbon tetrachloride	"	"	"		50.0	ND	"	
Chlorobenzene	"	"	"		50.0	ND	"	
Chloroethane	"	"	"		100	ND	"	
Chloroform	"	"	"		50.0	ND	"	
Chloromethane	"	"	"		250	ND	"	
2-Chlorotoluene	"	"	"		50.0	ND	"	
4-Chlorotoluene	"	"	"		50.0	ND	"	
1,2-Dibromo-3-chloropropane	"	"	"		250	ND	"	
Dibromochloromethane	"	"	"		50.0	ND	"	
1,2-Dibromoethane	"	"	"		50.0	ND	"	
Dibromomethane	"	"	"		50.0	ND	"	
1,2-Dichlorobenzene	"	"	"		50.0	ND	"	
1,3-Dichlorobenzene	"	"	"		50.0	ND	"	
1,4-Dichlorobenzene	"	"	"		50.0	ND	"	
Dichlorodifluoromethane	"	"	"		100	ND	"	
1,1-Dichloroethane	"	"	"		50.0	ND	"	
1,2-Dichloroethane	"	"	"		50.0	ND	"	
1,1-Dichloroethene	"	"	"		50.0	ND	"	
cis-1,2-Dichloroethene	"	"	"		50.0	ND	"	
trans-1,2-Dichloroethene	"	"	"		50.0	ND	"	
1,2-Dichloropropane	"	"	"		50.0	ND	"	
1,3-Dichloropropane	"	"	"		50.0	ND	"	
2,2-Dichloropropane	"	"	"		50.0	ND	"	
1,1-Dichloropropene	"	"	"		50.0	ND	"	
cis-1,3-Dichloropropene	"	"	"		50.0	ND	"	
trans-1,3-Dichloropropene	"	"	"		50.0	ND	"	
Ethylbenzene	"	"	"		50.0	ND	"	

North Creek Analytical, Inc.

*Refer to end of report for text of notes and definit

Howard Holmes, Project Manager

PBS Environmental	Project: Federal Building	Sampled: 7/17/97
1220 SW Morrison	Project Number: 5950.01	Received: 7/18/97
Portland, OR 97205	Project Manager: Doug Hancock	Reported: 8/1/97 13:55

Volatile Organic Compounds per EPA Method 8260A
North Creek Analytical - Portland

Analyte	Batch Number	Date Prepared	Date Analyzed	Surrogate Limits	Reporting Limit	Result	Units	Notes*
STX-1 (continued)			P707335-01				Soil	
Hexachlorobutadiene	0870017	7/31/97	7/31/97		100	ND	ug/kg dry	
2-Hexanone	"	"	"		250	ND	"	
Isopropylbenzene	"	"	"		50.0	ND	"	
p-Isopropyltoluene	"	"	"		50.0	ND	"	
4-Methyl-2-pentanone	"	"	"		250	ND	"	
Methylene chloride	"	"	"		500	ND	"	
Naphthalene	"	"	"		100	ND	"	
n-Propylbenzene	"	"	"		50.0	ND	"	
Styrene	"	"	"		50.0	ND	"	
1,1,1,2-Tetrachloroethane	"	"	"		50.0	ND	"	
1,1,2,2-Tetrachloroethane	"	"	"		50.0	ND	"	
Tetrachloroethene	"	"	"		50.0	ND	"	
Toluene	"	"	"		50.0	ND	"	
1,2,3-Trichlorobenzene	"	"	"		50.0	ND	"	
1,2,4-Trichlorobenzene	"	"	"		50.0	ND	"	
1,1,1-Trichloroethane	"	"	"		50.0	ND	"	
1,1,2-Trichloroethane	"	"	"		50.0	ND	"	
Trichloroethene	"	"	"		50.0	ND	"	
Trichlorofluoromethane	"	"	"		50.0	ND	"	
1,2,3-Trichloropropane	"	"	"		50.0	ND	"	
1,2,4-Trimethylbenzene	"	"	"		50.0	ND	"	
1,3,5-Trimethylbenzene	"	"	"		50.0	ND	"	
Vinyl chloride	"	"	"		100	ND	"	
o-Xylene	"	"	"		50.0	ND	"	
m,p-Xylene	"	"	"		50.0	ND	"	
Surrogate: 4-BFB	"	"	"	*65.0-130*		*106*	%	
Surrogate: Dibromofluoromethane	"	"	"	*65.0-130*		*150*	"	1
Surrogate: Toluene-d8	"	"	"	*65.0-130*		*92.6*	"	

PBS Environmental	Project: Federal Building	Sampled: 7/17/97
1220 SW Morrison	Project Number: 5950.01	Received: 7/18/97
Portland, OR 97205	Project Manager: Doug Hancock	Reported: 8/1/97 13:55

Volatile Organic Compounds per EPA Method 8260A
North Creek Analytical - Portland

Analyte	Batch Number	Date Prepared	Date Analyzed	Surrogate Limits	Reporting Limit	Result	Units	Notes*
STX-2			P707335-02				Soil	
Acetone	0870017	7/31/97	7/31/97		1250	ND	ug/kg dry	
Benzene	"	"	"		50.0	ND	"	
Bromobenzene	"	"	"		50.0	ND	"	
Bromochloromethane	"	"	"		50.0	ND	"	
Bromodichloromethane	"	"	"		50.0	ND	"	
Bromoform	"	"	"		100	ND	"	
Bromomethane	"	"	"		500	ND	"	
2-Butanone	"	"	"		1250	ND	"	
n-Butylbenzene	0870017	7/31/97	7/31/97		50.0	ND	ug/kg dry	
sec-Butylbenzene	"	"	"		50.0	ND	"	
tert-Butylbenzene	"	"	"		50.0	ND	"	
Carbon tetrachloride	"	"	"		50.0	ND	"	
Chlorobenzene	"	"	"		50.0	ND	"	
Chloroethane	"	"	"		100	ND	"	
Chloroform	"	"	"		50.0	ND	"	
Chloromethane	"	"	"		250	ND	"	
2-Chlorotoluene	"	"	"		50.0	ND	"	
4-Chlorotoluene	"	"	"		50.0	ND	"	
1,2-Dibromo-3-chloropropane	"	"	"		250	ND	"	
Dibromochloromethane	"	"	"		50.0	ND	"	
1,2-Dibromoethane	"	"	"		50.0	ND	"	
Dibromomethane	"	"	"		50.0	ND	"	
1,2-Dichlorobenzene	"	"	"		50.0	ND	"	
1,3-Dichlorobenzene	"	"	"		50.0	ND	"	
1,4-Dichlorobenzene	"	"	"		50.0	ND	"	
Dichlorodifluoromethane	"	"	"		100	ND	"	
1,1-Dichloroethane	"	"	"		50.0	ND	"	
1,2-Dichloroethane	"	"	"		50.0	ND	"	
1,1-Dichloroethene	"	"	"		50.0	ND	"	
cis-1,2-Dichloroethene	"	"	"		50.0	ND	"	
trans-1,2-Dichloroethene	"	"	"		50.0	ND	"	
1,2-Dichloropropane	"	"	"		50.0	ND	"	
1,3-Dichloropropane	"	"	"		50.0	ND	"	
2,2-Dichloropropane	"	"	"		50.0	ND	"	
1,1-Dichloropropene	"	"	"		50.0	ND	"	
cis-1,3-Dichloropropene	"	"	"		50.0	ND	"	
trans-1,3-Dichloropropene	"	"	"		50.0	ND	"	
Ethylbenzene	"	"	"		50.0	ND	"	

North Creek Analytical, Inc.

*Refer to end of report for text of notes and definiti

Howard Holmes, Project Manager

PDS Environmental	Project: Federal Building	Sampled: 7/17/97
1220 SW Morrison	Project Number: 5950.01	Received: 7/18/97
Portland, OR 97205	Project Manager: Doug Hancock	Reported: 8/1/97 13:55

Volatile Organic Compounds per EPA Method 8260A
North Creek Analytical - Portland

Analyte	Batch Number	Date Prepared	Date Analyzed	Surrogate Limits	Reporting Limit	Result	Units	Notes*
STX-2 (continued)			P707335-02				Soil	
Hexachlorobutadiene	0870017	7/31/97	7/31/97		100	ND	ug/kg dry	
2-Hexanone	"	"	"		250	ND	"	
Isopropylbenzene	"	"	"		50.0	ND	"	
p-Isopropyltoluene	"	"	"		50.0	ND	"	
4-Methyl-2-pentanone	"	"	"		250	ND	"	
Methylene chloride	"	"	"		500	ND	"	
Naphthalene	"	"	"		100	ND	"	
n-Propylbenzene	"	"	"		50.0	ND	"	
Styrene	"	"	"		50.0	ND	"	
1,1,1,2-Tetrachloroethane	"	"	"		50.0	ND	"	
1,1,2,2-Tetrachloroethane	"	"	"		50.0	ND	"	
Tetrachloroethene	"	"	"		50.0	ND	"	
Toluene	"	"	"		50.0	ND	"	
1,2,3-Trichlorobenzene	"	"	"		50.0	ND	"	
1,2,4-Trichlorobenzene	"	"	"		50.0	ND	"	
1,1,1-Trichloroethane	"	"	"		50.0	ND	"	
1,1,2-Trichloroethane	"	"	"		50.0	ND	"	
Trichloroethene	"	"	"		50.0	ND	"	
Trichlorofluoromethane	"	"	"		50.0	ND	"	
1,2,3-Trichloropropane	"	"	"		50.0	ND	"	
1,2,4-Trimethylbenzene	"	"	"		50.0	ND	"	
1,3,5-Trimethylbenzene	"	"	"		50.0	ND	"	
Vinyl chloride	"	"	"		100	ND	"	
o-Xylene	"	"	"		50.0	ND	"	
m,p-Xylene	"	"	"		50.0	ND	"	
Surrogate: 4-BFB	"	"	"	*65.0-130*		*103*	%	
Surrogate: Dibromofluoromethane	"	"	"	*65.0-130*		*131*	"	J
Surrogate: Toluene-d8	"	"	"	*65.0-130*		*95.3*	"	

PBS Environmental	Project:	Federal Building	Sampled: 7/17/97
1220 SW Morrison	Project Number:	5950.01	Received: 7/18/97
Portland, OR 97205	Project Manager:	Doug Hancock	Reported: 8/1/97 13:55

Volatile Organic Compounds per EPA Method 8260A
North Creek Analytical - Portland

Analyte	Batch Number	Date Prepared	Date Analyzed	Surrogate Limits	Reporting Limit	Result	Units	Note
STX-3			P707335-03				Soil	
Acetone	0870017	7/31/97	7/31/97		1250	ND	ug/kg dry	
Benzene	"	"	"		50.0	ND	"	
Bromobenzene	"	"	"		50.0	ND	"	
Bromochloromethane	"	"	"		50.0	ND	"	
Bromodichloromethane	"	"	"		50.0	ND	"	
Bromoform	"	"	"		100	ND	"	
Bromomethane	"	"	"		500	ND	"	
2-Butanone	"	"	"		1250	ND	"	
n-Butylbenzene	0870017	7/31/97	7/31/97		50.0	ND	ug/kg dry	
sec-Butylbenzene	"	"	"		50.0	ND	"	
tert-Butylbenzene	"	"	"		50.0	ND	"	
Carbon tetrachloride	"	"	"		50.0	ND	"	
Chlorobenzene	"	"	"		50.0	ND	"	
Chloroethane	"	"	"		100	ND	"	
Chloroform	"	"	"		50.0	ND	"	
Chloromethane	"	"	"		250	ND	"	
2-Chlorotoluene	"	"	"		50.0	ND	"	
4-Chlorotoluene	"	"	"		50.0	ND	"	
1,2-Dibromo-3-chloropropane	"	"	"		250	ND	"	
Dibromochloromethane	"	"	"		50.0	ND	"	
1,2-Dibromoethane	"	"	"		50.0	ND	"	
Dibromomethane	"	"	"		50.0	ND	"	
1,2-Dichlorobenzene	"	"	"		50.0	ND	"	
1,3-Dichlorobenzene	"	"	"		50.0	ND	"	
1,4-Dichlorobenzene	"	"	"		50.0	ND	"	
Dichlorodifluoromethane	"	"	"		100	ND	"	
1,1-Dichloroethane	"	"	"		50.0	ND	"	
1,2-Dichloroethane	"	"	"		50.0	ND	"	
1,1-Dichloroethene	"	"	"		50.0	ND	"	
cis-1,2-Dichloroethene	"	"	"		50.0	ND	"	
trans-1,2-Dichloroethene	"	"	"		50.0	ND	"	
1,2-Dichloropropane	"	"	"		50.0	ND	"	
1,3-Dichloropropane	"	"	"		50.0	ND	"	
2,2-Dichloropropane	"	"	"		50.0	ND	"	
1,1-Dichloropropene	"	"	"		50.0	ND	"	
cis-1,3-Dichloropropene	"	"	"		50.0	ND	"	
trans-1,3-Dichloropropene	"	"	"		50.0	ND	"	
Ethylbenzene	"	"	"		50.0	ND	"	

North Creek Analytical, Inc. *Refer to end of report for text of notes and definitions

Howard Holmes, Project Manager

PBS Environmental	Project:	Federal Building	Sampled: 7/17/97
1220 SW Morrison	Project Number:	5950.01	Received: 7/18/97
Portland, OR 97205	Project Manager:	Doug Hancock	Reported: 8/1/97 13:55

Volatile Organic Compounds per EPA Method 8260A
North Creek Analytical - Portland

Analyte	Batch Number	Date Prepared	Date Analyzed	Surrogate Limits	Reporting Limit	Result	Units	Notes*
STX-3 (continued)			**P707335-03**				**Soil**	
Hexachlorobutadiene	0870017	7/31/97	7/31/97		100	ND	ug/kg dry	
2-Hexanone	"	"	"		250	ND	"	
Isopropylbenzene	"	"	"		50.0	ND	"	
p-Isopropyltoluene	"	"	"		50.0	ND	"	
4-Methyl-2-pentanone	"	"	"		250	ND	"	
Methylene chloride	"	"	"		500	ND	"	
Naphthalene	"	"	"		100	ND	"	
n-Propylbenzene	"	"	"		50.0	ND	"	
Styrene	"	"	"		50.0	ND	"	
1,1,1,2-Tetrachloroethane	"	"	"		50.0	ND	"	
1,1,2,2-Tetrachloroethane	"	"	"		50.0	ND	"	
Tetrachloroethene	"	"	"		50.0	ND	"	
Toluene	"	"	"		50.0	ND	"	
1,2,3-Trichlorobenzene	"	"	"		50.0	ND	"	
1,2,4-Trichlorobenzene	"	"	"		50.0	ND	"	
1,1,1-Trichloroethane	"	"	"		50.0	ND	"	
1,1,2-Trichloroethane	"	"	"		50.0	ND	"	
Trichloroethene	"	"	"		50.0	ND	"	
Trichlorofluoromethane	"	"	"		50.0	ND	"	
1,2,3-Trichloropropane	"	"	"		50.0	ND	"	
1,2,4-Trimethylbenzene	"	"	"		50.0	ND	"	
1,3,5-Trimethylbenzene	"	"	"		50.0	ND	"	
Vinyl chloride	"	"	"		100	ND	"	
o-Xylene	"	"	"		50.0	ND	"	
m,p-Xylene	"	"	"		50.0	ND	"	
Surrogate: 4-BFB	"	"	"	*65.0-130*		*104*	*%*	
Surrogate: Dibromofluoromethane	"	"	"	*65.0-130*		*136*	"	*1*
Surrogate: Toluene-d8	"	"	"	*65.0-130*		*97.1*	"	

North Creek Analytical, Inc.

*Refer to end of report for text of notes and definitions

Howard Holmes, Project Manager

PBS Environmental	Project: Federal Building	Sampled: 7/17/97
1220 SW Morrison	Project Number: 5950.01	Received: 7/18/97
Portland, OR 97205	Project Manager: Doug Hancock	Reported: 8/1/97 13:55

Volatile Organic Compounds per EPA Method 8260A
North Creek Analytical - Portland

Analyte	Batch Number	Date Prepared	Date Analyzed	Surrogate Limits	Reporting Limit	Result	Units	Notes*
STX-4			**P707335-04**				**Soil**	
Acetone	0870017	7/31/97	7/31/97		1250	ND	ug/kg dry	
Benzene	"	"	"		50.0	ND	"	
Bromobenzene	"	"	"		50.0	ND	"	
Bromochloromethane	"	"	"		50.0	ND	"	
Bromodichloromethane	"	"	"		50.0	ND	"	
Bromoform	"	"	"		100	ND	"	
Bromomethane	"	"	"		500	ND	"	
2-Butanone	"	"	"		1250	ND	"	
n-Butylbenzene	0870017	7/31/97	7/31/97		50.0	ND	ug/kg dry	
sec-Butylbenzene	"	"	"		50.0	ND	"	
tert-Butylbenzene	"	"	"		50.0	ND	"	
Carbon tetrachloride	"	"	"		50.0	ND	"	
Chlorobenzene	"	"	"		50.0	ND	"	
Chloroethane	"	"	"		100	ND	"	
Chloroform	"	"	"		50.0	ND	"	
Chloromethane	"	"	"		250	ND	"	
2-Chlorotoluene	"	"	"		50.0	ND	"	
4-Chlorotoluene	"	"	"		50.0	ND	"	
1,2-Dibromo-3-chloropropane	"	"	"		250	ND	"	
Dibromochloromethane	"	"	"		50.0	ND	"	
1,2-Dibromoethane	"	"	"		50.0	ND	"	
Dibromomethane	"	"	"		50.0	ND	"	
1,2-Dichlorobenzene	"	"	"		50.0	ND	"	
1,3-Dichlorobenzene	"	"	"		50.0	ND	"	
1,4-Dichlorobenzene	"	"	"		50.0	ND	"	
Dichlorodifluoromethane	"	"	"		100	ND	"	
1,1-Dichloroethane	"	"	"		50.0	ND	"	
1,2-Dichloroethane	"	"	"		50.0	ND	"	
1,1-Dichloroethene	"	"	"		50.0	ND	"	
cis-1,2-Dichloroethene	"	"	"		50.0	ND	"	
trans-1,2-Dichloroethene	"	"	"		50.0	ND	"	
1,2-Dichloropropane	"	"	"		50.0	ND	"	
1,3-Dichloropropane	"	"	"		50.0	ND	"	
2,2-Dichloropropane	"	"	"		50.0	ND	"	
1,1-Dichloropropene	"	"	"		50.0	ND	"	
cis-1,3-Dichloropropene	"	"	"		50.0	ND	"	
trans-1,3-Dichloropropene	"	"	"		50.0	ND	"	
Ethylbenzene	"	"	"		50.0	ND	"	

North Creek Analytical, Inc.

*Refer to end of report for text of notes and definitions.

Howard Holmes, Project Manager

PBS Environmental	Project:	Federal Building	Sampled: 7/17/97
1220 SW Morrison	Project Number:	5950.01	Received: 7/18/97
Portland, OR 97205	Project Manager:	Doug Hancock	Reported: 8/1/97 13:55

Volatile Organic Compounds per EPA Method 8260A
North Creek Analytical - Portland

Analyte	Batch Number	Date Prepared	Date Analyzed	Surrogate Limits	Reporting Limit	Result	Units	Notes*
STX-4 (continued)			P707335-04				Soil	
Hexachlorobutadiene	0870017	7/31/97	7/31/97		100	ND	ug/kg dry	
2-Hexanone	"	"	"		250	ND	"	
Isopropylbenzene	"	"	"		50.0	ND	"	
p-Isopropyltoluene	"	"	"		50.0	ND	"	
4-Methyl-2-pentanone	"	"	"		250	ND	"	
Methylene chloride	"	"	"		500	ND	"	
Naphthalene	"	"	"		100	ND	"	
n-Propylbenzene	"	"	"		50.0	ND	"	
Styrene	"	"	"		50.0	ND	"	
1,1,1,2-Tetrachloroethane	"	"	"		50.0	ND	"	
1,1,2,2-Tetrachloroethane	"	"	"		50.0	ND	"	
Tetrachloroethene	"	"	"		50.0	ND	"	
Toluene	"	"	"		50.0	ND	"	
1,2,3-Trichlorobenzene	"	"	"		50.0	ND	"	
1,2,4-Trichlorobenzene	"	"	"		50.0	ND	"	
1,1,1-Trichloroethane	"	"	"		50.0	ND	"	
1,1,2-Trichloroethane	"	"	"		50.0	ND	"	
Trichloroethene	"	"	"		50.0	ND	"	
Trichlorofluoromethane	"	"	"		50.0	ND	"	
1,2,3-Trichloropropane	"	"	"		50.0	ND	"	
1,2,4-Trimethylbenzene	"	"	"		50.0	ND	"	
1,3,5-Trimethylbenzene	"	"	"		50.0	ND	"	
Vinyl chloride	"	"	"		100	ND	"	
o-Xylene	"	"	"		50.0	ND	"	
m,p-Xylene	"	"	"		50.0	ND	"	
Surrogate: 4-BFB	"	"	"	*65.0-130*		*110*	%	
Surrogate: Dibromofluoromethane	"	"	"	*65.0-130*		*134*	"	*1*
Surrogate: Toluene-d8	"	"	"	*65.0-130*		*95.2*	"	

NORTH CREEK ANALYTICAL
Environmental Laboratory Services

18939 120th Avenue N.E., Suite 101, Bothell, WA 98011-9508 (206) 481-9200 FAX 485-2992
East 11115 Montgomery, Suite B, Spokane, WA 99206-4779 (509) 924-9200 FAX 924-9290
9405 S.W. Nimbus Avenue, Beaverton, OR 97008-7132 (503) 643-9200 FAX 644-2202

CHAIN OF CUSTODY REPORT

Work Order #

ORT TO:
ENTION: HANCOCK
RESS: PBS ENVIRONMENTAL
NE: 248-1939 FAX: 248-0223
JECT NAME: FEDERAL BUILDING
JECT NUMBER: 5950.01
PLED BY: DH

INVOICE TO:
ATTENTION:
ADDRESS:
P.O. NUMBER: NCA QUOTE #:

TURNAROUND REQUEST in Business Days *
EA
Organic & Inorganic Analyses: 10 (Standard) | 7 | 5 | 4 | 3 | 2 | X | Same Day
Fuels & Hydrocarbon Analyses: 5 (Standard) | 3-4 | 2 | 1 | Same Day
OTHER Specify:
* Turnaround Requests less than standard may incur Rush Charges.

CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	NCA SAMPLE ID (Laboratory Use Only)	Analysis Request: VOCs 8260	MATRIX (W, S, A, O)	# OF CONTAINERS	COMMENTS
STX-1	7/17/97		X			
STX-2			X			
STX-3			X			
STX-4			X			

RELINQUISHED BY: Erik Anderson DATE: 7-18-97
PRINT NAME: Erik Anderson FIRM: PBS TIME: 15:45

RECEIVED BY: Claire Mull DATE: 7/18/97
PRINT NAME: Claire Mull FIRM: NCA TIME: 15:45

RELINQUISHED BY: DATE:
PRINT NAME: FIRM: TIME:

RECEIVED BY: DATE:
PRINT NAME: FIRM: TIME:

ADDITIONAL REMARKS:

JAN-12-1999 16:07
TOTAL P.13
P.13/13

APPENDIX B

IMPORTANT INFORMATION ABOUT YOUR ENVIRONMENTAL REPORT

Important Information About Your Geotechnical/Environmental Report

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include: the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used: (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors which were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The

consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the
ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland