Additional Environmental Assessment
3607 and 3609 Spenard Road
Anchorage, Alaska

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Alaska Department of Environmental Conservation
Contaminated Sites, Reuse & Redevelopment Program
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Fairbanks, Alaska 99709

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ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
ABCA	Analysis of Brownfields Cleanup Alternatives
ACM	Asbestos-Containing Material
ADEC	Alaska Department of Environmental Conservation
AHFC	Alaska Housing Finance Corp
AS	Air Sparge
ASTM	ASTM International
AWWU	Anchorage Water and Wastewater Utility
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CC	Cleanup Complete
CCIC	Cleanup Complete with Institutional Controls
CIHA	Cook Inlet Housing Authority
COBC	Compliance Order by Consent
COCs	Contaminants of Concern
CSM	Conceptual Site Model
DRO	Diesel Range Organics
EE/CA	Engineering Evaluation/Cost Analysis
EPA	Environmental Protection Agency
EPH	Extractable Petroleum Hydrocarbons
ESA	Environmental Site Assessment
GEET	Gilfilian Engineering & Environmental Testing, Inc.
GRO	Gasoline Range Organics
HVOC	Halogenated Volatile Organic Compound
ICs	Institutional Controls
LUST	Leaking Underground Storage Tank
mg/kg	Milligram per kilogram

ACRONYMS AND ABBREVIATIONS (continued)

mg/L	Milligram per liter
MOA	Municipality of Anchorage
MWH	Montgomery Watson Harza Americas
NEC	Notice of Environmental Contamination
NOV	Notice of Violation
PAH	Polynuclear Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PPA	Prospective Purchaser Agreement
REC	Recognized Environmental Condition
RCRA	Resource Conservation and Recovery Act
ROI	Radius of Influence
ROM	Rough Order of Magnitude
SVE	Soil Vapor Extraction
TPH	Total Petroleum Hydrocarbon
USGS	United Stated Geological Society
UST	Underground Storage Tank
VI	Vapor Intrusion
VOC	Volatile Organic Compound
VPH	Volatile Petroleum Hydrocarbons

ADDITIONAL ENVIRONMENTAL ASSESSMENT
3607 AND 3609 SPENARD ROAD
ANCHORAGE, ALASKA

1.0 INTRODUCTION

Shannon & Wilson has conducted this additional environmental assessment, including an analysis of remedial alternatives, for the property located at 3607 and 3609 Spenard Road in Anchorage, Alaska (the Property). The purpose of this assessment is to help facilitate the property transfer from the current owner (Alatna, Inc.) to the pending owner (Cook Inlet Housing Authority [CIHA]) and to progress toward developing funding proposals to partner agencies. Specific project objectives for the additional environmental assessment were identified by the Alaska Department of Environmental Conservation (ADEC) as:

- summarize future on and off-site assessment activities that meet the requirements of the ADEC overseeing project manager,
- conduct an analysis of corrective action alternatives that will meet the development requirements of CIHA, and
- document potential environmental concerns and associated costs to a future purchaser of the site.

To meet the project objectives, the following items are addressed in this document:

- a summary of the environmental activities that have been conducted on the Property,
- a summary of environmental actions for the Property that ADEC requires under the existing Compliance Order by Consent (COBC),
- a conceptual site model,
- a brief summary of CIHA's tentative development plans for the Property,
- a general course of action to take the Property to cleanup complete (CC) or cleanup complete with institutional controls (CCIC) in a suitable time period that meets with CIHA requirements. This includes an alternatives analysis that generally follows the EPA ABCA guidelines, and
- a cost estimate range for the proposed activities such that the CIHA can evaluate an approach to site remediation with an expectation of pending costs.

This work was performed in general accordance with our proposal for environmental services dated July 31, 2012. Shannon & Wilson conducted a Phase I Environmental Site Assessment (ESA) in accordance with ASTM E 1527-05 as part of the environmental services. Results of the Phase I ESA are provided in a separate document. Authorization to proceed with the Phase I

ESA and this Additional Environmental Assessment was provided by the ADEC in the form of Notice to Proceed 18-4002-12-52 dated August 6, 2012. The environmental services were funded through ADEC's Reuse & Redevelopment Program, with funding provided through ADEC's State and Tribal Response Program (Brownfield) grant.

2.0 SITE DESCRIPTION

2.1 Location and Legal Description

The street address for the Property is 3607 and 3609 Spenard Road, Anchorage, Alaska. The Property, located in a commercial/residential area, comprises one parcel encompassing 1.73 acres. A Vicinity Map showing the Property and surrounding area is included as Figure 1. Figure 2 is a site plan depicting general site features of the Property and adjacent parcels.

The Property is located in the southeast ¼ of Section 25, Township 13 North, Range 4 West, Seward Meridian, Alaska, as referenced by the United Stated Geological Society (USGS) Anchorage A-8 NW quadrangle. According to the Municipality of Anchorage (MOA) Assessor's office, the legal description of the Property is a portion of the north ½ of the northeast ¼ of the northwest ¼ of the southeast ¼ of Section 25, Township 13 North, Range 4 West, Anchorage, Alaska. MOA identifies the Property as Parcel No. 010-113-48-000.

2.2 Site Improvements

The Property is located at the northeast corner of Spenard Road and Chugach Way in the Spenard neighborhood of Anchorage. The Property was used as a gasoline fueling station from 1964 to 1993. The tanks, dispensers and piping associated with the station have been removed. Three commercial structures are currently located on the Property. The western half of the Property is paved and is used by an automotive repair company, car wash, and various vehicle rental companies. The eastern half of the Property is unpaved and is used by a firewood supply company, auto rental companies, and to store unused/abandoned vehicles.

The Property is bound to the north by a vehicle sales lot and a bakery. A residential neighborhood is located east of the Property. The Property is bound to the south by Chugach Way and to the west by Spenard Road. Commercial parcels are located south and west of the adjacent roads.

3.0 PREVIOUS INVESTIGATIONS/REMEDIAL ACTIONS

A summary of previous investigations and remedial actions that have been conducted on the Property are provided below. It is noted that the bulk of the historical environmental activities on the Property were conducted for the former underground storage tank (UST) system. The summary is based on documents provided by the ADEC and available in their public files under ADEC File #2100.26.072 and ADEC UST Facility #2288.

3.1 UST Site History

Olson Gas Services Store #1 began operation as a fueling station in approximately 1964. The following USTs and dispensers were utilized on the Property.

USTs	Size (gallons)	Product
#1	10,000	Diesel
#2	12,000	Unleaded Gasoline
#3	12,000	Regular Gasoline
#4	4,000	Unleaded Gasoline
#5	3,000	Unleaded Gasoline (formerly Regular)
#6	2,000	Premium Gasoline
#7	2,000	Diesel
#8	2,000	Diesel
#9	500	Used Oil

Dispensers	Location	Product	Fuel Source
#1	West Island	Unleaded (formerly Regular)	UST #5
#2	West Island	Premium (& piped for Unleaded)	UST #6 & #2
#3	West Island	Unleaded Gasoline	UST #2
#4	Near South Island	Diesel	UST #1
#5	Near South Island	Diesel	UST #7 & #8
#6	Near South Island	Regular & Unleaded Gasoline	UST #3 & #4
#7	Near South Island	Regular & Unleaded Gasoline	UST #3 & #4
#8	Near South Island	Regular & Unleaded Gasoline	UST #3 & #4
#9	Far South Island	Diesel	UST #1
#10	Far South Island	Diesel & Unleaded Gasoline	UST #1 & #2
#11	Far South Island	Regular Gasoline	UST #3
#12	Far South Island	Regular & Unleaded Gasoline	UST #2 & #3
#13	West Island	Unleaded (formerly Regular)	UST #5
#14	Remote	Diesel	UST #`1

During construction in the summer of 1987, a citizen complained of gasoline odors near the Property, which at the time was operating as Tesoro – Olson Gas Services Store #1. In October

1988, the ADEC conducted a site inspection of the Property and noted that the Property was "messy" and could have leaking underground storage tanks (LUSTs) on site. Tank tightness tests conducted in November 1990 indicated that the tanks were not leaking. According to ADEC database, on January 3, 1993, the service station was closed and the USTs were emptied. In June 1993, an EPA representative inspected the Property and found that five USTs were out of compliance due to dormancy. The UST system was removed from the Property in September 1995. The locations of the former USTs and dispensers are shown on Figure 2.

3.2 Compliance Order By Consent (1995)

The ADEC and Korovin Corporation, doing business as Olson's Gas Service, (Korovin) agreed to enter into a COBC on April 21, 1995. The COBC summarized events leading up to the issuance of the COBC including a site history and summary of violations incurred with respect to the UST system. Obligations required of Korovin are outlined in the COBC and include site assessment and remediation, reporting, and financial responsibilities.

Korovin has worked towards meeting some of the requirements of the COBC from its issuance in 1995 to 2009. During this time period, Korovin conducted site investigations, remedial activities, sporadic groundwater and system monitoring, and reporting as required by the COBC. Multiple notices of violation (NOV) have been issued to Korovin with respect to their not meeting the COBC requirements.

Based on discussions with Mr. Robert Weimer of the ADEC on September 17, 2012, the COBC will remain in effect for the Property until both on- and off-site contamination associated with the former UST system are remediated. At a minimum, the ADEC requires additional monitoring wells to delineate the groundwater plume; quarterly monitoring and reporting for the groundwater monitoring wells, active on- and off-site water wells and existing remediation system; and confirmation soil borings to demonstrate cleanup. The party responsible for conducting the COBC requirements will depend on the purchase agreement made by CIHA.

3.3 UST Site Assessment (1995)

A UST site assessment was conducted by Gilfilian Engineering & Environmental Testing, Inc. (GEET) in 1995, with the results presented in their October 17, 1995 report, *UST Site Assessment Report for Olson's Gas Service #1*. The purpose of the UST site assessment was to investigate the environmental impact from nine USTs and associated product piping and dispensers during removal. The entire UST system consisting of nine USTs, eight dispensers, and product piping to fourteen dispenser locations was removed from September 13 to 19, 1995. Figures showing the former UST, dispensers, and soil sampling locations and tables summarizing the soil sample analytical testing results from the 1995 report are included in Appendix A.

Field screening was performed and analytical soil samples were collected from beneath the tanks, dispensers and piping. Soil samples were selectively tested for extractable petroleum hydrocarbons (EPH) by EPA 8100M, volatile petroleum hydrocarbons (VPH) by EPA 8015M, and aromatic volatile organics including benzene, toluene, ethylbenzene and xylenes (BTEX) by EPA 8020. Samples collected from beneath tanks and dispensers formerly storing leaded gasoline were also analyzed for lead by EPA 7421. Samples collected from beneath the former used oil UST were also analyzed for total petroleum hydrocarbons (TPH) by EPA 418.1, arsenic by EPA 7060, cadmium by EPA 7131, chromium by EPA 7191, lead by EPA 7421, polychlorinated biphenyls (PCBs) by EPA 8080, and halogenated volatile organic compounds (HVOCs) by EPA 8010.

The analytical soil sample collected from beneath the used oil tank had either no detectable levels or concentrations of petroleum hydrocarbons, PCBs, and HVOCs less than the ADEC cleanup levels. Metal concentrations in the soil samples were within naturally occurring background levels. The used oil UST excavation was backfilled with clean imported fill material. No further cleanup action was recommended for this location.

Surface contamination was observed at the remote diesel dispenser (#14). A soil sample duplicate pair collected from 1 foot below ground surface (bgs) contained up to 8,980 milligram per kilogram (mg/kg) EPH. The UST assessment report stated that the surface contamination is "likely due to someone dumping motor oil in the hole of the concrete pad."

Soil samples collected beneath each of the eight gasoline and diesel USTs contained concentrations of petroleum hydrocarbons exceeding ADEC cleanup criteria including up to 23,800 mg/kg EPH, 5,194 mg/kg VPH, 24.6 mg/kg benzene, and 2,057 mg/kg total BTEX. The UST assessment report stated that the "source of the contamination appears to be loose fittings and joints in the piping associated with the UST system formerly on-site. In particular, piping to dispensers #4 and #5, piping around the pump of UST #1, and piping in the vicinity of USTs #2 - #8, showed indications of past leaks." Soil samples collected from beneath the former dispenser locations contained up to 22,400 mg/kg EPH, 3,116 mg/kg VPH, 65.6 mg/kg benzene, and 1,344 mg/kg total BTEX.

Groundwater was encountered beneath the site at 13.5 feet bgs. A soil sample collected from the top of the groundwater table contained 1,600 mg/kg VPH, 19.2 mg/kg benzene, and 758 mg/kg total BTEX indicating the groundwater beneath the site is impacted.

Lead concentrations in soil samples collected from beneath Dispensers #1, #7, #8, #12, and #13 ranged from 200 mg/kg to 540 mg/kg, exceeding the naturally occurring background concentrations and the 400 mg/kg ADEC cleanup level.

Three temporary stockpiles were generated during the UST system removal efforts. The soil was segregated according to potential contaminant type including 50 tons of diesel-impacted soil, 30 tons of gasoline-impacted soil, and 20 tons of used-oil impacted soil. The stockpiled soil consisted of soil excavated to expose and remove the UST system. Additional impacted soil was not excavated from the site. The soil stockpiles were thermally treated at an off-site facility.

3.4 Release Investigation (1996)

A release investigation was conducted by GEET with the results presented in their July 10, 1996 report, *Release Investigation: Installation of MW-1, MW-2, and MW-3, Olson's Gas Service #1*. The purpose of the release investigation was to determine if petroleum hydrocarbon contamination in the soil extended beyond the area of the former USTs and to determine if the groundwater had been impacted by the former USTs. Three groundwater monitoring wells, designated MW-1 through MW-3, were installed and sampled for the release investigation at the locations shown in Figure 3.

Analytical soil samples were collected near the groundwater table interface at 11 feet bgs in each monitoring well boring. The soil samples collected from MW-2 and MW-3 contained concentrations of petroleum hydrocarbons exceeding the ADEC cleanup levels with up to 105 mg/kg EPH, 1,000 mg/kg VPH, 55.4 mg/kg benzene, and 526 mg/kg total BTEX. The soil sample from MW-1 had petroleum hydrocarbon concentrations below the ADEC cleanup levels.

Groundwater samples from MW-2 and MW-3 contained up to 4.04 milligram per liter (mg/L) EPH, 231 mg/L VPH, and 35.2 mg/L benzene. The groundwater sample from MW-1 did not contain detectable concentrations of VPH or BTEX, including benzene, but contained 47.4 mg/L EPH. Results of the release investigation indicated the soil and/or groundwater is impacted at each of the three monitoring wells locations.

3.5 Release Investigation and Corrective Action Plan (1997)

An additional release investigation and limited corrective actions were conducted by GEET in 1997, with the results presented in their July 17, 1997 report, *Release Investigation and Corrective Action Plan Conducted at Olson's Gas Service #1*. The purpose of the release investigation was to further delineate the extent of soil and groundwater contamination associated with the former UST system. The release investigation included the installation and sampling of three additional groundwater monitoring wells, designated MW-4, MW-5, and MW-6. The limited corrective action activities focused on excavation of the shallow contaminated soil and installation of a passive bioventing system to treat petroleum hydrocarbon impacted soil remaining at the site.

MW-4, MW-5, and MW-6 were installed at the locations shown in Figure 3. Analytical soil samples were collected from each well at the groundwater table interface at about 12 to 12.5 feet bgs and tested for diesel range organics (DRO) by EPA Method 8100M, gasoline range organics (GRO) by EPA Method 8015M, and BTEX by EPA Method 8020. The soil samples did not contain concentrations of petroleum hydrocarbons exceeding the ADEC cleanup criteria. Groundwater samples collected from the three newly installed wells were tested for the same parameters. The three groundwater samples contained DRO concentrations ranging from 1.07 mg/L to 4.09 mg/L. The groundwater samples did not contain detectable concentrations of GRO. In addition, the sample from MW-5 was the only sample to contain a benzene concentration (0.00657 mg/L) exceeding the ADEC cleanup level.

The shallow impacted soil located beneath former dispensers #1 through #5 and #14 was excavated as part of the corrective action activities. The impacted soil excavation extended from the ground surface to a depth of about 4 feet bgs where a silt layer is present. The approximate extent of the shallow soil excavation is shown on a site plan from the 1997 report included in Appendix A. The release investigation report states that "Confirmation soil samples indicate that the shallow contamination was removed from around former dispensers #1 - #5. It should be noted that there is still contamination below 4 feet beneath dispensers #1 - #3". In addition, the confirmation sample collected from beneath former dispenser #14 contained 636 mg/kg DRO. The laboratory chromatogram indicated the contamination was characteristic of lube oil. A total of 59.25 tons of contaminated soil were excavated and transported off site for treatment.

A passive bioventing system consisting of four horizontal 4-inch diameter perforated pipes placed approximately 5.5 feet bgs was installed following the limited contaminated soil removal. Each of the four bioventing pipes, shown on the site plan from the 1997 report in Appendix A, were connected to a vertical, 4-inch diameter solid riser with a wind driven turbine. An observation well, designated OBS-A, was installed at the location shown in Figure 2 and was constructed of ¾-inch PVC piping extending to a depth of 9.3 feet bgs. Subsequent radius of influence (ROI) testing indicated that with a moderate breeze of 10 knots a slight vacuum can be observed in the monitoring wells up to 48 feet away from the biovent piping. It is assumed the passive bioventing piping was removed from the Property during the 2001 contaminated soil excavation activities discussed in Section 3.8.

3.6 Free Product Recovery (1998)

Free product recovery was conducted by GEET in 1998, with the results presented in their April 9, 1998 letter report, *Free Product Recovery, Olson's Gas Service #1, ADEC UST Facility I.D. #2288*. Free product was observed for the first time in MW-3 during the February 1998 quarterly monitoring event. The report indicates the following product volumes were recovered using disposable bailers:

Date	Initial NAPL Measured	Number of bails until no NAPL present
2/20/98	0.75 inches	2
4/1/98	1.5 inches	8
4/2/98	0.25 inches	1
4/6/98	light sheen	0

3.7 Well Search (2001)

A water well search was conducted by GEET in 2001, with the results presented in their June 1, 2001 report, *Well Search, Olson's Gas Service #1, 3607 Spenard Road, Anchorage, Alaska, ADEC UST Facility #2288*. The purpose of the well search was to identify probable drinking water wells located within a 500-foot radius of the Property. Five properties were identified with potential water supply wells within the search radius, including an on-Property water well. Private wells were identified at 3801 McCain Loop, 1204 Wilshire Avenue, 3704 Wilson Street and 3609 Spenard Road (the Property). In addition, a well serving two homes was identified at 3740 McCain Loop. The locations of the five properties are shown on the 2001 report site plan included in Appendix A. The approximate location of the active water well located on the Property is shown on Figure 4.

3.8 Contaminated Soil Excavation (2001)

Additional contaminated soil excavation was conducted by GEET in 2001, with the results presented in their October 17, 2001 report, *Excavation of Contaminated soil, Olson's Gas*

Service #1, 3609 Spenard Road, Anchorage, Alaska, ADEC UST Facility #2288. The purpose of the additional remedial activities was to remove as much of the contaminated soil as effectively possible and investigate the extent of remaining contamination. The investigation and remedial activities included the excavation and off-site treatment of 1,120 tons of contaminated soil, the installation and sampling of MW-7, and the installation of four access manholes and piping for future remediation wells. Figures showing the excavation limits, soil sample locations and remediation system piping and summary tables from the 2001 report are included in Appendix A.

Contaminated soil was excavated from beneath the former dispensers and USTs at the locations shown in Figure 2. The most heavily impacted soil appeared to be present from about 8 to 12 feet bgs. The excavations typically extended vertically to the groundwater table interface between 13 to 14 feet bgs. The southern end of the west dispenser island excavation was extended to 16 feet bgs. The former UST excavation was limited to the north due to the presence of the existing structure. Confirmation soil samples collected from the excavations indicate contaminated soil above ADEC cleanup levels remain on site in each of the excavation areas - primarily at the groundwater table interface and beneath the existing structure – with concentrations up to 8,410 mg/kg GRO, 9,520 mg/kg DRO, and 28.6 mg/kg benzene remaining in the site’s soil.

A test hole was excavated to the groundwater table south of the UST excavation adjacent to Chugach Way to evaluate the lateral extent of contamination. The soil sample collected from the base of the test hole at 12 feet bgs contained 0.963 mg/kg benzene and 11.2 mg/kg toluene which exceed the current ADEC Method 2 cleanup levels.

MW-7 was installed on the parcel west of the Property and Chugach Way at the location shown in Figure 3. Soil and groundwater samples collected from MW-7 did not contain concentrations of petroleum hydrocarbons exceeding the ADEC cleanup levels.

3.9 Release Investigation/Remediation System Installation (2003)

Additional release investigation and installation of an air sparge (AS) and soil vapor extraction (SVE) system were conducted by Montgomery Watson Harza Americas (MWH) in 2003, with the results presented in their May 2003 report, *March 2003 Release Investigation/Remediation System Installation and April 2003 Monitoring Event Report*. The purpose of the release investigation was to further evaluate the extent of soil contamination and groundwater quality at the site. The release investigation entailed installing and sampling two additional monitoring wells, MW-8 and MW-9, and sampling the existing site monitoring wells. The on-going groundwater monitoring was used to track migration and trends of contaminants in the site groundwater. The 2003 report also summarizes the components of the AI and SVE system installed on the site.

MW-8 and MW-9 were installed on parcels to the southwest and west of the Property, respectively, as shown in Figure 3. Soil samples collected from the groundwater table interface at about 10 feet bgs from both borings did not contain detectable concentrations of GRO, DRO or BTEX. The groundwater samples collected from both newly installed wells contained low levels of GRO (up to 0.840 mg/L) less than the ADEC cleanup level. The sample collected from MW-9 also contained 0.631 mg/L benzene which exceeds the ADEC cleanup level. Groundwater samples collected from MW-1 through MW-5 contained concentrations of benzene, toluene, ethylbenzene, xylenes, GRO and/or DRO exceeding the ADEC cleanup levels. Except for DRO, the highest concentrations were measured in the sample collected from MW-5 with 1.40 mg/L benzene, 11.0 mg/L toluene, 4.57 mg/L ethylbenzene, 22.13 mg/L xylenes, and 92.1 mg/L GRO. MW-4 contained the highest concentration of DRO at 2.27 mg/L. A groundwater sample was not collected from MW-7.

A water sample was collected from the drinking water well on the Property and analyzed for volatile organic compounds (VOCs) by EPA Method 524.2 and DRO. VOCs and DRO were not detected in the water sample.

Three combination AS and SVE wells, designated AS/SVE1 through AS/SVE3, were installed in 2002 as part of an air sparging pilot test. Three additional AS/SVE wells, designated AS/SVE4 through AS/SVE6, were installed during the 2003 release investigation efforts. The approximate locations of the AS/SVE wells are shown on Figure 2. In general, the borings for the AS/SVE wells were terminated at 16 to 17 feet bgs, where a dense silt layer was observed and interpreted as a potential confining layer/aquitard. General construction details are shown on the AS/SVE well schematic included in Appendix A. Soil and groundwater samples were not collected from the AS/SVE borings. The report states “obvious evidence of soil and ground water contamination was detected during the installation of the AS/SVE wells.”

The installed remediation system consisted of both AS and SVE blower systems. The SVE system included a Gast R5125Q-50 regenerative blower, moisture separator, and controller system. The controller system also operates the AS compressor, which consists of a Gast 2567-P132 compressor and motor. The blower systems were connected to the remediation piping in March 2003 but were not operational at the publishing time of the May 2003 report. Subsequent quarterly monitoring reports indicate the AS/SVE system was started on May 15, 2003. The operational history of the AS/SVE has not been researched as part of this historical summary.

3.10 Quarterly Groundwater Monitoring (2009)

Groundwater monitoring for the second quarter of 2009 was conducted by Design Build Consulting, with the results presented in their July 26, 2009 report, *June 2009 Groundwater Monitoring Event Report for Olson's Gas Service #1 [Former], 3607 Spenard Road, Anchorage, Alaska, ADEC UST Facility #2288, ADEC File #2100.26.072*. The quarterly report summarizes the results of the June 2009 groundwater sampling and drinking water well event and discusses the status of the on-site remediation system operations. The quarterly report also summarizes the results of sampling events conducted from 1996 to the time of publishing of the report. A copy of the summary results table is included in Appendix A. The tabulated data indicate that quarterly monitoring at the Property has been sporadic with years when no monitoring was conducted. It is noted that this 2009 groundwater monitoring report is the most recent report document available in the ADEC data files.

The nine groundwater monitoring wells, MW-1 through MW-9, were to be sampled for the June 2009 event. Samples were not collected from MW-1 due to the presence of a dumpster covering the well, MW-6 which was abandoned during construction of city sidewalks, and MW-8 which was buried beneath 12 inches of new gravel in a parking lot and could not be located. Concentrations of contaminants exceeding ADEC Table C cleanup levels were present in groundwater samples from MW-2 (0.007 mg/L benzene), MW-3 (0.126 mg/L benzene, 1.64 mg/L ethylbenzene, 49.0 mg/L GRO, and 3.85 mg/L DRO), MW-4 (0.470 mg/L benzene, 1.72 mg/L GRO) and MW-5 (0.173 mg/L benzene, 6.14 mg/L GRO). No target contaminants were detected at concentrations exceeding ADEC cleanup levels in MW-7 and MW-9. The report states "Groundwater contaminant levels for each of the wells sampled during this monitoring event were comparable to historic levels and demonstrate a continuing trend of decreasing contaminant concentrations, at both on and off site wells."

Water samples were collected from two active water wells, one located on the Property and the other off site at 3801 McCain Loop, and analyzed for BTEX, VOCs, GRO and DRO. Water wells at 3737 McCain Loop and 1204 Wilshire Avenue were not sampled as access could not be gained from the residence. No detectable concentrations of contaminants were measured in the two water well samples.

The quarterly report states that in January 2009 a refurbished SVE blower was installed and started for the SVE system. The SVE blower was set to run on a schedule of 24 hours each day, 7 days per week, drawing vapors from SVE-1, SVE-4, SVE-5 and SVE-6. According to the report, the SVE blower induces a vacuum of 25 to 50 inches of H2O, resulting in an air flow of 50 to 65 standard cubic feet per minute. No samples were collected from the SVE system for the June 2009 monitoring event. The AS blower was reportedly turned off in January 2009.

3.11 Off-Site Characterization Activities (2011)

Site characterization activities were conducted by BGES in January 2011 on the 3604 Spenard Road parcel located to the west of the Property, with the results presented in their March 7, 2011 letter report, *Summary and Estimated Costs, 3604 Spenard Road, Anchorage, Alaska*. The site characterization included the collection of four "grab" groundwater samples collected from four borings located on the 3604 Spenard Road parcel. Three of the borings were positioned in the vicinity of MW-5, MW-6 and MW-9. The "grab" groundwater samples collected from the three borings contained benzene concentrations (0.0107 mg/L to 0.139 mg/L) exceeding ADEC cleanup levels. In addition, one of the groundwater samples contained 12 mg/L GRO which exceeds the ADEC cleanup level. A soil sample collected from the smear zone at 9 to 12 feet bgs in one of the borings had no detectable concentrations of contaminants.

3.12 Phase I Environmental Site Assessment (2012)

A Phase I ESA was conducted by Shannon & Wilson, with the results presented in their September 2012 report, *Phase I Environmental Site Assessment, Tesoro - Olson Gas Services Store #1, 3607 and 3609 Spenard Road, Anchorage, Alaska*. The purpose of the Phase I ESA was to develop a professional opinion as to the presence of recognized environmental conditions (RECs), as defined by ASTM International (ASTM) Standard E 1527-05. A REC is the presence or likely presence of a hazardous substance or petroleum product under conditions that indicate an existing release, a past release, or a material threat of a release into structures on the Property or into the Property's ground, groundwater, or surface water.

The Phase I ESA also identifies other Environmental Conditions. Other Environmental Conditions include known, suspected, or potential sources of hazardous substances or petroleum products that are not considered RECs due to (a) the absence of a confirmed release or other material threat, (b) insufficient information to adequately evaluate the condition, (c) de minimis conditions that are not expected to be subject to regulatory action or (d) exclusion from the ASTM definition of hazardous material [e.g. asbestos-containing material (ACM)]. RECs and other Environmental Conditions indentified on the Property are summarized below. A site plan showing the approximate locations of these potential sources of environmental impact is included as Figure 4.

Recognized Environmental Conditions

The Property was used as a fuel service station and is listed as an "active" LUST site on the ADEC list of contaminated sites. According to the ADEC database, petroleum-impacted soil and groundwater are present at the site. Although multiple site characterization and cleanup efforts have been conducted, the extent of soil and groundwater contamination has not been fully delineated.

Based on aerial photograph review and conditions observed during our site visit, the Property has been used to store unused and/or discarded materials that may be classified as solid waste per state and federal environmental regulations. Among the miscellaneous items visible throughout the Property, potential sources of contamination include but are not limited to current or former contents of vehicles, fuel storage tanks, 55-gallons drums, and chemical containers with the potential to contain both petroleum and non-petroleum hazardous material contaminants.

During the August 17, 2012 site visit, numerous surface stains were noted throughout the Property on both paved and unpaved surfaces. In addition, areas of discolored soil were visible in aerial photographs taken in the 1960s, 1970s, and 1980s. The nature of the discolored soil is unknown and in some instances, may have been paved over with asphalt.

Floor drains were observed in the 3607 Spenard Road structure, the car wash structure, and outside adjacent to the car wash structure as shown in Figure 4. The discharge point of these drains is unknown. The drains may potentially be dry wells based on the age of the structures. In addition, containers of petroleum products, solvent-based tire dressing, and commercial-grade cleaners were observed in close proximity to the drains suggesting a potential for these chemicals to enter the drain system.

Other Environmental Conditions

Due to the construction date of the on-site structures (pre-1950 for the 3609 Spenard Road structure, pre-1964 for the 3607 Spenard Road structure, and pre-1970 for the car wash structure), it is possible that ACMs and/or lead-based paint were used in construction materials. ACM is a regulated hazardous air pollutant under the Clean Air Act, and is therefore subject to federal regulation as a hazardous substance. However, the ASTM standard explicitly identifies

ACM as outside the base scope of the ASTM standard of practice. Prior to performing remodeling, demolition, repair, or cleaning using abrasive agents in the structures, a comprehensive building material survey should be performed by a qualified inspector.

Based on our aerial photograph review and ENSTAR and Anchorage Water and Wastewater Utility (AWWU) records, structures were present on the Property and adjacent parcels prior to natural gas service and municipal sewer and water services. It is possible that heating oil USTs, private wells, and/or septic systems were utilized in this area. Releases from active and/or abandoned tanks associated with these structures could potentially impact the Property's soil and/or groundwater.

Areas of discolored soil were observed in aerial photographs taken in the 1960s through 2011. The nature of the discolored soil is unknown.

The presence of an on-site drinking water well potentially increases the risk to human health posed by the recognized environmental conditions and other environmental conditions at the site.

Off-site fill has been deposited on the Property. The nature of the fill is unknown.

4.0 SUBSURFACE CONDITIONS

Nine borings completed as groundwater monitoring wells, MW-1 through MW-9, have been advanced on and off-Property during former release investigations. The borings were advanced to 17 to 21 feet bgs. Copies of the boring logs are included in Appendix A. In addition, multiple excavations have been advanced on Property in conjunction with on-going remedial activities. The following soil and groundwater conditions have been summarized based on the information provided in the former release investigation, remedial action, and quarterly groundwater monitoring reports.

4.1 Soil

The Property in the vicinity of the former UST system is currently covered with asphalt pavement. Underlying the pavement, former borings and excavations typically encountered sand with varying gravel and silt content. The sand layer extended to a depth of 14 to 21 feet bgs. A thin, intermittent sandy silt layer measuring from less than 1 foot to about 4.5 feet in thickness was encountered in four of the soil borings (on-site wells MW-2 and MW-3, off-site wells MW-5 and MW-6) at depths ranging from 1 to 5.5 feet bgs. A gray, clayey silt to silt was encountered beneath the sand layer starting at depths ranging from 14 to 21 feet bgs with the exception of off-site wells MW-5 and MW-7 advanced to 21 and 19 feet bgs, respectively. The thickness of the clayey silt layer is unknown as historical borings have not been advanced deeper than this apparent confining layer.

4.2 Groundwater

Groundwater was encountered in the soil borings and excavations at depths ranging from 10 to 13.5 feet bgs. Historically, the direction of groundwater flow has ranged from the southwest to the northwest. The gradient has ranged from 0.3 to 2.6 percent.

5.0 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) was prepared to identify known and potential exposure pathways at the subject site. The CSM was developed using the ADEC's guidance CSM Scoping Form and Graphic Form, which are included in Appendix B.

5.1 Contaminant Sources

The primary known contaminant source was the former UST system, including nine USTs, 14 dispensers, and support piping. Petroleum hydrocarbon impacted soil and groundwater are present on and off site as a result of leaks from the former UST system. In addition, free product was observed on the groundwater in on-site well MW-3 in 1998.

Potential contaminant sources identified in Shannon & Wilson's 2012 Phase I ESA include petroleum hydrocarbons and a variety of other chemicals that could have been discharged through the site's floor drains or via leaks in vehicles, batteries, fuel storage tanks, 55-gallons drums, and chemical containers. In addition, numerous surface stains were noted throughout the Property on both paved and unpaved surfaces.

5.2 Contaminants of Concern

Contaminants of Concern (COCs) that have been documented in the Property's soil and groundwater are discussed in the following sections.

5.2.1 Soil

GRO, DRO, benzene, ethylbenzene, toluene and xylenes were detected at concentrations above the most stringent ADEC Method 2 cleanup levels in soil samples collected during historical release investigations and remedial actions on the Property. With the exception of

DRO, the highest concentrations of COCs documented at the site following the 2001 soil excavation were present in a soil sample collected from the north sidewall of the south excavation between the former locations of USTs #5 and #6. Contaminated soil along the north sidewall could not be removed due to the adjacent structure. The soil sample collected at 12 feet bgs contained 8,410 mg/kg GRO, 2,520 mg/kg DRO, 28.6 mg/kg benzene, 319 mg/kg toluene, 80.3 mg/kg ethylbenzene, and 1,100 mg/kg xylenes. The highest DRO concentration of 9,520 mg/kg was reported in a soil sample collected from the center bottom of the former diesel UST excavation (former UST #1) at a depth of 13 feet bgs.

Lead concentrations in soil samples collected during the 1995 UST Site Assessment from beneath Dispensers #1, #7, #8, #12, and #13 ranged from 200 mg/kg to 540 mg/kg, exceeding the ADEC's 400 mg/kg residential cleanup level. The magnitude of these lead concentrations suggest that the soils may also be regulated as a characteristic hazardous waste if removed from the ground for disposal. Subsequent soil excavation activities have resulted in the excavation of the lead impacted soil from beneath each of the dispenser locations with the exception of Dispenser #12. The soil sample collected from 1 foot bgs beneath Dispenser #12 contained 360 mg/kg lead.

A soil sample collected from beneath the former used oil UST was analyzed for TPH, EPH, VPH, BTEX, PCBs, metals, and VOCs. The sample had either no detectable levels of petroleum hydrocarbons, PCBs, and VOCs, or measured concentrations less than the ADEC cleanup levels. Metal concentrations in the soil sample were within naturally occurring background levels.

In addition to the potential COCs investigated as part of the UST closure assessment and remedial action, a potential exists for non-petroleum COCs to be present on the Property as a result of the other uncharacterized potential sources identified in the Phase I ESA.

5.2.2 Groundwater

GRO, DRO, benzene and ethylbenzene were detected at concentrations above the most stringent ADEC Table C cleanup levels in water samples collected from the most recent quarterly groundwater monitoring event conducted in June 2009. Toluene and xylene were also detected at concentrations exceeding the ADEC cleanup levels in groundwater samples collected in several wells through the August 2003 quarterly event. The highest concentrations of the groundwater COCs detected during the June 2009 sampling event were 49.0 mg/L GRO, 3.85 mg/L DRO, 1.64 mg/L ethylbenzene, and 6.84 mg/L xylenes from on-site well MW-3 and 0.470 mg/L benzene from on-site well MW-4. Toluene was not detected in the June 2009 groundwater samples.

On-site and off-site active water wells have periodically been tested for BTEX, VOCs, GRO and DRO. No detectable concentrations of contaminants have been present in the water well samples.

5.3 Extent of Contamination

This section summarizes what is currently known about the lateral and vertical extent of contamination at the site. The discussion is limited to those compounds that have been measured at concentrations greater than the most stringent ADEC cleanup levels.

5.3.1 Impacted Soil

Soil impacted with petroleum hydrocarbons has been documented on the Property in association with leaks from the former UST system. Since 1997, remedial action at the Property has included limited soil excavation and off-site treatment, passive bioventing and a combination of AS/SVE. The SVE system is apparently still operating. The estimated vertical and lateral extent of impacted soil, discussed herein, has been interpolated from analytical soil sample data collected from the 2001 soil excavation event and soil samples collected from borings MW-1 through MW-9 advanced during release investigation activities.

Over 2,000 tons of contaminated soil have been excavated and treated at an off-site facility. In general, impacted soil has been removed from the ground surface in the vicinity of the former USTs and dispensers to the groundwater table interface at 13 to 14 feet bgs. The objective of the 2001 excavation activities was “to remove as much impacted soil as effectively possible”. Contaminated soil was therefore removed from within the unsaturated zone to the west and south of the garage structure and at the former diesel UST location. Impacted soil associated with the former UST system within the vadose zone remained beneath the garage structure. Insufficient data has been collected to document the lateral extent of the impacted soil.

The 2001 excavation activities did not effectively remove the impacted soil present beneath the groundwater table as evident based on results of confirmation soil samples. Petroleum hydrocarbon impacted soil was documented at the base of each of the three excavation areas (west excavation, south excavation, and former diesel UST excavation). These excavations were typically extended to 13 to 14 feet bgs, with the south end of the west excavation advanced to 16 feet bgs. An apparent clayey silt confining layer is present at depths ranging from 14 to 18 feet bgs in the vicinity of the former UST system. The vertical extent of the impacted soil below the groundwater smear zone is not known.

Impacted soil has also been documented at the groundwater table interface in the 2001 test hole excavated south of the south excavation adjacent to Chugach Way and in the borings for MW-2 and MW-3. The lateral extent of the impacted smear-zone soil is unknown but is likely to extend into the right-of-way of Chugach Way and Spenard Road. It is noted that soil samples collected from the apparent groundwater smear zone interval in-site Borings MW-1 and MW-4 and off-site Borings MW-5 through MW-9 did not contain concentrations of petroleum hydrocarbons exceeding the ADEC cleanup criteria.

5.3.2 Groundwater Plume

The nine groundwater monitoring wells installed during previous release investigations have been sampled periodically since 1996. Four wells (MW-1 through MW-4) are located on the Property while the remaining five wells (MW-5 through MW-9) are located off-Property. MW-5 through MW-9 were positioned down-gradient with respect to groundwater flow, which has historically been documented to vary between the southwest and northwest, as shown on Figure 3. Based on historical groundwater sampling data through 2009, the impacted plume extends over the western portion of the Property encompassing MW-1 through MW-4, across Spenard Road, and onto the parcel to the west.

The history of measured benzene and GRO concentrations in on-site well MW-3 and off-site well MW-5, both located hydraulically downgradient from the former USTs and dispenser islands, suggest the magnitude and extent of groundwater contamination was affected by the September 2001 source soil removal activities. COC concentrations apparently decreased in on-site well MW-3 and increased in off-site well MW-5 as discussed below.

A January 2001 groundwater sample collected from on-site well MW-3, prior to the 2001 soil excavation, contained 21.7 mg/L benzene, 34.5 mg/L toluene, 6.30 mg/L ethylbenzene, 29.5 mg/L xylenes and 211 mg/L GRO. The April 2003 groundwater sample from MW-3 (collected after the 2001 excavation and prior to the May 2003 startup of the AS/SVE system) contained petroleum hydrocarbon concentrations one to two orders of magnitude lower than the 2001 sample with 0.438 mg/L benzene, 5.77 mg/L toluene, 1.83 mg/L ethylbenzene, 7.78 mg/L xylenes and 40.2 mg/L GRO. The decrease in MW-3 contaminant concentrations appears to follow removal of source-area soil as a secondary source. However, concentrations in samples from Well MW-3 have not notably decreased since 2003, with the most recent 2009 groundwater sample containing 0.126 mg/L benzene, non-detect toluene, 1.64 mg/L ethylbenzene, 6.84 mg/L xylenes and 49.0 mg/L GRO. The absence of a decreasing trend between 2003 and 2009 suggests the AS/SVE system operating on site has limited effectiveness in reducing groundwater contaminant concentrations.

In comparison, benzene, toluene, ethylbenzene, xylenes and GRO were generally not detected in samples collected from off-site well MW-5 from 1997 to 2001. The May 2002 sample, collected after the 2001 excavation, contained 7.07 mg/L benzene, 33.6 mg/L toluene, 5.96 mg/L ethylbenzene, 28.49 mg/L xylenes and 130 mg/L GRO. This increase suggests the source soil removal activities mobilized petroleum hydrocarbons from the saturated soil zone, with increased levels manifest in downgradient wells. The concentrations have since decreased by one to two orders of magnitude to 0.173 mg/L benzene, non-detect toluene, 0.128 mg/L ethylbenzene, 1.07 mg/L xylenes and 6.14 mg/L GRO.

Results from the most recent June 2009 quarterly event of samples collected from downgradient, off-Property wells MW-5 and MW-9 suggest the leading edge of the plume is located between these two wells. However, two samples collected from MW-9 in 2003 (the only other samples reportedly collected from MW-9) contained concentrations of benzene exceeding the ADEC cleanup level. Likewise, historical samples from MW-7 located southwest of the Property across Chugach Way have contained benzene concentrations exceeding ADEC cleanup levels although the June 2009 sample had no detectable benzene. It is noted that the quarterly monitoring has been sporadic with wells sampled on an inconsistent basis as indicated in the summary sample result table included in Appendix A.

MW-6 located northwest of the plume and MW-8 located southwest of MW-7 appear to be outside of the groundwater plume based on the limited historical sampling. Wells with the most recently collected groundwater sample containing concentrations of COCs greater than the ADEC cleanup levels are highlighted red in Figure 3. Note that the most recent sample from MW-1 was collected in 2003.

5.4 Exposure Pathways

Discussions of the potential exposure pathways are provided below. The narrative includes descriptions of site-specific considerations that increase or decrease the viability of each pathway at this Property. Note this CSM reflects only the known, documented COCs, and should be revised as warranted if additional site assessment is conducted to address data gaps regarding the nature and/or extent of impacted media.

5.4.1 Soil – Direct Contact

Direct contact with impacted soil comprises the incidental ingestion and dermal contact exposure routes. Both exposure routes are complete for current on-site commercial workers, site visitors, and trespassers and potentially complete for future on-site construction workers and residents. Factors that mitigate the risk associated with this pathway include the site pavement that serves as a partial cap over the impacted soil area.

The only known COC listed on ADEC's list of compounds evaluated for dermal exposure is PCBs. However, because the PCB concentrations measured in the used oil tank removal soil samples are less than 1/10th of the ADEC Method 2 cleanup level for direct contact, this pathway is considered insignificant.

5.4.2 Groundwater

ADEC guidance stipulates that ingestion of groundwater be considered a potentially complete exposure pathway unless a groundwater use determination is conducted in accordance with 18 AAC 75.350, and that determination finds that the groundwater is not "currently of reasonable expected future source of drinking water." Therefore, ingestion and inhalation of volatile compounds in groundwater are potentially complete exposure pathways for current and future commercial workers, site visitors, and trespassers. Potential future receptors include on-site construction workers and on- and off-site residents.

GEET conducted a drinking water well survey for the immediate Property vicinity in 2001. The results of that survey are discussed in Section 3.7. The one on-site water well identified by the survey is reportedly used as potable water for the on-site commercial tenants. Although well construction and soil lithology information was not obtained for the on-site or off-site wells as part of this study, we understand that sample(s) from the on-site well have not contained detectable concentrations of BTEX, VOCs, GRO and DRO. Moreover, present groundwater data indicate that the impacted groundwater plume does not extend to off-site residential water wells, and a prospective purchaser agreement (PPA) for the immediately down-gradient property prohibits installation of a well on that site. However, off-site residents are retained as potential future receptors in the event that the plume characteristics change.

5.4.3 Air

Volatile COCs have the potential to impact receptors through outdoor and indoor inhalation. The presence of volatile COC concentrations in soil within the top 15 feet bgs creates a potentially complete outdoor air exposure pathway for current and/or future site users, and potentially for users and residents of nearby properties. Due to the proximity of buildings to the former UST source area, the indoor air pathway is potentially complete for current and future site users and building tenants.

5.4.4 Surface Water

The proximity of the subject site to Fish Creek suggests that surface runoff from the site could enter Fish Creek. However, due to the depth and extent of known soil contamination, it is unlikely that contamination from the site would impact the creek. Moreover, it is unlikely that water from Fish Creek satisfies the ADEC standard for use, currently or in the future, as a drinking water source for residential, recreational, or subsistence purposes. Therefore, ingestion of surface water is not considered a presently complete human health exposure pathway. This pathway may warrant additional consideration based on the results of future site assessment and/or to consider potential ecological receptors.

5.4.5 Other

Other impacted media, including sediment and biota, were not identified at the site. Based on the commercial/industrial site use, ecological receptors were not considered for this assessment.

5.4.6 CSM Summary

Multiple complete or potentially complete exposure pathways have been identified at the site. Exposure to impacted soil is currently mitigated by the site's commercial use, and exposure to impacted soil associated with the former UST system is further mitigated by the pavement surface. The groundwater ingestion pathway is potentially complete for on-site commercial workers and site visitors, although sampling data have verified non-detectable COC concentrations in drinking water wells. Based on the 2001 soil samples, both outdoor air and indoor air inhalation remain viable exposure pathways although the pathway is mitigated by the operation of the SVE system.

It is noted that changes in the site use or other site conditions may affect the viability of potential exposure pathways. In particular, the CSM will need to be re-evaluated and revised as necessary if construction occurs at the site, a change in land use occurs, or additional information is obtained regarding either the previously-documented contaminated media and/or potential on-site sources.

5.5 Data Gaps

The remedial alternative analysis presented in Section 7.0 is based on the available site characterization data collected to date. During the course of our assessment, we identified the following data gaps – resolution of these data gaps may affect the analyses and findings presented herein. This list is not intended to be comprehensive.

- The most recent soil contaminant data is from the GEET 2001 soil excavation removal effort. An AS/SVE system has been operational on-Property since 2003. Current concentrations of petroleum hydrocarbons in the subsurface soil may be reduced as a result of the system operation.
- The lateral and vertical extent of the impacted soil has not been defined, as discussed in Section 5.3.1.
- The most recent groundwater contaminant data is from the 2009 monitoring event. Current concentrations of petroleum hydrocarbons in the groundwater are unknown.
- Historical analyses of soil and groundwater have not included testing for polynuclear aromatic hydrocarbons (PAH); therefore the CSM cannot address the potential dermal exposure from this potential petroleum contaminant.
- A clayey silt layer was encountered in each on-site boring and three of the five off-site borings at depths starting from 14 to 21 feet bgs. The thickness of the clayey silt layer is unknown as historical borings have not been advanced beyond this apparent confining layer. Insufficient data has been collected to determine whether impacted soil and/or groundwater penetrate through the apparent confining layer into a deeper groundwater aquifer.
- Lead concentrations in soil samples collected from beneath Dispensers #1, #7, #8, #12, and #13 ranged from 200 mg/kg to 540 mg/kg, exceeded the naturally occurring background concentrations. Additional sampling for lead in soil and groundwater has not been conducted.
- Construction details of the on-Property water well, including total depth, screen interval depth, integrity of the well casing and well head seal are unknown.
- Surface stains were observed both on the paved and unpaved areas of the Property during the 2012 Phase I ESA. The stained surface soil has not been characterized.
- In addition to the former UST system, the 2012 Phase I ESA identified multiple potential sources of contamination including floor drains, vehicles, underground garage, fuel

storage tanks, 55-gallons drums, and chemical containers. Impact to the Property's soil and groundwater from these potential sources has not been investigated.

- Soil gas data have not been collected. The vapor intrusion pathway is potentially complete for existing on- and off-Property structures, and future Property development.

The remedial actions considered for this analysis are limited to the treatment of soil and groundwater associated with the former UST system. In this context, the data gaps listed above may be critical flaws to the analysis and the existing data may not be sufficient to support an alternatives analysis for the specific remedial objectives.

6.0 CLEANUP GOALS AND OBJECTIVES

Project-specific cleanup objectives have been developed to be protective of human health and the environment, and to comply with applicable State and Federal laws.

6.1 Cleanup Goals

The ultimate cleanup goal for the Property is to obtain a CC or CCIC status from the ADEC. The ADEC generally grants a CC status when remedial efforts reduce contaminants in the impacted media to concentrations less than the most stringent ADEC Method 2 cleanup criteria, although ADEC guidance allows for a CC without meeting the default numerical standards in some circumstances when risk is demonstrated to be sufficiently mitigated.

Reducing the concentrations of contaminants to the most stringent cleanup criteria may not be practicable or cost effective in certain situations. In such cases, the ADEC may allow contaminants to remain at higher concentrations if the contamination does not pose an unacceptable risk to human health or the environment. ADEC will typically require site controls and/or land use restrictions be placed on the property if contamination remains for compliance by current and future owners. In these situations, the ADEC grants a CCIC status. Institutional Controls (ICs) may include long-term groundwater monitoring, a notice of environmental contamination (NEC) on the deed, restrictions on soil excavation or other specific site activities, a ban on installing new drinking water wells, and/or site access restrictions.

6.2 Applicable Regulations and Cleanup Standards

The State of Alaska is the lead regulator for this project, and is responsible for making regulatory determinations under the ADEC Contaminated Sites program. Site cleanup will be conducted under the State of Alaska Oil and Other Hazardous Substances Pollution Control regulations (18

AAC 75), which provides for protection of human health and the environment based on current and future land uses.

State cleanup standards for contaminated soil and groundwater are presented in Title 18, Chapter 75 of the Alaska Administrative Code (18 AAC 75), *Oil and Other Hazardous Substances Pollution Control* (October 2008). The cleanup standards for individual chemicals in soil are based on the ADEC's Method 2 cleanup levels listed in Tables B1 and B2, 18 AAC 75.341 (October 2008), for the "under-40-inches precipitation zone." As listed below, distinct soil cleanup levels are provided for the "Direct Contact," "Outdoor Inhalation," and "Migration to Groundwater" exposure pathways. The direct contact and outdoor inhalation concentrations must be attained in the surface and subsurface soil to a depth of at least 15 feet, unless an institutional control or site conditions eliminate potential for exposure. In addition, cleanup to the most stringent Method 2 standard – typically the migration to groundwater standard - is normally required by ADEC for a cleanup complete (without institutional controls) determination. Cleanup standards for groundwater are the ADEC groundwater cleanup levels listed in Table C, 18 AAC 75.345.

ADEC SOIL AND GROUNDWATER CLEANUP LEVELS

COC	SOIL (ADEC Method 2)			GROUNDWATER (ADEC Table C)
	Direct Contact	Outdoor Inhalation	Migration to Groundwater	
GRO	1,400 mg/kg	1,400 mg/kg	300 mg/kg	2.2 mg/L
DRO	10,250 mg/kg	12,500 mg/kg	250 mg/kg	1.5 mg/L
Benzene	150 mg/kg	11 mg/kg	0.025 mg/kg	0.005 mg/L
Ethylbenzene	10,100 mg/kg	110 mg/kg	6.9 mg/kg	0.7 mg/L
Toluene	8,100 mg/kg	220 mg/kg	6.5 mg/kg	1.0 mg/L
Xylenes	20,300 mg/kg	63 mg/kg	63 mg/kg	10 mg/L
Lead*	400 mg/kg	-	400 mg/kg	0.015 mg/L

*Resource Conservation and Recovery Act (RCRA) TCLP criteria (5 mg/L) may also be applicable to lead-impacted media.

In addition to soil and groundwater cleanup levels, the ADEC has published target levels for soil gas in their Draft Vapor Intrusion Guidance for Contaminated Sites dated July 2009.

6.3 CIHA Development Plans

Future development plans of the pending owner, CIHA, were discussed with Mr. Tyler Robinson of CIHA on September 17, 2012. According to Mr. Robinson, CIHA does not currently have detailed development plans. They are considering a mixed-use development with retail facilities on the ground floor and residential units on the second floor, similar to their Mountain View at Park development. With the exception of utilities, Mr. Robinson anticipates the development will not entail underground components (i.e. no basements, etc.). CIHA would like to use existing utilities to the extent practicable; however, they anticipate the existing utilities may not meet code for their proposed development. In addition, they plan on connecting the proposed development to the AWWU sewer and water system. The existing structures on the Property will likely be demolished. CIHA conducted a historic analysis of the cabin structure dating back to the 1950s. The cabin has been altered significantly and is not considered a historic structure. CIHA will attempt to secure funding for the development in the next year with potentially starting foundation work in 2014 and 2015.

CIHA does not know if institutional controls will be acceptable to a future lender. They currently anticipate seeking funding from the Alaska Housing Finance Corp (AHFC). It is CIHA's desire to outline the environmental risks with the Alaska Department of Law, using a PPA to identify a limit on cleanup costs and to assist a potential lender understand their limits of liability associated with environmental contamination issues.

7.0 ALTERNATIVES ANALYSIS

This analysis of remedial alternatives was prepared in general accordance with Environmental Protection Agency (EPA) guidance for cleanups with EPA grant funds and the Engineering Evaluation/Cost Analysis (EE/CA) Equivalent Analysis of Brownfields Cleanup Alternatives (ABCA) Checklist (EPA, 2004). The alternatives analysis includes an evaluation of four cleanup alternatives including "no action". These cleanup alternatives were selected based on general effectiveness for the known site-specific contaminants and impacted media and our understanding of the previous remedial efforts conducted on the Property.

The alternatives were selected to address the known soil and groundwater contaminant plumes associated with the UST system formerly operated on the Property. These alternatives may not be applicable and/or adequate for cleanup of potential contamination resulting from the other potential sources identified in the Phase I ESA, such as floor drains, oil/water separator, drums, batteries, stained surface soil, etc. Additional site assessment activities to determine if these potential sources have impacted the site soil and/or groundwater are recommended prior to final selection and design of the remedial action.

7.1 Evaluation and Comparison of Cleanup Alternatives

The following subsections discuss and compare potential cleanup alternatives for the impacted soil and groundwater associated with the UST system formerly operated on the Property. The benefits and limitations of the four alternatives were evaluated with respect to effectiveness, implementability, and cost. A general evaluation of the four potential alternatives considered in this alternatives analysis is summarized in Table 1. The table is structured for comparison of alternatives by describing the benefits and limits of the effectiveness, implementability, and cost of each alternative.

7.1.1 Alternative 1: No Action

The No Action alternative is included for comparison purposes. This alternative does not comprise a systematic approach to achieving cleanup objectives. Although natural attenuation is expected to reduce contaminant concentrations and volume over time, the absence of regular monitoring and other controls renders this alternative ineffective in pursuing specific cleanup, land use, and closure milestones. It is easily implemented. The no action alternative has no additional cost. Alternative 1 would not meet the requirements of the COBC and is therefore assumed to be an unacceptable option to ADEC.

7.1.2 Alternative 2: Operation of Existing AS/SVE

Alternative 2 consists of continued operation of the existing AS/SVE system to reduce contaminant concentrations in both soil and groundwater. SVE functions by applying a vacuum to the subsurface, creating a pressure/concentration gradient that strips volatile compounds from soil. The AS component functions by forcing ambient air into the aquifer to strip (volatilize) dissolved-phase organic contaminants. Air sparging also replenishes subsurface oxygen levels to enhance biodegradation of petroleum hydrocarbons. The combined AS/SVE will treat both soil and groundwater, and can also be used as a vapor intrusion (VI) mitigation measure by controlling gas/vapor movement through the subsurface.

Six combined AS/SVE wells are currently installed within the soil and groundwater contaminant plumes in the vicinity of the former USTs and dispensers. Two AS/SVE wells are positioned in the vicinity of each of the west, south and diesel UST excavation areas. An AS/SVE well schematic showing the general AS/SVE well construction details is included in Appendix A. A remediation shed is present on the Property and houses the required system components including the extraction and injection blowers and other equipment. Volatile constituents mobilized during operation of the AS/SVE are apparently discharged into ambient air. Specific details regarding the current condition of the system components were not researched for this report.

Historical pilot testing indicates the vertical SVE wells installed to a depth of approximately 10 feet bgs have a ROI of 61 feet each and the vertical AS wells installed to 15.5 to 17 feet bgs have a ROI of 4 to 5 feet each. The approximately 3-foot screen of the AS wells is set directly above the confining silt layer therefore extending through approximately the bottom half of the generally 6-foot contaminated water bearing zone soil.

Effectiveness. Alternative 2 is a permanent and irreversible treatment process. Contaminant concentrations are reduced by physical removal and enhanced biodegradation, thereby reducing the potential for mobility and toxicity. Operation of the SVE portion of the system may be effective in controlling vapor intrusion into current and/or future structures.

The effectiveness of Alternative 2 is limited by the ROI of each SVE/AS well, and the low number of individual wells. Reduction of COC concentrations in the saturated soil and groundwater outside of the limited ROI is primarily dependent upon natural attenuation through biodegredation. Confirmation sampling will be conducted to document reduction in COC levels. For cost estimating purposes, an assumed 24 push probes will be advanced within the soil plume to collect confirmation samples.

Depending on the specific land use, Alternative 2 may require additional administrative and/or engineering controls during the treatment period to supplement the SVE/AS system in mitigating specific exposure pathways. In addition, an eventual CC or CCIC determination will likely entail institutional controls due to the limited system ROI, and the potential for on and off-site contamination to remain after the system is shut off. These controls may include a deed notice, land use restrictions, requirements for soil excavation activities during development, use of drinking water wells, and future land use changes.

Implementability. Alternative 2 can be readily implemented using experienced contractors available in the Anchorage vicinity. An evaluation of the current condition of the existing AS/SVE system components may need to be conducted and portions of the system upgraded or replaced, as needed.

Alternative 2 requires the longest treatment time period of the alternatives evaluated, other than the no action alternative. For cost estimating purposes, we assume an operational period of 30 years as reduction of petroleum hydrocarbon concentrations in the groundwater plume will primarily be a function of natural attenuation through biodegradation. We assume monthly monitoring of the AS/SVE will be conducted for the first 5 years of operation with incremental reduction in the monitoring frequency for the following 25 years. The actual time for cleanup may be substantially different.

Cost. For cost estimating purposes, we assume a 30-year operational life of the AS/SVE (with reduced monitoring frequencies for years 6 through 30) to reduce COC concentrations below ADEC cleanup criteria for soil and groundwater. The total Rough Order of Magnitude (ROM) cost to implement Alternative 2 is **$900,000** including an approximate 25% contingency (estimated base cost of $720,000 with $180,000 contingency). It is noted that a substantial portion of the total remediation cost is contained in operation, maintenance, and monitoring over the system's 30-year plan life, with approximately $20,000 needed to facilitate this alternative.

Summary. The primary advantage of Alternative 2 is the relative ease to implement this alternative as the AS/SVE system is already installed and assumed to be functional. Operation of the existing AS/SVE system satisfies the remedial requirements set forth in the COBC. In addition, Alternative 2 may be useful for VI mitigation, although other more effective methods may be appropriate for some development scenarios. The total cost to implement Alternative 2 is the lowest of the three active remedial alternatives considered for this assessment. Further, short-term capital costs are one to two orders of magnitude lower than Alternatives 3 and 4, respectively. The primary disadvantage of Alternative 2 is its limited effectiveness in reducing contaminant levels in the saturated zone and site groundwater due to the low ROI. Therefore, Alternative 2 has the lowest certainty of COC concentration reduction, and cleanup of the groundwater plume would likely be primarily a function of naturally occurring biodegradation (as enhanced using the six AS wells). The time needed to achieve meaningful contaminant concentration reduction in the groundwater is expected to be on the order of 30 years therefore requiring a prolonged period of system operation, monitoring and maintenance.

7.1.3 Alternative 3: Operation of Enhanced AS/SVE

Alternative 3 consists of enhancement and operation of the existing AS/SVE system currently located on the Property to reduce contaminant concentrations in both soil and groundwater. The treatment mechanisms for the enhanced AS/SVE will be the same as discussed for the existing AS/SVE.

For Alternative 3, additional vertical injection wells will be installed within the soil and groundwater contaminant plume to supplement the current system consisting of six AS/SVE wells. Based on an assumed ROI of 4 to 5 feet and an assumed 12,600 square foot area of impacted saturated soil, approximately 160 AS wells would be required to provide adequate coverage to strip the dissolved-phase organic components from the saturated soil. The number of AS wells would likely be significantly reduced when the replenishment of subsurface oxygen levels to enhance biodegradation of contaminants is factored into the design. For cost estimating purposes, an assumed 100 AS wells in the vicinity of the west and south excavation areas and 10 AS wells in the vicinity of the former diesel UST excavation area will be installed and added to the existing AS/SVE system. Prior to final design and installation of the extraction and injection wells, a treatability study and modeling will be performed to evaluate the number of AS and SVE wells needed and gather other design data. The remediation shed currently located on the Property will be remodeled to house a portion of the required system components including the extraction and injection blowers, knock-out drum, granulated activated carbon filters, and other equipment. A second remediation shed will most likely be required to house a portion of the required equipment.

Effectiveness. Alternative 3 is a permanent and irreversible treatment process. The concentration of contaminants is reduced by physical removal and enhanced biodegradation, thereby reducing the potential for mobility and toxicity. Of the alternatives considered, Alternative 3 has the potentially largest ROI for soil and groundwater treatment. Operation of the SVE portion of the system will likely be effective in mitigating the VI exposure pathway, as the system design can anticipate needs for potential future site development scenarios. Volatile constituents mobilized during operation of the AS/SVE may be discharged into ambient air, although at sufficiently high concentrations treatment may be appropriate to reduce emissions. GAC filters could be used to treat volatile emissions, if necessary, to protect workers and residents from outdoor or indoor air inhalation exposure routes.

For cost estimating purposes we assume an operational period of 10 years, based on our experience at similar sites. We assume monthly monitoring of the AS/SVE will be conducted throughout its operation. Confirmation sampling will be conducted to document reduction in COC levels. For cost estimating purposes, an assumed 24 push probes will be advanced within the soil plume to collect confirmation samples.

Alternative 3 may require short/intermediate-term administrative or engineering controls due to the presence of off-site contamination in areas that are likely outside the system ROI (e.g., beneath road rights-of-way). In addition, an eventual CC or CCIC determination may entail institutional controls if off-site contamination remains after the system is shut off. These controls may include a deed notice, land use restrictions, requirements for soil excavation activities during development, use of drinking water wells, and future land use changes. The nature of potential engineering controls or eventual institutional controls for Alternative 3 are expected to be less stringent than for Alternative 2 due to the more extensive soil and groundwater treatment system.

Implementability. Alternative 3 can be readily implemented using experienced contractors available in the Anchorage vicinity. We assume the soil excavated during well installation and trenching activities can be used to backfill the trenches, or otherwise consolidated within the source area, for in-situ treatment via the AS/SVE. For cost estimating purposes, we assume a 10-year operational life of the AS/SVE to reduce COC concentrations below ADEC cleanup criteria for soil and groundwater. The actual time for cleanup may be substantially different.

Cost. The total ROM cost to implement Alternative 3 is **$1,700,000** including an approximate 25% contingency (estimated base cost of $1,350,000 with $350,000 contingency). It is noted that a substantial portion of the total remediation cost is contained in operation, maintenance, and monitoring over the system's 10-year plan life, with approximately $500,000 needed to facilitate initial system enhancement efforts.

Summary. The primary advantages of Alternative 3, relative to the other remedial alternatives, are the large treatment area for both soil and groundwater remediation, and the flexibility to treat potential contaminant rebound after initial source-area remediation. In addition, the system can be designed for more effective and long-term VI mitigation than the other remedial action alternatives. A primary disadvantage of Alternative 3 is the relatively high capital cost to design and construct the expanded AS/SVE, which is estimated to be an order of magnitude higher than the capital cost for the existing AS/SVE. Other drawbacks include the time required to achieve meaningful COC concentration reduction and uncertainties in the rate of concentration reduction, relative to Alternative 4. The new AS wells cannot be installed and hooked up to the existing AS/SVE system until the existing site structures and asphalt pavement are removed. In addition, the AS/SVE wells and manifold piping will require decommissioning following achievement of site cleanup. Accessing the system components may be hindered by site improvements (structures, asphalt pavement, etc.) made during the lifespan of the AS/SVE.

7.1.4 Alternative 4: Excavation and Off-Site Treatment

Alternative 4 consists of source-area soil and groundwater removal with off-site disposal. Contaminated soil associated with the former UST system within the vadose zone is currently thought to be generally limited to beneath the garage structure. Contaminated soil within the saturated zone is present at the base of each of the three 2001 excavation areas (west excavation, south excavation and former diesel UST excavation). The lateral extent is unknown but contaminated soil was documented at the water table interface at MW-2, MW-3 and the 2001 Test Hole. The vertical extent of the contaminated saturated soil is assumed to extend from the groundwater table interface at an average depth of approximately 11 feet bgs, to the apparent clayey silt confining layer present at depths ranging from 14 to 18 feet.

For design and cost estimating purposes, we used conservative estimates of impacted soil volume in the smear zone and saturated soil above the shallow confining layer. We further assume the remaining volume of impacted soil in the vadose zone will be removed during the excavation, but is small relative to the volume in the saturated zone. The lateral extent of contaminated soil in the vicinity of the existing garage structure (west and south excavations) is assumed to extend over an approximately 11,000 square foot area. The lateral extent of the contaminated soil in the vicinity of the former diesel UST excavation is assumed to extend over an approximately 1,600 square foot area. The contaminated soil at both locations is assumed to extend from 11 feet bgs to 18 feet bgs, for a thickness of 7 feet. Using these assumptions and a 25% bulking factor, an estimated 5,600 cubic yards of assumed clean overburden and 3,600 cubic yards of petroleum hydrocarbon contaminated soil will be excavated from the existing garage structure area (west and south excavations). An estimated 800 cubic yards of assumed clean overburden and 500 cubic yards of petroleum hydrocarbon contaminated soil will be excavated from the former diesel UST excavation area.

The existing garage structure, two outbuildings (which apparently include the AS/SVE remediation shed), asphalt pavement and other structures/items located within the planned excavation areas must be removed and/or demolished prior to implementation of the excavation activities. In addition, excavation of the overburden soil and contaminated soil may result in damage or demolition of on-site house utilities, the AS/SVE wells and piping, and wells MW-2 and MW-3. Dewatering of the excavations will be required to remove saturated contaminated soil. Appropriate permits from AWWU and ADNR will need to be obtained for dewatering and disposal purposes. In addition, stained near-surface soil which may be present within the planned excavation areas should be characterized and potentially segregated from the petroleum hydrocarbon-impacted soil associated with the LUST remediation work.

For cost-estimating purposes, the following assumptions were made:

- Overburden soil will be excavated and placed in unlined stockpiles on site. Characterization samples will not be required for the overburden soil.
- Contaminated soil will be excavated and placed directly in lined stockpiles to drain excess water.
- The water removed during excavation dewatering, along with excess water drained from the stockpiled soil, will be discharged to the AWWU system.
- The contaminated soil will be placed in lined trucks for delivery to a local thermal treatment facility. Note that on-site, ex-situ, soil treatment options were not considered in this analysis, but could present opportunities for cost savings in some land use and development scenarios.
- The anticipated rate of excavation is approximately 500 cubic yards per day for the overburden then 100 cubic yards per day for the contaminated soil.
- Confirmation samples will be collected from the final excavation.
- The excavation will be backfilled after collection of excavation samples using a combination of stockpiled clean overburden soil, and with clean imported material.

Effectiveness. The removal of the contaminated soil is a permanent solution and will result in a significant reduction in contaminant mass at the site. In addition, removing the impacted soil will aide in the reduction of toxicity and mobility of the COCs. Over time, the remaining contaminant concentrations in groundwater should continue to decrease following the removal of the source-area soils as a secondary source. Compared to the other alternatives, Alternative 4 quickly reduces the present risk to human and ecological receptors through physical removal of the contaminated soil and groundwater from the subsurface. With Alternative 4, the impacted soil exceeding both the direct contact and outdoor inhalation cleanup criteria is removed. Vapor intrusion from remaining impacted groundwater may or may not need to be addressed in the design of on-Property structures.

Alternative 4 could result in a CC or CCIC determination much sooner than the other Alternatives. For this reason, the potential presence of residual on- and/or off-site impacted media may require institutional controls. A deed notice and land use restrictions will likely be required pertaining to use of drinking water wells.

Implementability. Alternative 4 can be readily implemented using experienced contactors available in the Anchorage vicinity. As discussed above, implementation will require removal of permanent structures and objects from the planned excavation area. The excavation area will be limited alongside Spenard Road and Chugach Way as prism of undisturbed soil will need to be maintained to prevent undermining. The prism will extend a minimum of 18 feet into the Property if the excavation is advanced to 18 feet bgs. In addition, permits for dewatering will need to be obtained. The field and reporting activities required for Alternative 4 can be implemented in one field season. Groundwater monitoring for an estimated 5 years will be required to document the groundwater conditions following removal of the source soil.

Cost. The total ROM cost to implement Alternative 4 is **$1,800,000** including an approximate 25% contingency (estimated base cost of $1,440,000 with $360,000 contingency). It is noted that a substantial portion of the total remediation cost (estimated $1,250,000) is contained in the upfront costs needed to facilitate initial excavation and disposal efforts.

Summary. The primary advantage of Alternative 4, relative to the other remedial alternatives, is the relatively quick and permanent removal of contaminants within the source area, and potential elimination of need for future engineering controls for VI mitigation. Further, Alternative 4 may facilitate more flexibility in the immediate development of the Property. The primary drawback is the higher cost, particularly with respect to the initial expenditure. In addition, this Alternative has no contingency to address contaminant rebound, should it occur.

7.1.5 Summary of Alternative Analysis

Alternative 1 – No action is considered to be the least effective alternative in meeting the cleanup objectives of site closure, and may not satisfy the technical requirements of the COBC. Of the remaining three alternatives, Alternative 2 – Existing AS/SVE has the lowest certainty of effective progress towards cleanup objectives and eventual site closure due to its limited ROI for treating the saturated soil and groundwater contaminant plume. Contaminant concentrations in the groundwater may decrease over time primarily through natural attenuation under Alternative 2. Both Alternative 3 – Enhanced AS/SVE and Alternative 4 – Excavation and Off-Site

Treatment are considered effective cleanup methods for treating on-site soil and groundwater within a reasonable time period, particularly within the remaining source area

The four alternatives considered in this analysis are each implementable. Alternative 2 is substantially more easily implemented than Alternative 3 or 4, as Alternative 2 would take advantage of the AS/SVE system components already present on site. Alternatives 3 and 4 would both require the assumed impacted contaminated soil areas (encompassing an estimated 12,600 square feet in the vicinity of the former UST systems) be free of structures, pavement, outbuildings, and other items prior to implementation. Implementation efforts for both Alternatives 3 and 4 are relatively high initially. Alternative 3 requires the installation of up to 100 AS wells, trenching and installing manifold piping, and construction and startup of the remediation shed while Alternative 4 requires excavation and backfilling an estimated 10,500 cubic yards of soil.

Alternative 4 is expected to result in sufficient reduction of contaminant concentrations in the groundwater via contaminant mass removal from the source area saturated soil in a shorter time frame (5 years) than Alternative 3 (10 years). In contrast, Alternative 3 may affect treatment over a larger area, and would be better designed to address potential contaminant rebound.

ROM costs for implementing Alternatives 2, 3 and 4 range from an estimated $900,000 for Alternative 2 – Existing AS/SVE to $1,800,000 for Alternative 4 – Excavation and Off-Site Treatment. The three alternative costs each include an estimated 25% contingency ranging from $180,000 to $360,000.

7.2 Recommendation of Preferred Alternative

Based on the alternative analysis, Alternative 4 – Excavation and Off-Site Treatment is recommended for obtaining site closure of the Property. Alternative 4 results in the relative immediate removal of a substantial portion of the remaining source-area contaminant mass; allows for unhindered site development as invasive, cleanup activities would presumably be accomplished prior to development; has the shortest cleanup time frame; and has approximately the same ROM costs as Alternative 3 – Enhanced AS/SVE. Further, if space and time allows, the cost to implement Alternative 4 may be reduced by designing and implementing an on-site, ex-situ, bioventing treatment cell for the contaminated soil as opposed to off-site thermal treatment.

We emphasize that selection and implementation of a remedial alternative should not be made until adequate site characterization has been conducted to document the current soil and groundwater conditions as well as assess the potential sources of contamination identified during the 2012 Phase I ESA. This alternatives analysis was developed based on the most recent historical soil data collected in 2001 and groundwater data collected in 2003 and 2009. It is possible that concentrations of contaminants in the soil and groundwater have decreased to levels that may not require the aggressive treatment as presented in this alternatives analysis. A site assessment to address identified data gaps may cost an estimated $50,000 to $200,000.

Estimated costs for obtaining CC or CCIC are limited to addressing the documented petroleum hydrocarbon impacted soil and groundwater associated with releases from the former UST system. The estimated costs do not include:

- Demolition of the existing structures and utilities on Property including costs for handling lead-based paint and asbestos.
- Decommissioning of the on-Property active water well.
- Decommissioning of the active, off-Property water wells and hookup of parcels to AWWU city water system.
- Assessment and/or remediation costs associated with potential sources of contamination identified on the Property such as floor drains, stained soil, underground garage, vehicles, batteries, fuel storage tanks, 55-gallons drums, and chemical containers.
- Costs associated with hazardous waste that may have resulted from existing or former site operations.
- Costs associated with future off-Property development/remediation that may occur due to the presence of impacted soil and/or groundwater.

8.0 CLOSURE/LIMITATIONS

This report is an instrument of service prepared by Shannon & Wilson for the exclusive use of the ADEC, herein referred to as the Client, and its affiliates. This report was prepared for the exclusive use of the Client for evaluating the Property as it relates to the environmental aspects discussed herein. The conclusions contained in this report are based on information provided from the sources identified herein, and further assume that the conditions observed are representative of the conditions throughout the Property. The data presented in this report should be considered representative of the time of our site assessment. Changes due to natural processes or human activity can occur over time. In addition, changes in government codes, regulations, or laws may occur. Because of such changes beyond our control, our observations and interpretations applicable to this Property may need to be revised.

In order to create a report on which the Client can rely, Shannon & Wilson worked closely with the Client and their representatives to develop the scope of services upon which all subsequent tasks have been based. No party other than the Client and its affiliates is permitted by Shannon & Wilson to rely on this instrument of Shannon & Wilson's service. With the permission of the Client, Shannon & Wilson will meet with a third party, approved in writing by the Client, to identify the additional services required, if any, to permit such third party to rely on the information contained in this report. Such reliance by any third party is limited to the same extent of Client's reliance, and subject to the same contractual, technological and other limitations to which the Client has agreed.

Copies of documents that may be relied upon by our client are limited to the printed copies (also known as hard copies) that are signed or sealed by Shannon & Wilson with a wet, blue ink signature. Files provided in electronic media format are furnished solely for the convenience of the client. Any conclusion or information derived from electronic files shall be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, or you question the authenticity of the report, please contact the undersigned.

Shannon & Wilson has prepared the attachments in Appendix C, "Important Information About Your Geotechnical/Environmental Report," to assist you and others in understanding the use and limitations of our report.

Please contact Mr. Matt Hemry, P.E. or the undersigned at (907) 561-2120 with questions or comments concerning the contents of this report.

SHANNON & WILSON, INC.

Timothy M. Terry, C.P.G.
Senior Associate

STATE OF ALASKA
49th
Della LeeAnne Osgood
CE - 8808
10-29-2012
REGISTERED PROFESSIONAL ENGINEER

LeeAnne Osgood, P.E.
Environmental Engineer

DLO:TMT/msh

9.0 REFERENCES

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TABLE 1
ALTERNATIVES ANALYSIS SUMMARY

Alternative	Effectiveness				Implementability [c]		Cost (d)			
	Mechanism to achieve the cleanup objectives [a]	Institutional Controls Required [b]	Land Use Considerations	Significant risks or impacts to human health and the environment	Time to achieve objectives/completion	Other Factors	Capital Costs	O&M Costs	Contingency	Total Cost [e]
Alternative 1 - No Action	Natural attenuation (without monitoring)	No (no closure)	Some land uses may be inappropriate based on complete and unmitigated human health exposure routes.	No change in risk of exposure to vapors and contaminated soil and groundwater.	Indefinite	-	-	-	-	No cost.
Alternative 2 - Existing AS/SVE	Reduces volume of COCs through treatment of impacted soil in vadose zone and limited treatment of saturated soil and groundwater. Effectiveness is limited by radius of influence and number of SVE/AS wells. Relies primarily on natural attenuation to reduce COCs in saturated soil and groundwater.	Yes [f]	Property useable for commercial/residential use with implementation of proper administrative and/or engineering controls to mitigate exposure routes. Existing SVE may mitigate vapor Intrusion pathway.	Limitations in the existing system ROI/effectiveness may not adequately protect all applicable exposure routes associated with specific land uses.	Estimated 30 years to meet ADEC cleanup criteria for soil and groundwater. Cost estimate assumes soil borings are used to collect confirmation samples after treatment period..	Other than the no-action alternative, Alternative 2 has the lowest certainty of concentration reduction and the smallest treatment ROI.	$20,000	$700,000	$180,000	$900,000
Alternative 3 - Enhanced AS/SVE [e]	Reduces volume of COCs through treatment of impacted soil and groundwater. Overall effectiveness depends on ROI, which is a function of number of SVE/AS wells and blower design.	Yes [f]	Property useable for commercial/residential use with implementation of proper administrative and/or engineering controls to mitigate exposure routes. Modified SVE can be designed to mitigate vapor Intrusion pathway.	Vapors extracted through the SVE may require treatment during system operation and must also be considered in the extraction blower housing design. Rebound may occur after system is shut off.	Operation of AS/SVE for an estimated 10 years to meet ADEC cleanup criteria for soil and groundwater. Cost estimate assumes soil borings are used to collect confirmation samples after treatment period.	Requires installation of extensive well network, piping and remedial shed. Potentially largest treatment ROI. Requires decommissioning of well and piping network after treatment is complete.	$500,000	$850,000	$350,000	$1,700,000
Alternative 4 - Excavation and Off-Site Treatment [e]	Reduces volume of COCs through removal of source-area soil and groundwater.	Yes [f]	Property useable for commercial/residential use, possibly without engineering controls. Mitigation for vapor intrusion pathway may or may not be necessary based on presence and magnitude of contamination remaining after excavation.	Short-term exposure to vapors and impacted media would increase during excavation of soil and dewatering of groundwater. May experience rebound as surrounding areas re-equilibrate with source area after excavation.	Approximately 2 months to implement source soil removal efforts and reporting. Long-term groundwater monitoring for estimated 5 years to demonstrate stable or shrinking plume.	Alternative 4 has the highest certainty of concentration reduction. Cannot excavate within Chugach Way and Spenard Road ROW, therefore impacted soil may be left in place after remediation is complete.	$1,250,000	$190,000	$360,000	$1,800,000

Notes:

(a) The cleanup objective is to obtain site closure with either a Cleanup Complete (CC) or Cleanup Complete with Institutional Controls (CCIC).

(b) Institutional controls (IC) may include a notice of environmental contamination (NEC) on the deed, restrictions on soil excavation or specific land uses, a ban on installing drinking water wells, and/or long-term groundwater monitoring.

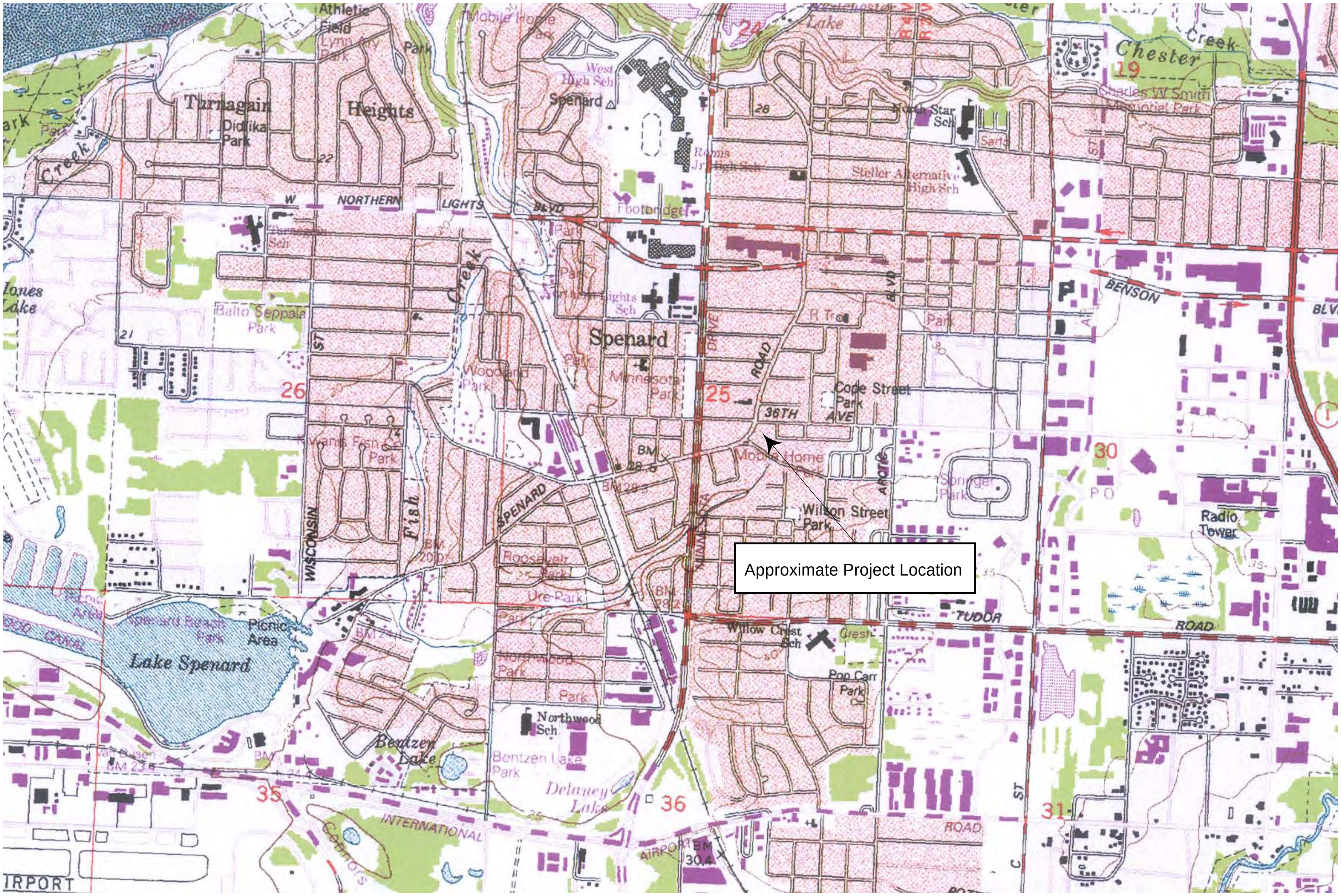
(c) All alternatives considered for this analysis are practicable and technically feasible; discussion of implementability focuses on difference in treatment time and other relevant technical factors.

(d) Costs provided are present day rough order of magnitude (ROM) costs including capital cost for implementing the alternative (mobilization, demobilization, field treatability studies, installation, monitoring well installation, soil disposal, etc.); annual operation and maintenance cost (long term groundwater monitoring, system monitoring, maintenance, energy use, decommissioning, confirmation sampling, etc.); and approximate 25% contingency.

(e) Does not include costs to conduct site assessment/characterization activities to address identified data gaps.

(f) Long-term ICs may vary between active treatment alternatives based on the degree of treatment achieved at the time of the CC or CCIC closure determination.

IC = Institutional Controls
AS/SVE = Air Sparge/Soil Vapor Extraction
COC = Contaminant of Concern
ROI = Radius of Influence



Elevation in Meters
Contour Interval 5 Meters
Taken from Anchorage A-8 NW
U.S. Geological Survey Quadrangle (1994)

0 2000 4000
APPROXIMATE SCALE IN FEET

N

3607 and 3609 Spenard Road
Anchorage, Alaska

VICINITY MAP

October 2012

32-1-17525-001

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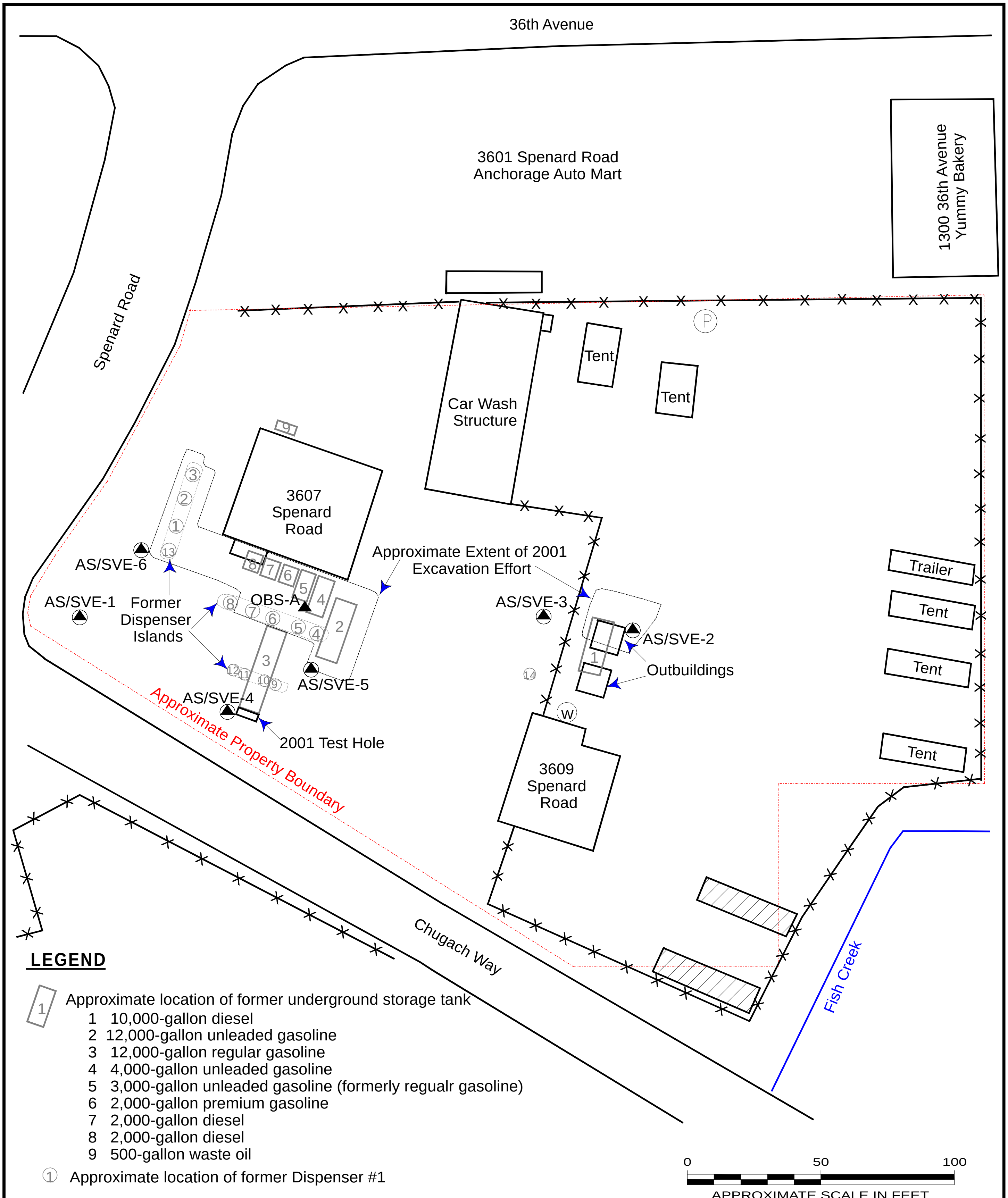
Fig. 1



LEGEND

- Approximate location of former underground storage tank
  1. 10,000-gallon diesel
  2. 12,000-gallon unleaded gasoline
  3. 12,000-gallon regular gasoline
  4. 4,000-gallon unleaded gasoline
  5. 3,000-gallon unleaded gasoline (formerly regualr gasoline)
  6. 2,000-gallon premium gasoline
  7. 2,000-gallon diesel
  8. 2,000-gallon diesel
  9. 500-gallon waste oil
- Approximate location of former Dispenser #1
- Approximate location of air sparging (AS) and soil vapor extraction (SVE) well
- Approximate location of passive bioventing system observation well
- Approximate location of drinking water well
- Approximate location of connex storage container
- Approximate location of pole-mounted transformer
- Approximate location of piped Fish Creek
- Approximate location of fence

3607 and 3609 Spenard Road
Anchorage, Alaska

SITE PLAN

October 2012 — 32-1-17525-001

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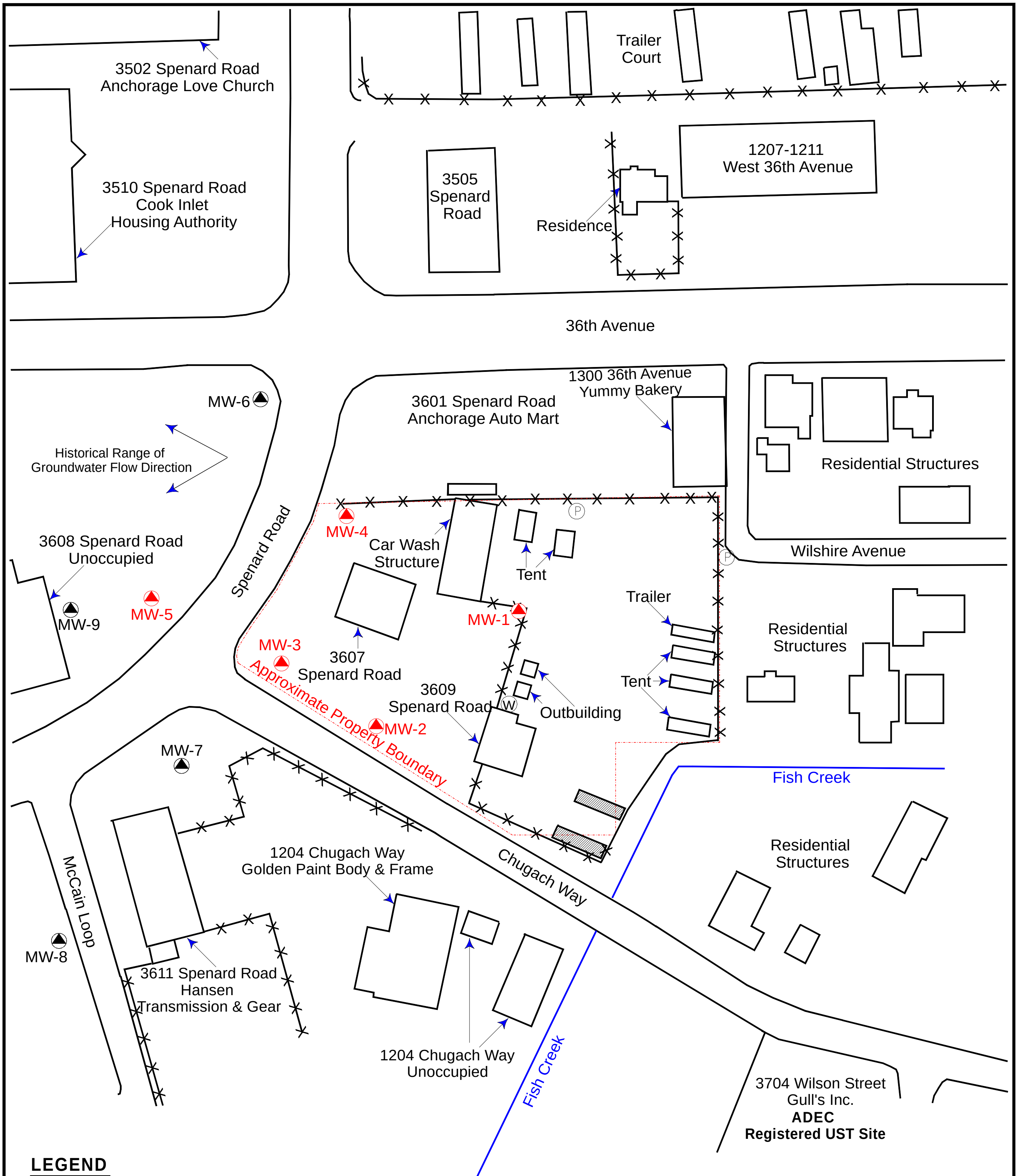
Fig. 2



LEGEND

MW-1 Approximate location of groundwater Monitoring Well MW-1
Red indicates most recent groundwater sample contained GRO, DRO, benzene and/or ethylbenzene exceeding ADEC cleanup levels.

(W) Approximate location of drinking water well

Approximate location of connex storage container

(P) Approximate location of pole-mounted transformer

Approximate location of piped Fish Creek

Approximate location of fence

0 100 200
APPROXIMATE SCALE IN FEET

3607 and 3609 Spenard Road
Anchorage, Alaska

MONITORING WELL LOCATIONS

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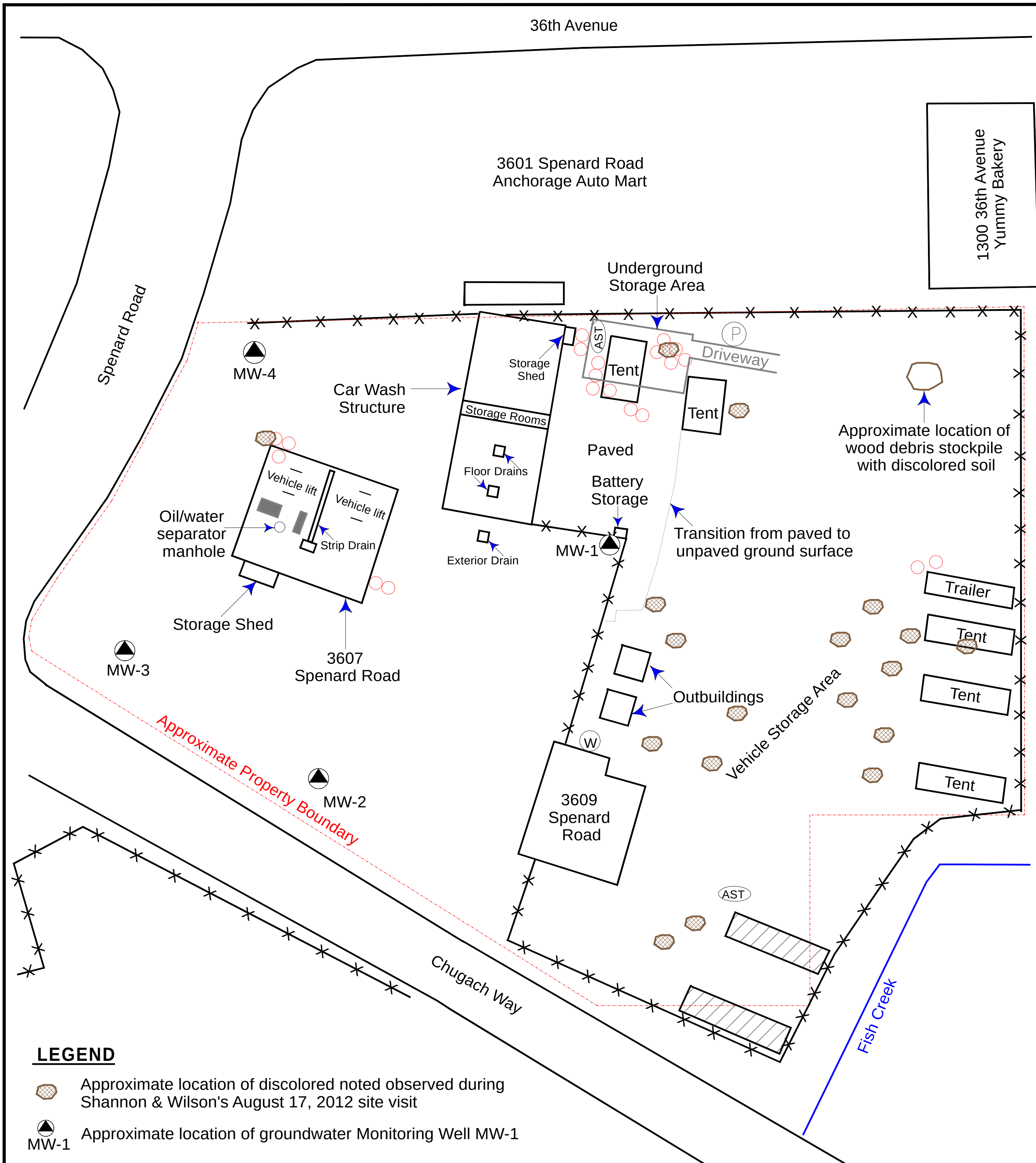
Fig. 3



LEGEND

Approximate location of discolored noted observed during Shannon & Wilson's August 17, 2012 site visit

MW-1 Approximate location of groundwater Monitoring Well MW-1

Approximate location of 55-gallon drum

Approximate location of abandoned floor drain and/or lift

AST Approximate location of storage tank

W Approximate location of drinking water well

Approximate location of connex storage container

P Approximate location of pole-mounted transformer

Approximate location of Fish Creek (in culvert)

Approximate location of fence

0 50 100

APPROXIMATE SCALE IN FEET

N

3607 and 3609 Spenard Road
Anchorage, Alaska

POTENTIAL CONTAMINANT SOURCES

October 2012 | 32-1-17525-001

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Fig. 4

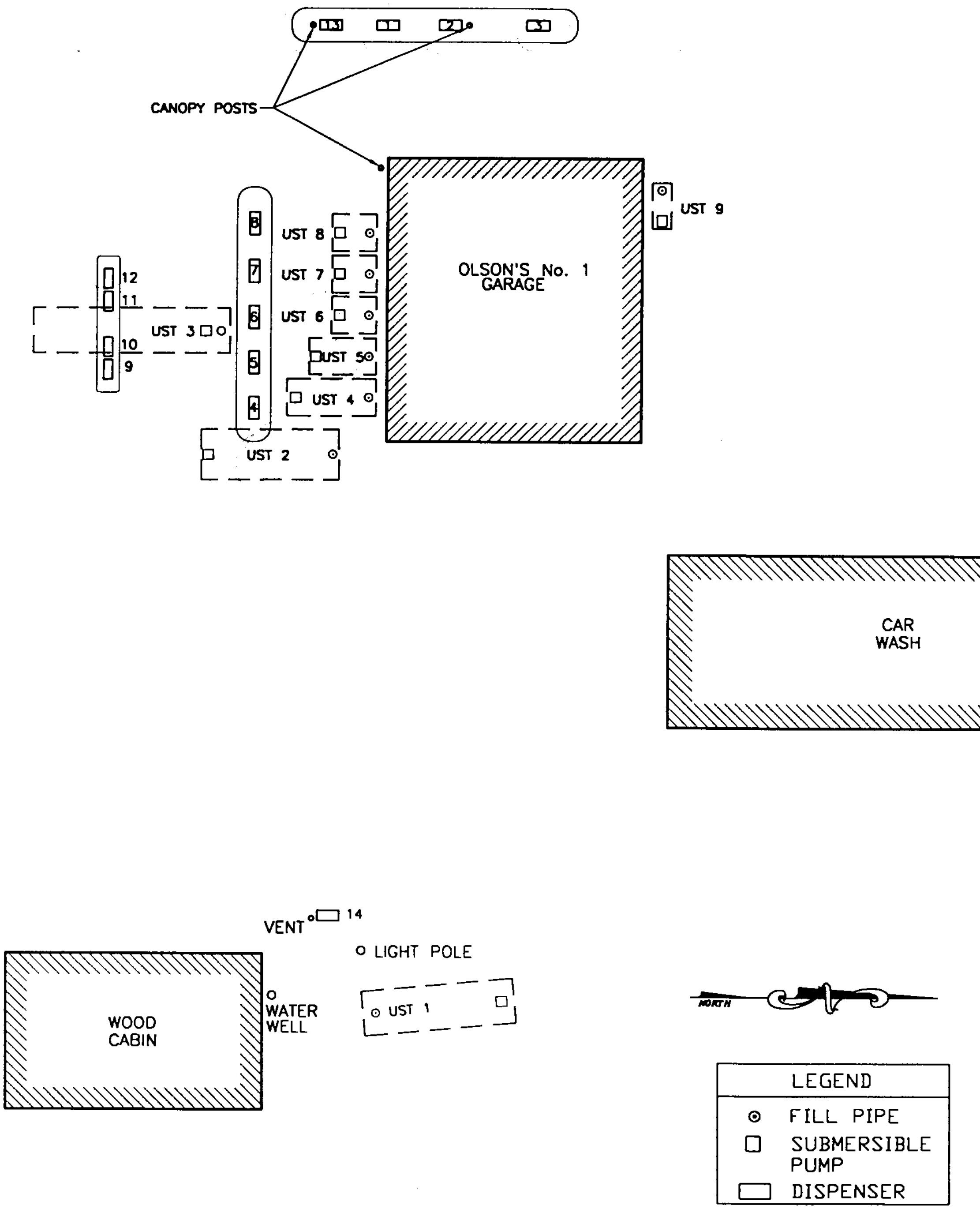
APPENDIX A

HISTORICAL RELEASE INVESTIGATION AND REMEDIAL ACTION TABLES AND FIGURES

October 1995 UST Site Assessment

NOTE:
Not an As-Built Survey. Property lines and site drawing shown are of record based on swing-tie measurements.

0144



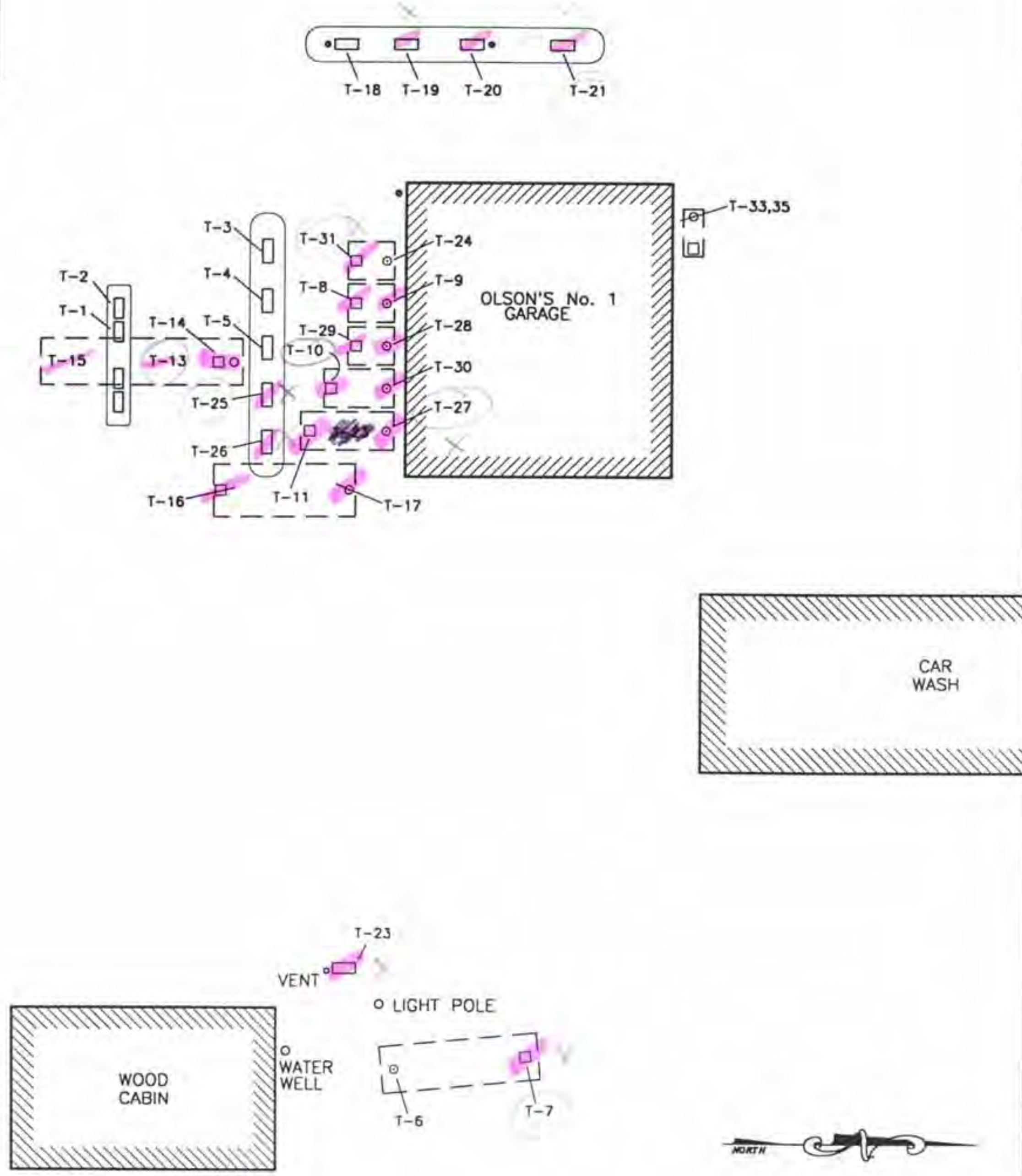
(J.G.)DRAWINGS\91051\SPRD-1B

FIGURE 2: OLSON'S No.1 – SITE PLAN

GILFILIAN ENGINEERING & ENVIRONMENTAL TESTING, INC. 2605 Denali St., Suite 203, Anchorage, Alaska 99503-2749	SCALE: 1"=30'
	DATE: 10/16/95
	GEI PROJECT NO. 91051B

0146

NOTE:
Not an As-Built Survey.
Property lines and
site drawing shown are
of record based on
swing-tie measurements.



LEGEND

- ⊙ FILL PIPE
- □ SUBMERSIBLE PUMP
- ▭ DISPENSER

FIGURE 4: OLSON'S No.1 – SAMPLE LOCATIONS

GILFILIAN ENGINEERING &
ENVIRONMENTAL TESTING, INC.
2605 Denali St., Suite 203, Anchorage, Alaska 99503-2749

SCALE:	1" = 30'
DATE:	10/16/95
GEI PROJECT NO. 91051B	

(J.G.)DRAWINGS\91051\SP...D-1B

Tables 1,2, and 3. Cleanup level A is required for this location as per the ADEC Matrix Score Sheet (Figure 5).

0138

Table 1
EPH & VPH/BTEX
Analytical Soil Sample Results

Sample Number	Location	Depth (bgs)	PID* (ppm)	EPH (mg/kg)	VPH (mg/kg)	Benzene (mg/kg)	BTEX (mg/kg)
T-19	Dispenser #1	.5	320	NT	708	ND (0.54)	281
T-20	Dispenser #2	1	155	NT	85.5	0.179	42
T-21	Dispenser #3	1	300	NT	3,116	65.6	1,344
T-22	dup of T-21			NT	1,262	16.8	510
T-26	Dispenser #4	1	500	15,600	NT	NT	NT
T-25	Dispenser #5	1	210	22,400	NT	NT	NT
T-5	Dispenser #6	1	2	NT	ND (1.10)	ND (0.055)	ND(0.275)
T-4	Dispenser #7	1	3	NT	1.1	ND (0.055)	0.366
T-3	Dispenser #8	1	25	NT	8.24	ND (0.050)	2.206
T-1	Dispenser #11	1	0	NT	ND (1.0)	ND (0.050)	ND(0.25)
T-2	Dispenser #12	1	0	NT	ND (1.10)	ND (0.055)	ND(0.275)
T-18	Dispenser #13	1	13	NT	4.92	0.06	0.617
T-23	Dispenser #14	1	0	8,240	NT	NT	NT
T-32	dup of T-23			8,980	NT	NT	NT
T-6	UST #1-fill end	9.5	7	55.6	NT	NT	NT
T-7	UST #1-pump end	9.5	350	23,800	NT	NT	NT
T-17	UST #2-fill end	12.5	480	NT	613	0.096	147
T-16	UST #2-pump end	12.5	375	NT	387	1.32	140
T-14	UST #3-north end	11	300	NT	1,195	7.54	420
T-13	UST #3-center	11	300	1,830	2,338	21.6	1,045
T-15	UST #3-south end	13.5	300	NT	1,600	19.2	758
T-27	UST #4-fill end	9.5	2,000**	NT	5,194	24.6	2,057
T-11	UST #4-pump end	10	2,000**	NT	281	0.126	83
T-12	dup of T-11			NT	297	0.211	74
T-30	UST #5-fill end	10	150	NT	122	ND (0.50)	44
T-10	UST #5-pump end	10	2,000**	NT	2,231	8.87	1,028
T-28	UST #6-fill end	9	100	NT	61	ND (0.005)	12
T-29	UST #6-pump end	9	170	NT	175	ND (0.50)	78
T-9	UST #7-fill end	9	350	3,030	NT	NT	NT
T-8	UST #7-pump end	9	360	2,710	NT	NT	NT
T-24	UST #8-fill end	9	25	18.5	NT	NT	NT
T-31	UST #8-pump end	9	200	7,040	NT	NT	NT
T-33&35	UST #9	6	7	59.3	ND (1.0)	ND (0.05)	ND (0.25)
Level A Cleanup Standard				100	50	.01	10

Notes:
NT = Not Tested for this analyte
ND = Not Detected above the indicated practical quantification limit
Shaded areas indicate locations above Level A cleanup standards
* HNu PID except where noted otherwise
** photovac Tip II PID

0139

Table 2
Waste Oil Tank
Analytical Soil Sample Results

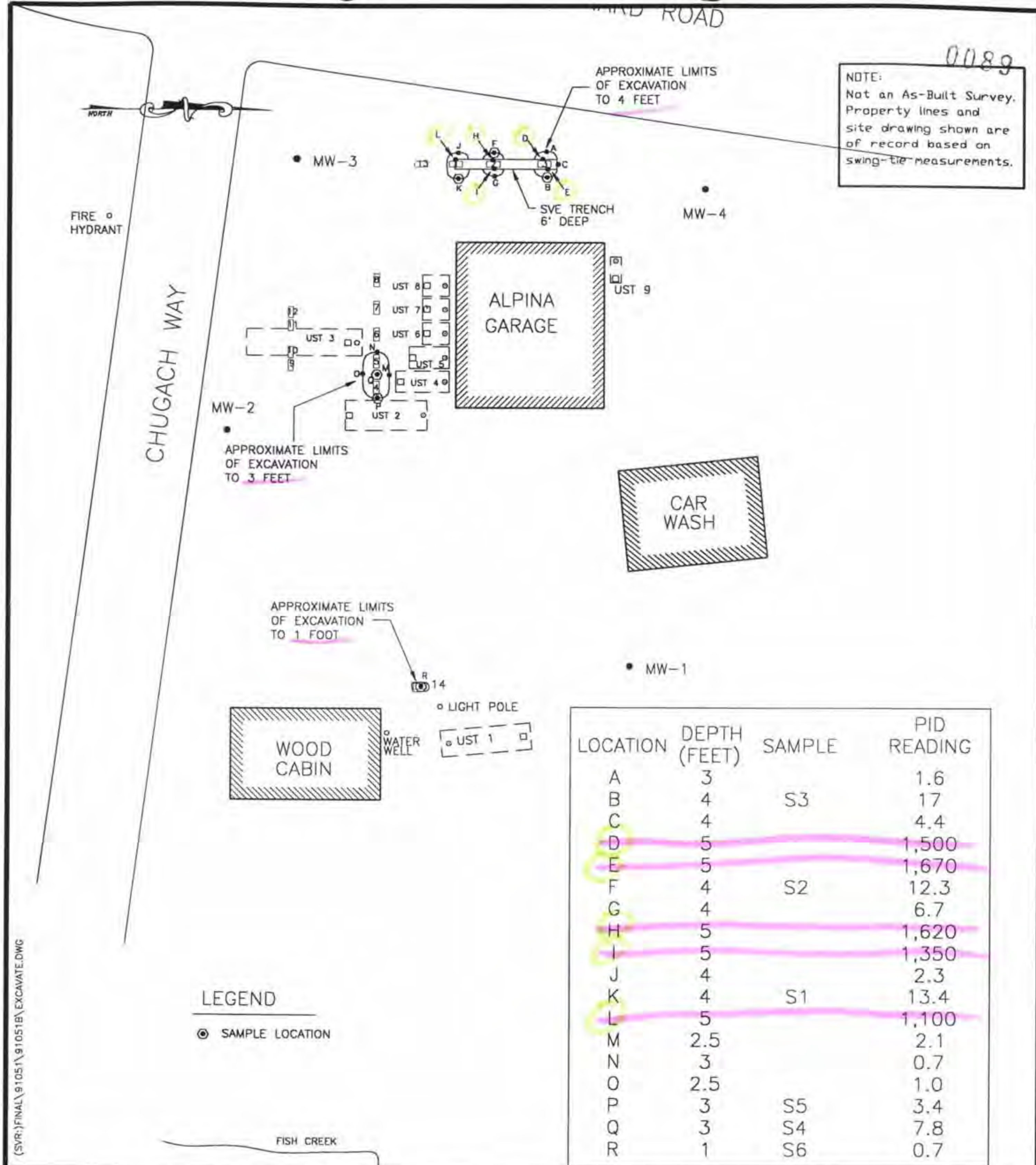
Parameter Tested	Results (sample T33&T35) mg/kg	Duplicate (sample T34 &T36) mg/kg	Level A Cleanup Std
TPH	128	159	2,000
Arsenic	3.8	4.0	
Cadmium	0.049	0.048	
Chromium	40	39	
Lead	5.7	5.5	
PCBs	0.0035	0.0035	
Volatile Chlorinated Solvents *	ND (0.050)	ND (0.050)	
EPH	59.3	NT	100
VPH	ND (1.00)	NT	50
Benzene	ND (0.05)	NT	0.01
BTEX	ND (0.25)	NT	10

* Indicated quantification limit is for each solvent individually
ND = Not Detected above the indicated practical quantification limit

Table 3
Lead
Analytical Soil Sample Results

Sample Number	Location	Lead mg/kg
T-1	Dispenser #11	54
T-2	Dispenser #12	360
T-3	Dispenser #8	350
T-4	Dispenser #7	200
T-5	Dispenser #6	60
T-10	UST #5 - pump end	13
T-14	UST #3 - south end	16
T-18	Dispenser #13	490
T-19	Dispenser #1	540, 470

The sample collected under the remote diesel dispenser (#14) registered a surprisingly high EPH level. This result was unanticipated since the surrounding area was overgrown with vegetation and observations made during the field assessment indicated no signs of diesel contamination. A photograph of the location is included in Figure 6. The CT&E chromatogram from this location



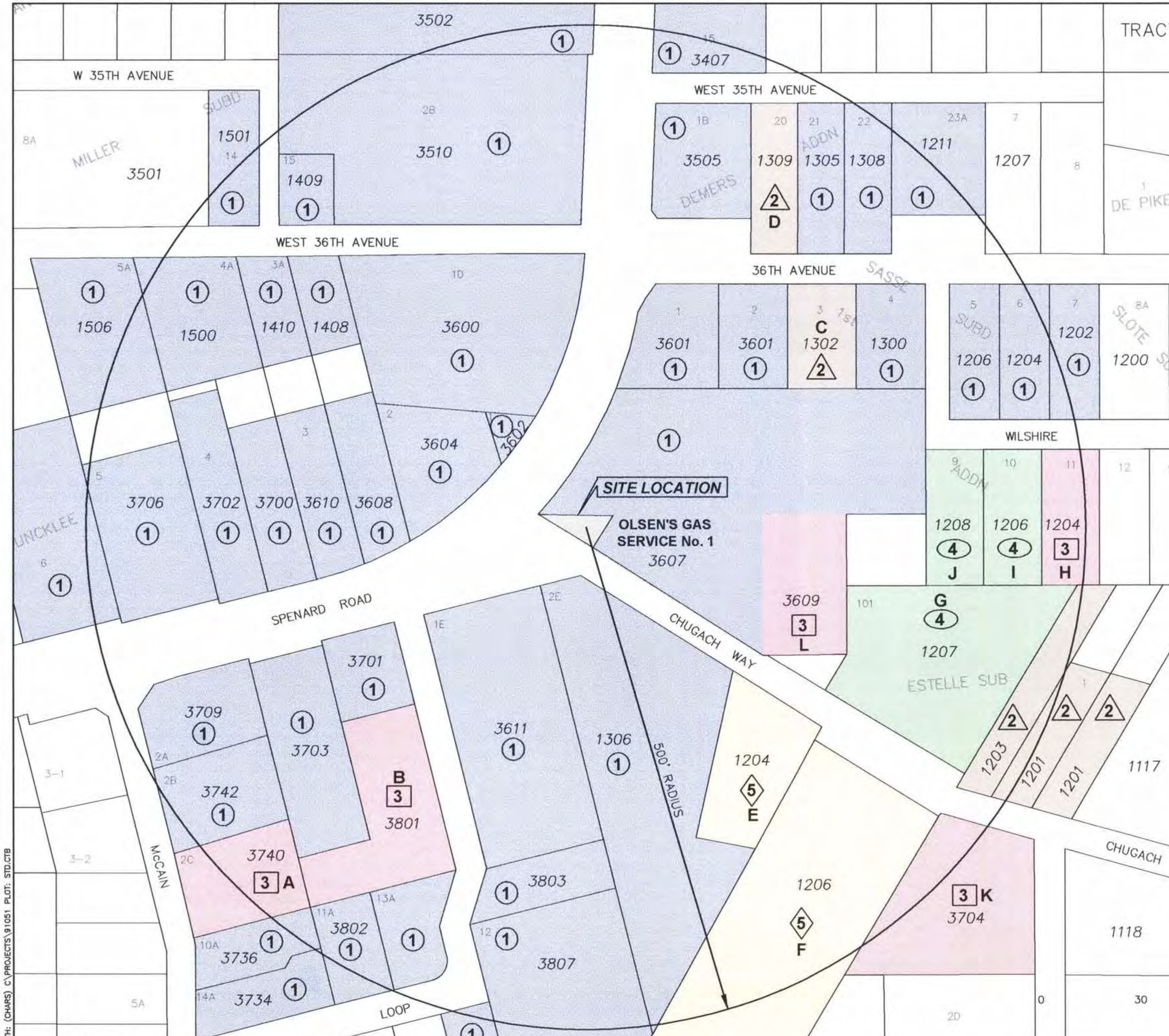
LOCATION	DEPTH (FEET)	SAMPLE	PID READING
A	3		1.6
B	4	S3	17
C	4		4.4
D	5		1,500
E	5		1,670
F	4	S2	12.3
G	4		6.7
H	5		1,620
I	5		1,350
J	4		2.3
K	4	S1	13.4
L	5		1,100
M	2.5		2.1
N	3		0.7
O	2.5		1.0
P	3	S5	3.4
Q	3	S4	7.8
R	1	S6	0.7

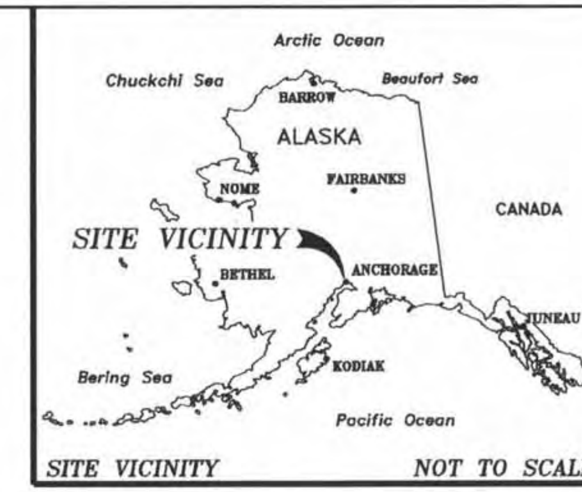
FIGURE 2 – EXCAVATION LIMITS AND SAMPLE LOCATIONS

GILFILIAN ENGINEERING & ENVIRONMENTAL TESTING, INC.
2605 Denali St., Suite 203, Anchorage, Alaska 99503-2749

SCALE:	1" = 40'
DATE:	7/17/97
PROJECT NO.	91051B

2001 Well Search





LEGEND

- (1) CITY WATER CONFIRMED BY AWWU
- (2) HOUSE APPEARS VACANT
- [3] PRIVATE ON-SITE WELL
- (4) PRIVATE OFF-SITE WELL
- (5) DEVELOPED PROPERTY WITH UNKNOWN WATER SOURCE
- A - L REFERENCE REPORT PAGES 2 AND 3, SECTION 4.1

Gilfilian Engineering & Environmental Testing, Inc.
2605 Denali Street, Suite 203
Anchorage, Alaska 99503

0048

WELL LOCATION MAP

OLSON'S GAS SERVICE No. 1
ADEC UST FACILITY I.D. #2288
3607 SPENARD ROAD
ANCHORAGE, ALASKA

PROJECT No.	91051
DATE	5/29/01
DRAWING	91051F4
DRAWN	CEH
APPROVED	KAI

FIGURE II

PATH: (CHARS) C:\PROJECTS\91051 PLOT: STD.CTB

October 2001 Excavation

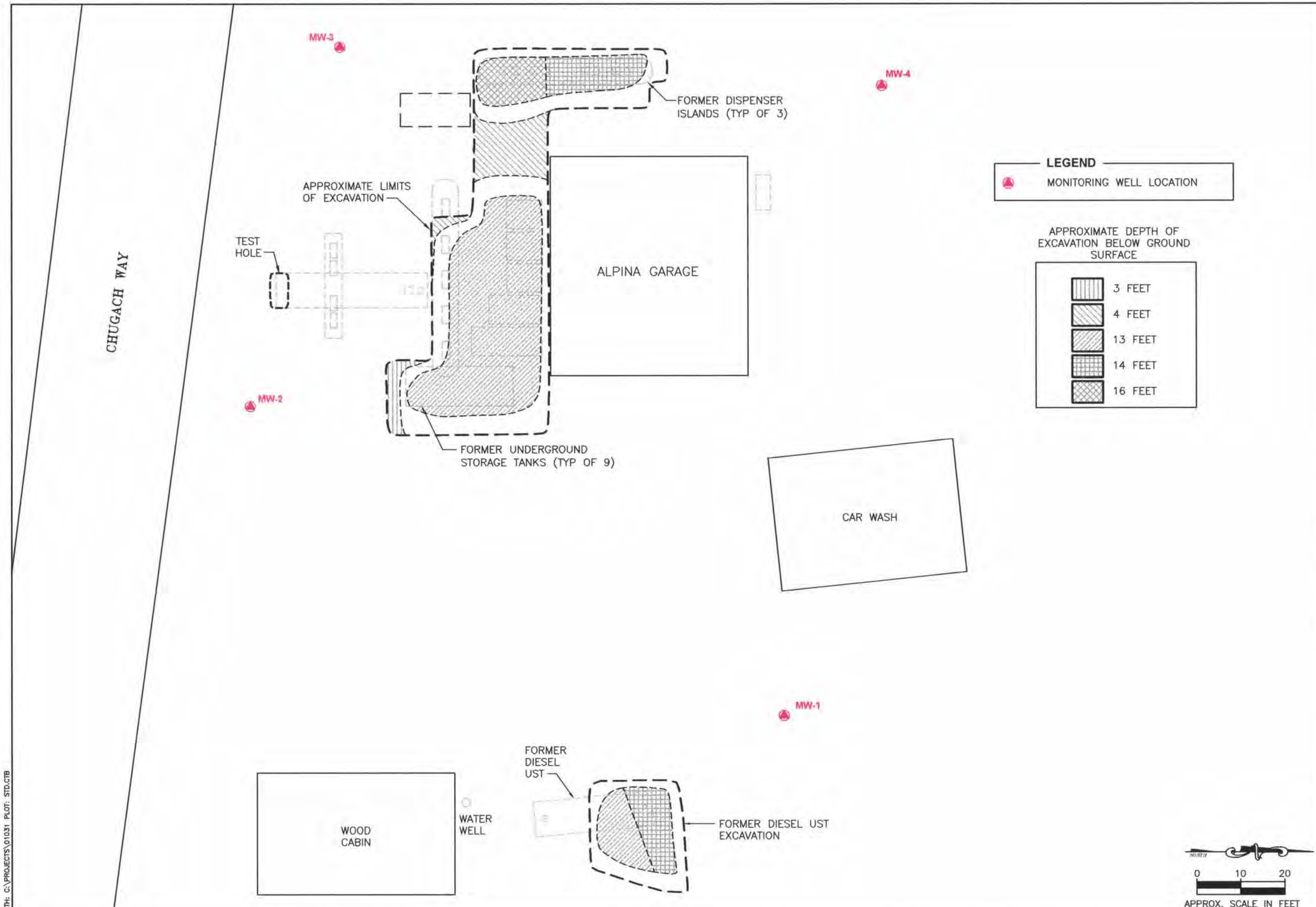
0093

TABLE 1: ANALYTICAL SOIL SAMPLE RESULTS (WEST & SOUTH EXCAVATION)

Collected from September 4 to 7, 2001

Sample ID	Location/Depth	Benzene (mg/kg)	Toluene (mg/kg)	Ethyl-benzene (mg/kg)	Xylenes (mg/kg)	GRO (mg/kg)	DRO (mg/kg)	PID[1] (ppmv)
1-14	N bottom@ W excav / 14 ft	**0.068**	0.177	0.117	0.806	6.85	ND	2.7
2-14	Center W bottom@ W excav / 14 ft	**0.0663**	0.0745	0.0370	0.291	2.64	ND	10.7
3	NE bottom@ W excav / 14 ft	NT	NT	NT	NT	NT	NT	1.3
4	Center E bottom@ W excav / 14 ft	NT	NT	NT	NT	NT	NT	0.8
SW-1	N sidewall@ W excav / 12 ft	NT	NT	NT	NT	NT	NT	7.3
SW-2	NW sidewall@ W excav / 12 ft	NT	NT	NT	NT	NT	NT	9.2
SW-3	NE sidewall@ W excav / 12 ft	NT	NT	NT	NT	NT	NT	23.3
SW-4	N center sidewall@ W excav / 12 ft	**1.25**	**12.8**	**6.79**	29.5	**804**	83.1[2]	1401
SW-5	E center sidewall@ W excav / 12 ft	NT	NT	NT	NT	NT	NT	24.7
5	E center bottom@ W excav / 15 ft	NT	NT	NT	NT	NT	NT	1200[4]
6	S center bottom@ W excav / 15 ft	NT	NT	NT	NT	NT	NT	1381[4]
SW-6[5]	SE sidewall@ W excav / 12 ft	**0.789**	4.14	0.481	9.02	48.2[5]	ND[5]	237
SW-7	SW sidewall@ W excav / 12 ft	**14.7**	**260**	**84.1**	**480**	**3930[3]**	29.3[2]	1100
7-16	S bottom@ W excav / 16 ft	**3.73**	1.14	2.31	10.3	63.4	ND	43.4
SW-8	N sidewall@ S excav/ 12 ft	**28.6**	**319**	**80.3**	**1100**	**8410[3]**	**2520**	2000+
8-13	E end bottom@ S excav / 13 ft	**2.46**	**13.7**	1.05	8.39	82.5	ND	618
9-13	Center bottom@ S excav / 13 ft	**2.94**	**15.4**	1.20	9.10	86.1	ND	322
10-13	W end bottom@ S excav / 13 ft	**3.89**	**17.0**	2.61	20.8	155	ND	618
12-12	SE bottom@ S excav / 12 - 13 ft	**0.481**	3.64	3.36	19.9	**351**	38.2	1311
SW-9	NE sidewall@ S excav / 12 ft	**0.306**	0.849	0.899	7.17	40.6	ND	42.8
SW-10	SE sidewall@ S excav / 12 ft	**0.146**	0.774	0.785	6.11	31.2	ND	28.6
SW-11	NE sidewall@ S excav / 11 ft	NT	NT	NT	NT	NT	NT	28.3
SW-12	W sidewall@ S excav / 11 ft	NT	NT	NT	NT	NT	NT	7.2
SW-13	S sidewall@ S excav / 11 ft	NT	NT	NT	NT	NT	NT	430
SW-14	SW sidewall@ S excav / 11 ft	**2.34**	**41.9**	**6.28**	**122**	**773**	**375**	1571
SW-15	S center sidewall@ S excav / 11 ft	NT	NT	NT	NT	NT	NT	866
SW-16	SE center sidewall@ S excav / 11 ft	**0.444**	2.75	0.382	6.55	34.3	ND	2000+
QC Samples								
11-13	Duplicate of 10-13	**4.55**	**18.2**	2.50	19.6	164	ND	618
Trip Blank	WO #P1I0272	ND	ND	ND	ND	ND	NT	NT
Trip Blank	WO #P1I0277	ND	ND	ND	ND	ND	NT	NT
Soil Cleanup Levels		0.02	5.4	5.5	78	300	250	NA

Notes:
Benzene, toluene, ethylbenzene and xylenes, tested by EPA Method 8021b
GRO = Gasoline range organics, tested by Alaska Test Method AK101
DRO = Diesel range organics, tested by Alaska Test Method AK102
[1]PID = Photoionization detector. Reported units relative to calibration of PID with a 100 ppmv isobutylene standard.
[2]Detected hydrocarbons appear due to heavily weathered gas and diesel.
[3]Surrogate recovery is outside control limits due to matrix interference.
[4]Not analyzed as additional soil was removed.
[5]Analyzed past hold time.
Yellow indicate values at or above Table B1, Method Two, soil cleanup levels.
ND = Not detected above the PQLs shown in the analytical reports in Appendix B.
NT = Not tested or analyzed.



Gilfilian Engineering & Environmental Testing, Inc.
2605 Denali Street, Suite 203
Anchorage, Alaska 99503

0103

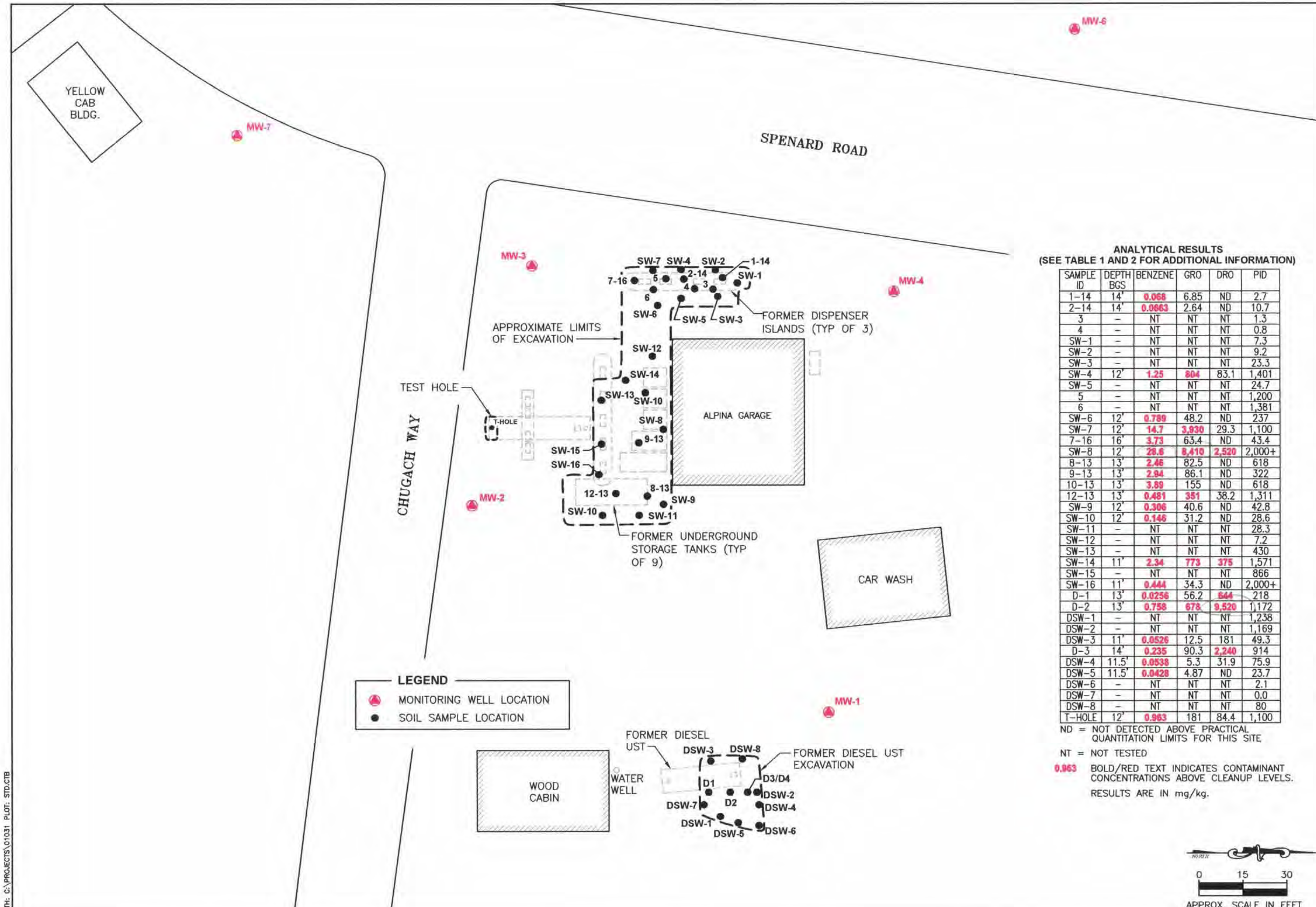
APPROXIMATE LIMITS AND DEPTH OF EXCAVATIONS

OLSON'S GAS SERVICE No. 1

ADEC UST FACILITY I.D. #2288
3607 SPENARD ROAD
ANCHORAGE, ALASKA

PROJECT No. 01031
DATE 10/18/01
DRAWING 01031F3
DRAWN CEH
APPROVED GMD

FIGURE II



ANALYTICAL RESULTS
(SEE TABLE 1 AND 2 FOR ADDITIONAL INFORMATION)

SAMPLE ID	DEPTH BGS	BENZENE	GRO	DRO	PID
1–14	14'	**0.068**	6.85	ND	2.7
2–14	14'	**0.0663**	2.64	ND	10.7
3	–	NT	NT	NT	1.3
4	–	NT	NT	NT	0.8
SW–1	–	NT	NT	NT	7.3
SW–2	–	NT	NT	NT	9.2
SW–3	–	NT	NT	NT	23.3
SW–4	12'	**1.25**	**804**	83.1	1,401
SW–5	–	NT	NT	NT	24.7
5	–	NT	NT	NT	1,200
6	–	NT	NT	NT	1,381
SW–6	12'	**0.789**	48.2	ND	237
SW–7	12'	**14.7**	**3,930**	29.3	1,100
7–16	16'	**3.73**	63.4	ND	43.4
SW–8	12'	**28.6**	**8,410**	**2,520**	2,000+
8–13	13'	**2.46**	82.5	ND	618
9–13	13'	**2.94**	86.1	ND	322
10–13	13'	**3.89**	155	ND	618
12–13	13'	**0.481**	**351**	38.2	1,311
SW–9	12'	**0.306**	40.6	ND	42.8
SW–10	12'	**0.146**	31.2	ND	28.6
SW–11	–	NT	NT	NT	28.3
SW–12	–	NT	NT	NT	7.2
SW–13	–	NT	NT	NT	430
SW–14	11'	**2.34**	**773**	**375**	1,571
SW–15	–	NT	NT	NT	866
SW–16	11'	**0.444**	34.3	ND	2,000+
D–1	13'	**0.0256**	56.2	**644**	218
D–2	13'	**0.758**	**678**	**9,520**	1,172
DSW–1	–	NT	NT	NT	1,238
DSW–2	–	NT	NT	NT	1,169
DSW–3	11'	**0.0526**	12.5	181	49.3
D–3	14'	**0.235**	90.3	**2,240**	914
DSW–4	11.5'	**0.0538**	5.3	31.9	75.9
DSW–5	11.5'	**0.0428**	4.87	ND	23.7
DSW–6	–	NT	NT	NT	2.1
DSW–7	–	NT	NT	NT	0.0
DSW–8	–	NT	NT	NT	80
T–HOLE	12'	**0.963**	181	84.4	1,100

ND = NOT DETECTED ABOVE PRACTICAL QUANTITATION LIMITS FOR THIS SITE

NT = NOT TESTED

0.963 BOLD/RED TEXT INDICATES CONTAMINANT CONCENTRATIONS ABOVE CLEANUP LEVELS.

RESULTS ARE IN mg/kg.

Gilfilian Engineering & Environmental Testing, Inc.
2605 Denali Street, Suite 203
Anchorage, Alaska 99503

0104

SOIL SAMPLE LOCATIONS AND ANALYTICAL RESULTS

OLSON'S GAS SERVICE No. 1

ADEC UST FACILITY I.D. #2288
3607 SPENARD ROAD
ANCHORAGE, ALASKA

PROJECT No. 01031
DATE 10/17/01
DRAWING 01031F2
DRAWN CEH
APPROVED GMD

FIGURE III

PATH: C:\PROJECTS\01031 PLOT: STD.CTB

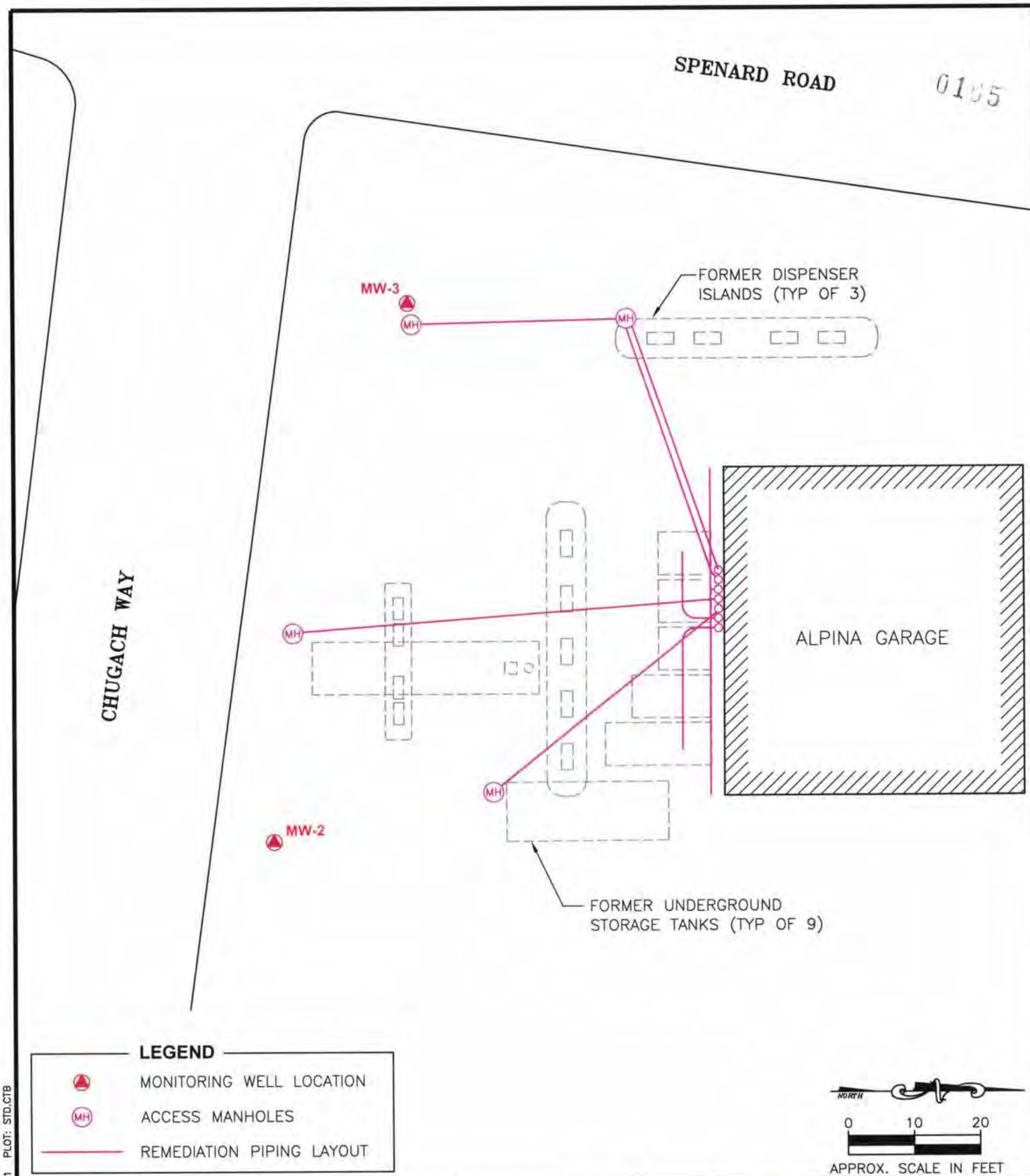


FIGURE IV

ACCESS MANHOLES AND REMEDIATION PIPING

OLSON'S GAS SERVICE No. 1

ADEC UST FACILITY I.D. #2288
3607 SPENARD ROAD
ANCHORAGE, ALASKA

Gilfilian Engineering & Environmental Testing, Inc.
2605 Denali Street, Suite 203
Anchorage, Alaska 99503

PROJECT No.: 01031
DATE: 10/26/01
SCALE: AS SHOWN
FILE: 01031F1.DWG
DRAWN BY: CEH
CHECKED BY: GMD

PATH: (CHARS) C:\PROJECTS\01031 PLOT: STD.CTB

TABLE 2: ANALYTICAL SOIL SAMPLE RESULTS (FORMER DIESEL UST EXCAVATION & TEST HOLE)

Collected from September 6 to 7, 2001

Sample ID	Location/Depth	Benzene (mg/kg)	Toluene (mg/kg)	Ethyl-benzene (mg/kg)	Xylenes (mg/kg)	GRO (mg/kg)	DRO (mg/kg)	PID[1] (ppmv)
D-1	S bottom@D excav / 13 ft	**0.0256**	0.0149	0.600	4.55	56.2	**644**	218
D-2	Center bottom@D excav / 13 ft	**0.758**	1.17	**7.26**	35.3	**678**	**9520**	1172
DSW-1	E sidewall@D excav / 11 ft	NT	NT	NT	NT	NT	NT	1238[2]
DSW-2	N sidewall@D excav / 11 ft	NT	NT	NT	NT	NT	NT	1169[2]
DSW-3	SW sidewall@D excav / 11 ft	**0.0526**	0.181	0.145	1.18	12.5	181	49.3
D-3	N bottom@D excav / 14 ft	**0.235**	0.184	0.675	2.54	90.3	**2240**	914
DSW-4	N sidewall@D excav / 11.5 ft	**0.0538**	0.112	0.0959	0.135	5.30	31.9	75.9
DSW-5	E center sidewall@D excav / 11.5 ft	**0.0428**	0.083	ND	0.0765	4.87	ND	23.7
DSW-6	NE sidewall@D excav / 11.5 ft	NT	NT	NT	NT	NT	NT	2.1
DSW-7	SE sidewall@D excav / 11 ft	NT	NT	NT	NT	NT	NT	0.0
DSW-8	NW sidewall@D excav / 11 ft	NT	NT	NT	NT	NT	NT	80
T Hole	Bottom of test hole / 12 ft	**0.963**	**11.2**	5.21	32.2	181	84.4	1100
QC Samples								
D-4	Duplicate of D-3	**0.0959**	**0.0941**	0.444	1.66	75.5	**2460**	914
Trip Blank	WO #P1I0277	ND	ND	ND	ND	ND	NT	NT
	Soil Cleanup Levels	0.02	5.4	5.5	78	300	250	NA

Notes:
Benzene, toluene, ethylbenzene and xylenes, tested by EPA Method 8021b
GRO = Gasoline range organics, tested by Alaska Test Method AK101
DRO = Diesel range organics, tested by Alaska Test Method AK102
[1]PID = Photoionization detected. Reported units relative to calibration of PID with a 100 ppmv isobutylene standard.
[2]Not analyzed as additional soil was removed.
Yellow indicates values at or above Table B1, Method Two, soil cleanup levels.
ND = Not detected above the PQLs shown in the analytical reports in Appendix B.
NT = Not tested or analyzed.

The obviously clean and questionably clean soil stockpile, approximately 450 cubic yards, was sampled for field screen and analytical results, as shown in Tables 3 & 4.

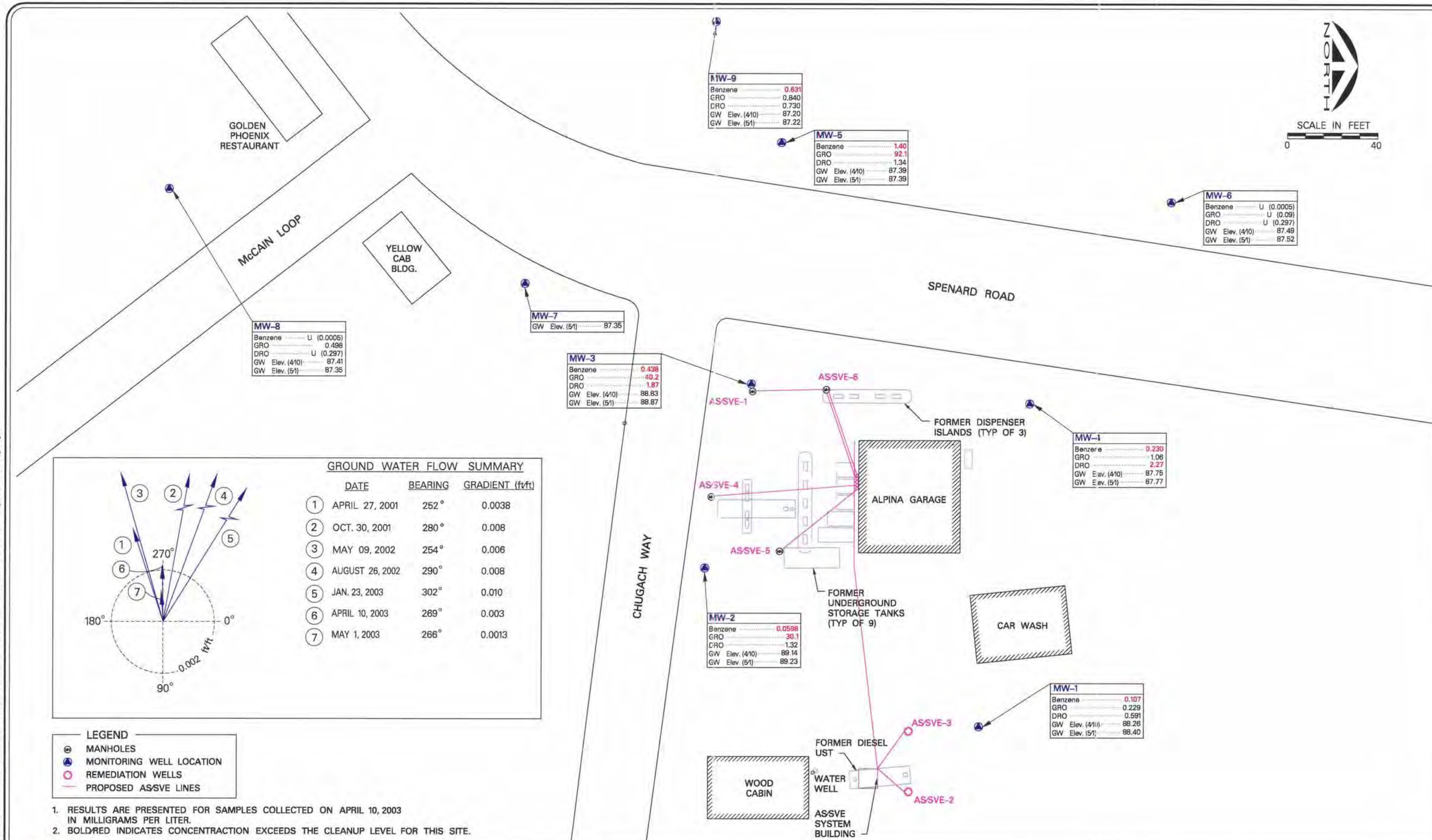
TABLE 3: ANALYTICAL SOIL SAMPLE RESULTS (STOCKPILE SAMPLES)

Collected on September 7, 2001

Sample ID	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)	GRO (mg/kg)	DRO (mg/kg)	PID[1] (ppmv)
STP-3	ND	ND	ND	0.2065	3.76	117[2]	27.5
STP-6	0.0102	ND	ND	ND	ND	59.2[2]	30.0
STP-28	ND	ND	ND	0.0965	ND	75.4[2]	61.7
STP-41	ND	ND	ND	0.0856	ND	21.9[3]	51.5
STP-42	ND	ND	ND	0.1306	2.60	105[2]	91.2
QC Samples							
STP-46	ND	ND	ND	0.0335	ND	186[2]	30.0
Trip Blank	ND	ND	ND	ND	ND	NT	NT
SCLs	0.02	5.4	5.5	78	300	250	

Notes:
Benzene, toluene, ethylbenzene and xylenes, tested by EPA Method 8021b
GRO = Gasoline range organics, tested by Alaska Test Method AK101
DRO = Diesel range organics, tested by Alaska Test Method AK102
[1]PID = Photoionization detector. Reported units relative to calibration of PID with a 100 ppmv isobutylene standard.
[2]Pattern consistent with weathered middle distillate.
[3]Unknown hydrocarbon with several peaks.
ND = Not detected above the PQLs shown in the analytical reports in Appendix B.
NT = Not tested or analyzed.
STP-46 is a duplicate of STP-6.

May 2003 Release Investigation/Remediation System Installation



GROUND WATER FLOW SUMMARY

	DATE	BEARING	GRADIENT (ft/ft)
1	APRIL 27, 2001	252°	0.0038
2	OCT. 30, 2001	280°	0.008
3	MAY 09, 2002	254°	0.006
4	AUGUST 26, 2002	290°	0.008
5	JAN. 23, 2003	302°	0.010
6	APRIL 10, 2003	269°	0.003
7	MAY 1, 2003	266°	0.0013

1. RESULTS ARE PRESENTED FOR SAMPLES COLLECTED ON APRIL 10, 2003 IN MILLIGRAMS PER LITER.
2. BOLD/RED INDICATES CONCENTRACTION EXCEEDS THE CLEANUP LEVEL FOR THIS SITE.

MWH
Anchorage, Alaska

FIGURE 2

OLSON'S GAS SERVICE NO. 1
ADEC UST FACILITY I.D. #2288

SITE PLAN WITH GROUND WATER ANALYTICAL RESULTS

June 2009 Quarterly Monitoring Report
Historical Groundwater Results Summary Table

FIGURE II

Monitoring Well MW-1

Date Sampled	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	Xylenes (mg/L)	GRO (mg/L)	DRO (mg/L)	GW Elev. (feet)
05/29/96	U	U	U	U	U	47.4	86.02
11/18/96	U	0.001	U	0.001	0.023	0.704	86.03
05/09/97	U	U	U	U	U	0.193	88.30
07/08/97	NT	NT	NT	NT	NT	NT	85.97
02/20/98	U	U	U	U	U	0.15	85.84
06/17/98	U	U	U	U	U	0.16	86.90
05/17/00	U	U	U	U	U	U	87.59
08/26/02	NT	NT	NT	NT	NT	NT	NM
01/23/03	NT	NT	NT	NT	NT	NT	NM
04/10/03	0.107	U	U	U	0.229	0.591	87.18
08/28/03	NT	NT	NT	NT	NT	NT	NM
06/14/06	NT	NT	NT	NT	NT	NT	NM
06/18/09	NT	NT	NT	NT	NT	NT	NM
GCL's	**0.005**	**1.0**	**0.7**	**10.0**	**1.3**	**1.5**	**NA**

Monitoring Well MW-2

Date Sampled	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	Xylenes (mg/L)	GRO (mg/L)	DRO (mg/L)	GW Elev. (feet)
05/29/96	0.136	0.175	0.648	3.150	9.860	0.81	85.90
11/18/96	0.045	0.006	0.063	0.152	0.626	0.81	86.16
05/09/97	0.019	0.008	0.084	0.312	0.870	0.49	86.08
08/21/97	0.039	0.006	0.128	0.378	1.400	0.92	86.09
11/07/97	0.021	U	0.076	0.220	1.140	1.7	86.25
02/20/98	0.005	U	0.045	0.127	0.840	1.55	85.67
06/17/98	0.003	U	0.032	0.115	0.440	1.86	86.69
05/17/00	0.002	U	0.004	0.008	0.140	0.001	87.42
08/31/00	0.002	U	0.004	0.012	0.193	3.53	87.03
01/05/01	0.002	U	0.005	0.017	0.375	2.31	86.62
04/27/01	0.002	U	0.007	0.017	0.522	1.36	87.38
10/30/01	4.920	10.200	1.990	10.800	56.300	2.49	87.71
05/09/02	0.119	5.100	5.270	24.800	73.600	2.01	87.25
08/26/02	0.080	0.773	3.260	15.030	38.000	1.24	88.83
01/23/03	0.050	0.300	1.470	5.810	26.600	2.05	88.76
04/10/03	0.060	0.100	2.060	8.110	30.100	1.32	88.60
06/14/06	0.036	U	0.076	0.083	0.749	0.405	87.81
06/18/09	0.007	U	0.013	0.029	0.335	0.001	87.95
GCL's	**0.005**	**1.0**	**0.7**	**10.0**	**1.3**	**1.5**	**NA**

FIGURE II

Monitoring Well MW-3

Date Sampled	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	Xylenes (mg/L)	GRO (mg/L)	DRO (mg/L)	GW Elev. (feet)
05/29/96	35.200	44.300	7.000	35.300	231.000	2.78	85.80
11/18/96	32.600	37.600	6.600	32.500	197.000	6.71	85.73
05/09/97	26.400	31.300	6.500	31.500	190.000	8.12	85.89
07/08/97	NT	NT	NT	NT	NT	NT	85.79
08/21/97	29.400	39.800	6.700	34.300	210.000	11.70	85.85
11/07/97	20.000	24.000	5.300	26.000	159.000	13.00	86.06
02/20/98	24.000	29.000	5.700	26.000	240.000	36.00	85.60
06/17/98	19.000	25.000	5.500	26.000	180.000	17.70	86.37
05/17/00	30.800	37.200	6.500	30.100	220.000	8.76	87.20
08/31/00	14.500	17.700	3.700	18.200	187.000	9.12	86.99
01/05/01	21.700	34.500	6.300	29.500	211.000	11.30	86.45
04/27/01	18.800	28.700	5.300	24.800	202.000	11.70	87.04
10/30/01	15.000	23.800	4.300	19.800	126.000	7.80	87.50
05/09/02	6.580	25.500	6.000	25.800	187.000	3.41	87.83
08/26/02	1.980	18.400	4.190	18.700	115.000	3.82	88.53
01/23/03	0.389	5.780	2.210	9.120	50.900	3.12	88.41
04/10/03	0.438	5.770	1.830	7.780	40.200	1.87	88.33
08/28/03	0.001	2.730	0.892	5.290	0.001	2.28	87.79
06/14/06	0.068	0.092	0.716	3.320	11.600	1.44	87.45
06/18/09	0.126	U	1.640	6.840	49.000	3.85	87.79
GCL's	**0.005**	**1.0**	**0.7**	**10.0**	**1.3**	**1.5**	**NA**

Monitoring Well MW-4

Date Sampled	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	Xylenes (mg/L)	GRO (mg/L)	DRO (mg/L)	GW Elev. (feet)
07/08/97	0.001	U	U	U	U	1.07	86.03
08/21/97	U	U	U	U	U	0.51	86.15
11/07/97	U	U	U	U	U	0.28	86.17
02/20/98	U	U	U	U	U	0.26	85.82
06/17/98	U	U	U	U	U	0.27	86.55
05/17/00	U	U	U	U	U	U	87.24
08/31/00	NT	NT	NT	NT	NT	NT	NM
01/05/01	NT	NT	NT	NT	NT	NT	NM
04/27/01	NT	NT	NT	NT	NT	NT	87.26
10/30/01	U	U	U	U	U	0.52	87.23
05/09/02	0.002	U	U	U	U	U	86.97
08/26/02	NT	NT	NT	NT	NT	NT	86.75
01/23/03	NT	NT	NT	NT	NT	NT	86.73
04/10/03	0.230	0.051	0.027	0.108	1.060	2.27	86.63
08/28/03	NT	NT	NT	NT	NT	NT	86.51
06/14/06	NT	NT	NT	NT	NT	NT	NM
06/18/09	0.470	U	U	U	1.720	U	87.95
GCL's	**0.005**	**1.0**	**0.7**	**10.0**	**1.3**	**1.5**	**NA**

FIGURE II

Monitoring Well MW-5

Date Sampled	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	Xylenes (mg/L)	GRO (mg/L)	DRO (mg/L)	GW Elev. (feet)
07/08/97	0.007	0.003	U	U	U	2.37	85.62
08/21/97	0.001	0.002	U	0.002	U	0.26	85.75
11/07/97	U	U	U	U	U	0.30	85.79
02/20/98	U	U	U	U	U	0.13	85.35
06/17/98	U	0.002	0.002	0.007	0.059	0.14	86.06
05/17/00	U	U	U	U	U	U	86.94
08/31/00	0.002	U	U	U	U	U	86.98
01/05/01	U	U	U	U	U	0.33	86.30
04/27/01	U	U	U	U	U	U	86.66
10/30/01	U	U	U	U	U	0.46	85.76
05/09/02	7.070	33.600	5.960	28.490	130.000	1.56	87.15
08/26/02	4.480	23.500	6.620	33.800	126.000	2.12	87.12
01/23/03	1.880	16.800	4.800	22.050	120.000	2.17	86.94
04/10/03	1.400	11.000	4.570	22.130	92.000	1.34	86.88
08/28/03	1.330	8.220	4.430	26.000	118.000	0.00	86.82
06/14/06	0.306	0.204	2.010	9.830	31.500	2.21	86.64
06/18/09	0.173	U	0.128	1.070	6.140	0.00	87.26
GCL's	**0.005**	**1.0**	**0.7**	**10.0**	**1.3**	**1.5**	**NA**

Monitoring Well MW-6

Date Sampled	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	Xylenes (mg/L)	GRO (mg/L)	DRO (mg/L)	GW Elev. (feet)
07/08/97	U	U	U	U	U	4.090	85.98
08/21/97	NT	NT	NT	NT	NT	NT	NM
11/07/97	U	U	U	U	U	0.205	86.00
02/20/98	U	U	U	U	U	0.130	85.69
06/17/98	U	0.001	U	0.003	U	0.170	86.20
05/17/00	U	U	U	U	U	U	86.88
08/31/00	NT	NT	NT	NT	NT	NT	NM
01/05/01	NT	NT	NT	NT	NT	NT	NM
04/27/01	NT	NT	NT	NT	NT	NT	NM
10/30/01	U	U	U	U	U	0.151	NM
05/09/02	U	U	U	U	U	U	87.34
08/26/02	NT	NT	NT	NT	NT	NT	87.19
01/23/03	NT	NT	NT	NT	NT	NT	NM
04/10/03	U	U	U	U	U	U	87.01
08/28/03	NT	NT	NT	NT	NT	NT	NM
06/14/06	NT	NT	NT	NT	NT	NT	NM
06/18/09	Well was abandoned during construction of city sidewalks						
GCL's	**0.005**	**1.0**	**0.7**	**10.0**	**1.3**	**1.5**	**NA**

FIGURE II

Monitoring Well MW-7

Date Sampled	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	Xylenes (mg/L)	GRO (mg/L)	DRO (mg/L)	GW Elev. (feet)
10/30/01	U	U	U	U	U	0.473	86.85
05/09/02	0.023	U	0.003	0.028	0.114	U	87.56
08/26/02	0.036	U	0.027	0.031	0.192	U	87.49
01/23/03	0.004	U	0.006	0.009	U	U	87.37
04/10/03	NT	NT	NT	NT	NT	NT	NM
08/28/03	NT	NT	NT	NT	NT	NT	NM
06/14/06	NT	NT	NT	NT	NT	NT	NM
06/18/09	U	U	U	U	U	U	87.60
GCL's	**0.005**	**1.0**	**0.7**	**10.0**	**1.3**	**1.5**	**NA**

Monitoring Well MW-8

Date Sampled	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	Xylenes (mg/L)	GRO (mg/L)	DRO (mg/L)	GW Elev. (feet)
04/10/03	U	U	U	U	0.498	U	NA
08/28/03	NT	NT	NT	NT	NT	NT	NM
06/14/06	NT	NT	NT	NT	NT	NT	NM
06/18/09	NT	NT	NT	NT	NT	NT	NM
GCL's	**0.005**	**1.0**	**0.7**	**10.0**	**1.3**	**1.5**	**NA**

Monitoring Well MW-9

Date Sampled	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	Xylenes (mg/L)	GRO (mg/L)	DRO (mg/L)	GW Elev. (feet)
04/10/03	0.631	U	U	U	0.840	0.730	NA
08/28/03	0.110	U	U	U	0.295	U	87.20
06/14/06	NT	NT	NT	NT	NT	NT	NM
06/18/09	U	U	U	U	U	U	87.40
GCL's	**0.005**	**1.0**	**0.7**	**10.0**	**1.3**	**1.5**	**NA**

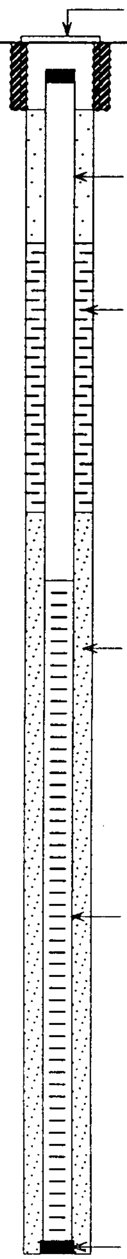
Boring Logs

GILFILIAN ENGINEERING &
ENVIRONMENTAL TESTING, INC.

LOG OF MW-1

0119

WELL CONSTRUCTION



DEPTH (feet)	BLOWS/FT	PID (units)	SAMPLE NUMBER	MATERIALS DESCRIPTION
0				Pavement
	13	0		SAND with some Gravel brown, dry to slightly damp
				Silty SAND with ocassional Gravel brown, damp
5	18	0	S1	SAND uniform, medium grain, brown, damp
10	17	0	S2	
				SAND w/ ocassional small Gravel and coarser Sand
		0	S3	
	13	0		SAND w/ more abundant coarser sand
15				Clayey SILT
	19	0	S4	
				Total Depth = 18 feet Ground Water encountered at 11.75 feet
20				

LOG OF MW-1

PROJECT Olson's Gas Service #1	DRILLING COMPANY Denali Drilling
LOCATION Anchorage, Alaska	DATE DRILLED 5/17/96
JOB NUMBER 91051B	SURFACE ELEVATION approx. 105 Unknown
GEOLOGIST Chris Hawe	TOTAL DEPTH OF HOLE 18 Ft
DRILL RIG 6" Hollow Stem Auger	DEPTH TO GROUNDWATER 11.75 Ft

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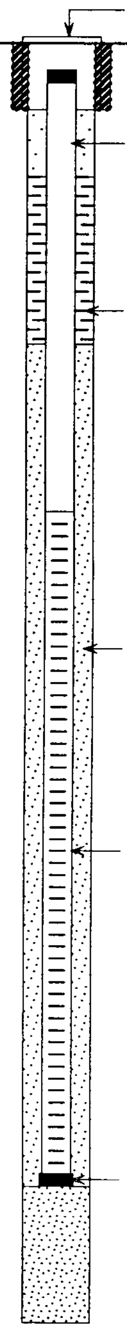
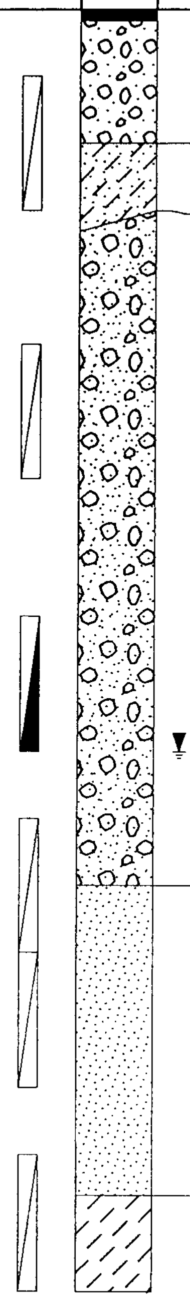
ENVIRONMENTAL TESTING, INC.

LOG OF MW-2

Page 1 of 1

WELL CONSTRUCTION





DEPTH (feet)	BLOWS/FT	PID (units)	SAMPLE NUMBER	MATERIALS DESCRIPTION
0				Pavement
				Gravelly SAND brown, damp
	11	3.5	S5	SILT w/ Sand and ocassional roots and Gravel, grey, damp
5	40	0	S6	Gravelly medium to coarse SAND gravel to 1 inch dia. brown, slightly damp
10	35	58.5	S7	petroleum odor 9 to 11 feet
	30	0	S8	SAND, uniform medium grain brown/rust color to 13.5 feet grey from 13.5 to 17.6 feet
15	23	0	S9	
	16	0	S10	SILT w/ clay and some sandy silt zones grey
20				Total Depth = 19 feet Ground Water encountered at 11 feet

LOG OF MW-2

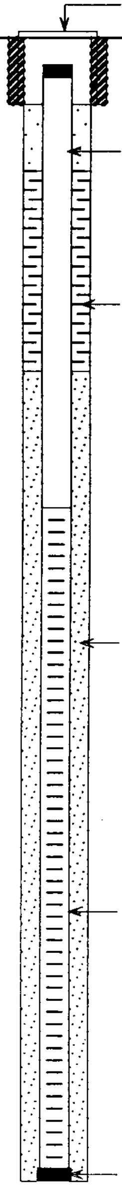
PROJECT	Olson's Gas Service #1	DRILLING COMPANY	Denali Drilling
LOCATION	Anchorage, Alaska	DATE DRILLED	5/17/96
JOB NUMBER	91051B	SURFACE ELEVATION	Unknown
GEOLOGIST	Chris Hawe	TOTAL DEPTH OF HOLE	19 Ft
DRILL RIG	6" Hollow Stem Auger	DEPTH TO GROUNDWATER	11 Ft

GILFILIAN ENGINEERING &
ENVIRONMENTAL TESTING, INC.

LOG OF MW-3

Page 1 of 1

WELL CONSTRUCTION



DEPTH (feet)	BLOWS/FT	PID (units)	SAMPLE NUMBER	MATERIALS DESCRIPTION
0				Pavement
				SAND and GRAVEL brown, slightly damp
	16	102	S11	
				Sandy SILT brown, damp
5	14	22.9	S12	SAND uniform, medium grain, grey, damp
10	29	450	S13	petroleum odor and rust color near 10.5'. Gravelly SAND grey, saturated. amount of gravel increases with depth to 16.7'
15	47	290	S14	
	19	200	S15	
				SILT grey-green, damp
20				

Total Depth = 17 feet
Ground Water encountered at 10.75 feet

LOG OF MW-3

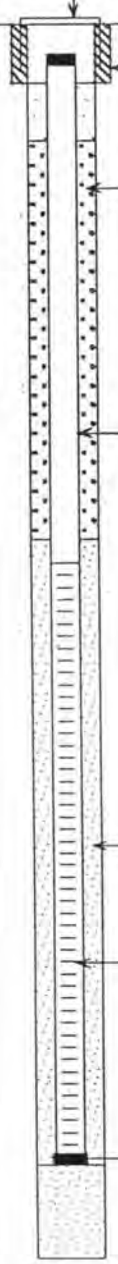
PROJECT	Olson's Gas Service #1	DRILLING COMPANY	Denali Drilling
LOCATION	Anchorage, Alaska	DATE DRILLED	5/17/96
JOB NUMBER	91051B	SURFACE ELEVATION	Unknown
GEOLOGIST	Chris Hawe	TOTAL DEPTH OF HOLE	17 Ft
DRILL RIG	6" Hollow Stem Auger	DEPTH TO GROUNDWATER	10.75 Ft

GILFILIAN ENGINEERING & ENVIRONMENTAL TESTING, INC.

LOG OF BORING MW-4

0093

WELL CONSTRUCTION



BLOWS/FT	PID (units)	SAMPLE NUMBER
13	0.5	
14	0.7	
21	0.7	S1
10	0	

MATERIALS DESCRIPTION

- Pavement
- SAND and GRAVEL brown, loose, dry
- Silty SAND
- SAND, fine grain, brown, dry
- 0.2-inch layer of coarse grain sand at 8'
- SAND, medium grain, uniform brown, dry
- 0.2-inch layer of wood and coal
- SAND, medium grain
- Coarse Sandy GRAVEL brown, wet
- Color changes to gray at 13.75'
- Clayey SILT gray, damp

Total Depth =21 feet
Ground Water encountered at 12 feet

LOG OF BORING MW-4

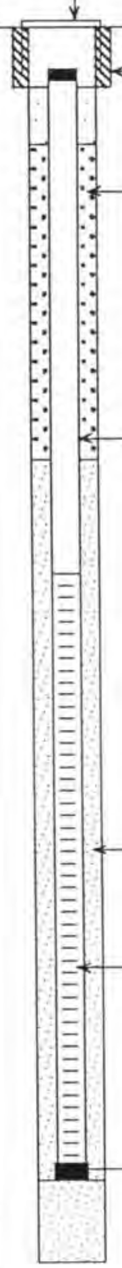
PROJECT: Olson's Gas Service #1	DRILLING COMPANY: Denali Drilling
LOCATION: Anchorage, Alaska	DATE DRILLED: 8/19/97
JOB NUMBER: 91501B	SURFACE ELEVATION: Unknown
ENGINEER: Janet Bartel	TOTAL DEPTH OF HOLE: 21.0 Ft
DRILL RIG: CME-85, 8 3/4" HOLLOW STEM AUGER	DEPTH TO GROUNDWATER: 12.0 Ft

GILFILIAN ENGINEERING &
ENVIRONMENTAL TESTING, INC.

LOG OF BORING MW-5

0094

WELL CONSTRUCTION



DEPTH (feet)	BLOWS/FT	PID (units)	SAMPLE NUMBER
5			
	19	0	
10			
	27	0	
	18	0	S2&S3
15			
	21	0	
20			

MATERIALS DESCRIPTION

- Pavement
- Sandy GRAVEL
- SILT and SAND brown, dry
- medium-coarse SAND w/ trace gravel
- SAND, medium grain, uniform brown, dry
- SAND w/ trace gravel
- Sandy GRAVEL, dry, reddish brown
- SAND, medium grain, uniform, brown, wet
- SAND, medium-coarse grain, gray, wet
- SAND, fine-medium, gray, wet

Total Depth =21 feet
Ground Water encountered at 12.5 feet

LOG OF BORING MW-5

PROJECT: Olson's Gas Service #1	DRILLING COMPANY: Denali Drilling
LOCATION: Anchorage, Alaska	DATE DRILLED: 8/19/97
JOB NUMBER: 91501B	SURFACE ELEVATION: Unknown
ENGINEER: Janet Bartel	TOTAL DEPTH OF HOLE: 21.0 Ft
DRILL RIG: CME-85, 8 3/4" HOLLOW STEM AUGER	DEPTH TO GROUNDWATER: 12.5 Ft

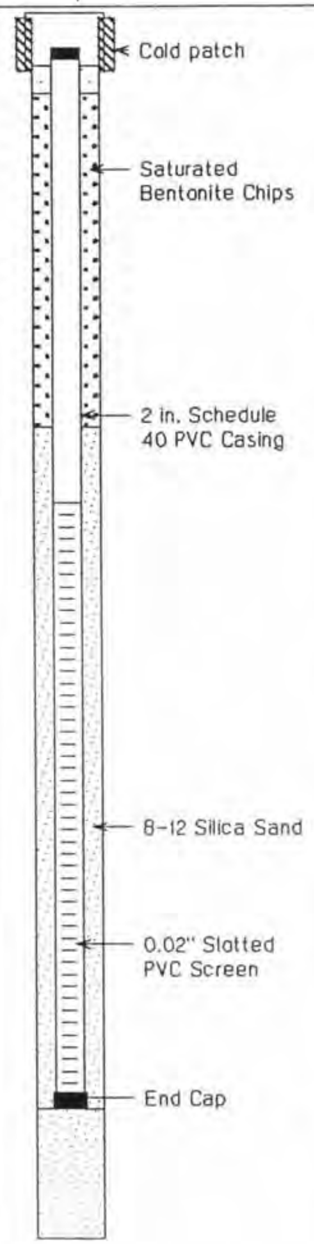
GILFILIAN ENGINEERING &
ENVIRONMENTAL TESTING, INC.

LOG OF BORING MW-6

0095

Page 1 of 1

WELL CONSTRUCTION



DEPTH (feet)	BLOWS/FT	PID (units)	SAMPLE NUMBER
5–7	17	0	
10–12	21	0	
12–14	22	0	S4
16–18	27	0	
20–21	13	0	

MATERIALS DESCRIPTION

- Sandy GRAVEL
- fine Sandy SILT
- SAND, brown, loose, dry
- Wood & coal
- fine grain SAND, uniform, brown
- fine-medium grain SAND, brown, wet
- fine-medium grain SAND, gray, wet
- Sandy GRAVEL
- medium-coarse grain SAND, gray, wet
- Clayey SILT

Total Depth =21 feet
Ground Water encountered at 12.5 feet

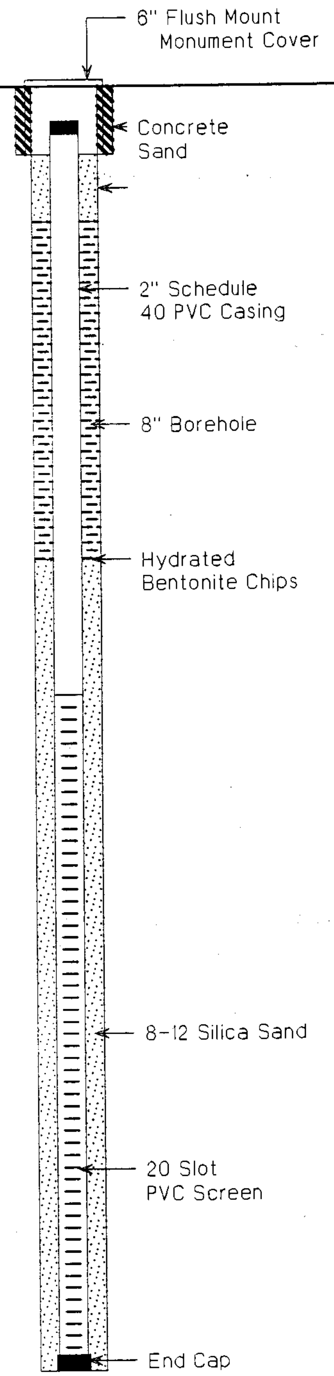
LOG OF BORING MW-6

PROJECT: Olson's Gas Service #1	DRILLING COMPANY: Denali Drilling
LOCATION: Anchorage, Alaska	DATE DRILLED: 8/19/97
JOB NUMBER: 91501B	SURFACE ELEVATION: Unknown
ENGINEER: Janet Bartel	TOTAL DEPTH OF HOLE: 21.0 Ft
DRILL RIG: CME-85, 8 3/4" HOLLOW STEM AUGER	DEPTH TO GROUNDWATER: 12.5 Ft

GILFILIAN ENGINEERING & ENVIRONMENTAL TESTING, INC.

LOG OF BORING MW-7

01 7



DEPTH (feet)	BLOWS/FT.	PID (units)	SAMPLE NUMBER	MATERIALS DESCRIPTION
0				Asphalt, 3" thick
				Lt. brn, dry, gravelly SAND (fill material).
				Gray-brn, dry, mod. dense, silty SAND.
				Slight change in drilling noted.
	11			Brn, dry, mod. dense, fine to med. SAND.
5	17	0.0	MW-7-6	No fuel odor or staining noted.
	27			Gray-brn, mod. dense, damp, fine to coarse SAND.
	77	2.5	MW-7-8	Brn to rusty brn, dense, dry, sandy GRAVEL. Fine to coarse sand and small gravel.
	52			
10	54	1.4	MW-7-10	Gravelly, rusty-brn, damp, mod. dense SAND. No fuel odor or staining.
	25			Gray and rusty-brn, fine to coarse SAND. Damp above GW interface, increasing moisture with depth.
	37	2.6	MW-7-12	Ground Water encountered at 12'
15				Fine to coarse, saturated, gray SAND.
				(Soil descriptions, other than SS samples, are based upon auger cuttings.)
				Total Depth 19.0'
20				

HS = Headspace Screening

PROJECT: Olson's #1 Gas Service	DRILLING COMPANY: Discovery Drilling, Inc.
LOCATION: Anchorage, Alaska	DATE DRILLED: 8-7-01
JOB NUMBER: 01031E	SURFACE ELEVATION: Unknown
ENGINEER: G. Dubuisson	TOTAL DEPTH OF HOLE (feet): 19
DRILL RIG: CME-75	DEPTH TO GROUNDWATER (feet): 12

MWH
4100 Spenard Road
Anchorage, Alaska

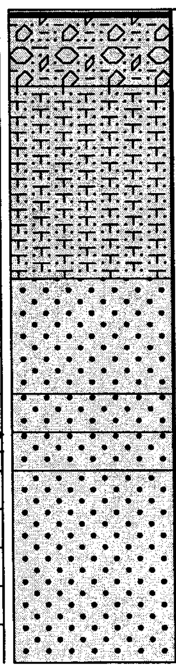
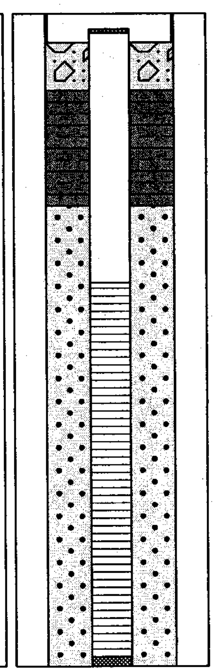
FIELD BOREHOLE LOG

BOREHOLE NO.: **MW-8**
TOTAL DEPTH: **17**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Olson's Gas Service #1**	DRILLING CO.:	**Denali Drilling**
SITE LOCATION:	**Anchorage, Alaska**	DRILLER:	**Orvil Ennes**
JOB NO.:	**1850870**	RIG TYPE:	**CME 65**
LOGGED BY:	**Gary Dubuisson**	METHOD OF DRILLING:	**8" Hollow Stem Auger**
PROJECT MANAGER:	**Gary Dubuisson**	SAMPLING METHODS:	**Split Spoon**
DATES DRILLED:	**3-4-03**	HAMMER WT./DROP	**340 lb, 30 in.**

NOTES: Cloudy, 30's F

▼ Water level in boring

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	SAMP. #	Blows / ft.	PID ppmv	BORING COMPLETION	WELL DESCRIPTION
0			GRAVEL AND SAND: Brn, dry, med.dense (fill)					8-inch Access Vault Sand
			SILTY SAND: Gray-brn, dry, /w occas. gravel					Bentonite Chip Seal
-5								2-inch I.D. Schedule 40 Blank
			SAND: Dk gray, dry, fine-med. /w trace silt & occas. gravel					
-10			SAND: Gray, damp fine					8-inch boring Annulus
▼			SAND: Gray, wet, med.	MW08001	4 5 6 8	0.1		
			SAND: Dark gray, saturated, fine-med sand /w trace silt, silt layer encountered @ approx. 17'					Colorado Sand 8-12
-15								20-slot Well Screen

MWH
4100 Spenard Road
Anchorage, Alaska

FIELD BOREHOLE LOG

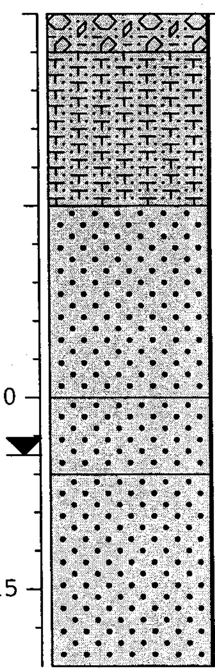
BOREHOLE NO.: **MW-9**
TOTAL DEPTH: **17**

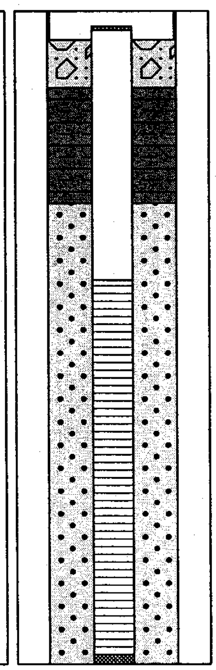
PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Olson's Gas Service #1**	DRILLING CO.:	**Denali Drilling**
SITE LOCATION:	**Anchorage, Alaska**	DRILLER:	**Orvil Ennes**
JOB NO.:	**1850870**	RIG TYPE:	**CME 65**
LOGGED BY:	**Gary Dubuisson**	METHOD OF DRILLING:	**8" Hollow Stem Auger**
PROJECT MANAGER:	**Gary Dubuisson**	SAMPLING METHODS:	**Split Spoon**
DATES DRILLED:	**3-4-03**	HAMMER WT./DROP	**340 lb, 30 in.**

NOTES: Cloudy, 30's F

▼ Water level in boring

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	SAMP. #	Blows / ft.	PID ppmv	BORING COMPLETION	WELL DESCRIPTION
0			GRAVEL AND SAND: (fill)					8-inch Access Vault Sand
			SILTY SAND: Gray-brn, dry, fine-med.					Bentonite Chip Seal
-5			SAND: Gray-brn, dry, /w occas. gravel					2-inch I.D. Schedule 40 Blank
-10			SAND: Gray, damp, fine-med.	MW09001	4 10 17 17	0.3		8-inch boring Annulus
			SAND: Gray, fine-med., trace silt, silt layer encountered @ approx. 17'					Colorado Sand 8-12
-15								20-slot Well Screen





MWH
4100 Spenard Road
Anchorage, Alaska

FIELD BOREHOLE LOG

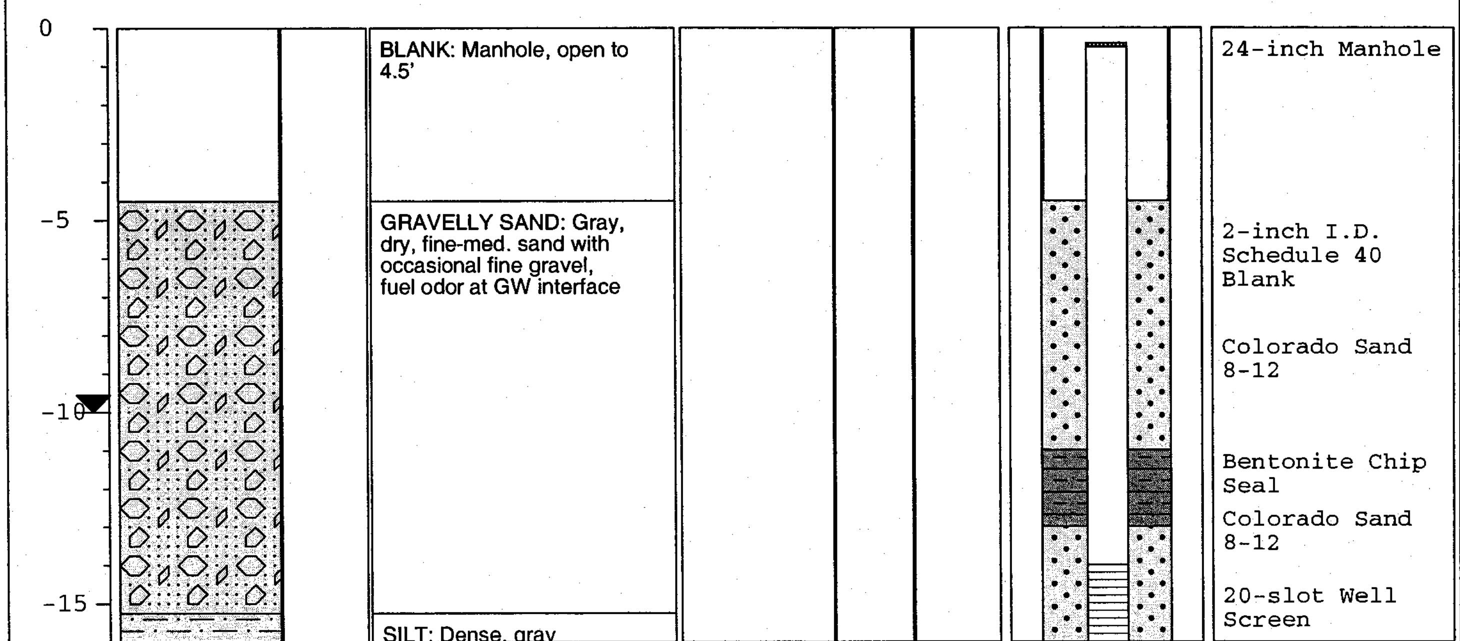
BOREHOLE NO.: **AS/SVE-4**
TOTAL DEPTH: **16**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Olson's Gas Service #1**	DRILLING CO.:	**Denali Drilling**
SITE LOCATION:	**Anchorage, Alaska**	DRILLER:	**Orvil Ennes**
JOB NO.:	**1850870**	RIG TYPE:	**CME 65**
LOGGED BY:	**Gary Dubuisson**	METHOD OF DRILLING:	**10" Hollow Stem Auger**
PROJECT MANAGER:	**Gary Dubuisson**	SAMPLING METHODS:	
DATES DRILLED:	**3-4-03**	HAMMER WT./DROP	**340 lb, 30 in.**

NOTES: Cloudy, 30's F

▼ Water level in boring

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	SAMP. #	Blows / ft.	PID ppmv	BORING COMPLETION	WELL DESCRIPTION



MWH
4100 Spenard Road
Anchorage, Alaska

FIELD BOREHOLE LOG

BOREHOLE NO.: **AS/SVE-5**
TOTAL DEPTH: **17**

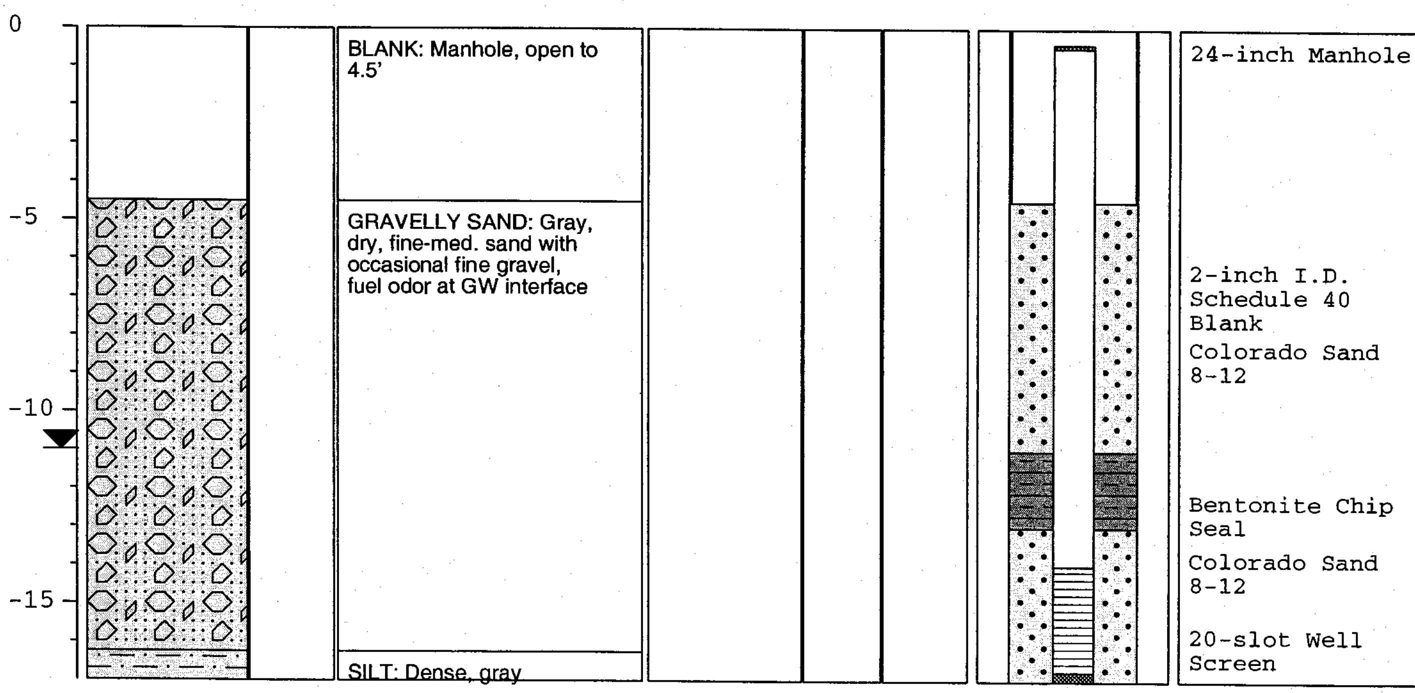
PROJECT INFORMATION	
PROJECT:	Olson's Gas Service #1
SITE LOCATION:	Anchorage, Alaska
JOB NO.:	1850870
LOGGED BY:	Gary Dubuisson
PROJECT MANAGER:	Gary Dubuisson
DATES DRILLED:	3-5-03

DRILLING INFORMATION	
DRILLING CO.:	Denali Drilling
DRILLER:	Orvil Ennes
RIG TYPE:	CME 65
METHOD OF DRILLING:	10" Hollow Stem Auger
SAMPLING METHODS:	
HAMMER WT./DROP	340 lb, 30 in.

NOTES: Cloudy, 30's F

▼ Water level in boring

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	SAMP. #	Blows / ft.	PID ppmv	BORING COMPLETION	WELL DESCRIPTION



MWH
4100 Spenard Road
Anchorage, Alaska

FIELD BOREHOLE LOG

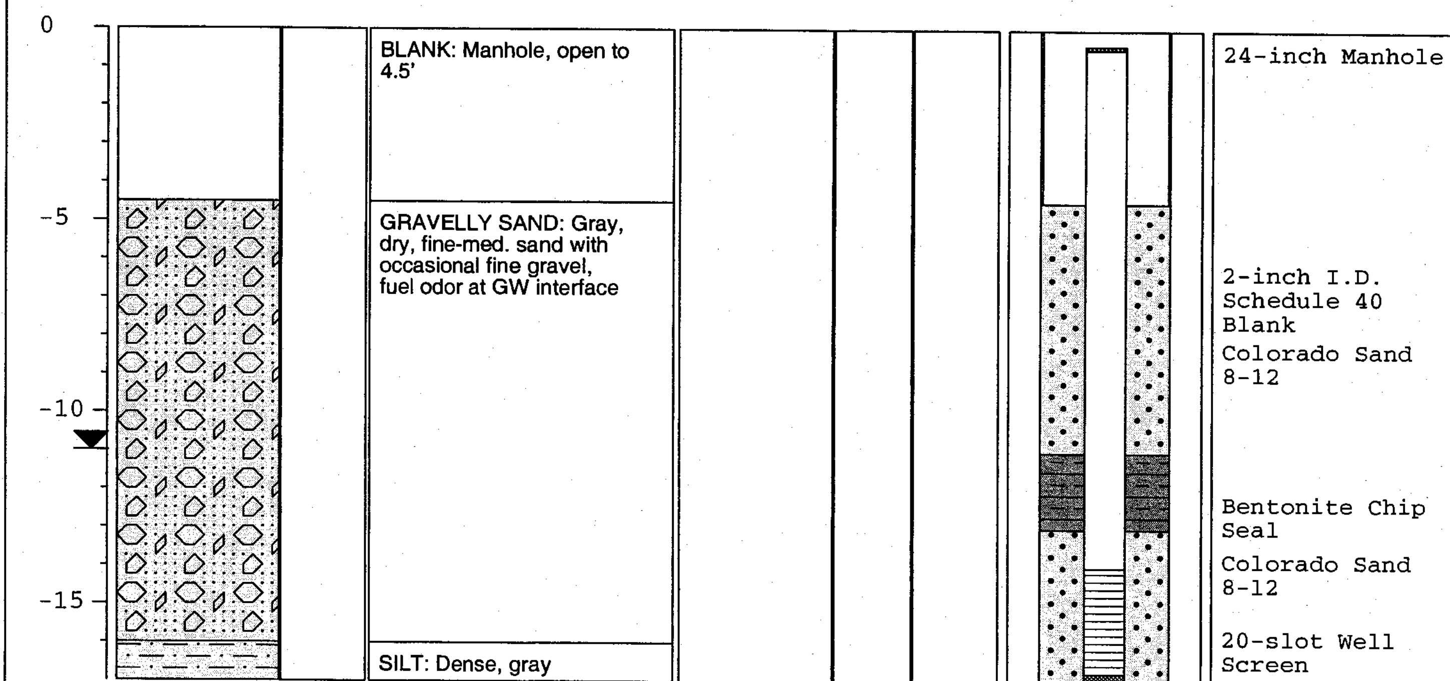
BOREHOLE NO.: **AS/SVE-6**
TOTAL DEPTH: **17**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Olson's Gas Service #1**	DRILLING CO.:	**Denali Drilling**
SITE LOCATION:	**Anchorage, Alaska**	DRILLER:	**Orvil Ennes**
JOB NO.:	**1850870**	RIG TYPE:	**CME 65**
LOGGED BY:	**Gary Dubuisson**	METHOD OF DRILLING:	**10" Hollow Stem Auger**
PROJECT MANAGER:	**Gary Dubuisson**	SAMPLING METHODS:	
DATES DRILLED:	**3-6-03**	HAMMER WT./DROP	**340 lb, 30 in.**

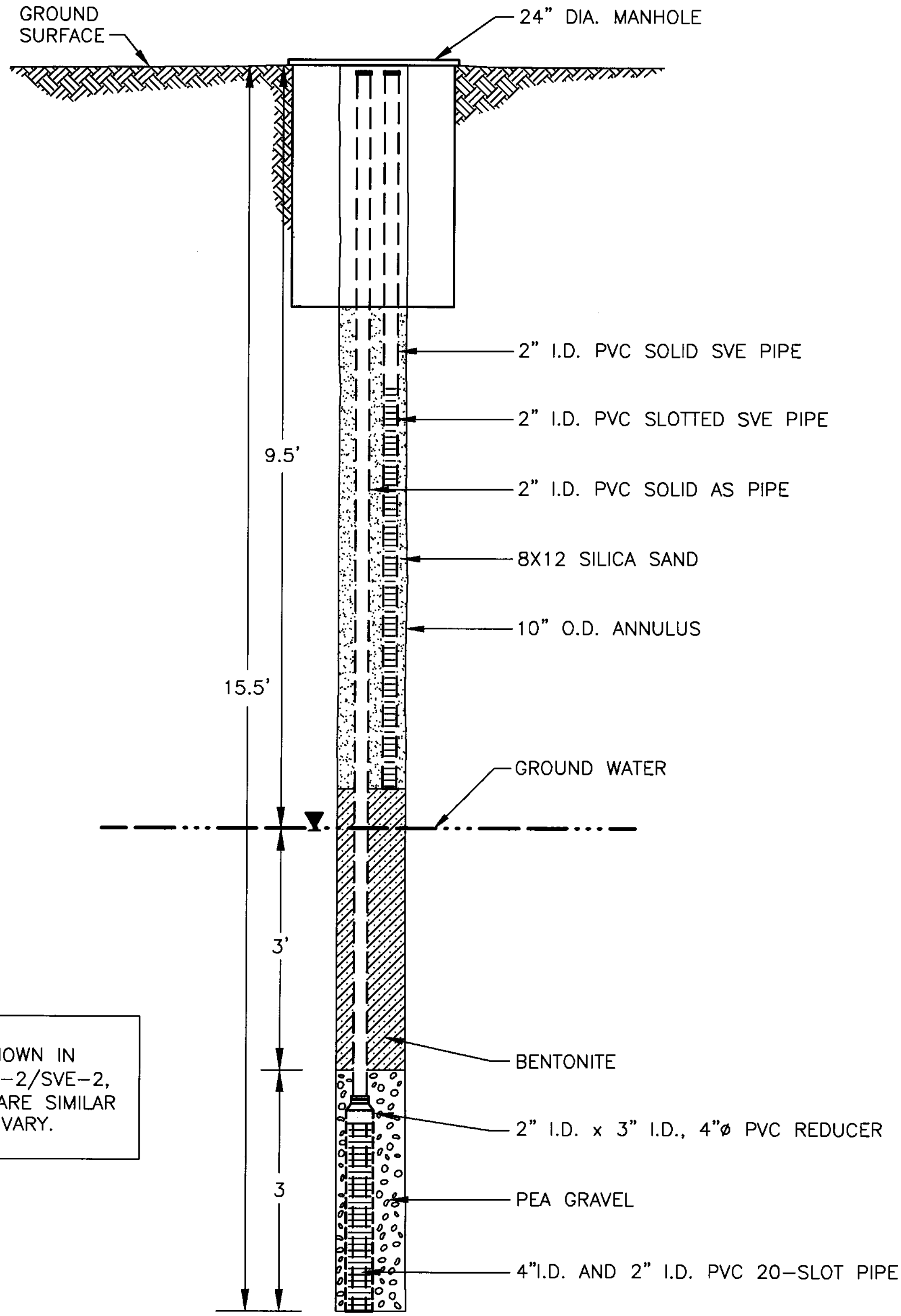
NOTES: Clear, 30's

▼ Water level in boring

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	SAMP. #	Blows / ft.	PID ppmv	BORING COMPLETION	WELL DESCRIPTION



Air Sparge/Soil Vapor Extraction Well Construction Schematic



NOTE:
AS-1/SVE-1 IS SHOWN IN THE SCHEMATIC. AS-2/SVE-2, AND AS-3/SVE-3 ARE SIMILAR ALTHOUGH DEPTHS VARY.

SCALE = 1" = 2'

MWH
MONTGOMERY WATSON HARZA
Anchorage, Alaska

FIGURE 3

OLSON'S GAS SERVICE NO. 1
ADEC UST FACILITY I.D. #2288
AS/SVE WELL SCHEMATIC

JOB No. 01031 TIME: 0000 FILE: s:\cad\projects\korovin\01031-olsons\fig3.dwg

APPENDIX B

CONCEPTUAL SITE MODEL

HUMAN HEALTH CONCEPTUAL SITE MODEL GRAPHIC FORM

Site: 3607 & 3609 Spenard Rd, Anchorage, Alaska

Completed By: Shannon & Wilson

Date Completed: 9/18/2012

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

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

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

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

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

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

Media / Transport Mechanisms

☑ Surface Soil (0-2 ft bgs)
- Direct release to surface soil — check soil
- ☑ *Migration to subsurface* — check soil
- ☑ *Migration to groundwater* — check groundwater
- ☑ *Volatilization* — check air
- ☐ *Runoff or erosion* — check surface water
- ☐ *Uptake by plants or animals* — check biota
- ☐ *Other (list):*______

☑ Subsurface Soil (2-15 ft bgs)
- Direct release to subsurface soil — check soil
- ☑ *Migration to groundwater* — check groundwater
- ☑ *Volatilization* — check air
- ☐ *Uptake by plants or animals* — check biota
- ☐ *Other (list):*______

☑ Ground-water
- Direct release to groundwater — check groundwater
- ☑ *Volatilization* — check air
- ☐ *Flow to surface water body* — check surface water
- ☐ *Flow to sediment* — check sediment
- ☐ *Uptake by plants or animals* — check biota
- ☐ *Other (list):*______

☐ Surface Water
- Direct release to surface water — check surface water
- ☐ *Volatilization* — check air
- ☐ *Sedimentation* — check sediment
- ☐ *Uptake by plants or animals* — check biota
- ☐ *Other (list):*______

☐ Sediment
- Direct release to sediment — check sediment
- ☐ *Resuspension, runoff, or erosion* — check surface water
- ☐ *Uptake by plants or animals* — check biota
- ☐ *Other (list):*______

Exposure Media / Exposure Pathway/Route / Current & Future Receptors

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

Revised, 10/01/2010

Print Form

Human Health Conceptual Site Model
Scoping Form

Site Name: 3607 & 3609 Spenard Road, Anchorage, Alaska

File Number: 2100.26.5076, Facility ID 2288

Completed by: Matt Hemry/Shannon & Wilson

Introduction

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

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

1. General Information:

Sources *(check potential sources at the site)*

- ☒ USTs
- ☒ ASTs
- ☒ Dispensers/fuel loading racks
- ☒ Drums
- ☒ Vehicles
- ☐ Landfills
- ☐ Transformers
- ☒ Other: miscellaneous uncharacterized debris

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

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

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

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

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

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

* bgs - below ground surface

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

a) Direct Contact -

1. Incidental Soil Ingestion

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

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

Comments:

Mitigating factors include the commercial/industrial site use and partial asphalt paving

2. Dermal Absorption of Contaminants from Soil

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

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

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

Comments:

This pathway is complete due to the presence of PCB in confirmation soil samples from the former used oil UST excavation. Because concentrations are less than 1/10th the ADEC cleanup level, this pathway is considered insignificant.

b) Ingestion -

1. Ingestion of Groundwater

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

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

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

Comments:

2. Ingestion of Surface Water

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

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

If both boxes are checked, label this pathway complete: [ ]

Comments:

Fish Creek is nearest surface water body and could receive site drainage. However, Fish Creek is not a viable drinking water source.

3. Ingestion of Wild and Farmed Foods

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

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

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

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

Comments:

c) Inhalation-

1. Inhalation of Outdoor Air

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

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

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

Comments:

2. Inhalation of Indoor Air

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

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

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

Comments:

Note 3 of Appendix D of the guidance document states that the ADEC does not require evaluation of DRO for the indoor air inhalation pathway.

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

Dermal Exposure to Contaminants in Groundwater and Surface Water

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

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

Generally, DEC groundwater cleanup levels in 18 AAC 75, Table C, are assumed to be protective of this pathway.

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

Comments:

Contaminated groundwater is at 11 feet bgs and construction workers could be exposed during deep utility installation.

Inhalation of Volatile Compounds in Tap Water

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

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

Generally, DEC groundwater cleanup levels in 18 AAC 75, Table C, are assumed to be protective of this pathway.

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

Comments:

Inhalation of Fugitive Dust

Inhalation of fugitive dust may be a complete pathway if:

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

Generally, DEC direct contact soil cleanup levels in Table B1 of 18 AAC 75 are protective of this pathway because it is assumed most dust particles are incidentally ingested instead of inhaled to the lower lungs. The inhalation pathway only needs to be evaluated when very small dust particles are present (e.g., along a dirt roadway or where dusts are a nuisance). This is not true in the case of chromium. Site specific cleanup levels will need to be calculated in the event that inhalation of dust containing chromium is a complete pathway at a site.

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

Comments:

Direct Contact with Sediment

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

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

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

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

Comments:

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

APPENDIX A

BIOACCUMULATIVE COMPOUNDS OF POTENTIAL CONCERN

Organic compounds are identified as bioaccumulative if they have a BCF equal to or greater than 1,000 or a log K_{ow} greater than 3.5. Inorganic compounds are identified as bioaccumulative if they are listed as such by EPA (2000). Those compounds in Table B-1 of 18 AAC 75.341 that are bioaccumulative, based on the definition above, are listed below.

Aldrin	DDT	Lead
Arsenic	Dibenzo(a,h)anthracene	Mercury
Benzo(a)anthracene	Dieldrin	Methoxychlor
Benzo(a)pyrene	Dioxin	Nickel
Benzo(b)fluoranthene	Endrin	PCBs
Benzo(k)fluoranthene	Fluoranthene	
Cadmium	Heptachlor	Pyrene
Chlordane	Heptachlor epoxide	Selenium
Chrysene	Hexachlorobenzene	Silver
Copper	Hexachlorocyclopentadiene	Toxaphene
DDD	Indeno(1,2,3-c,d)pyrene	Zinc
DDE		

Because BCF values can relatively easily be measured or estimated, the BCF is frequently used to determine the potential for a chemical to bioaccumulate. A compound with a BCF greather than 1,000 is considered to bioaccumulate in tissue (EPA 2004b).

For inorganic compounds, the BCF approach has not been shown to be effective in estimating the compound's ability to bioaccumulate. Information available, either through scientific literature or site-specific data, regarding the bioaccumulative potential of an inorganic site contaminant should be used to determine if the pathway is complete.

The list was developed by including organic compounds that either have a BCF equal to or greater than 1,000 or a log K_{ow} greater than 3.5 and inorganic compounds that are listed by the United States Environmental Protection Agency (EPA) as being bioaccumulative (EPA 2000).

The list was developed by including organic compounds that either have a BCF equal to or greater than 1,000 or a log K_{ow} greater than 3.5 and inorganic compounds that are listed by the United States Environmental Protection Agency (EPA) as being bioaccumulative (EPA 2000). The BCF can also be estimated from a chemical's physical and chemical properties. A chemical's octanol-water partitioning coefficient (K_{ow}) along with defined regression equations can be used to estimate the BCF. EPA's Persistent, Bioaccumulative, and Toxic (PBT) Profiler (EPA 2004) can be used to estimate the BCF using the K_{ow} and linear regressions presented by Meylan et al. (1996). The PBT Profiler is located at http://www.pbtprofiler.net/. For compounds not found in the PBT Profiler, DEC recommends using a log K_{ow} greater than 3.5 to determine if a compound is bioaccumulative.

APPENDIX B

VOLATILE COMPOUNDS OF POTENTIAL CONCERN

A chemical is identified here as sufficiently volatile and toxic for further evaluation if the Henry's Law constant is 1 x 10^{-5} atm-m^3/mol or greater, the molecular weight is less than 200 g/mole (EPA 2004a), and the vapor concentration of the pure component posed an incremental lifetime cancer risk greater than 10^{-6} or a non-cancer hazard quotient of 0.1, or other available scientific data indicates the chemical should be considered a volatile. Chemicals that are solid at typical soil temperatures and do not sublime are generally not considered volatile.

Acetone	Mercury (elemental)
Benzene	Methyl bromide (Bromomethane)
Bis(2-chloroethyl)ether	Methyl chloride (Chloromethane)
Bromodichloromethane	Methyl ethyl ketone (MEK)
Bromoform	Methyl isobutyl ketone (MIBK)
n-Butylbenzene	Methylene bromide
sec-Butylbenzene	Methylene chloride
tert-Buytlbenzene	**1-Methylnaphthalene**
Carbon disulfide	**2-Methylnaphthalene**
Carbon tetrachloride	Methyl *tert*-butyl ether (MTBE)
Chlorobenzene	**Naphthalene**
Chlorodibromomethane (Dibromochloromethane)	Nitrobenzene
Chloroethane	n-Nitrosodimethylamine
Chloroform	**n-Propylbenzene**
2-Chlorophenol	**Styrene**
1,2-Dichlorobenzene	1,1,2,2-Tetrachlorethane
1,3-Dichlorobenzene	Tetrachloroethylene (PCE)
1,4-Dichlorobenzene	**Toluene**

Dichlorodifluoromethane	1,2,4-Trichlorobenzene
1,1-Dichloroethane	1,1,1-Trichloroethane
1,2-Dichloroethane	1,1,2-Trichloroethane
1,1-Dichloroethylene	Trichloroethane
cis-1,2-Dichloroethylene	2,4,6-Trichlorophenol
trans-1,2-Dichloroethylene	1,2,3-Trichloropropane
1,2-Dichloropropane	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)
1,3-Dichloropropane	Trichlorofluoromethane (Freon-11)
Ethylbenzene	**1,2,4-Trimethylbenzene**
Ethylene dibromide (1,2-Dibromoethane)	**1,3,5-Trimethylbenzene**
Hexachlorobenzene	Vinyl acetate
Hexachloro-1,3-butadiene	Vinyl chloride (Chloroethene)
Hexachlorocyclopentadiene	**Xylenes (total)**
Hexachloroethane	GRO (see note 3 below)
Hydrazine	DRO (see note 3 below)
Isopropylbenzene (Cumene)	RRO (see note 3 below)

Notes:

1. Bolded chemicals should be investigated as volatile compounds when petroleum is present. If fuel containing additives (e.g., 1,2-dichloroethane, ethylene dibromide, methyl *tert*-butyl ether) were spilled, these chemicals should also be investigated.
2. If a chemical is not on this list, and not in Tables B of 18 AAC 75.345, the chemical has not been evaluated for volatility. Contact the ADEC risk assessor to determine if the chemical is volatile.
3. At this time, ADEC does not require evaluation of petroleum ranges GRO, DRO, or RRO for the indoor air inhalation (vapor intrusion) pathway.

APPENDIX C

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/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