Analysis Of Brownfields Cleanup Alternatives
3607 & 3609 Spenard Road
Anchorage, Alaska

Prepared for:
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Project Manager:
Matthew Hemry, P.E.

August 2016

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ANALYSIS OF BROWNFIELDS CLEANUP ALTERNATIVES
3607 & 3609 SPENARD ROAD
ANCHORAGE, ALASKA

1.0 INTRODUCTION

Shannon & Wilson, Inc. (Shannon & Wilson) has prepared this Analysis of Brownfields Cleanup Alternatives (ABCA) for the parcel located at 3607 & 3609 Spenard Road, Anchorage, Alaska (Property). The overall cleanup objective for the Property is to obtain a closure status that will facilitate site redevelopment.

We prepared this ABCA in general accordance with U.S. Environmental Protection Agency (EPA) guidance for cleanups with EPA grant funds and the Engineering Evaluation/Cost Analysis (EE/CA) Equivalent ABCA Checklist (EPA, 2004). Though this project has been funded, wholly or in part, by EPA, the contents of this document do not necessarily reflect the views and policies of the EPA.

2.0 PROPERTY & SITE DESCRIPTION

The Property is located in a commercial/residential area and comprises one parcel encompassing 1.73 acres. 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 Survey (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. A vicinity map and site plan showing the Property and surrounding area are included as Figures 1 and 2, respectively.

3.0 PREVIOUS ENVIRONMENTAL INVESTIGATIONS AND CLEANUP

3.1 Site History

Historically, the western half of the site has been used as a fueling station, car wash, and auto repair facility. A residential structure was located near the south central portion of the Property. Prior to 2016, the eastern half of the Property was cleared and graded, but historical usage appears to have been generally limited to vehicle storage and use by a firewood supply company. In preparation for the proposed development, all of the former structures on the property were razed and prior pavements removed in 2015. The Property is relatively flat with a gentle downward slope to an approximately 350-foot section of open stream on the eastern Property boundary. This waterway is depicted on MOA Watershed Management maps and identified as "Fish Creek" (US Army Corps of Engineers [USACE] jurisdictional review pending in 2016). Based on topographic contours provided by the MOA, it appears that there is about 5 to 6 feet of relief from the west end of the Property to the east end.

Tesoro Olson Gas Services Store #1 began operation as a fueling station in approximately 1964. At the time, nine underground storage tanks (USTs) ranging in capacity from 500 gallons to 12,000 gallons were used on the Property. The USTs reportedly contained diesel fuel; unleaded, premium, and regular gasoline; and used oil. The entire UST system (nine USTs, associated piping and dispensers) was removed between September 13 and 19, 1995. Approximately 100 tons of petroleum-impacted soil were excavated during the UST removal effort and were thermally treated at an off-site facility. An additional 1,120 tons of petroleum-impacted soil were excavated in 2001 and treated off-site.

3.2 Release Investigation and Cleanup

The Property is listed in the Alaska Department of Environmental Conservation (ADEC) Contaminated Sites database under File Number 2100.26.072. Twelve site characterization and assessment efforts have been conducted on the Property between 1995 and 2015. Potential source areas identified during the site characterization and assessment efforts include the former USTs and associated dispenser systems and piping, chemical storage areas, floor drains, former hydraulic ram units, and surface stains on both paved and unpaved ground surfaces. Data from these efforts have consistently indicated the highest remaining petroleum hydrocarbon concentrations in soil are generally located at or below the observed groundwater interface, which was typically encountered between 11 and 13 feet below ground surface, and is largely confined to the immediate vicinity of the former UST/dispenser source area(s) extending beneath the former garage structure and potentially into the Spenard Road right of way (ROW).

During site demolition activities in September 2015, two metal ram units were discovered beneath the former on-site garage building. Between September and November 2015, approximately 110 cubic yards (cy) of chlorinated compound-impacted soil were excavated from beneath the former garage structure to remove contaminant concentrations greater than cleanup levels for human health exposure (i.e., direct contact and outdoor air inhalation). Additional chlorinated compound-impacted soils were excavated in April 2016. Confirmation soil samples contained tetrachloroethene (PCE) concentrations greater than the ADEC Method Two migration to groundwater cleanup level but less than the ADEC Method Two human health level. However, one excavation sample (a duplicate sample) exceeded the ADEC Method Two human health level for trichloroethene (TCE). Details regarding the extent of impacted media are provided in Shannon & Wilson, Inc.'s March 2016 document *"Additional Site Characterization and Interim Removal Action, 3607 & 3609 Spenard Road, Anchorage, Alaska."*

Sixteen (16) on- and off-Property monitoring wells were installed between 1996 and 2013 to investigate the direction and extent of the impacted groundwater plume. In March and April 2016, Shannon & Wilson decommissioned eight groundwater monitoring wells that were removed from the site's groundwater monitoring program. The groundwater contaminant plume appears to be delineated and stable (or potentially shrinking).

3.3 2016 Fill and Grading

In 2016, a Fill and Grading Plan was executed to obtain a level site surface for construction staging and to remove potentially impacted soil that would likely be disturbed in future site development from the surface to 5 feet below ground surface (bgs). The approximate extents of the 2015 and April 2016 excavations, approximate locations of the remaining on-Property wells, inferred extent of chlorinated compound-impacted soil, and zones of potentially clean and impacted soil to guide the Fill and Grading Plan are shown on Figure 2. As part of this project, an Environmental Management Plan (EMP) was developed to guide handling and remediating/disposing potentially contaminated soil. The EMP contained the following provisions for segregating soil based on field observations:

- Soil presumed to be clean based on direct screening readings less than 2 ppm;
- Soil potentially impacted with petroleum hydrocarbons based on direct screening readings greater than 2 ppm;
- Soil presumed to contain grossly petroleum-impacted soil based on direct screening readings and visual and/or olfactory evidence of contamination;
- Soil presumed to contain chlorinated compounds; and,
- Wood chips, and organic soil/peat.

Approximately 2,100 cy of soil were generated and stockpiled during the Fill and Grading activities. An estimated 500 cy were re-used on site, leaving about 1,600 cy requiring additional treatment and/or disposal. Characterization of the stockpiles will be completed prior to the implementation of the EPA Brownfields grant-funded work.

4.0 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) was prepared to identify known and potential exposure pathways associated with petroleum hydrocarbons and chlorinated compounds at the subject site. The CSM was developed using the ADEC's *Policy Guidance on Developing Conceptual Site Models* (October 2010), and the ADEC's CSM Human Health Graphic and Scoping Forms. The ADEC forms are included in Appendix A. This section provides a summary of our current understanding of contaminant sources, extent of impacted media, and potential exposure pathways, and includes descriptions of site-specific considerations that increase or decrease the viability of each pathway.

4.1 Contaminant Sources

Potential contaminant sources identified in Shannon & Wilson's 2012 Phase I ESA include former UST, piping, and dispenser system 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. Numerous surface stains were noted throughout the Property on both paved and unpaved surfaces. The May 2013 analytical soil data provide qualified indications that hydrocarbon contamination may be associated with surface stains on the Property.

Prior to the 2015 site work, 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 in groundwater Monitoring Well MW-3 in 1998.

As described in Section 3.2, two metal ram units were also discovered beneath the former on-site garage building which were speculated to have been part of a hydraulic lift system. Chlorinated compound-impacted soil associated with the ram and other elements of the former auto shop were removed during site demolition activities in September 2015. Additional chlorinated compound-impacted soil was excavated in April 2016.

4.2 Contaminants of Concern

Contaminants of concern (COC) at the site include the following petroleum-related compounds: gasoline range organics (GRO), diesel range organics (DRO), residual range organics (RRO), non-chlorinated volatile organic compounds (VOC) [including but not limited to benzene, toluene, ethylbenzene, xylenes, and 1,2,4-trimethylbenzene], and polynuclear aromatic hydrocarbons (PAH). In addition, non-petroleum COC include chlorinated VOC (in particular PCE, TCE, vinyl chloride [VC], cis-1,2-dichloroethene [DCE]), and metals.

4.3 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.

4.3.1 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.

Detected COCs such as DRO, RRO, GRO and those that are also listed in Appendix B of the ADEC CSM guidance document for dermal exposure include seven polynuclear aromatic hydrocarbons (PAH) compounds and the metals arsenic, cadmium, and lead. The seven PAHs detected in soil samples collected from Borings B11 and B12 were each measured at concentrations are less than 1/10th of the ADEC Method 2 cleanup level for direct contact. Similarly, the reported metals concentrations are either within naturally-occurring background levels and/or are less than 1/10th the direct contact cleanup level. Therefore this pathway is considered insignificant for these compounds.

4.3.2 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.

The most recent drinking water data (January 2015) indicate that the impacted groundwater plume does not extend to on-site or off-site residential water wells, as provided in Shannon & Wilson, Inc.'s March 2016 document *"Additional Site Characterization and Interim Removal Action, 3607 & 3609 Spenard Road, Anchorage, Alaska"*. However, off-site residents are retained as potential future receptors in the event that the plume characteristics change and due to contaminant concentrations above the ADEC Method 2 cleanup levels in the soil.

4.3.3 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. The concentrations of GRO and RRO measured in the October 2015 soil samples from Borings PB5 and PB10, respectively, are greater than ADEC outdoor inhalation cleanup levels.

Depending on future redevelopment plans, the indoor air pathway may be potentially complete for future site users and building tenants. To address the inhalation pathway, CIHA plans to install engineered vapor intrusion controls beneath the site's future vertical structures where required to mitigate this pathway.

4.3.4 Surface Water

The proximity of the subject site to the open stream on the eastern boundary of the Property suggests that surface runoff from the site could enter the waterway. 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 waterway on the eastern boundary of the Property 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.

4.3.5 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.

4.3.6 CSM Summary

Multiple complete or potentially complete exposure pathways have been identified at the site. Exposure to impacted soil is currently mitigated by the absence of site development (i.e., vacant lot). The groundwater ingestion pathway is potentially complete for on-site commercial workers and site visitors. Outdoor and indoor air are both potentially complete pathways, although additional soil data and/or site use plans are likely needed to more fully assess the potential risk posed to human health at this site.

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.

5.0 CLEANUP GOALS AND OBJECTIVES

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

5.1 Brownfields Cleanup Goals and Objectives

The overall cleanup goal for the Property is to facilitate development through a Cleanup Complete – Institutional Controls (CCIC) designation from ADEC. To facilitate this goal, CIHA has conducted a multi-phased site characterization and cleanup efforts to mitigate exposure pathways that have the potential to impact human health for the proposed land use(s) and to otherwise progress towards a site closure determination from the ADEC. Institutional Controls (ICs) for this Property may include 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 vapor intrusion mitigation controls. In context of the overall cleanup goal, the specific objective of the Brownfields grant-funded work is to dispose of the petroleum and chlorinated hydrocarbon-impacted and wood chips, and organic soil/peat soil generated during 2016 Fill and Grading Plan. It is noted that additional site characterization and/or cleanup activities may be necessary for site closure after completion of EPA Brownfields grant funded activities.

5.2 Applicable Regulations

We anticipate the ADEC will be the lead agency for this project, and will be responsible for making regulatory determinations under their Contaminated Sites program. Accordingly, site cleanup will be conducted under the State of Alaska Oil and Other Hazardous Substances Pollution Control regulations (18 AAC 75).

5.3 Cleanup and Disposal Standards

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* (January 2016). 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

(January 2016), for the "under-40-inches precipitation zone." In addition, other standards may be applicable based on soil disposal alternatives selected (i.e., facility acceptance criteria).

5.4 Land-Use Considerations

CIHA's proposed property development is consistent with the West Anchorage District Plan and the Anchorage 2020 Comprehensive Plan, and comprises a mixed-use development with retail facilities and residential units. A similar mixed-use facility will be developed across Spenard Road, and multiple residential properties east of the subject site will be redeveloped into duplex and townhouse style units, for a total estimated redevelopment of 50 to 70 units.

With the exception of utilities, CIHA anticipates the development will not entail underground components (i.e. no basements, etc.) which will help to reduce the expenses associated with cleanup that will render the safe reuse of the site. However, CIHA plans to implement and install vapor intrusion mitigation measures beneath the site's future vertical structures where required to mitigate this pathway. CIHA plans to use existing utilities to the extent practicable; however, it is anticipated the existing utilities may not meet code for their proposed development, requiring excavation and cleanup in select areas. In addition, connections to the proposed development to the Anchorage Water and Wastewater Utility sewer and water system are planned, therefore eliminating the need for groundwater extraction onsite.

6.0 ALTERNATIVES ANALYSIS

This ABCA includes an analysis of four alternatives for soil disposal.

6.1 Cleanup Alternatives

The cleanup alternatives are described below and evaluated in Section 6.2. These cleanup alternatives were selected based on a pre-screening for applicability to the site and general effectiveness for the site-specific COCs and impacted media. Other assumptions in developing and evaluating the alternatives for this assessment include the following:

- The alternatives were selected based on their effectiveness to mitigate petroleum hydrocarbon-impacted and chlorinated compound-impacted soils (GRO, DRO, RRO, BTEX, and halogenated volatile organic compounds [HVOCs]) in stockpiled soil.

- Observed and forecasted climate change conditions will not adversely impact the effectiveness of the remedial alternatives evaluated for this ABCA. This determination is based on known site and climatic conditions, the nature of the remedial alternatives, the timeline for expected completion, and other site-specific risk factors.

- An estimated volume of 1,600 cy of soil in multiple stockpiles, including a combination of potentially petroleum hydrocarbon-impacted and chlorinated compound-impacted soils and variety of soil types (including organics/peat/wood chips) will require additional treatment and/or disposal.

- The stockpiled soils are not RCRA regulated material by characteristic criteria and therefore not subject to RCRA regulations pertaining to containerization, treatment time, and other permitting requirements for accumulated waste.

Alternative 1: No Action. No remedial activities would be implemented for this alternative. Risks to human health and the environment would not be directly addressed and stockpiles of impacted soil would remain, leaving the Property unsuitable for re-development.

Alternative 2: On-site Treatment using Landfarming and/or Landspreading. Consists of remediating the impacted soil using landfarming and/or landspreading methodologies.

Alternative 3: On-site Treatment with Chemical Oxidant Additive. This alternative consists of a combination of treating the source soils containing organic contamination (both hydrocarbon and HVOCs) using an oxidant addition to chemically transform the contaminants to inert compounds and transporting and disposing of wood chips and organic soil/peat at a landfill facility.

Alternative 4: Off-site Treatment and/or Disposal. This alternative consists of transporting and disposing of impacted soil at a thermal treatment and/or landfill facilities.

If remaining EPA Brownfields grant funds are available after treatment and/or disposal of the stockpiles, these funds may be used to import classified backfill material and/or decommission onsite monitoring wells to facilitate re-development.

6.2 Evaluation and Comparison of Cleanup Alternatives

We evaluated the benefits and limitations of the four alternatives with respect to effectiveness, implementability, and cost. A general evaluation of the four potential alternatives considered in this ABCA 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.

Effectiveness. The effectiveness criterion is defined by whether the alternative meets cleanup objectives, considering significant risks or impacts of the action, potential institutional controls, and treatment time of the alternative.

Implementability. The implementability criterion addresses how feasible and practicable the alternative is for the site and land-use requirements. Because each of the alternatives presented in this analysis were pre-screened to be practical and technically feasible, the discussion of implementability focuses largely on site access, logistics, and other relevant factors.

Cost. The total cost of each alternative comprises several elements. We present rough order of magnitude (ROM) costs for each alternative. We obtained cost information from various sources, including estimates from local contractors and our experience on similar projects. The cost estimate for each alternative, including capital and a 15 percent contingency, is summarized in Table 1.

6.2.1 Alternative 1: No Action

The No Action alternative is included for comparison purposes as stipulated in the ABCA process. This alternative does not include any remedial site activities and does not meet the cleanup objectives. This alternative is not effective at reducing contaminant concentrations or volume. It is easily implemented. The no action alternative has no additional cost.

6.2.2 Alternative 2: On-site Treatment using Landfarming and/or Landspreading

In Alternative 2, a landfarm and/or landspread cell will be constructed at the site and consists of spreading (maximum 2-foot lift) and periodically aerating the contaminated soil (for Landfarming) during the summer months to promote aerobic degradation of the contaminants. The soil may be placed on a liner or directly on the ground, if approved by the ADEC. Typically, baseline characterization samples are collected from the landfarmed soil to document contaminant concentrations and nutrients levels. Characterization samples are collected annually at the end of the tilling/maintenance season to evaluate whether the cleanup objectives are met. For cost estimation purposes, we assumed 1,605 cy of contaminated soil will be placed in the landfarming cell. Once analytical results are received some stockpiles may contain contaminant concentrations below the ADEC Method 2 cleanup levels and therefore will not be landfarmed and/or landspread.

The contaminated soil in the landfarming cell will need to be monitored and maintained over multiple field seasons. The total ROM cost, including estimated capital cost and 15 percent contingency, to implement Alternative 2 is **$250,000**. The advantage of Alternative 2 is the low cost to implement the landfarming and/or landspreading activities. The disadvantages of Alternative 2 include the uncertain and potentially indefinite treatment time and the need to identify reuse of the soils that are not geotechnical suitable for future development.

6.2.3 Alternative 3: On-site Treatment using a Chemical Oxidant Additive

Alternative 3 consists of soil treatment using chemical oxidant additive. The oxidation process with RegenOx™ (or equivalent), with the oxidant applied directly to the stockpiled soil and mixed using a loader, backhoe, or mechanical mixer.

For cost estimating purposes, we assume an application of 90,000 pounds RegenOx™ to treat the 1,175 cy of contaminated soil. Note this quantity of chemical oxidant is a preliminary estimate. If Alternative 3 is selected, CIHA's remediation contractor will work with the oxidant supplier to calculate the actual mass necessary based on final analytical sample data, soil type, volume, and total organic load (including both contaminant mass and naturally-occurring organic materials such as peat or wood chips), and estimated events and rates of soil treatment. The assumed time for treatment will be approximately 1 week. At the conclusion of the field season, confirmation samples will be collected from the treated soil.

If the ex-situ treatment process is not successful in meeting the target cleanup criteria, the excavated soil remains a solid waste requiring additional oxidant loading and/or treatment and/or disposal at an appropriate permitted facility, such as that discussed for Alternative 4 (Section 6.2.4). Approximately 430 cy of wood chips and organic soils/peat will not be treated using chemical oxidants due to the amount of detritus materials that will reduce the effectiveness of the oxidant for treatment purposes. The wood chips and organics soils/peat will be disposed of at landfill facility. The total ROM cost to implement Alternative 3 is **$540,000**

The primary advantage of Alternative 3, relative to the other remedial alternatives, is the contaminant mass that can be permanently transformed in the short term, is a potentially cost-effective manner relative to off-site disposal. The primary limitation of Alternative 3 is uncertainties in treatment effectiveness – due to the heterogeneity in contaminant distribution it may be difficult to achieve sufficient concentration reduction to achieve CCIC with a single oxidant application, and/or presence of naturally-occurring organics (e.g., wood chips, peat, etc) may be too large of a "sink" for the oxidant.

6.2.4 Alternative 4: Off-site Treatment and/or Disposal

Alternative 4 consists of remediating 1,600 cy of petroleum hydrocarbon-impacted, chlorinated compound-impacted, and wood chips/organic soil/peat soil at off-site facilities. Approximately 1,020 cy and 530 cy of stockpiled soils are assumed to be disposed of at Anchorage Regional Landfill (ARL) and Alaska Soil Recycling, Inc. (ASR) respectively. In addition, 50 cy of soil are assumed to be disposed of at CRL in Arlington, Oregon due to elevated HVOC concentrations. The removal of the contaminated soil is a permanent solution for the stockpiled soil and facilitates immediate re-use of areas occupied by the stockpiled soil, subject to the CCIC determination by the ADEC. The total ROM cost, including estimated capital cost and 15 percent contingency, to implement Alternative 4 is **$440,000**. Note that this cost is dependent on the assumed soil volume distribution to the three facilities; the actual distribution will be based on the final analytical soil data and negotiations with the facilities regarding acceptance criteria.

The primary advantage of Alternative 4, relative to the other remedial alternatives, is the alternative results in permanent removal of contaminants within the targeted stockpiles, and certainty in cleanup of those soils. The primarily limitation is potential cost if lesser volumes of soil can be accepted at ARL.

6.3 Recommendation of Preferred Alternative

Absent changes in our current project understanding, Alternative 4 is recommended as the preferred alternative because it facilitates immediate re-use of areas occupied by the stockpiled soil without uncertainty of Alternative 3.

7.0 REFERENCES

ADEC. 2014. *18 AAC 78, Underground Storage Tanks Procedures Manual*. August

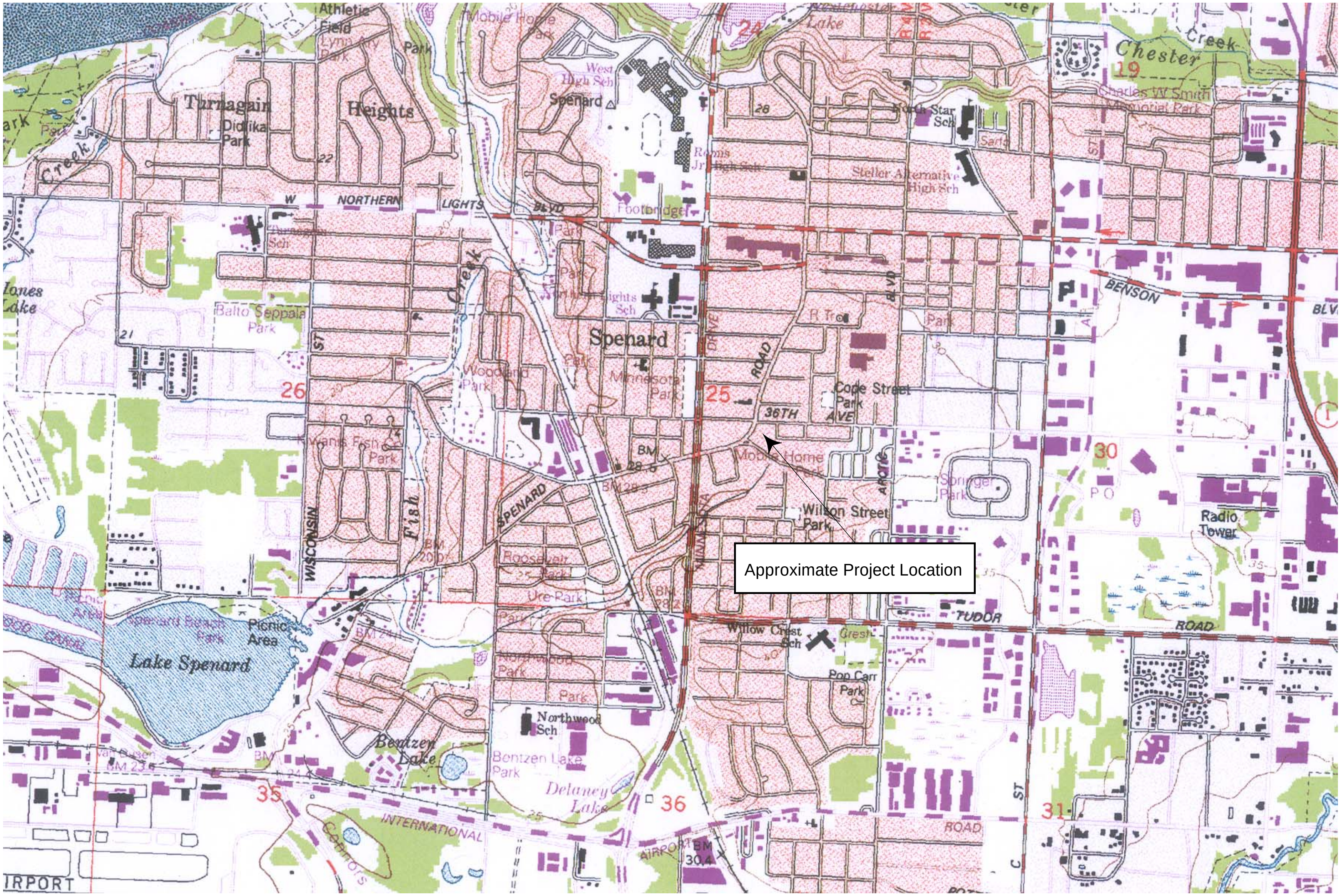
ADEC. 2016. *18 AAC 75, Oil and Other Hazardous Substances Pollution Control*. January.

EPA. 2004. *Region 10 Draft ABCA Checklist v.5*. June 24.

TABLE 1
ALTERNATIVES ANALYSIS SUMMARY

	Effectiveness				Implementability[c]		
Alternative	**Mechanism to achieve the cleanup objectives[a]**	**Institutional Controls Required[b]**	**Time to achieve objectives/completion**	**Significant risks or impacts to human health and the environment**	**Land Use Considerations**	**Other Factors**	**ROM Cost[d]**
Alternative 1 - No Action	Natural attenuation (without monitoring)	No (no land re-use)	Indefinite	No reduction in risk of exposure to contaminated soil.	No contaminated soil removal. Land is likely unsuitable for re-use. [f]	-	No cost.
Alternative 2 - Landfarming and/or Landspreading	Reduces concentrations of COCs through natural attenuation.	Yes [e]	*Intermediate/Long-term* completion time. Several field seasons (or more for RRO-impacted soil) to achieve target concentration reduction. Confirmation soil sampling may be required after implementation.	Short-term exposure to vapors would increase during the tilling of soil. Also potential contact exposure due to unauthorized site access.	The planned area of the treatment cell/landfarm is at least temporarily unavailable for re-development. [f]	Removal may be required in the future if different land-use benefit is desired.	$250,000
Alternative 3 - Chemical Oxidation Additive	Reduces concentrations of COCs through active treatment of impacted soil. Overall effectiveness depends on oxidant application/loading and contact efficiency.	Yes [e]	*Short* completion time. Several days to weeks to effect chemical oxidation process. Confirmation soil sampling after implementation.	Depending on oxidant load, could generate elevated temperatures and/or "sterilize" soil, thereby reducing future natural attenuation potential.	The planned area of the treatment cell/landfarm is at least temporarily unavailable for re-development. [f]	Effectiveness of chemical oxidation additive in organic-rich soils may be ineffective or cost-prohibitive due to reaction of oxidizer and organic material. There is also uncertainty in the level of COC concentration reduction with a single application. multiple applications may be necessary to reach cleanup objectives.	$540,000
Alternative 4 - Off-Site disposal at a Thermal Treatment and/or Landfill Facility	Eliminates COCs through removal of impacted soil.	Yes [e]	*Immediate* completion time. Objective achieved when soil removed.	Short-term exposure to vapors may increase during soil loading into transport vehicles.	Impacted soil is removed from property.	Assumes soil is not RCRA. Greatest flexibility in future land use.	$440,000

(a) The cleanup objective is to facilitate beneficial re-use by treating and/or disposing of existing stockpiles and impacted soil.
(b) Institutional controls (IC) may include engineering controls to building design, a notice of environmental contamination (NEC) on the deed, restrictions on soil excavation or other specific site activities, and/or ban any future water wells. etc.
(c) All alternatives considered for this analysis are practicable and technically feasible.
(d) Costs provided are present day rough order of magnitude (ROM) costs including capital cost plus 15 percent contingency.
(e) Long-term ICs may vary between treatment alternatives based on the degree of treatment achieved at the time of the CC or CCIC closure determination.
(f) Each of these options would also eventually need on- and/or off-site soil disposal
IC Institutional Controls
COC Contaminant of Concern
ROM Rough Order of Magnitude

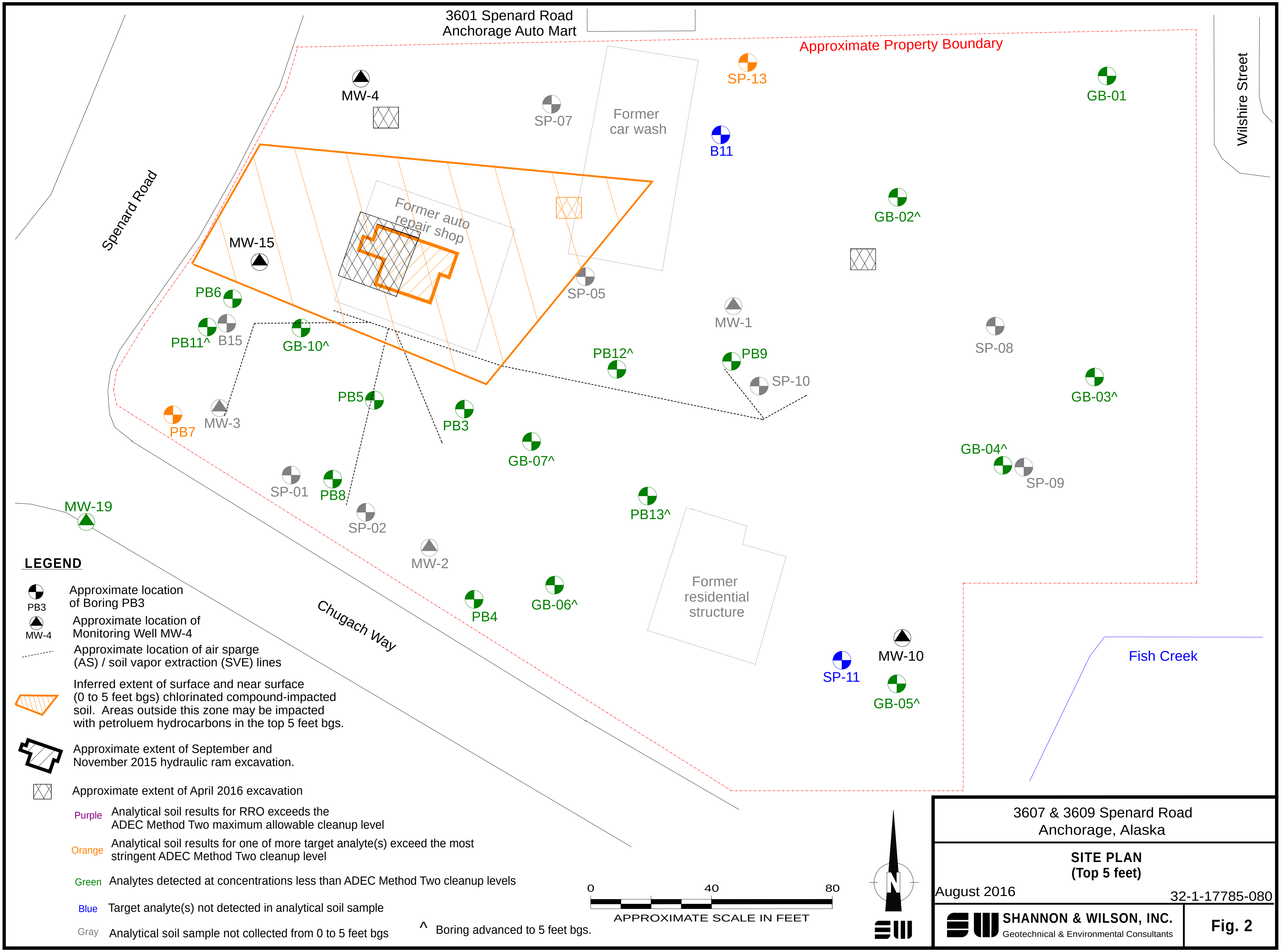


Elevation in Meters
Contour Interval 5 Meters
Taken from Anchorage A-8 NW
U.S. Geological Survey Quadrangle (1994)

0 2000 4000
APPROXIMATE SCALE IN FEET

N

3607 & 3609 Spenard Road Anchorage, Alaska
VICINITY MAP
August 2016   32-1-17785-080
SHANNON & WILSON, INC. Geotechnical & Environmental Consultants   **Fig. 1**


3601 Spenard Road
Anchorage Auto Mart
Approximate Property Boundary
Wilshire Street
Spenard Road
Chugach Way
Fish Creek
Former car wash
Former auto repair shop
Former residential structure
MW-4
SP-07
SP-13
B11
GB-01
GB-02^
MW-15
SP-05
PB6
PB11^
B15
GB-10^
MW-1
SP-08
PB12^
PB9
SP-10
GB-03^
PB5
PB3
PB7
MW-3
GB-07^
GB-04^
SP-09
SP-01
PB8
MW-19
SP-02
PB13^
MW-2
PB4
GB-06^
MW-10
SP-11
GB-05^
LEGEND
PB3
Approximate location of Boring PB3
MW-4
Approximate location of Monitoring Well MW-4
Approximate location of air sparge (AS) / soil vapor extraction (SVE) lines
Inferred extent of surface and near surface (0 to 5 feet bgs) chlorinated compound-impacted soil. Areas outside this zone may be impacted with petroluem hydrocarbons in the top 5 feet bgs.
Approximate extent of September and November 2015 hydraulic ram excavation.
Approximate extent of April 2016 excavation
Purple Analytical soil results for RRO exceeds the ADEC Method Two maximum allowable cleanup level
Orange Analytical soil results for one of more target analyte(s) exceed the most stringent ADEC Method Two cleanup level
Green Analytes detected at concentrations less than ADEC Method Two cleanup levels
Blue Target analyte(s) not detected in analytical soil sample
Gray Analytical soil sample not collected from 0 to 5 feet bgs
^ Boring advanced to 5 feet bgs.
0
40
80
APPROXIMATE SCALE IN FEET
N
3607 & 3609 Spenard Road
Anchorage, Alaska
SITE PLAN
(Top 5 feet)
August 2016
32-1-17785-080
SHANNON & WILSON, INC.
Geotechnical & Environmental Consultants
Fig. 2

APPENDIX A

HUMAN HEALTH CONCEPTUAL SITE MODEL

HUMAN HEALTH CONCEPTUAL SITE MODEL GRAPHIC FORM

Site: 3607 & 3609 Spenard Rd, Anchorage, Alaska

Completed By: Shannon & Wilson

Date Completed: August 2016

***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

Media	Transport Mechanisms	
[x] Surface Soil (0-2 ft bgs)	Direct release to surface soil	check soil
	[x] Migration to subsurface	check soil
	[x] Migration to groundwater	check groundwater
	[x] Volatilization	check air
	[ ] Runoff or erosion	check surface water
	[ ] Uptake by plants or animals	check biota
	[ ] Other (list):________	
[x] Subsurface Soil (2-15 ft bgs)	Direct release to subsurface soil	check soil
	[x] Migration to groundwater	check groundwater
	[x] Volatilization	check air
	[ ] Uptake by plants or animals	check biota
	[ ] Other (list):________	
[x] Ground-water	Direct release to groundwater	check groundwater
	[x] 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
[x] soil	[x] Incidental Soil Ingestion	F	C/F	C/F	C/F			
	[x] Dermal Absorption of Contaminants from Soil		C/F	C/F	C/F			
	[ ] Inhalation of Fugitive Dust							
[x] groundwater	[x] Ingestion of Groundwater	F	F	F	F			
	[x] Dermal Absorption of Contaminants in Groundwater				F			
	[x] Inhalation of Volatile Compounds in Tap Water	F	F	F	F			
[x] air	[x] Inhalation of Outdoor Air	C/F	C/F	C/F	F			
	[x] Inhalation of Indoor Air	F	F	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							

Print Form

Human Health Conceptual Site Model
Scoping Form

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

File Number: 2100.26.072, Facility ID 23592

Completed by: 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:

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 PCBs in confirmation soil samples from the former used oil UST excavation and 11 PAH compounds detected during the 2013 sampling efforts. Note that PCBs were not detected in Borings B11R or B12 advanced during the May 2013 additional site characterization effort and were detected in only one sample collected during the Fall 2013 TBA field

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 the 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:

Eleven Appendix D compounds were detected in the October and November 2015 soil samples above ADEC Method 2 cleanup levels.

2. Inhalation of Indoor Air

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

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

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

Comments:

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

Dermal Exposure to Contaminants in Groundwater and Surface Water

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

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

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

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

Comments:

Inhalation of Volatile Compounds in Tap Water

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

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

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.