ANALYSIS OF BROWNFIELD CLEANUP ALTERNATIVES
SELAWIK IRA FUEL PROJECT FORMER TANK FARM
SELAWIK, ALASKA

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1.0 INTRODUCTION

Shannon & Wilson, Inc. (Shannon & Wilson) has prepared this Analysis of Brownfields Cleanup Alternatives (ABCA) for the Selawik Indian Reorganization Act (IRA) Fuel Project Former Tank Farm located in Selawik, Alaska (the Property). This document presents the evaluation criteria used for selecting a site specific remedial option for a project funded using Federal Brownfield monies.

We prepared this ABCA in general accordance with Environmental Protection Agency (EPA) guidance for cleanups with EPA grant funds and the Engineering Evaluation/Cost Analysis (EE/CA) Equivalent ABCA Checklist (EPA, 2004). The proposed scope of services included evaluating remedial alternatives to facilitate site reuse and redevelopment.

2.0 SITE DESCRIPTION

The Property is located on Lot 6, Block 1, Tract A, of U.S. Survey No. 4492; Selawik Townsite, and has an area of approximately 0.62 acre. As shown on Figure 1, the Property is located on the northern portion of an island in the Selawik River, within the City of Selawik. The Property is situated on the east side of Ballot Street, north of Community Avenue. The Community Hall is located at the southern edge of the Property. The approximate locations of the former IRA Tank Farm, the Community Hall, and proposed store building footprint are shown in Figure 2. The footprint of the former tank farm was inferred from aerial photographs.

The Property is relatively higher than the surrounding area, with dense vegetative cover consisting primarily of tall grasses. The site generally slopes to the east toward Selawik River. An estimated 46 white-painted steel piles stick up roughly 4 feet vertically from the ground surface of the Property. Based on Shannon & Wilson's fall 2010 field observations, the piles were marked with Arctic Foundations, Inc. labels, and the larger 8-inch and 10-inch diameter piles appeared to be refrigerated based on the capped ports on the sides. Access to the Property is available using a wooden bridge extending over a utilidor from the Ballot Street boardwalk. The vegetation is broken by two double-tracked dirt paths that curve from the bridge and run between the piles to parcels north of the former tank farm.

Two utilidors are present in the vicinity of the Property. An aboveground sewer and water utilidor is located to the west of the site and runs along the east side of Ballot Street. A second utilidor runs west to east across the southern portion of the site creating a partial barrier between the Community Hall and the location of the former tank farm.

3.0 SITE HISTORY AND PREVIOUS INVESTIGATIONS

3.1 Site History

The former tank farm was reportedly active between 1972 and 1996. The former tank farm consisted of a dispenser shed and seven cylindrical above-ground tanks, five placed with their axis horizontal and two placed vertically. The storage capacity was estimated to be 100,000 gallons of diesel/heating oil, and 20,000 gallons of gasoline.

The IRA Council initiated a project to construct a new grocery store at the IRA Fuel Project Former Tank Farm location. The project was initiated with the installation of refrigerated piles to support a new building. Plans to continue construction of the store have been put on hold due to the threat of potential contamination remaining from the former tank farm.

3.2 ADEC Database

Based on the ADEC Contaminated Sites Database, an oil spill of 1,000 gallons was reported at the site in 1984. In an attempt to clean up the estimated 900 square feet of stained soil, an unknown quantity of contaminated soil was removed and disposed at the community dump. An ADEC site inspection in 1991 indicated evidence of leaks and previous spills from fuel pipes, stressed vegetation, and petroleum sheen on a pond located on an adjacent parcel. According to the information included in Shannon & Wilson’s May 2011 Property Assessment and Cleanup Plan (PACP), an October 1992 inspection describes a steel containment dike with a floor and open drains. Leaks along the approximately 100-foot long pipeline to the Selawik River were evident, and a fuel odor was noted in the dispensing shed. It was not clear from the inspection report on which reach of the river the pipeline terminated. The inspection report noted that heating oil and gasoline were stored at the IRA tank farm.

3.3 Property Assessment and Cleanup Plan (PACP)

Shannon & Wilson prepared a Property Assessment and Cleanup Plan (PACP) for four sites in Selawik, including the Property, in fall 2010, with results presented in the May 2011 report, *Property Assessment and Cleanup Plan, Selawik Area-Wide, Selawik Alaska.* The field activities at the Property in 2010 included a site reconnaissance, advancing test pits, and collecting a limited number of field screening and analytical soil samples. Ten test pits, designated Test Pit I1 through Test Pit I10, were advanced by shovel and hand auger at the Property to recover surface and near-surface soil samples. Approximate locations of the test pits are shown in Figure 2.

Soil conditions encountered in the test pits generally consisted of a vegetation mat at the ground surface underlain by brown to gray sandy and organic silts. Frozen silts were generally encountered between 2.5 to 4 feet below the ground surface (bgs). Liquid water was not observed in the test pits during the period they were open.

3.3.1 Soil Samples

Eleven analytical samples, including one field duplicate, were selected from the test pits based on the headspace screening readings, locations in relationship to the proposed store, and visual and olfactory evidence of contamination. In general, one depth interval per test pit was selected for analytical sample collection; however, two analytical samples were obtained from different depths in Test Pit I6. Field observations and screening did not suggest the presence of petroleum hydrocarbons in Test Pit I8, and no analytical samples were collected.

The analytical samples collected from the test pits were analyzed for gasoline range organics (GRO) by Alaska Method (AK) 101; diesel range organics (DRO) by AK102, and aromatic volatile organics, including benzene, toluene, ethylbenzene, and xylenes (BTEX) using Environmental Protection Agency (EPA) Solid Waste Method (SW) 8021B. The duplicate sample set was also analyzed for polynuclear aromatic hydrocarbons (PAHs) by SW8270D selected ion monitoring (SIM).

Concentrations of target analytes exceeding the most stringent Arctic Zone cleanup levels (either direct contact/ingestion or inhalation) were detected in the project samples from Test Pits I2, I3, I4, I6, and I7. Impacted soil exceeding the applicable cleanup levels was encountered in the shallow soil (top 6 inches beneath the vegetation mat) within the footprint of the proposed store as represented by Sample I2S1, in soil beneath the proposed building footprint and suspected to be beneath fill potentially placed at the former tank farm – represented by Samples I3S3 and I4S3, and from samples representing the bottom of the active layer at the top of the permafrost as - represented by Sample Set I6S3/I6S12, and Sample I7S2 (Figure 2).

The GRO concentrations exceeding the applicable cleanup level ranged from 1,530 milligrams per kilogram (mg/kg) in Test Pit I3 to 21,200 mg/kg in Test Pit I6. The DRO concentrations that exceed the cleanup criterion ranged from 17,200 mg/kg in Test Pit I7 to 37,300 mg/kg in Test Pit I2. The DRO and GRO concentrations also exceed ADEC’s maximum allowable concentrations for these compounds. According to the laboratory case narrative, each sample that contained GRO or DRO concentrations exceeding the cleanup levels exhibited chromatogram patterns consistent with either weathered gasoline or weathered middle distillate fuels.

The highest BTEX constituent concentrations were identified in samples from Test Pit I6. In particular, the highest benzene concentration reported for the duplicate pair I6S3/I6S12, collected from Test Pit I6, was 1,270 mg/kg. This benzene concentration has the potential to fail EPA's toxicity characteristic leaching procedure (TCLP), which would require excavated soil to be handled as a characteristic hazardous waste under RCRA.

One PAH compound, naphthalene (67.4 mg/kg), was measured at a concentration that exceeds the applicable clean level.

3.3.2 Identified or Potential Source Areas

The former tank farm, dispenser shed, and pipeline used to fill the tanks represent potential sources of petroleum contaminants at the site. The fuel storage and dispensing equipment have been removed from the site; however, this former site use remains an environmental concern due to the remaining presence of petroleum hydrocarbon-impacted soil. The laboratory results suggest that both gasoline and diesel (heating oil) were released. Three 55-gallon drums and a burn barrel located near the northern edge of the property also have the potential to be contaminant sources. Based on the installation date and style of piles, the refrigerant is likely to be carbon dioxide. A release of carbon dioxide would disperse into the atmosphere.

3.3.3 Recommended Investigation and Remedial Actions

The PACP contained recommendations to conduct additional characterization and investigation to better define the extent of impacted soil, determine the TCLP benzene concentration, the level of risk associated with potentially complete exposure pathways, and to narrow the selection and design of remedial action alternatives, institutional controls, and/or engineering controls. In particular, the PACP recommended investigating if, and to what extent, the contaminants may be mobile and moving from on-site soil to air, surface water, and/or off-site soil. The additional characterization recommendations included:

- Collecting ambient air samples from the Property. Of particular concern are petroleum vapor concentrations when the top 1 to 2 feet of soil is thawed.
- Collecting water samples from the shallow pond east of the site and from runoff occurring in the late spring.
- Hand-excavating test pits following the methodology used in the PACP to investigate the eastern extent of contamination and to further evaluate the benzene contamination identified in Test Pit I6.

- Reevaluating potential exposure risks and the applicability of monitored natural attenuation with institutional and engineering controls based on the results of the additional investigation.

The following engineering controls were considered for the building design in the PACP to reduce the potential inhalation risks associated with the volatile hydrocarbons measured in the soil:

- Construct the proposed building on the piles that are currently in place at the site. The piles would elevate the bottom of the proposed building at least 3 feet above the ground surface and allow for air to circulate freely beneath the building;
- Install a sealed vapor intrusion barrier on the underside of the building;
- Place the air intake for heating, ventilation, and air conditioning systems high on the building and at the upwind end relative to the prevailing summer wind direction;
- Avoid windows low on the building that might be kept open in the summer months; and
- To help minimize inhalation exposure outside the building, design boardwalks for access, parking, and material handling that are elevated above the soil and have well-ventilated decks.

The following three remedial actions were identified in the PACP to address inhalation, ingestion, and/or contact exposure pathways.

- Capping the site with an impermeable barrier and passively venting or actively extracting the volatile hydrocarbons that accumulate beneath the barrier. Active soil vapor extraction was not considered to be a cost effective remedial alternative based on the fine-grained soil observed at the site and the time periods the soil is frozen.

- On-site treatment by mixing a chemical oxidizer into the soil. This option was likely not preferred/cost effective if benzene concentrations fail the toxicity characteristic and are considered hazardous.

- Excavating and treating and/or disposing the impacted soil.

4.0 CONCEPTUAL SITE MODEL

The Conceptual Site Model (CSM) identifies known and potential exposure pathways associated with petroleum hydrocarbon-impacted media at the Property. The CSM was developed in general accordance with the ADEC's *Policy Guidance on Developing Conceptual Site Models* (October 2010), using ADEC's CSM Human Health Graphic and Scoping Forms. Copies of the Human Health Graphic and Scoping Forms are included as Appendix A. The CSM is based on the current and proposed site use, our institutional knowledge of the Property, and the information available from the ADEC Contaminated Sites Database. A re-examination of potential exposure pathways may be needed if land use, access, or other site conditions change.

4.1 Contaminant Sources

Potential contaminant sources identified on the Property include the former ASTs and associated piping and dispensers that used to store and deliver gasoline and diesel/heating oil. The primary release mechanisms at the Property are assumed to be historic spills and leaks from the fuel storage and distribution systems operated at the site. The contaminated soil at the Property may function as a secondary source.

As illustrated in Figure 2, the source area(s) of the petroleum hydrocarbon impacted soil appear to be located at the former AST locations and vicinity. However, the extent of petroleum hydrocarbon-impacted media has not been defined.

4.2 Contaminants of Concern

Based on results of analytical testing conducted in 2010, GRO, DRO, BTEX, and naphthalene constituents are present at the Property at concentrations greater than the ADEC cleanup levels.

4.3 Exposure Routes

The potentially complete exposure pathways for the property include direct contact with contaminated soil (through either incidental ingestion or dermal exposure), inhalation of fugitive dust, inhalation of outdoor and d indoor air, and dermal exposure to and/or ingestion of surface water.

4.3.1 Soil Direct Contact

Incidental soil ingestion, dermal absorption, and inhalation of fugitive dust are complete exposure pathway for on-site commercial workers, site visitors, trespassers and/or future construction workers due to the presence of petroleum hydrocarbons in the surface and subsurface at the Property.

4.3.2 Groundwater Ingestion

Because groundwater is not used for drinking, and groundwater is not believed to be present for a few hundred feet beneath the permafrost, the groundwater exposure pathway is not considered complete.

4.3.3 Outdoor Air Inhalation

GRO, BTEX, and DRO concentrations documented within the top 5 feet of the soil column at the Property exceed Outdoor Inhalation Cleanup Levels. The presence of volatile COCs, benzene in particular, in near surface soil creates a complete exposure pathway for current and/or future site users. This exposure pathway will require further mitigation through treatment, capping, and/or institutional controls prior to site reuse / redevelopment.

GRO, BTEX, and DRO concentrations documented within the top 5 feet of the soil column at the Property exceed Outdoor Inhalation Cleanup Levels. Volatile COCs, benzene in particular, have the potential to impact receptors through outdoor and indoor air inhalation. The presence of volatile petroleum hydrocarbon concentrations in near surface soil creates a complete exposure pathway for current and/or future site users. This exposure pathway will require further mitigation through treatment, capping, and/or institutional controls prior to site reuse / redevelopment.

4.3.4 Indoor Air Inhalation / Vapor Intrusion

Vapor intrusion (VI) is a concern for occupied buildings within 100 feet of impacted soil. The community building and residential structures are within 100 feet from the impacted media. Although risk-based soil cleanup standards have not been promulgated for VI assessment, we assume this exposure pathway will need to be further assessed for both existing structures and prior to implementing on-Property reuse/redevelopment scenario(s) that include construction of enclosed structures.

4.3.5 Surface Water

Contact with and consumption of contaminated surface water by humans, plants, and animals is a potential exposure pathway. The impacted soil identified at the site has the potential to impact surface water, including the Selawik River, although surface water samples were not collected during previous investigations.

4.3.6 Ingestion of Wild or Farmed Food

Hunting or harvesting may not be performed at the Property. However, vegetation on the Property may be consumed by animals or humans. Further, contaminants that have the potential to bioaccumulate may be present at the Property. This exposure pathway is considered complete.

4.3.7 Sediment

Sediment samples have not been collected from the Property or vicinity. The known contaminants at the Property are not likely to directly affect the sediments in the vicinity of the site. This exposure pathway is considered incomplete.

4.4 Data Gaps

The ABCA is based on the available site characterization data. During the course of our document review, 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 depth to which petroleum contamination has penetrated the permafrost, and the horizontal boundaries of contaminated soil have not been determined. The eastern extent of soil contamination in particular is not delineated. Test Pit I7 contained DRO and xylene contamination near the eastern Property boundary.

- The leachable benzene concentrations need to be measured by TCLP analysis to determine whether the soil is hazardous waste under RCRA. As requested by the ADEC, we assumed that the soil is non-hazardous for the purposes of this ABCA.

- Lead additives to gasoline were phased out in 1978. The tank farm was likely active in 1976. Additional soil sampling could be performed to investigate the potential for lead in the soil.

- The concentrations of petroleum contaminants detected in the soil samples suggest that surface water that comes in contact with the contaminated soil may potentially become impacted. The water in the small pond on the parcel east of the Property could be sampled and analyzed to assess whether the surface water is impacted with petroleum hydrocarbons.

As described in Section 5.0, remedial actions considered for this ABCA are limited to the source area soil treatment. In this context, the data gaps listed above are not critical flaws to the ABCA and the existing data are sufficient to support an alternatives analysis for the specific remedial objectives.

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 ultimate cleanup goal for the Property is to obtain a Cleanup Complete status from the ADEC. The ADEC grants a Cleanup Complete status when remedial efforts reduce COCs in the impacted media to concentrations less than the most stringent cleanup criteria. Reducing the concentrations of COCs to the most stringent cleanup criteria may not be practicable or cost effective in certain situations. In such cases, the ADEC may allow COCs to remain at higher concentrations if the contamination does not pose an unacceptable risk to human health or the environment, typically with site controls and/or land use restrictions placed on the property for compliance by current and future owners. In these situations, the ADEC grants a Cleanup Complete – Institutional Controls (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. Obtaining a Cleanup Complete status, with or without IC, is likely not an outcome of this project due to funding constraints coupled with the contaminant mass and distribution characteristics at the site.

The general purpose of the Brownfields program is to facilitate reuse/redevelopment of environmentally contaminated sites. As described above, the land use(s) that can be potentially achieved at the site are anticipated to be restricted by available funding and the site's contamination characteristics. In this context, mitigating the identified complete exposure pathways should be sufficient to allow beneficial reuse (e.g., constructing the planned new grocery store) while making material progress toward eventual site closure and/or relatively less-restrictive land uses. It is recognized that a site reuse/redevelopment plan that is not accompanied by a "Cleanup Complete" determination will need to be compatible with the site continuing to be regulated by ADEC as an active, open contaminated site.

For this project, the remedial action objective (RAO) is source area remediation to address exposure pathways for direct contact with soil (ingestion, dermal contact, and fugitive dust) and outdoor air inhalation. Other complete or potentially completed exposure pathways, such as surface water ingestion or indoor air vapor intrusion, are not directly targeted by the present cleanup effort, although effective source area concentration reduction or containment will likely result in beneficial risk reduction for these exposure pathways as a secondary effect.

5.2 Applicable Regulations

We anticipate the State of Alaska will be the lead regulator for this project, and will be responsible for overall project oversight, and 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.

5.3 Cleanup 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* (October 2011). 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 2011), for the "Arctic Zone cleanup levels". As listed below, distinct soil cleanup levels are provided for the "Direct Contact/Ingestion" and "Outdoor Inhalation" 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 the potential for exposure. In addition, cleanup to the most stringent Method 2 standard is normally required by ADEC for a cleanup complete (without institutional controls) determination.

ADEC SOIL CLEANUP LEVELS

	SOIL (ADEC Method 2)	
COC	Direct Contact	Outdoor Inhalation
GRO	1,400 mg/kg	1,400 mg/kg
DRO	12,500 mg/kg	12,500 mg/kg
Benzene	200 mg/kg	17 mg/kg
Toluene	11,000 mg/kg	220 mg/kg
Ethylbenzene	13,700 mg/kg	110 mg/kg
Xylenes	27,400 mg/kg	63 mg/kg
PAH - Naphthalene	1,900 mg/kg	-

In addition to soil cleanup levels, the ADEC has published target levels for soil gas in their Draft Vapor Intrusion Guidance for Contaminated Sites dated July 2009. We are not presently including these target concentrations as project-specific cleanup levels due to their guidance status (vs. promulgated by regulation), and because the remedial alternatives considered for this ABCA do not directly address soil gas treatment.

5.4 Land-Use Considerations

We understand that the IRA Council initiated a project to construct a new grocery store at the Property by installing refrigerated piles. Plans to continue construction of the store have been put on hold due to the threat of potential contamination remaining from the former tank farm.

The ADEC conducted a preliminary evaluation of the mitigation alternatives discussed in the PACP and understands that cleanup decisions must be based on available funding. The funding limitations suggest that impacted soil containing COC concentrations greater than the most stringent cleanup levels will be left in place, regardless of the remedial alternative selected. Thus, future land reuse/redevelopment planning should incorporate engineering controls for the site and building design to eliminate the complete and potentially complete exposure pathways.

6.0 ALTERNATIVES ANALYSIS

This ABCA includes an analysis of the three cleanup alternatives identified by the ADEC that vary in the extent of contaminated soil treatment and management. The first alternative is the "no action" alternative. Leaving the site in its current condition, with no remedial action taken, will leave the Property unsuitable for reuse. The second option is capping and ICs. The third option is complete removal of contaminated soil, although this option is likely to be cost-prohibitive. A fourth option (in-situ chemical oxidation, which consists of applying a chemical oxidant such as RegenOx® to the impacted near surface soil) was also considered in the screening process. The cost of in-situ chemical oxidation treatment exceeded the $150,000 limit set by the ADEC for fourth option, and thus eliminated from this ABCA

The ADEC considers the only fiscally feasible option to be mitigation via capping and ICs, supplemented with further characterization work.

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. Our remedial alternative analysis contains a strong emphasis on the effect of funding limitations on each alternative. Other factors in developing and evaluating the alternatives for this assessment include the following:

- Due to funding constraints, the proposed alternatives that comprise active remediation focus on source-area soil treatment/mitigation. The primary remedial effect is to decrease exposure risk through soil ingestion, inhalation, and dermal contact. By addressing impacted soil as a secondary source, however, source-area soil mitigation will also facilitate COC reduction in run-off and surface water.
- The alternatives were selected based primarily on their effectiveness to mitigate petroleum hydrocarbons (GRO, DRO and BTEX).
- The use of sustainable remediation technologies. In particular, the use of technologies that generate a smaller carbon footprint through reduced fuel consumption and equipment operation.
- Institutional controls. None of the remedial alternatives considered in the ABCA is anticipated to achieve soil cleanup levels that would support a cleanup complete determination. Therefore, each alternative will likely require some measure of institutional controls and long-term management. Additional controls will depend on the exposure pathway mitigation of each alternative.
- Additional characterization activities will be conducted apart from the selected mitigation alternative presented in the ABCA to further define the extent of contamination in areas not evaluated during previous investigations.

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.

Alternative 2: Mitigation through Capping and Institutional Controls. This alternative consists of placing a permeable geotextile liner and soil cap over the footprint of the proposed grocery store and vicinity. Institutional controls and engineering designs will be required to reuse the Property.

Alternative 3: Excavation and Off-Site Treatment of Contaminated Soil. This alternative consists of excavating, transporting, and remediation of estimated 800 cubic yards of petroleum hydrocarbon-impacted soil at an off-site facility.

6.2 Evaluation and Comparison of Cleanup Alternatives

The following subsections discuss and compare potential cleanup alternatives for the IRA Fuel Project Former Tank Farm site. We evaluated the benefits and limitations of the three alternatives with respect to effectiveness, implementability, and cost. A general evaluation of the three 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, land-use restrictions, and institutional controls that may be required.

Implementability. The implementability criterion addresses how feasible and practicable the alternative is for the site. 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 that include capital costs (mobilization, demobilization, access road construction, imported soil for capping or backfill, soil disposal, deed restrictions, confirmation sampling, etc, as applicable) and a 15% contingency cost. 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 contingency costs, is summarized in Table 2.

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: Mitigation through Capping and Institutional Controls

Alternative 2 consists of the placement of a permeable geotextile liner and soil cap over the footprint of the proposed grocery store and vicinity. The cap will extend over an estimated 15,000 square feet, covering the former IRA tank farm, footprint of the proposed store, and vicinity.

Prior to initiating capping activities, an access road will be constructed and the vegetation will be mowed and the site will be leveled at the proposed cap area. We assumed about 165 cubic yards of imported soil will be used to construct the estimated 165 feet access road. A permeable geotextile fabric liner will be placed over the cleared, proposed cap area. An 18-inch soil layer will be placed across the area covered with the liner and will be compacted. For cost estimating purposes, we assume approximately 850 cubic yards fill will be brought to the site for the soil cap. The capped area will be vegetated using regional wild seed mix.

Alternative 2 effectively eliminate the direct contact exposure pathways and facilitate beneficial reuse of the Property – construction of the proposed store. The risk to human and ecological receptors is reduced by capping of the contaminated soil. The cap over the contaminated area will prevent direct contact by potential receptors and reduce contaminant migration caused by overland run-off. Potential vapor intrusion to the proposed store structure can be mitigated by design and ICs recommended in the PACP (constructing the proposed building on the piles, installing tightly sealed vapor intrusion barrier on the underside of the building, etc.).

The cap will not remove or destroy the contaminants and institutional controls and long-term management will likely be required. The level of risk reduction gained by implementation of Alternative 2, coupled with engineering controls for the building design, may allow construction of the planned grocery store on the Property. Alternative 2 will likely require institutional controls. Land use restrictions may include stipulations to limit soil excavation activities and future land use changes. Other institutional controls may include measures to ensure the cap integrity, and to stipulate proper handling and disposal of the contaminated material if disturbed.

Alternative 2 can be readily implemented using experienced contactors available in Kotzebue. The practicability of this alternative is predicated on the assumption that soils can be transported from permitted pit via barge. The field and reporting activities required for Alternative 2 can be implemented in one field season.

The total ROM cost, including estimated capital cost and 15 percent contingency, to implement Alternative 2 is **$227,000**.

The primary relative advantage of Alternative 2 is it allows for reuse of the Property and its low cost, which increases the level of certainty the alternative can be implemented using the available funds. Primary drawbacks include long term liability associated with residual contamination; uncertain costs related to future assessment, cleanup and disposal needs; and potentially restrictive institutional controls.

6.2.3 Alternative 3: Excavation and Off-Site Treatment of Contaminated Soil

Alternative 3 consists of excavating, transporting, and thermally remediating 800 cubic yards (1,200 tons) of petroleum hydrocarbon-impacted soil at an off-site facility. The generated impacted soil will be transported to Tacoma, Washington for remediation. Fill material will be imported to Selawik from permitted pit to backfill the excavated areas and restore the site. The soil is assumed to be non-hazardous for the purposes of this evaluation, although this has not been verified.

The source-area soil would be excavated, placed directly in 5-cubic yard supersacks, and transported to an out of state disposal facility. The anticipated rate of excavation is approximately 120 cubic yards per day. Confirmation samples will be collected from the final excavation. The excavation will be backfilled with clean imported material after collection of excavation samples. As discussed in Alternative 2, a permeable geotextile fabric liner will be placed in the excavation's base prior to backfilling, and the backfill will be compacted and vegetated.

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 most highly-impacted soil will aide in the reduction of toxicity and mobility of the COCs. Over time, the remaining petroleum hydrocarbon constituent concentrations, if any, should continue to decrease in the soil with the removal of the source-area soil. Alternative 3 effectively meets the cleanup objectives of progress toward site closure and facilitating beneficial reuse of the Property. After cleanup under Alternative 3 if residual contaminants remain on the Property, a deed notice and land use restrictions will likely be required pertaining to soil excavation activities and future land use changes.

Alternative 3 can be readily implemented using experienced contactors available in Kotzebue. The field and reporting activities required for Alternative 3 can be implemented in one field season.

The total ROM cost, including estimated capital cost and 15 percent contingency, to implement Alternative 3 is **$995,000**.

The primary advantage of Alternative 3, relative to the other remedial alternatives, is the alternative results in a quick and permanent removal of contaminants within the targeted areas. Further, Alternative 3 may facilitate more flexibility in the immediate reuse of the Property and engineering controls for the building design. The primary drawback is the high cost, with respect to both the initial expenditure and the ultimate cost effectiveness per unit mass of contaminant removal. In addition, Alternative 3 has a relatively high carbon footprint due to the transport of soil to an out-of-state disposal facility.

6.3 Recommendation of Preferred Alternative

Absent changes in our current project understanding, Alternative 2 is recommended as the preferred alternative for the IRA Fuel Project Former Tank Farm site. Of the three alternatives considered, it is our opinion that Alternative 2 allows Property re-use within existing funding.

7.0 REFERENCES

ADEC. 2003. *18 AAC 78, Underground Storage Tanks*. January 30.

ADEC. 2008. *18 AAC 75, Oil and Other Hazardous Substances Pollution Control*. October.

ADEC. 2009. *Draft Vapor Intrusion Guidance for Contaminated Sites*. July.

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

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TABLE 1
ALTERNATIVES ANALYSIS SUMMARY

Alternative	Effectiveness				Implementability [c]		Cost [d]
	Alternative meets the cleanup objective [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	
Alternative 1 - No Action	No	No (no land re-use)	No contaminated soil removal or capping. Land is likely unsuitable for re-use.	No change in risk of exposure to contaminated soil, vapors, and groundwater.	Not Applicable		No cost.
Alternative 2 - Mitigation through Capping and IC	Yes	Yes	Property useable to construct the planned grocery store with implementation of IC and engineering controls for building design.	Reduces mobility of COC by reducing vertical infiltration of surface water into contaminated soil. Reduces potential off-gassing of COC to ambient air. Removes exposure pathway for direct contact with contaminated soil.	Approximately 2 months to clear vegetation, grade site and place liner and soil cap, and reporting. Long-term IC and management given lack of source-area treatment.		$227,000
Alternative 3 - Excavation and Off-Site Treatment of Contaminated Soil	Yes	Yes	Property useable to construct the planned grocery store with potential implementation of IC.	Reduces mobility, toxicity and volume of COCs through removal of source area soils. Short-term exposure to vapors may increase during soil excavation.	Approximately 2 months to implement source soil removal efforts and reporting. Potential long-term IC and management if residual soil contamination remains.	Assumes soil is not RCRA. Greatest flexibility in future land use.	$995,000

(a) The cleanup objective is to mitigate the primary exposure pathways and facilitate beneficial re-use while making material progress towards eventual site closure and/or relatively less-restrictive land uses.
(b) Institutional controls (IC) may include measures to insure cap integrity, 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 site access restrictions.
(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 for implementing the alternative.
IC Institutional Controls
COC Contaminant of Concern

TABLE 2
SUMMARY OF ROUGH ORDER OF MAGNITUDE COSTS

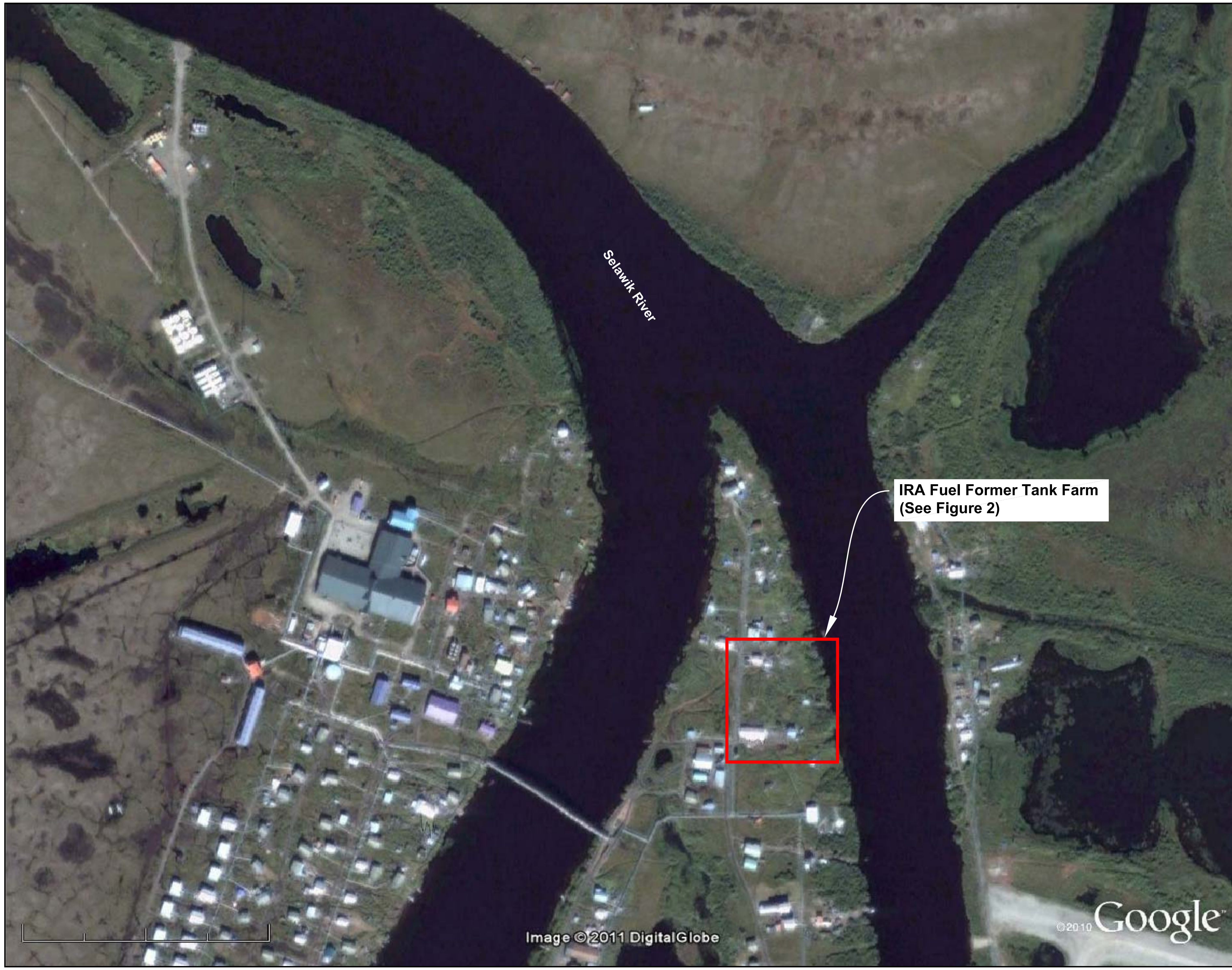
	Capital Costs[(a)]	15% Contingency[(b)]	Total[(c)]
Alternative 1 - No Action	$0	$0	$0
Alternative 2 - Liner and Soil Cap	$197,000	$30,000	$227,000
Alternative 3 - Soil Excavation and Off-Site Remediation	$865,000	$130,000	$995,000

Notes:

(a) Capital costs include costs to implement the alternative (mobilization, demobilization, access road construction, imported soil for capping or backfill, soil disposal, deed restrictions, confirmation sampling, etc.

(b) A 15% contingency is recommended for unanticipated or changed conditions.

(c) Total costs are the estimated Rough Order of Magnitude (ROM) costs for implementing the alternative including capital and 15% contingency costs.



Map adapted from aerial imagery provided by Google Earth Pro, reproduced by permission granted by Google Earth™ Mapping Service.

0 100 200 400
APPROXIMATE SCALE IN FEET

IRA Fuel Former Tank Farm
Selawik, Alaska

VICINITY MAP

March 2012 32-1-17457

SHANNON & WILSON, INC.
Geotechnical & Environmental Consultants

Fig. 1

LEGEND

I2 Approximate location of Test Pit I2 by Shannon & Wilson, Inc., 2010, with soil sample results greater than the ADEC cleanup levels. Concentrations of analytes with exceedences shown in mg/kg.

I1 Approximate location of Test Pit I1 by Shannon & Wilson, Inc., 2010, with soil sample results less than the ADEC cleanup level, or not analyzed (I8).

Approximate location of former AST

0 25 50 100
APPROXIMATE SCALE IN FEET

Notes:
1) Figure based on June 26, 2008 and June 15, 1986 aerial photographs from AeroMetric, Inc. - Alaska Division and the Alaska DCRA 1999 Community Map, Selawik.

2) Lot Identifiers are for U.S. Survey No. 4492 Tract B.

3) Property boundaries are approximate.

N

IRA Fuel Former Tank Farm
Selawik, Alaska

SITE PLAN

March 2012 | 32-1-17457

SHANNON & WILSON, INC.
Geotechnical & Environmental Consultants

Fig. 2

APPENDIX A

HUMAN HEALTH CONCEPTUAL SITE MODEL

HUMAN HEALTH CONCEPTUAL SITE MODEL GRAPHIC FORM

Site: Selawik IRA Fuel Project Former Tank Farm
Selawik, Alaska

Completed By: Shannon & Wilson, Inc.
Date Completed: March 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	F	C/F		
	☑ Dermal Absorption of Contaminants from Soil		F	C/F	F	C/F		
	☑ Inhalation of Fugitive Dust		F	C/F	F	C/F		
☐ groundwater	☐ Ingestion of Groundwater							
	☐ Dermal Absorption of Contaminants in Groundwater							
	☐ Inhalation of Volatile Compounds in Tap Water							
☑ air	☑ Inhalation of Outdoor Air		F	C/F	F	C/F		
	☑ Inhalation of Indoor Air		F	F				
	☑ Inhalation of Fugitive Dust		F	C/F	F	C/F		
☑ surface water	☑ Ingestion of Surface Water		I	C/F	I	C/F		F
	☑ Dermal Absorption of Contaminants in Surface Water		I	C/F	I	C/F		F
	☑ Inhalation of Volatile Compounds in Tap Water		I	I	I			
☑ sediment	☑ Direct Contact with Sediment		F	C/F	F	C/F		F
☑ biota	☑ Ingestion of Wild or Farmed Foods			C/F			C/F	

Print Form

Human Health Conceptual Site Model
Scoping Form

Site Name: Selawik IRA Fuel Project Former Tank Farm, Selawik, Alaska

File Number: ADEC File No. 500.38.001

Completed by: Shannon & Wilson, Inc.

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:

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:

DRO and GRO detected in excess of Direct Contact Cleanup Levels.

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:

PAHs have been detected at less than direct contact cleanup levels.

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: Incomplete

Comments:

Usable groundwater has not been successfully located in the Selawik area, and the contaminants are not expected to penetrate permafrost, however a DEC determination has not been pursued.

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: Complete

Comments:

The potential for migration to surface water exists, but has not been characterized. The Selawik River is a 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: Complete

Comments:

The fuel contaminants detected on site are not listed as bioaccumulative compounds, however the potential for lead from gasoline exists.

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:

DRO, GRO, and BTEX have been measured at concentrations above the Outdoor Inhalation 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:

Foundation piles for a potential building are present in the area where volatile contaminants have been measured in the soil.

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:

If the migration to surface water is found to be a complete pathway (to the Selawik River) this pathway may need evaluation.

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:

The current water intake for the municipal water supply is upstream and on a different channel of the river. Some users may dip containers into the river down stream of the site, however.

Inhalation of Fugitive Dust

Inhalation of fugitive dust may be a complete pathway if:

- o 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.
- o 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.
- o 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:

The majority of compounds detected are volatile, however DRO has the potential to cling to respirable particles, and the silt encountered on the site has the potential to contain respirable particles.

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:

- o Climate permits recreational activities around sediment.
- o 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:

If the migration to surface water via runoff is found to be a complete pathway (to the Selawik River) this pathway may need evaluation.

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