EXECUTIVE SUMMARY

This report presents the findings of Shannon & Wilson Inc.'s site assessment activities performed at four Alaska Department of Transportation and Public Facilities (ADOT&PF) sites in Aniak, Alaska. This project was administered under Shannon & Wilson's Term Contract with the State of Alaska Department of Environmental Conservation (ADEC) for site assessment activities No. 18-20-1210. The objectives of the site assessment were to further characterize the nature and extent of contamination at four ADOT&PF sites and to evaluate potential remedial alternatives, which could be used to resolve outstanding environmental contamination issues at the sites. The information obtained during the site assessment and the evaluation of remedial alternatives will be used by the ADEC to determine an appropriate course of remedial action to pursue site closure.

Site assessment activities were performed at four ADOT&PF sites in Aniak. The sites consisted of Site 1: ADOT&PF Building 301; Site 2: Runway Apron consisting of an exposed culvert and former aboveground storage tank (AST) area (Runway Apron) and a debris disposal area (Disposal Pit Area); Site 3a: ADOT&PF Maintenance Facility Building; Site 3b: Former AST Area; Site 3c: Underground Pipeline Area; and Site 4: White Alice Communication (WAC) Site. The site assessment activities were divided into a Phase I and Phase II field effort. During the Phase I field effort, a number of test pits and hand borings were advanced and sampled to identify potential source areas and delineate near surface soil contamination. In addition, groundwater samples were collected from existing monitoring wells at the Runway Apron (Site 2) and the Former AST Area (Site 3b). Based on the results of the Phase I field effort, 19 monitoring wells and three soil borings were advanced and sampled to evaluate the vertical extent of soil contamination and assess the extent and magnitude of potential groundwater contamination.

The results of our assessment indicate that soil contamination exceeding the Method 2 cleanup levels contained in the ADEC Oil and Hazardous Substances Pollution Control Regulations, 18 AAC 75, is present at each of the sites and has resulted in the exceedance of groundwater cleanup levels at three of the six individual sites. Soil contaminants exceeding the cleanup levels are primarily related to diesel range organics (DRO), although gasoline range organics (GRO), benzene, toluene, ethylbenzene, and xylenes (BTEX), and dichlorodiphenyltrichloroethane (DDT) were reported to exceed the Method 2 cleanup levels in limited areas. Method 3 soil cleanup levels were developed for Sites 1, 2, and 3 using site-specific data regarding infiltration rate and average total organic carbon content of the soils. A Method 3 soil cleanup level for Site 4 was developed using a leaching assessment and the one-dimensional fate and transport model SESOIL. However, a large volume of impacted soil still remains above the applicable Method 3 cleanup levels. Impacted soil exceeding the ADEC Maximum Allowable Concentration (MAC) for DRO and applicable ingestion standards for DRO and DDT is estimated at approximately 720 cubic yards. Additional soil exceeding the Method 3 cleanup levels for the migration to groundwater pathway were estimated at approximately 4,200 cubic yards. While impacted groundwater exceeding the cleanup levels was limited to three of the six individual sites, the extent of groundwater contamination appears to be limited to the inferred source area and does not appear to threaten downgradient receptors. At the Disposal Pit Area of Site 2 the source and extent of groundwater contamination by trichloroethene (TCE) is unknown.

The presence of DDT impacted soils at Site 1 complicate the evaluation of remedial alternatives. The DDT concentrations exceed the ADEC soil cleanup standards for ingestion and due to their probable source are likely to be considered a RCRA hazardous waste, if excavated. Remedial alternatives evaluated for this soil included cold asphalt emulsion recycling, concrete stabilization, transport to an appropriate facility in the contiguous United States, and capping the impacted area with fill. Regulatory guidance is necessary to determine the status of the remaining petroleum contaminated soil at Site 1 which is impacted by lower concentrations of DDT.

Remedial alternatives evaluated for petroleum contaminated soils included: 1) ex situ treatment by thermal desorption; 2) ex situ treatment within an active bioventing cell; 3) ex situ treatment within a passive bioventing cell; and 4) natural attenuation with groundwater monitoring. Remedial alternatives evaluated for the impacted groundwater included: 1) natural attenuation with groundwater monitoring; 2) air injection (sparging/biosparging); and 3) injection of solid-phase oxygen releasing compound.

Based on the results of our evaluation, excavation and treatment of contaminated soil within a passive bioventing treatment cell was determined to be the lower cost alternative for site-specific remediation. However, due to the remoteness of Aniak, equipment and personnel mobilization and demobilization was observed to be a significant expense for just about each remedial alternative. Therefore, pursuing remedial activities at multiple sites is recommended as a cost savings approach. In this fashion, treatment alternatives such as Hot Air Vapor Extraction (HAVE) and Enhanced Thermal Conduction become practical and cost competitive.

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LIST OF ACRONYMS

ADEC	Alaska Department of Environmental Conservation
ADOT&PF	Alaska Department of Transportation and Public Facilities
AST	aboveground storage tank
bgs	below the ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CFU	colony forming units
CT&E	CT&E Environmental Services Inc.
DDE	dichlorodiphenyldichloroethyle
DDD	dichlorodiphenyldichloroethane
DDT	dichlorodiphenyltrichloroethane
DO	dissolved oxygen
DQO	data quality objectives
DRO	diesel range organics
E&E	Ecology and Environment
EPA	Environmental Protection Agency
GRO	gasoline range organics
HAVE	hot air vapor extraction
HVO	halogenated volatile organics
IDW	investigation derived waste
MAC	maximum allowable concentrations
MPN	most probable number
OHM	OHM Remediation
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyls
PID	photoionization detector
ppm	parts per million
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RFP	Request for Proposal
RRO	Residual Range Organics
SSHSP	Site Specific Health and Safety Plan
TCLP	Toxicity Characteristic Leaching Procedure
TOC	total organic carbon
TPH	total petroleum hydrocarbons
UST	underground storage tank
TSD	treatment, storage, and disposal
VOC	volatile organic compound
WAC	White Alice Communications
WP	workplan

SITE ASSESSMENT
ADOT&PF SITES
ANIAK, ALASKA

1.0 INTRODUCTION

This document presents the results of Shannon & Wilson's site assessment activities performed at four Alaska Department of Transportation and Public Facilities (ADOT&PF) sites in Aniak, Alaska. This work was performed in general accordance with Shannon & Wilson's October 1998 work plan. The work plan was requested by the Alaska Department of Environmental Conservation (ADEC) in the July 1, 1998 Request for Proposal (RFP) entitled "Site Assessment Work Plan & Remedial Alternatives for Aniak ADOT&PF Sites" and was developed in accordance with Shannon & Wilson's proposal dated July 10, 1998. Notice to proceed with the site assessment activities was received from Mr. Dennis Harwood of the ADEC on October 8, 1998. The project was administered under Shannon & Wilson's Term Contract with the ADEC for site assessment activities No. 18-20-1210 and the ADEC Notice to Proceed No. 1820121007A. The ADEC project managers are Mr. John Halverson and Ms. Anne Marie Palmieri.

The objectives of this site assessment were to further characterize the nature and extent of contamination at four ADOT&PF sites in Aniak, and to evaluate potential remedial alternatives, which could be used to resolve outstanding environmental contamination issues at the sites.

2.0 SITE AND PROJECT DESCRIPTION

Aniak, Alaska is located approximately 90 miles northeast of Bethel, and approximately 320 miles west of Anchorage in Section 12, Township 17 North, Range 57 West, Seward Meridian. The city is situated on the Kuskokwim River flood plain, bordered by the Kuskokwim River to the north and Aniak Slough to the southeast, as shown in Figure 1.

This project consisted of performing site assessment activities at four ADOT&PF sites in Aniak, Alaska. The locations of the sites are shown on Figure 2 with detailed site maps included as Figures 3 through 10. The individual project sites are:

- Site 1: ADOT&PF Building 301;
- Site 2: Runway Apron and Disposal Pit Area;
- Site 3: Consisting of;
    - Site 3a: ADOT&PF Maintenance Facility Building (Maintenance Shop);

  - Site 3b: Former AST Area;
  - Site 3c: Underground Pipeline Area; and,
- Site 4: White Alice Communication (WAC) Site.

The site assessment activities were performed in accordance with our October 1998 project specific Work Plan (WP), Quality Assurance Project Plan (QAPP), and Site Specific Health and Safety Plan (SSHSP). The SSHSP was prepared in general accordance with Shannon & Wilson's corporate Safety and Health Program and complies with Occupational Safety and Heath Administration (OSHA) regulations and the requirements of 29 CFR 1910.120.

This report describes our field sampling activities, presents the results of field screening and laboratory analyses, discusses the subsurface conditions, presents a review of viable remedial options, and provides a recommendation for remedial options. B.C. Excavating (BCX) provided personnel to excavate the test pits. Discovery Drilling (Discovery) provided personnel and equipment to advance the borings and install the monitoring wells. CT&E Environmental Services Inc. (CT&E) provided laboratory analysis of the soil and groundwater samples. McClintock Land Associates, Inc. (McClintock) conducted the horizontal and vertical surveys of the new monitoring wells and various pre-existing site features. BCX, Discovery, and CT&E are of Anchorage, Alaska and provided services under subcontract to Shannon & Wilson. McClintock is of Eagle River, Alaska and also provided services under subcontract to Shannon & Wilson.

3.0 FIELD ASSESSMENT ACTIVITIES

In October 1998, a representative of Shannon & Wilson conducted a preliminary site visit of the ADOT&PF sites to view the sites, coordinate utility locates, identify potential conflicts, and research local information. The site visit was performed prior to the accumulation of snow cover on the ground surface and aided in the planning of the field assessment activities.

Assessment activities consisted of two main phases of field activities. Phase I activities were conducted during November 1998, and consisted of shallow explorations, utilizing test pits and hand borings, in an effort to collect data related to the lateral extent of soil contamination at the four sites. The Phase I activities were also used to evaluate the location of the follow-on Phase II borings and monitoring wells. Also during Phase I, six existing monitoring wells were sampled. Phase II activities were conducted during March and April 1999, and consisted of drilling and sampling three borings, installing, developing, and sampling 19 groundwater monitoring wells, and sampling six existing monitoring wells and one water well.

A representative of Shannon & Wilson was present continuously during the subsurface investigation activities to identify the locations of the test pits and borings, log the materials encountered during excavation and drilling activities, and sample and screen the subsurface soils and groundwater. Photographs of the field activities are included in Appendix A. Boring logs and monitoring well construction details are included as Appendix B. Graphs of grain size classifications are included as Appendix C and a copy of the laboratory reports are included as Appendix D.

3.1 Health and Safety Monitoring

Shannon & Wilson's field representative served as the site safety officer for the duration of the project. Field personnel were familiar with the SSHSP and field work was performed in accordance with these procedures. A personal acknowledgement form, confirming that the field personnel understood the SSHSP provisions, and a pre-shift safety meeting and attendance form was completed by each worker. Before starting each day's activities, or as needed, our field representatives and contracted personnel held safety meetings to discuss procedures and safety from the previous day and to prepare for the upcoming day. An OVM 580B photoionization detector (PID) was regularly used to monitor total hydrocarbon vapors in the breathing zone during field activities.

3.2 Phase I Field Activities

The Phase I field program consisted of the investigation of source areas and the lateral delineation of soil contamination using hand borings and test pits. In addition, existing monitoring wells at the Former AST Area and the Runway Apron were sampled. A description of the specific field activities is presented below.

3.2.1 Hand Borings

Hand borings were used to explore the near surface soil at the Former AST Area, the Underground Pipeline Area, and the WAC Site. Where possible backhoe was utilized to advance the hand borings. Hand boring locations that were inaccessible to the backhoe were explored using shovels and a hand auger. A total of 54 hand borings were advanced and sampled for field screening and analytical testing. The hand borings ranged from 0.5 to 4 feet in depth and samples were generally collected at 0.5- to 2-foot intervals using a stainless steel spoon. The auger equipment and stainless steel spoons were decontaminated between sample locations. At the completion of each hand boring, the excavated soil was used to backfill the hole.

3.2.2 Test Pits

Test pits were used to investigate ADOT&PF Building 301 (Building 301), the Runway Apron, the Maintenance Shop, the Former AST Area, and the Underground Pipeline Area. A total of 37 test pits and three exploratory trenches were excavated for field screening and the collection of soil samples for laboratory testing. The test pits ranged in depth from about 4 to 14.5 feet. Soil samples were generally collected from the sidewalls and the base of the test pits at 0.5 and 2 feet bgs. Beneath 2 feet bgs soils samples were generally collected from the backhoe bucket at 2-foot intervals to the terminal depth of the test pit. Headspace screening was conducted on soil from each sample depth. Based on headspace results up to two analytical samples were collected from each test pit.

Three exploratory trenches were advanced near the southern portion of the Maintenance Shop in an attempt to locate subsurface piping to a reported dry well. The trenches ranged in depth from approximately 6.0 to 8.0 feet bgs.

To allow the rapid determination of potentially contaminated soil and segregation of soil on either side of the test pit, the soil in the backhoe bucket was screened using direct field screening methods. Soil that exhibited evidence of contamination was placed on one side of the test pit and the potentially clean soil was placed on the other side. All of the stockpiled soil was placed back into the excavation following the field screening and sampling efforts.

3.2.3 Locating and Sampling Wells

A drinking water well was reportedly located adjacent to the west side of Building 301. Although the area was searched and inquiries were made to ADOT&PF personnel, the well could not be found. A well located northeast of the Maintenance Shop was observed and is reportedly used as a non-potable water well. At the Maintenance Shop, Former AST Area, and Runway Apron, existing monitoring wells were observed. Additionally, a former water well was observed at the Runway Apron.

Groundwater samples were collected from the three existing monitoring wells at the Former AST Area and the three existing monitoring wells at the Runway Apron. In addition to groundwater samples for analytical testing, the depth to groundwater and field parameters of pH, specific conductance, temperature, and dissolved oxygen (DO) were measured at each well.

3.3 Phase II Field Activities

The Phase II field program consisted of the installation and sampling of 17 monitoring wells, two biovent/monitoring wells, and three borings. In addition, six existing monitoring wells and one former water well were sampled. The existing and new monitoring wells, the former water well, and selected monitoring wells at nearby sites were surveyed for horizontal and vertical locations. A description of the specific field activities is presented below.

3.3.1 Soil Borings

The soil borings were advanced by a track-mounted CME-55 drill rig equipped with four and one-quarter-inch inside diameter (I.D.) hollow-stem augers and a two and one-half-inch O.D. split-spoon sampler. The borings completed as monitoring wells were advanced approximately five feet below the groundwater identified during drilling. The drilling was documented on field boring logs which included the project name, boring number, time of start up, standby periods and shutdown, type of work conducted, names of on-site personnel, location, sample time, number, and depth, field screening results, material description, and groundwater details. Boring logs are included as Appendix B.

If potentially impacted soil was identified during drilling through field screening, olfactory, and/or visual evidence, soil samples were collected at approximately 2.5-foot depth intervals. If potentially impacted soil was not identified during drilling, soil samples were collected at approximately 5-foot intervals. Soil samples were collected from the borings at 2.5-foot intervals as the suspected groundwater depth was approached. Soil samples for field screening and potential laboratory testing were collected from each sample interval.

The augers were decontaminated after each use at a temporary decontamination station constructed for this project at the Maintenance Shop. The auger sections were pressure washed to remove potential contamination and the decon water was collected for treatment. Water generated during decontamination was processed through a 30-gallon activated carbon canister prior to disposal on the ground surface.

3.3.2 Monitoring Well Installation

A total of 17 monitoring wells were constructed of 2-inch nominal I.D. Schedule 40 PVC pipe with threaded connections. The lower portion of the wells consisted of PVC well screen with 0.010-inch slots and an end cap at the terminal end. The screened section extended from approximately 5 feet below to about 5 feet above the static water table for a total screen length of

10 feet. Although the workplan specified a 5-foot screen length, the lengths of the screens were adjusted to ten feet, with ADEC approval, to allow for seasonal water table fluctuations.

A continuous sand filter pack consisting of Number 8-12 filter sand was used to backfill around the well screens to approximately one to two feet above the top of the screen. An additional one foot of sand pack consisting of #20-#40 sand was placed between the filter sand and the hydrated bentonite chips to protect the filter sand from the bentonite. Bentonite chips were used to backfill around the PVC in the vadose zone to about one foot below the surrounding ground surface. Aboveground protective casings were used around 16 of the monitoring wells and a flush-mounted protective casing was used around one of the wells. As the result of subzero temperatures the protective casings could not be embedded in cement and were embedded in sand. Monitoring well construction logs are included in Appendix B.

3.3.3 Bioventing Wells

Two of the borings, AST-MW5, located at the Former AST Area, and WAC-MW2, located at the WAC Site, were completed as bioventing wells. The wells were constructed using the same types of materials as the monitoring wells, however, the screened interval extended to within 3 to 4 feet of the ground surface. These wells were installed in areas of deep soil contamination for the purpose of bioventing feasibility testing. Feasibility testing was not included in our Phase II field assessment.

3.3.4 Monitoring Well Development

Prior to the collection of the groundwater samples, the monitoring wells and biovent wells were developed using a ES-60 submersible pump in an effort to extract the maximum quantity of fine materials from the borehole and stabilize the filter pack. During development, water samples were recovered at approximately 2.5 to 5-gallon intervals and tested for pH, temperature, turbidity, DO, and conductivity using a HORIBA U-10 water quality instrument. Well development was considered complete when the well water was substantially free of visual sediment and the pH, temperature and conductivity measurements stabilized.

3.3.5 Monitoring Well Survey

McClintock conducted a vertical and horizontal survey of the new monitoring wells installed under this project, as well as selected existing wells located on or near the subject sites. The survey identified the horizontal and vertical locations of the top of the well casings and tied the wells to a single reference datum at the airport with a known elevation of 84.00 feet mean sea level (MSL). The elevation survey was conducted within an accuracy of plus or minus 0.01 feet. A mark was placed on the top rim of the well casings at the point of measurement during the vertical survey and this mark was used for subsequent measurements of depth to groundwater. The horizontal locations of the monitoring wells were recorded using a Global Positioning System (GPS).

3.4 Waste Handling

Investigation derived waste (IDW) generated during the field program consisted of soil cuttings, excavated soil, well development water and purgewater, decontamination water, used protective equipment, used disposable sampling equipment, and activated charcoal.

Drill cuttings from potentially impacted borings/monitoring wells, based on field screening, olfactory, and/or visual evidence, were placed in 10-mil polyethylene sacks inside 1 cubic yard soil containment supersacks and placed next to the potentially impacted borings. Potentially clean drill cuttings were landspread on site near the borings.

The drill cuttings from Boring AST-B7, at the Former AST Area, were placed into a labeled 55-gallon drum because the results of a previous assessment noted soils containing potentially hazardous concentrations of trichloroethylene (TCE). The boring was backfilled with bentonite chips.

At each test pit the excavated soil was segregated on either side of the test pit, based on the results of field screening. Following the completion of the test pit and sampling, potentially impacted soil was placed back into the test pit, as near as possible to the impacted intervals and clean soil was placed near zones of clean soil and at the surface of the backfilled test pits.

Water generated during decontamination was processed using a 30-gallon activated carbon canister prior to disposal on the ground surface at the Maintenance Shop. The development water and purgewater was processed at each of the sites using a 30-gallon granulated activated charcoal (GAC) filter prior to being discharged to the ground surface.

Used protective equipment and used disposable sampling equipment was placed in garbage bags and taken to the Aniak Landfill. The used GAC was containerized in two, labeled 55-gallon drums and stored at Building 301.

3.5 Waste Disposal

During the Phase II assessment activities eight supersacks, one 55-gallon drum of drill cuttings, and two drums of used GAC were generated and left at the various sites, as described above. Based on review of the analytical results from the borings, the soil in supersacks from Monitoring Wells 301-MW2, PL-MW11 and WAC-MW4 and the soil in a drum from Boring AST-B7 were landspread at the respective boring locations in August 1999. The soil in supersacks from Monitoring Well 301-MW1, AST-MW5, PL-MW9, and PL-MW10 contained concentrations of petroleum hydrocarbons exceeding the applicable cleanup levels and, based on approval by Mr. Terry Hoffman, Aniak Airport Manager, are currently stored at the respective boring locations pending the implementation of remedial activities. The soil from Monitoring Well WAC-MW2 does not exceed the recently proposed alternate cleanup level for Site 4. Since the proposed alternate cleanup level for Site 4 was developed following the August 1999 site visit, the Monitoring Well WAC-MW2 soil cuttings remain in a supersack adjacent to the monitoring well location.

The used granulated activated carbon (GAC) was consolidated into one drum and transported to Anchorage by air-carrier in August 1999. Upon arrival in Anchorage, the drum was transported to Alaska Pollution Control's facility for regeneration.

4.0 SAMPLING PROCEDURES

Sampling of soil and water was conducted in accordance with the procedures outlined in Shannon & Wilson's October 1998 project specific work plan. The soil and water samples were stored in chilled coolers and transported to CT&E of Anchorage, Alaska using chain-of-custody procedures. Sampling procedures are described in the following sections.

Under the sample numbering scheme used for this project a typical analytical sample number was Y-5946-301-TP1-S1 for test pit samples, Y-5946-RA-MW1-S1 for boring samples, and Y-5946-WAC-MW1-W1 for groundwater samples. The 'Y-5946' represents the Shannon & Wilson job number. The '301', 'RA', 'MS', 'AST', 'PL', 'WAC' designations represents samples collected from the Building 301, Runway Apron, Maintenance Shop, Former AST Area, Underground Pipeline Area, and WAC Site, respectively. The 'TP1' and 'MW1' designations represent the sample locations and the 'S1' and 'W1' designations represent the soil and water sample numbers, respectively. For brevity in the text and tables of this report, the 'Y-5946' prefix is omitted and samples are identified by their location designations and sample numbers.

4.1 Field Screening

The soil was evaluated or "screened" for volatile organic compounds using an OVM 580B PID calibrated with 100 parts per million (ppm) of isobutylene standard gas. The PID was used to sample the total hydrocarbon vapors released from the soil using headspace screening methods and, in some instances, direct soil screening methods. Samples for headspace screening were collected in re-sealable bags by filling them with freshly exposed soil to approximately one-half of their volumes using a stainless steel spoon and then sealing the bag. Contaminant free stainless steel spoons were used to take each headspace sample. Headspace samples were allowed to warm to a common temperature inside a warm field vehicle prior to headspace screening. Field PID readings were obtained within one hour of sampling. To screen the atmosphere in the sample container, the plastic bag was agitated for about 15 seconds, then the PID sampling probe was inserted into the air space above the soil in the bag. The PID display was observed and the maximum reading was recorded for each sample. The PID readings were used to select samples for analytical testing and to assess soil quality.

In some cases, generally restricted to the segregation of soil during the backhoe test pits, direct field screening methods were used to evaluate soil contaminant levels. Direct screening was accomplished by creating a depression in the soil in the backhoe bucket with a stainless steel spoon and holding the PID probe in the depression. The PID reading was used to determine if the soil was potentially contaminated or clean.

4.2 Soil Sampling

Analytical soil samples, with the exception of gasoline range organics (GRO) and aromatic volatile organics including benzene, toluene, ethylbenzene, and xylenes (BTEX), were collected by quickly and completely filling the appropriate laboratory provided jars using a decontaminated stainless steel spoon. The analytical samples analyzed for GRO and BTEX were collected using the ADEC sampling procedure for Alaska Method 101 (AK 101). Approximately 50 grams of soil were quickly placed into a laboratory supplied 4 oz. jar that had been pre-weighed. Afterward, 25 milliliters (ml) of reagent grade methanol were added to completely submerge the soil. The methanol extracted the volatile petroleum hydrocarbons from the soil at the time of sampling, thereby reducing the possible loss of volatile constituents prior to sample analysis. The sampler's name, the date, and time of sample collection are listed on the chain-of-custody forms included in Appendix D.

4.3 Groundwater Sampling

Prior to purging and sampling, the depth to water in the monitoring wells was measured to within 0.01 feet using an electronic water level indicator. At least three volumes of water inside the wells were purged prior to sampling. Purging was conducted using a Whale variable-speed submersible pump equipped with new disposable tubing or a new disposable bailer. The pH, temperature, turbidity, DO, and conductivity of each purged well volume was measured using a HORIBA U-10 meter and recorded. The wells were purged until they were substantially free of visible sediment and the pH, temperature, and conductivity values had stabilized.

The groundwater samples were collected once the wells had recovered to at least 80 percent of their pre-developed water level. Water samples were obtained from the wells using the Whale variable-speed submersible pump and new tubing or new polyethylene disposable bailers. The water samples were immediately collected and placed into the laboratory-supplied sample bottles. The samples were transferred to containers in the order of volatility. The sample containers for GRO, BTEX, and HVO analyses were filled such that no headspace was present. The remaining sample containers had headspace up to 10% of the total container volume to prevent breakage of the containers during transportation. The sampler's name, the date, and time of sample collection are listed on the chain-of-custody forms included in Appendix D.

4.4 Quality Control Sampling

In addition to the project samples, quality control samples were collected and analyzed. The quality control samples included field duplicates, methanol field blanks, methanol trip blanks, water trip blanks, and decontamination (rinsate) blanks. Approximately one field duplicate sample was collected and analyzed for every 10 project samples analyzed. The ratio of the field, trip, and rinsate blanks to the project samples was approximately one per set of 20 project samples analyzed.

Field duplicate samples were collected from as close in time and location to the project samples as possible and were transported to the analytical laboratory with the project samples. A unique sample number was assigned to the field duplicate samples.

Methanol field blank soil samples were prepared by adding 25 ml of reagent grade methanol to a laboratory-supplied pre-weighed 4-oz jar containing 25 milligrams of Ottawa sand. Field blanks were opened at the site during sampling and used to document the potential presence of volatile petroleum hydrocarbons in the ambient air. In addition, CT&E provided soil sampling trip blanks consisting of 4-oz jars containing 25 milligrams of Ottawa sand and 25 ml of reagent grade methanol. The trip blanks accompanied the volatile soil sample bottles from the laboratory to the site during soil sampling activities and back again to CT&E. The trip blanks were used to document potential contamination occurring during the shipping and handling of the samples.

The rinsate blanks were collected by pouring analyte-free deionized water over the split-spoon samplers or other sampling equipment following decontamination procedures. The deionized water was collected in the appropriate laboratory-provided bottles and submitted for analysis. The rinsate blanks enabled us to assess the effectiveness of our decontamination procedures.

5.0 LABORATORY ANALYSES

Soil and water samples collected during the site assessment activities were transported to the laboratory in chilled coolers using chain-of-custody procedures. Sample analyses were selected based on types of known and/or potential sources of contamination associated with each of the four ADOT&PF sites. Additionally, samples were selected to obtain the necessary data to evaluate possible remedial alternatives for the sites. Copies of the laboratory reports are presented in Appendix D.

5.1 Soil Samples

A total of 161 soil samples, including duplicates, were collected during the Phase I and Phase II assessment activities. Generally two soil samples were collected from each test pit and boring and one soil sample was collected from selected hand borings. Soil samples collected from the four ADOT&PF sites were selectively analyzed for GRO by AK 101, diesel range organics (DRO) by AK 102, BTEX by EPA Method 8021B (EPA 8021B) as modified by AK 101, and polynuclear aromatic hydrocarbons (PAHs) by EPA 8270 SIM.

In addition, a limited number of samples were selectively analyzed for halogenated volatile organics (HVOs) by EPA 8021, pesticides by EPA 8081, polychlorinated biphenyls (PCBs) by EPA 8082, lead by the toxicity characteristic leaching procedure (TCLP) by EPA 1311/6010, Resource Conservation and Recovery Act (RCRA) metals including arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver by EPA 6000/7000 series, and volatile organic compounds (VOCs) by EPA 8260.

To evaluate the potential for biodegradation to be occurring and for use as a potential remedial option, selected samples from each of the four sites were analyzed for nitrate/nitrite by EPA 300.0, phosphorus soluble acid by ASA 1982:24-5, potassium by EPA 6010B, pH by

SW846-9045, oil degrading bacteria using the sheen screen method, and heterotrophic plate count by SM 19 9215.

To evaluate other subsurface conditions selected samples were analyzed for geotechnical sieve analysis by ASTM D 4422-93 and total organic carbon (TOC) by CT&E's Standard Operating Procedure (CTESOP) which is a modification of Method 415. Because Method 415 is an aqueous method, CTESOP is a modification of the method to quantify TOC in soil. The method removes carbonates by acidification and relates the mass of carbon dioxide given off by combustion of the sample to organic carbon rather than an ash method which combusts organic carbon along with other compounds. We feel the method adequately quantifies TOC in soil. The results of the sieve analyses are included as Appendix C.

5.2 Water Samples

A total of six groundwater samples were collected during Phase I and 26 groundwater samples were collected during Phase II. The samples were analyzed for GRO by AK 101, DRO by AK 102, and BTEX by EPA 8021B. Selected samples were also analyzed for PAHs by EPA 8310 or EPA 8270 SIM, pesticides by EPA 8081, PCBs by EPA 8082, HVOs by EPA 8021, RCRA metals by EPA 6000/7000 series, total lead by EPA 7421, and semi-volatile organic compounds (SVOCs) by EPA 8270.

5.3 Quality Control

The data quality objectives (DQO) for this project are contained in Shannon & Wilson's October 1998 project specific QAPP. A total of 14 duplicate soil samples, five duplicate water samples, five soil field blanks, six soil trip blanks, three rinsate samples, and one water trip blank were collected and analyzed as part of this project.

The analytical data were systematically reviewed and compared to established criteria to assure that conclusions about the sites are based on precise, accurate, and complete sampling results. Field reports were checked for completeness, accuracy, adherence to field procedures, and for information that would impact data quality. Quality control and quality assurance protocols were followed by CT&E and reported in Level 1 Data Deliverables packages. Continuing calibration checks, method blanks, surrogate spikes, matrix spike, and matrix spike duplicate information were used to establish whether the precision, accuracy, and completeness of the analyses were performed within the boundaries of the data quality objectives. The field data and laboratory packages were reviewed to identify factors that would indicate data inadequacy.

Fourteen duplicate soil sample sets were collected as part of this project. The results of the project samples were compared to the duplicate results and the relative percent difference (RPD) calculated. The following table details the data quality objectives for this project, including the RPD and completeness of the duplicate sets, and the order of magnitude difference between the duplicate samples.

SOIL FIELD DUPLICATE QUALITY CONTROL RESULTS

	Analytical Parameters and Relative Percent Difference/Order of Magnitude Difference Goals								
Location and Sample Set	GRO ±25/5x	DRO ±20/5x	Benzene ±25/5x	Toluene ±25/5x	Ethylbenzene ±25/5x	Xylenes ±25/5x	PAHs ±50/5x	Pesticides ±30/5x	PCBs ±30/5x
Site 1									
TP15-S4/S10	-	153/7.5	-	-	-	-	*	56/1.8	-
TP16-S2/S10	*	*	*	*	*	*	-	-	-
MW1-S3/S10	-	23/1.3	-	-	-	-	2-47/1-1.6	121-187/4-31	-
Site 2									
TP4-S2/S10	120/4.0	16/1.2	*	115/3.7	164/10	156/8	51-92/1.7-2.7	-	*
TP6-S2/S10	-	2/1.0	-	-	-	-	-	-	-
TPB2-S1/S10	-	41/1.5	-	-	-	-	-	-	-
Site 3b									
TP1-S2/S10	*	77/2.2	*	12/1.1	*	74/2.2	96/2.9	-	-
TP12-S2/S10	*	28/1.3	*	*	*	*	-	-	-
Site 3c									
TP1-S3/S10	3/1.0	29/1.3	*	*	2/1.0	3/1.0	-	-	-
HB9-S2/S10	-	37/1.5	-	-	-	-	-	28-56/1.3-1.8	-
MW11-S6/S10	-	*	-	-	-	-	-	-	-
MW12-S5/S10	-	*	-	-	-	-	-	-	-
Site 4									
HB2-S3/S10	8/1.1	46/1.6	*	41/1.5	*	9/1.1	-	-	-
MW4-S4/S15	*	21/1.2	*	*	*	*	-	-	-
Completeness^	67%	18%	NA	33%	50%	33%	33%	13%	NA

KEY

-	Sample set not analyzed for this parameter
*	Analyte not detected in one or both samples
NA	Not applicable
^	Project completeness goals were 95%

As shown above, where the RPD could be calculated, approximately 65% of the target analytes were outside the goals established in the work plan. Of these analytes, 32 of the 38 analyte sets compared were within a factor of five of each other and are therefore considered acceptable. Generally when soil duplicates are within a factor of five of each other the samples are considered acceptable. The inconsistent duplicate sample results are likely the result of heterogeneity of the silty sandy sample matrix typical of the samples collected during this project. Three sample sets accounted for the six analytes that were greater than a factor of five of each other. Samples TP15-S4 and TP15-S10, collected from Test Pit TP15 at Building 301, had inconsistent DRO results. Sample TP15-S4 contained concentrations of DRO above cleanup levels whereas Sample TP15-S10 contained concentrations of DRO below cleanup levels. The samples were collected from a former UST excavation and the inconsistent DRO results may be the result of clean backfill material mixing with impacted soil at the sample location. Other samples collected during this project and by DOWL in 1997 in the general area contained concentrations of DRO exceeding cleanup levels, therefore it is our opinion that the sample exceeding cleanup levels is valid. Samples MW1-S3 and MW1-S10, collected from Monitoring Well MW1 at Building 301 at a depth of about 12.5 to 14.5 feet bgs, had inconsistent pesticide values. Three pesticide analytes were greater than a factor of eight of each other. These results may have been influenced by soil heterogeneity. The concentration of pesticides noted in the two samples are approximately 100 times below cleanup levels and therefore, do not negatively influence the findings of this report. Samples TP4-S2 and TP4-S10, collected from Test Pit TP4 at the Runway Apron, contained concentrations of ethylbenzene and xylenes within a factor of 10 and 8 times, respectively, of each other. The two samples contained elevated concentrations of DRO and GRO potentially influencing the quantitation of ethylbenzene and xylenes in the samples. The samples were also collected from a fill material that may consist of varying soil types and contaminant levels.

Numerous surrogate recovery levels for the PAH, pesticides, and DRO analyses were out of the laboratory's quality control objectives. According to the project laboratory, CT&E, the surrogate recovery can be biased low due to the presence of silty soil or the presence of high DRO concentrations. The surrogate will bind to the silt particles and bias the surrogate recovery or the surrogate is diluted out as the result of the high DRO concentrations. Low surrogate recoveries were reported for many of the PAH and pesticide sample batches. Soil associated with the out of control low surrogate recoveries were typically silty in nature or contained high DRO concentrations. The PAH and pesticide results for these samples, therefore, may be biased low. In our opinion the affected PAH and pesticide results should be considered estimates. In addition, samples with high concentrations of DRO will bias the recovery of the DRO surrogates high. Many of the samples with DRO surrogate recovery problems contained high concentrations of DRO, therefore the DRO results for these samples should be considered estimates. In our opinion, however, the reported PAH, pesticides, and DRO results of affected samples are valid, although considered estimates, and our conclusions and recommendations are not affected.

Five duplicate water sample sets were collected as part of this project. The following table details the groundwater field duplicate quality control results, including the RPD and completeness of the duplicate sets, and the order of magnitude difference between the duplicate samples.

GROUNDWATER FIELD DUPLICATE QUALITY CONTROL RESULTS

	Analytical Parameters and Relative Percent Difference/Order of Magnitude Difference Goals									
Location and Sample Set	GRO ±20/3x	DRO ±20/3x	Benzene ±20/3x	Toluene ±20/3x	Ethylbenzene ±20/3x	Xylenes ±20/3x	HVOs ±25/3x	PAHs ±50/3x	Pesticides ±25/3x	PCBs ±25/3x
<u>Site 2</u>										
MW4/MW14	7/1.1	*	20/1.2	3/1.0	8/1.1	3/1.0	-	-	-	-
MW8/MW18	*	*	*	*	*	*	*	-	*	*
<u>Site 3b</u>										
MW3/MW2	66/2.0	50/1.7	*	*	*	21/1.2	-	-	-	-
<u>Site 3c</u>										
MW9/MW19	14/1.2	15/1.2	15/1.2	19/1.2	16/1.2	17/1.2	-	-	-	*
<u>Site 4</u>										
MW2/MW12	*	0.9/1.0	*	*	*	*	-	*	-	-
Completeness^	67%	67%	100%	100%	100%	67%	NA	NA	NA	NA

<u>KEY</u>

-	Sample set not analyzed for this parameter
*	Analyte not detected in one or both samples
NA	Not applicable
^	Project completeness goals were 95%

As shown above, with the exception of Sample AST-MW3 and Duplicate Sample AST-MW2 collected during Phase I, the RPD values were within the goals established by Shannon & Wilson's QAPP. Samples AST-MW2 and AST-MW3 were collected using a disposable bailer, therefore, the duplicate sample set contained sediment that may account for the results. Although the RPD for this sample set was outside the DQOs, the sample set varied by a factor of only 1.7. Typically when water duplicates are within a factor of 3 of each other the samples are considered acceptable. For each analyte only three sample sets were used to gather the data necessary to calculate the completeness values for the duplicate samples. The remainder of the sample sets contained insufficient data to calculate RPD values. Three of the six analytes were below the completeness goals defined for this project. With the exception of Samples AST-MW2 and AST-MW3 the remainder of the samples are within the quality control goals defined for this project. With the limited number of samples used to compute the completeness values the one sample set that was out of range disproportionally influenced the completeness values, therefore completeness DQOs of 95% were not met for GRO, DRO, and xylenes.

Six methanol/trip blanks accompanied the soil samples from the laboratory to the site during Phase I and Phase II soil sampling activities and back again to CT&E. A trip blank also accompanied the Phase I water samples from the laboratory to the site and back again to CT&E. The trip blanks did not contain detectable concentrations of GRO or BTEX. One soil methanol/trip blank that accompanied the Phase II soil samples collected from the former AST area was also analyzed for HVOs and did not contain detectable concentrations HVOs. This indicates that cross contamination did not occur during the shipment or handling of the samples. Due to extremely cold weather conditions the trip blanks that were to accompany the Phase II water samples broke during shipment to Aniak.

Five field blanks were collected and submitted to CT&E during the Phase I and Phase II field activities. The field blanks did not contain detectable concentrations of BTEX or GRO. This indicates that the samples collected were not contaminated by volatiles in the ambient air during field activities.

Three rinsate samples, designated Samples PL-RS1, WAC-RS1, and WAC-RS3, were collected during the Phase II boring program and submitted to CT&E for analysis. Sample PL-RS1, collected at the Underground Pipeline Area, did not contain detectable BTEX or GRO. This indicates that volatiles were sufficiently removed by the decontamination of the field sampling equipment at the former Underground Pipeline Area. Samples WAC-RS1 and WAC-RS1, collected at the WAC Site, did not contain detectable GRO, benzene, ethylbenzene, or xylenes and 0.00107 ppm and 0.00130 ppm toluene, respectively. The concentrations of toluene are slightly above the laboratory detection limit of 0.0010 ppm. Sample WAC-RS1 was collected from the split-spoon sampler following the collection of Sample WAC-MW2-S2, which contained elevated levels of petroleum hydrocarbons, including 0.163 ppm toluene. Sample WAC-RS3 was collected following the collection of Sample WAC-MW4-S4 from Boring WAC-MW4. Sample WAC-MW4-S4 did not contain detectable GRO or BTEX. Although, low levels of toluene were present in the two rinsate blanks, the concentrations of toluene detected were well below cleanup levels and therefore, do not affect the validity of the analytical samples.

6.0 CLEANUP LEVELS

The applicable cleanup standards for each site were determined using the January 22, 1999 Oil and Hazardous Substances Pollution Control Regulations 18 AAC 75.

6.1 Groundwater Cleanup Levels

Because the residents of Aniak currently utilize the groundwater for drinking water and there are numerous wells relatively close to the four ADOT&PF sites, the groundwater at the four sites is considered to be a potential source of drinking water. The groundwater cleanup levels referenced in Table C of 18 AAC 75.345 were used with no modification. The appropriate groundwater cleanup levels are presented in Table 1.

6.2 Soil Cleanup Levels

Soil cleanup levels were developed using the ADEC Methods 2 and 3 criteria contained in 18 AAC 75.340. Method 2 consists of a table of risk-based soil cleanup levels based on exposure pathways for ingestion, inhalation, and migration to groundwater. For the petroleum hydrocarbon constituents identified at the ADOT&PF sites, typically benzene, toluene, ethylbenzene, xylenes, GRO, and DRO, the most stringent cleanup level is for the migration to groundwater pathway. Therefore, ADEC Method 3, which allows the modification of some of the default parameters used to calculate the cleanup levels with site-specific data, was used to develop site-specific migration to groundwater and inhalation cleanup levels.

In the case of DDT, dichlorodiphenyldichloroethane (DDD), and DDE, the most stringent soil cleanup levels are for ingestion and Method 3 calculations do not alter the cleanup levels. Additionally, DDT is a source-based waste under RCRA, classified as a U061 waste. Therefore, DDT impacted soil which may be construed to have resulted from the spilling of DDT rather than normal application must be considered a RCRA waste. This issue is of particular significance at the Building 301 site due to the previous DDT cleanup activities at the Federal Aviation Administration property adjacent to Building 301.

The cleanup level for lead is based on the residential cleanup level of 400 ppm. Because the operating AST system at the WAC Site is a fenced and controlled area, the commercial/industrial cleanup level for lead of 1,000 ppm may apply, although institutional controls for the site may be necessary to ensure that site access remains controlled.

Concentrations of arsenic and chromium were reported in samples from the Runway Apron at up to 6.28 ppm and 29 ppm, respectively. These concentrations are above the applicable cleanup levels. Detected concentrations of other RCRA metals in soil at the Runway Apron (DOWL, July 1997) also exceeded the applicable cleanup levels. Ecology and Environment, Inc. (E&E) (Sept. 1997) collected background samples for metals analysis during their study at the WAC Site. The results of the sampling indicated background concentrations of these metals in Aniak can exceed the cleanup standards. The concentrations identified by Shannon & Wilson are within the same order of magnitude as the background concentrations identified by E&E for the WAC Site and those identified by DOWL at the Runway Apron and are not considered elevated. The applicable cleanup levels are presented in Table 1 and a discussion of the development of the Method 3 soil cleanup levels is presented in Section 6.2.1. The background concentrations reported by E&E are summarized in Table 1.

6.2.1 Migration to Groundwater Criteria

Site-specific alternative soil cleanup levels were evaluated using the equations set out in *Guidance on Cleanup Standards Equations and Input Parameters*, adopted by reference in 18 AAC 75.325. Based on site-specific data collected during the site assessment, the input parameters for total organic carbon (TOC) in the soil and infiltration rate were modified to compute an alternate migration to groundwater soil cleanup level. The default values for the remaining input parameters were used. The modification of other input parameters such as source length parallel to groundwater flow, hydraulic gradient, and average soil moisture content was evaluated, but the modified parameters were determined to have a negligible affect on the proposed soil cleanup level determined using the TOC and infiltration rate data.

The site-specific determination for infiltration rate is 20% of the sum of the average annual rainfall and one standard deviation. Based on the average rainfall for Aniak, 18.79 inches and one standard deviation of 3.91 inches, as determined by 18 years of data compiled by the National Weather Service, the infiltration rate is 0.115 meters per year.

Sixteen samples were collected and analyzed for TOC during our Phase I and Phase II assessment activities and a summary of these samples is tabulated below.

SUMMARY OF TOC RESULTS

Site	Sample Location	Depth (feet)	TOC (ppm)	Sample Description
Site 1	TP16-S6	10.0	8,834	Brown, silty SAND
Site 1	MW2-S4	15 - 17	8,726	Brown, sandy SILT
Site 2	TP7-S2	2.0	<1,860	Brown, sandy GRAVEL, trace silt
Site 2	TP11-S3	4.0	4,655	Brown to gray, silty SAND to sandy SILT
Site 2	MW5-S5	17.5-19.5	1,078	Brown, slightly gravelly SAND, trace silt
Site 2	MW6-S5	17.5-19.5	<1,000	Brown, sandy SILT to silty SAND, trace gravel
Site 2	MW8-S5	15 -17	2,448	Brown to gray, silty SAND, trace gravel
Site 3a	TP2-S1	0.5	<918	Brown, silty, sandy GRAVEL
Site 3b	TP3-S4	6.0	14,780	Brown to gray, silty SAND to sandy SILT
Site 3b	MW5-S2	10 –11.5	4,226	Brown, sandy SILT, trace of gravel
Site 3b	MW5-S3	15 - 17	3,673	Brown, fine sandy SILT to silty SAND
Site 3c	TP1-S5	8.0	4,659	Brown, silty SAND to sandy SILT
Site 3c	MW9-S8	20 - 22	17,740	Brown to gray, sandy SILT
Site 4	HB3-S3	2.0	2,160	Brown, sandy GRAVEL, trace silt
Site 4	HB13-S2	1.0	6,165	Brown, sandy GRAVEL, trace silt
Site 4	MW1-S9	22.5-24.5	3,429	Gray, sandy SILT to silty SAND, trace gravel

An area-wide TOC average was determined using each of the TOC values referenced above. TOC concentrations which did not exceed the laboratory reporting limit were given a value of zero. Additionally, the TOC values are from samples, which generally did not exceed 10 ppm petroleum hydrocarbons. Samples MW5-S3 and MW9-S8, from Site 3b and 3c, respectively, contained 28.9 ppm and 65.5 ppm DRO, respectively. However, it is our opinion that these concentrations of petroleum hydrocarbons have minimal affect on the total reported TOC values. The area-wide average of the TOC content of the soils was determined to be 0.52% and has been rounded down to 0.5%.

Based upon modified input parameters, described above, the Method 3 alternate migration to groundwater cleanup levels for GRO and DRO are 1,294 ppm and 1,245 ppm, respectively. The modified migration to groundwater cleanup levels for benzene, toluene, ethylbenzene, and xylenes are 0.035 ppm, 15 ppm, 19 ppm, and 275 ppm, respectively. The Method 3 cleanup levels for the petroleum constituents are shown on Table 1.

An alternative cleanup level (ACL) of 10,250 ppm DRO is proposed for Site 4. This ACL was developed using a leaching assessment and the seasonal soil compartment model SESOIL, a one-dimensional fate and transport algorithm. By simulating vertical contaminant migration through the unsaturated soil profile, the modeling predicts the impact to groundwater from a specified contaminant load in the soil.

The first step in the assessment was to evaluate the potential effect of the existing contaminant load, as determined from soil sample analyses. Model input data consisted of site-specific soil properties, representative chemical properties of diesel fuel, the subsurface contaminant distribution, and a modeling time period. Several key soil properties, such as total organic carbon, were measured in the field. To select representative values for parameters that were not directly measured, it was assumed that the soil profile consists of a 10-foot stratum of sandy gravel overlying a less permeable sandy silt. Chemical properties for diesel were taken from ADEC guidance documents used to develop the Method 2 cleanup levels listed in 18 AAC 78.341, Table B-2. A fractionation approach was used to model the aliphatic and aromatic components of diesel fuel separately. To model the contaminant distribution, it was assumed that the existing contamination is contained within the top 10 feet below the ground surface. Analytical results were used to develop a weighted contaminant distribution that was applied at depths of 4.5 feet and 9.5 feet bgs. The modeling was used to simulate contaminant transport over a 70 year period. A complete discussion of input values, assumptions, and modeling approach is provided in Appendix E.

The initial modeling results indicated that the present diesel contamination does reach groundwater, but that the resulting groundwater concentration is several orders of magnitude less than the groundwater cleanup standard listed in 18 AAC 75.345, Table C. Additional modeling iterations were conducted to estimate the maximum DRO concentration in the soil column that will not pose an unacceptable risk to groundwater. Based on these results, the maximum allowable DRO concentration listed in Table B2 was demonstrated to be protective of groundwater. Because surface exposure pathways are also applicable at this site, the ACL is taken as the more stringent of the ingestion and inhalation cleanup levels. The proposed DRO cleanup level for Site 4 is therefore 10,250 ppm. Note that this concentration applies only to Site 4, and reflects the average concentration within the top 10 feet bgs.

6.2.2 Maximum Allowable Concentrations

The ADEC has also established Maximum Allowable Concentrations (MACs) which are ceiling levels for petroleum hydrocarbon concentrations in soil. The MACs are the limiting factor in the inhalation criteria for petroleum hydrocarbons. Based on 18 AAC 75.340 Table B2 Note 14, the MAC concentrations for GRO, DRO, and RRO represent an increased potential for hazardous substance migration or for risk to human health, safety or welfare, or to the environment. Soil exceeding MAC levels may not remain at a site unless proven the hydrocarbons will not migrate or pose a significant risk to human health, safety, or welfare, or to the environment. The MACs for GRO, DRO, and RRO are 1,400 ppm, 12,500 ppm, and 22,000 ppm, respectively.

7.0 SUBSURFACE CONDITIONS

7.1 Soil

The subsurface soils encountered at the four ADOT&PF sites consist of alluvial silts, sands, and gravels. The predominant soil type encountered included sandy silt with interbeds of silty sand. Silty, sandy gravel was encountered at depth in a number of the borings and was often interbedded with the silty sand or sandy silt. In developed areas a silty, sandy gravel often overlies sandy silt or silty sand and is inferred to be fill material. Based on Modified Standard Penetration Resistance methods, the consistency of the silt generally ranges from very soft to stiff and the density of the sands and gravels generally ranges from very loose to medium dense. The water bearing soil generally consisted of silty sand or silty, sandy gravel.

Aniak is located in a region of discontinuous permafrost. While permafrost was not encountered during our explorations, seasonal frost was observed to extend to depths from 4 to 7 feet bgs.

7.2 Groundwater

The unconfined aquifer underlying Aniak was encountered at depths of 20 to 30 feet during the November 1998 Phase I and March and April 1999 Phase II field investigations. The unconfined aquifer is used as a drinking water source in Aniak and numerous water wells are located throughout the village. Although the depth of the drinking water well at the Middle School is reportedly on the order of 100 feet, numerous wells in the village are reportedly installed at shallower depths of approximately 40 to 70 feet. Based on the monitoring well survey data, depth to groundwater measurements on April 2 and 4, 1999, and compilation of the data using SURFER, the overall project-wide groundwater flow direction is to the northwest, parallel with the flow of the Kuskokwim River, as shown in Figure 11. An overall gradient of approximately 0.0004 vertical feet per foot horizontal was determined.

Site-specific determinations of flow direction somewhat varied from the overall groundwater flow direction. The site-specific groundwater flow direction at Building 301 was due north. The site-specific groundwater flow direction at the culvert area and former AST area at the Runway Apron was northwest and at the disposal pit area at the Runway Apron was due north. The site-specific groundwater flow direction at the Former AST Area and the Underground Pipeline Area ranged from northwest to west-northwest, respectively. The site-specific groundwater flow direction at the WAC Site was approximately north-northwest.

The overall survey consisted of 25 wells located south of the runway and one well located north of the runway. Therefore, it is unknown if the groundwater north of the runway is influenced by the river and flows north-northwest toward the river. Based on former assessment activities by others, the groundwater flow direction may vary locally, as a result of seasonal groundwater level fluctuations and river stage fluctuations.

7.3 Biodegradation Indicator Parameters

Analytical results of heterotrophic bacteria, oil-degrading bacteria, pH, and nutrients of nitrogen, phosphorus, and potassium and field measurements of DO were evaluated to assess subsurface conditions for biodegradation potential. Heterotrophic bacteria were reported at approximately 3×10^3 colony forming units (CFU) per gram at the Disposal Pit Area at the Runway Apron, but were reported to range from approximately 1×10^4 to 2×10^7 CFU per gram at the remaining sites. While the number of bacteria reported at the Disposal Pit Area is considered relatively low, the number of heterotrophic bacteria at the remaining sites indicate sufficient populations of microbes are present in the subsurface soil to support aerobic biodegradation. Low concentrations of pesticides in the soils at the Building 301 site do not appear to have adversely affected the biological populations.

With the exception of the WAC Site, the number of "oil-degrading" bacteria (basically heterotrophic bacteria observed to degrade a droplet of fuel in a laboratory setting) were reported to range from less than 23 to 11,000 MPN (most probable number) per gram of soil. "Oil-degrading" bacteria at the WAC Site were reported to range from approximately 2×10^3 to 2×10^6 MPN/gram. Although significant variability in the number of "oil-degrading" bacteria was reported for the sites, it is our experience that environmental conditions and populations of indigenous microbes are typically sufficient to support biodegradation of soil contaminants. Populations of microbes are often limited by the availability of oxygen within contaminated soils and in the absence of oxygen may utilize nitrate as the electron acceptor. Low concentrations of nitrate/nitrite were reported in several of the samples suggesting depletion or relative lack of this important nutrient. The nutrient levels for phosphorus and potassium across the site are within an acceptable range of 0.983 ppm to 5.61 ppm and 242 ppm to 991 ppm, respectively. Soil pH was reported below a pH of 6 in three of the 14 samples. The optimum pH range for biodegradation is considered to be roughly 6 to 8. Low soil pH is often a function of biodegradation as the mineralization of the hydrocarbons results in carbon dioxide as one of the end products.

A primary indicator of ongoing aerobic biodegradation in the groundwater is the concentration and distribution of DO. Although the trends in DO concentration across the sites are often subtle and vary, DO measurements in the groundwater from the existing wells at the Runway Apron and the Former AST Area in November 1998, and at each of the sites in April 1999, generally indicate the lowest DO concentrations are associated with the most impacted wells.

8.0 SITE 1: ADOT&PF BUILDING 301

8.1 Site Location and Description

ADOT&PF Building 301 (Building 301) is located on Lot 1, Block 1, Aniak, Alaska, approximately 300 feet southeast of the east end of the Aniak Airport runway, as shown in Figure 2. Federal Aviation Administration (FAA) Building 200 is located approximately 60 feet southwest of Building 301, as shown in Figure 3. The toe of the levee separating the Building

301 property from the Aniak Slough to the east is located approximately 90 to 100 feet from the southeast wall of Building 301. A riverbank erosion protection system was installed east of the levee during 1997.

The nearest drinking water well is reportedly located at a private residence located approximately 190 feet west of Building 301. The residence was formerly the village clinic facility. According to E&E (September 1997), another well exists adjacent to the west side of Building 301. This well could not be located during Shannon & Wilson's site assessment.

8.2 Background Information

Contamination in the area of Building 301 was identified by the U.S. Army Corps of Engineers (USACE) during assessment and remediation at FAA Building 200. Reportedly, the FAA has used the Building 200 facility since 1940, for maintenance of air tracking equipment. Previous assessment work was undertaken at Building 200 by E&E and OHM Remediation (OHM), and follow-on remediation activities were conducted by OHM. The contamination that was detected in the Building 200 area consisted primarily of DRO and the pesticide DDT. DDT is highly soluble in petroleum products and diesel fuel was commonly used as a carrier for pesticide distribution in the past.

During the summer of 1995, OHM, on behalf of the USACE, excavated DDT contaminated soils adjacent to Building 200. An approximately 1,650 square foot area northeast of Building 200 was excavated to various depths ranging to a maximum of 4 feet bgs. During the course of the assessment and remediation of the FAA property, OHM collected background soil samples southwest of Building 301. Some of the samples contained concentrations of DRO exceeding ADEC Level B cleanup criteria of 200 ppm and DDT concentrations exceeding the 10 ppm regulatory cleanup guideline established at the time for DDT. The DDT concentrations in soil at a depth of approximately 4 inches ranged from 0.443 ppm to 230.6 ppm.

DOWL Engineers (DOWL) conducted a sampling program at the Building 301 site in 1996 and 1997. The initial objective of the DOWL work was to characterize the nature and extent of DDT and associated DRO contamination at the Building 301 property. Fourteen test pits were excavated to 4 feet bgs and sampled. The locations of the test pits are shown on Figure 3. Immunoassay screening was conducted on the soil samples using screening levels of 1 ppm and 10 ppm. A limited number of samples were analyzed by the laboratory for DDT, and a correlation curve was established between the immunoassay screening results and the analytical results. DOWL reported DDT concentrations in the soil samples, except one, were less than 10 ppm. One sample, collected from Test Pit TP07 at 0.5 feet bgs, contained a DDT concentration of 29.19 ppm (duplicate 42.8 ppm). DOWL identified two potential methods of addressing the DDT concentration that exceeded the applicable cleanup criteria; 1) limited excavating and disposal of contaminated soil, and 2) covering the soil with inert material, such as asphalt paving, to prevent exposure to the material and restrict percolation of water through the material.

Petroleum contaminated soils were also identified by DOWL during the work at the Building 301 property. Test Pits TP10, TP11 and TP12, located southeast of Building 301, contained significantly elevated concentrations of petroleum contamination that was inferred to be potentially the result of a release from an UST that had been located adjacent to the southeast side of Building 301. At TP11 and TP12, GRO and DRO concentrations greatly exceeded cleanup levels. An elevated lead concentration of 322 ppm was detected in a sample collected from 4 feet bgs in TP12.

DOWL advanced an approximately 27 feet deep soil boring near the TP11 and TP12 location to further explore the identified petroleum contamination. Groundwater was identified in the boring at approximately 27 feet bgs and soil samples were collected from 10 feet bgs and 25 feet bgs. The soil sample collected from 10 feet bgs contained concentrations of GRO and DRO exceeding cleanup levels. DDT and the pesticide DDD were detected at trace concentrations. The soil sample collected from 25 feet bgs contained concentrations of GRO and DRO below the ADEC Level A petroleum cleanup criteria. DDT and DDD were detected at trace concentrations. Concentrations of DDT and petroleum hydrocarbons identified by OHM and DOWL are noted on Figure 3.

DOWL's recommendations regarding the identified petroleum contamination included additional sampling to establish the extent of the impacted soils, and installation of monitoring wells to determine groundwater quality and groundwater flow direction. A corrective action plan was prepared by DOWL for ADOT&PF in April 1998. The corrective action plan for the Building 301 site was based on an assumed area of impact that was based solely on the information that existed from the previous exploration work, and included an estimated 300 cubic yards of soil. The proposed method of corrective action was excavating the impacted soils and remediating the soil using landfarming methods. Excerpts from previous site investigation reports are included in Appendix F.

8.3 Summary of Field Assessment

The primary objectives of the field program for Building 301 consisted of determining the former location of the UST at the site, evaluating the lateral and vertical extent of contamination associated with the UST, and evaluating the potential presence and extent of groundwater contamination.

8.3.1 Phase I Program

During our October 1998 site visit, an approximately 1,000-gallon UST was observed on the ground surface southeast of Building 301. From visual and test pit observations, the tank was formerly situated approximately 7 feet southeast of the building and about 1.5 feet bgs. The former location of the tank was determined based on the location of the furnace and feed/return lines inside of Building 301 and a trench, Test Pit 301-TP14 (TP14), dug perpendicular to the building following the vent line and feed/return lines, as shown in Photo 1 in Appendix A. The former location of the UST is approximately shown on Figure 3 and Photo 2. The feed/return lines consisted of two ½-inch diameter copper lines inside separate 1-inch diameter steel lines. The vent line and feed/return lines were located on the northwestern end of the tank and the fill pipe was located on the southeastern end of the tank. A test pit, Test Pit TP15, was advanced perpendicular to the former tank at the approximate location of the former fill pipe. Samples were collected beneath the bottom of the former tank. Three additional test pits were advanced near the former UST location. Test Pit TP16, was located northeast of the UST and two test pits, Test Pits TP19 and TP20, were located southeast of the tank across an approximately 20-foot wide utility easement, consisting of three underground cable television and phone lines, as shown in Figure 3. Pieces of drums were uncovered in Test Pit TP19.

8.3.2 Phase II Program

One soil boring and three borings completed as monitoring wells were advanced at the Building 301 site during Phase II activities. The locations of the boring and monitoring wells were selected based on the results of the Phase I activities and the former DOWL assessment results and are shown on Figure 3. Boring 301-B5 was positioned south of test pits advanced by DOWL in an effort to determine the extent of contamination south of Building 301. Monitoring Well 301-MW1 was positioned southwest of the former UST location in an effort to determine the vertical extent of soil contamination and assess the potential presence of groundwater contamination associated with the impacted soil noted during DOWL's assessment activities. Monitoring Well 301-MW2 was positioned west of the former UST location in an attempt to evaluate the extent of the potentially impacted groundwater. Monitoring Well 301-MW3 was placed adjacent to the location of the Test Pit TP19 to further evaluate the depth of contamination identified during Phase I activities. Monitoring Wells 301-MW1 and MW3 are shown in Photo 3. Boring logs are included in Appendix B.

8.4 Analytical Results

Sample locations and descriptions are included in Table 2.1. The soil analytical results from the Phase I and Phase II assessment are summarized in Table 2.2. The water sampling log includes water level measurement and sampling and purging data and is included in Table 2.3. The groundwater analytical results are summarized in Table 2.4. Copies of the analytical results are included in Appendix D.

Soil contaminants identified during our assessment included DRO, GRO, toluene, ethylbenzene, xylenes, PAHs (naphthalene and phenanthrene), and pesticides (aldrin, DDE, DDD, and DDT). Benzene, TCLP lead, and other PAHs and pesticides not noted above were reported to not exceed the laboratory reporting limit in the samples. DRO was reported to range from not in excess of 4.13 ppm to 5,510 ppm. GRO, toluene, ethylbenzene, and xylenes were reported at a maximum of 79.2 ppm, 0.078 ppm, 0.369 ppm, and 1.62 ppm, respectively. Naphthalene and phenanthrene were reported at a maximum concentration of 3.57 ppm and 0.0547 ppm, respectively. Aldrin, DDE, DDD, and DDT were reported at a maximum concentration of 0.00804 ppm, 0.0145 ppm, 0.245 ppm, and 0.0360 ppm, respectively.

Groundwater contaminants identified during our assessment included DRO, toluene, and xylenes. GRO, benzene, ethylbenzene, PAHs, and pesticides were not reported to exceed the laboratory reporting limit in the samples. Concentrations of DRO were reported to range from not in excess of 0.316 ppm to 0.890 ppm. Toluene and xylenes were reported at a maximum concentration of 0.00489 ppm and 0.00589 ppm, respectively.

8.5 Discussion of Results

Based on the results of our assessment, the results of background samples collected by OHM west of Building 301, and the results of DOWL's assessment in 1997, soil contamination by benzene, DRO, and DDT exceeding the applicable cleanup levels and the MAC for DRO are present at the site. The soil contamination identified at Building 301 appears to be the result of surface spills and UST overfills. The former location of the UST was identified during the Phase I field assessment and is shown on Figure 3. Based on both the 1997 DOWL investigation and our assessment efforts, two general areas of soil contamination are present at Building 301. These areas include near surface soil contamination located west of Building 301 and near surface and deeper soil contamination west of and at the former UST location. The area west of Building 301 has been reported to contain levels of DDT which exceed the applicable cleanup level, while existing analytical data from the area west of the former UST has not identified DDT concentrations exceeding the cleanup level.

During our investigation soil cleanup levels were exceeded by DRO only and soil concentrations of GRO, BTEX, PAHs, pesticides and lead were not reported to exceed the applicable cleanup criteria or, in the case of lead, RCRA Hazardous Waste criteria based on toxicity characteristic. DOWL identified concentrations of DRO exceeding the MAC and DRO, benzene, and DDT exceeding the appropriate cleanup levels.

Near surface soil contamination identified by DOWL to the west of Building 301 appears related to surface spills and exceeds the applicable cleanup level for benzene at three locations (TP02, TP03, and TP04) ranging in depth from 2 to 4 feet. Assuming the impacted soil encompasses an area of approximately 500 square feet and extends to an average depth of 3 feet, approximately 55 to 60 cubic yards of impacted soil exceeding benzene cleanup levels is present. Within this same area OHM identified elevated DDT concentrations which exceed the applicable cleanup level in near surface soils at several locations. The DDT impacted soil may be construed as RCRA waste if excavated.

Located to the southeast of and possibly connected to the area described above, DOWL identified soil containing concentrations of DDT exceeding the appropriate cleanup level at a depth of 0.5 feet in Test Pit TP07. DOWL did not analyze the soil samples from Test Pit TP07 for petroleum hydrocarbons. Soil samples collected from the remaining DOWL test pits and our investigation efforts did not contain concentrations of DDT exceeding cleanup levels. The DDT concentrations may be construed to be related to a DDT release and, therefore, a RCRA waste if excavated. Although OHM's and DOWL's investigative results suggest localized areas of DDT exceeding the ADEC Method Two ingestion-based cleanup level, the vertical distribution of DDT impacted soil is not well defined at the locations where the cleanup level is exceeded. Assuming a DDT impacted area extending from the west side of Building 301 to OHM Sample C9 and north of OHM Sample C10 to OHM Sample C14, approximately 1,125 square feet of area is present. If DDT impacted soils extend to a depth of one foot, approximately 42 cubic yards of soil are present. If DDT impacted soils extend to a depth of two feet, approximately 84 cubic yards of soil are present. Another area where OHM identified DDT concentrations above the ADEC cleanup level is located south of the former FAA Building 200 excavation. DDT concentrations in this area are not well defined but may include an additional 5 to 10 cubic yards of impacted soil. In summary, the DDT impacted soil exceeding applicable cleanup criteria may include approximately 50 to 100 cubic yards. A portion of these soils include the 55 to 60 cubic yards of benzene impacted soil described above.

Near surface soil contamination identified by DOWL to the west of the former UST location (TP10, TP11, and TP12) also appears related to surface releases and exceeded the MAC for DRO at depths ranging from 2 to 4 feet. Although this area has not been well defined, the impacted soil is estimated to encompass an area of approximately 300 square feet and extend to a depth of approximately 5 feet. The impacted soil exceeding the MAC for DRO is estimated at a volume of approximately 55 to 60 cubic yards. DOWL also identified elevated concentrations of lead which exceed typical background levels, but do not exceed soil cleanup levels and elevated levels of DDT.

Soil contamination exceeding the cleanup levels for DRO is present within the former UST location and below the near surface soil contamination to the west of the former UST location. The impacted soil is estimated to extend to a depth of approximately 10 feet at the former UST location (TP15) and to a depth of 15 to 20 feet in the area west of the former UST location (301-MW1). The impacted soil may extend into the area identified as a utility easement. Because of the underground utilities, no subsurface investigation was performed in this area. Excluding potentially impacted soils within the utility easement, we estimate approximately 170 to 180 cubic yards of soil exceeding DRO cleanup levels are present in this area.

One test pit location (TP19) on the south side of the utility easement encountered pieces of buried drums and soil contamination below the DRO cleanup level. Based on field screening results, the impacted soil appears to be localized at a depth of approximately 6 feet. The extent of buried debris or potential soil contamination in this area is unknown and cannot be approximated.

Groundwater samples collected from Monitoring Wells 301-MW1 and 301-MW3 contained 0.890 ppm DRO and 0.387 ppm DRO, respectively. Low levels of toluene were reported in Monitoring Wells 301-MW1 and 301-MW3 and low levels of xylenes were reported in 301-MW1. The concentrations of DRO and BTEX are below the applicable groundwater cleanup levels. Monitoring Well 301-MW2 did not contain detectable DRO, benzene, or BTEX.

8.6 Conclusions

Soil contamination exceeding applicable cleanup levels for DDT, benzene, and DRO is present in the vicinity of Building 301. The area west of the building is estimated to contain approximately 60 cubic yards of impacted soil exceeding the cleanup level for benzene and possibly up to 100 cubic yards of soil exceeding the ADEC Method Two ingestion-based cleanup level for DDT.

Soil in the vicinity of the former UST location and extending west to possibly Boring 301-B5 is impacted with DRO at concentrations exceeding the appropriate cleanup levels. Soils exceeding the cleanup level for DRO do not appear to extend below a depth of approximately 10 feet at the former UST location and 20 feet at Monitoring Well 301-MW1. In addition, based on DOWLs assessment efforts, near surface soils (2 to 4 feet bgs) extending at least 20 feet west of the former UST exceed the MAC for DRO and contain elevated lead and DDT concentrations. Concentrations of DDT, identified by DOWL in this area, do not exceed the cleanup levels. However, the DDT may be construed as a RCRA waste, if excavated, due to the apparent release of DDT and cleanup of DDT contaminated soil, which occurred on the adjacent property. Although the highest concentration of DRO we encountered at the site was not associated with lead concentrations exceeding the RCRA Hazardous Waste criteria based on toxicity characteristic, the sample was not collected from the location of elevated lead concentrations identified by DOWL. We estimate approximately 60 cubic yards of near surface soil exceed the MAC for DRO and an additional 170 to 180 cubic yards of soil exceeding the cleanup level for DRO lies below this area of the site.

The utility easement located south of the former UST has not been explored due to the lack of detailed utility locates. The extent of soil contamination within this corridor is unknown. An area south of the utility easement was observed to contain pieces of drums and DRO impacted soil that did not exceed cleanup levels. The extent of debris burial or potential soil contamination has not been delineated.

Based on the April 1999 analytical results from the three monitoring well locations, the groundwater has not been impacted by petroleum hydrocarbons at levels exceeding the cleanup standards, although concentrations of DRO, toluene, and xylenes were detected in two of the wells. At the time of our Phase II assessment the groundwater flow at the Building 301 site was towards the north at a gradient of approximately 0.003 vertical feet per foot horizontal. The contaminant levels in the groundwater and the groundwater flow direction are expected to vary seasonally, as a result of changes in groundwater level and the stage of the Kuskokwim River. The magnitude of such changes has not been determined.

9.0 SITE 2: RUNWAY APRON

9.1 Site Location and Description

The Runway Apron area is located approximately 2,100 feet southeast of the west end of the Aniak runway, and approximately 500 feet northwest of the north end of the Aniak Middle School, as shown in Figures 2, 4, and 5. A residential neighborhood is situated approximately

600 feet southwest of the Runway Apron site. The site is currently owned by the ADOT&PF, but was formerly used by the US Air Force (USAF) as a WAC facility. The site consists of a former AST area and exposed culvert at the southeast end (Runway Apron) and a debris disposal area (Disposal Pit Area) located at the northwest end, as shown on Figures 4 and 5, respectively. The area has also been used as a construction camp and storage area during upgrades of the runway. A bulk fuel storage area and numerous buildings and debris have been located on the site in the past.

The nearest drinking water well (E&E, September 1997) is located approximately 450 feet southeast of the site at the Middle School. Additional drinking water wells exist in a residential neighborhood approximately 600 feet southwest of the site and at the High School approximately 675 feet south of the site. The school area and residential neighborhood are shown in Figure 2.

9.2 Background Information

During excavating activities at the Runway Apron in 1994-95, the ADOT&PF uncovered a culvert approximately 2 to 3 feet bgs near the southeast end of the area. ADEC staff, present in Aniak at the time, identified petroleum vapors in the excavation area. During May 1996, ADEC noted ponded water with a petroleum sheen in the small depression containing the culvert.

DOWL (1997) determined the excavation area where the culvert was encountered was located inside the former bermed area of a former bulk fuel storage site, visible in a 1991 aerial photograph. Three monitoring wells were installed in December 1996, near the former bulk fuel storage location and the exposed culvert. The locations of the monitoring wells are shown on Figure 4. One soil sample from each boring was submitted for analysis. A soil sample collected from about 2.0 feet bgs in Monitoring Well MW-1, located inside the former bermed area and near the culvert, contained concentrations of GRO and DRO exceeding the Level A criteria applicable at the time of the assessment. The results of field screening suggested that petroleum contamination exceeding Level A criteria might be limited to soil above a depth of about 7 feet bgs at Monitoring Well MW-1. A water sample collected from Monitoring Well MW-1 contained concentrations of DRO exceeding currently established cleanup levels. DOWL (1997) recommended additional sampling of the monitoring wells at the site, as well as characterization of the lateral extent of the contamination identified at the culvert. Concentrations of petroleum hydrocarbons identified by DOWL at the respective boring locations are noted on Figure 4.

A former debris disposal area associated with the former WAC Site was reportedly located northwest of the former Runway Apron AST area and the exposed culvert, although we are not aware of any previous assessments. Excerpts from previous site investigation reports are included in Appendix F.

9.3 Summary of Field Assessment

Two primary field objectives were considered at the Runway Apron, 1) exploration of the exposed culvert area (Runway Apron), and 2) evaluation of the debris disposal area (Disposal Pit Area). The site specific objectives of the assessment at the Runway Apron consisted of exposing the ends of the culvert, exploring the source of the contamination noted at the culvert area, evaluating the vertical and lateral extent of soil contamination in the area of the exposed culvert, and evaluating the potential extent of groundwater contamination at the site. The site specific objectives of the field assessment at the Disposal Pit Area consisted of determining the location of the disposal pit, determining whether there is contamination at the disposal pit, and evaluating the groundwater quality beneath the site.

9.3.1 Phase I Program

Phase I activities at the Runway Apron consisted of identifying the location of the culvert, advancing 18 test pits, and sampling three pre-existing wells. The test pits were placed in and around a former AST area and the existing culvert located at the site. The approximate locations of the test pits, former ASTs, and culvert are shown on Figure 4. The former AST area is shown in a 1991 aerial photograph and apparently consisted of a 90,000-gallon AST and three 10,000-gallon ASTs. The 90,000-gallon AST was reportedly formerly located north of the existing 90,000-gallon AST at the WAC Site, as shown on Figure 4.

During the November 1998 Phase I activities, the ends of the culvert were identified and Test Pits RA-TP1 (TP1) and TP2 were advanced at the east and west ends of the culvert, respectively. The culvert consisted of one-foot diameter corrugated steel pipe and was approximately 50 feet long. The exposed culvert is shown in Photo 4. Test Pit TP3 was advanced along the middle section of the culvert. Three test pits, Test Pits TP10, TPB1, and TPB2, were advanced along the route of a former ditch, shown in a 1959 aerial photograph, that apparently extended west from the existing 90,000-gallon AST at the WAC site to the exposed culvert. A corrugated steel pipe similar to the culvert was discovered in the sidewall of the berm of the existing 90,000-gallon AST at the WAC Site, as shown in Photo 5. A valve used to drain the bermed area surrounding the AST was observed and appeared to be connected to the exposed pipe at the base of the berm. The remaining 12 test pits were advanced around the perimeter of the former AST area to evaluate the lateral extent of soil contamination. In addition to the excavation of the test pits described above, groundwater samples were collected during the Phase

I activities from existing Monitoring Wells MW-1, MW-2, and MW-3 installed by DOWL in 1997.

During site reconnaissance activities conducted in October 1998, partially buried debris was located north of the Runway Apron and at the Disposal Pit Area. The Disposal Pit Area is shown on Figure 5 and Photo 6. *Reportedly, debris from the former WAC Site and construction debris from various camps built at the Runway Apron were buried in this area. Based on our visual observations and discussions with various residents of Aniak, the partially buried debris consists of various equipment and machinery from the WAC Site, a plane, drums, and piping. Phase I activities were not performed in this area.

9.3.2 Phase II Program

Two monitoring wells and one boring were installed/advanced at the Runway Apron. Boring RA-B5 was installed inside the former bermed area surrounding the former ASTs. Monitoring Wells RA-MW4 and RA-MW5 were installed near the western end of the former culvert and downgradient of the culvert and former ASTs, respectively. The locations of the boring and monitoring wells were selected based on the results of our Phase I activities and are shown on Figure 4.

Three monitoring wells, designated RA-MW6, RA-MW8, and RA-MW9, were installed at the Disposal Pit Area. The monitoring wells were placed east and southeast of the debris disposal area. The locations of the monitoring wells are shown on Figure 5 and Photo 7. The wells were placed to evaluate the soil and groundwater in the vicinity of the former WAC construction camp and the disposal pit. Due to access limitations, monitoring wells could not be placed to the north, south, or west of the debris disposal area. Monitoring Well RA-MW9 was placed southeast of the debris disposal area at a location chosen to avoid encountering buried debris during drilling. Monitoring Well RA-MW6 was installed in the vicinity of a former quonset hut and Monitoring Well RA-MW-8 was installed in a former material storage area, identified by aerial photographs.

9.4 Analytical Results

Sample locations and descriptions are included in Table 3.1. The soil analytical results from the Phase I and Phase II assessment at the Runway Apron are summarized in Table 3.2. The soil analytical results from the Phase II assessment at the Disposal Pit Area are summarized in Table 3.3. The water sampling log includes groundwater level measurement and sampling and purging data and is included in Table 3.4. The groundwater analytical results for both the

Runway Apron and the Disposal Pit Area are summarized in Table 3.5. Copies of the analytical results are included in Appendix D.

Soil contaminants identified during our assessment included RRO, DRO, GRO, benzene, toluene, ethylbenzene, xylenes, a number of PAHs, and pesticides. *PCBs were not reported to exceed the laboratory reporting limit at either site. TCLP lead, evaluated at the Runway Apron Site only, was not reported to exceed the laboratory reporting limit. HVOs, evaluated at the Disposal Pit Area site only, were not reported to exceed the laboratory reporting limit.

Assessment of RRO was limited to the Disposal Pit Area and concentrations of RRO were reported at a maximum concentration of 1,140 ppm. DRO was reported to range from not in excess of 3.84 ppm to 14,600 ppm at the Runway Apron and not in excess of 3.79 ppm to 685 ppm at the Disposal Pit Area. GRO was reported to range from not in excess of 1.22 ppm to 388 ppm at the Runway Apron and not in excess of 1.18 ppm to 556 ppm at the Disposal Pit Area. Benzene was reported at a maximum concentration of 0.194 ppm at the Runway Apron and 0.0383 ppm at the Disposal Pit Area. Toluene was reported at a maximum concentration of 49.1 ppm at the Runway Apron and 0.0581 ppm at the Disposal Pit Area. Ethylbenzene was reported at a maximum concentration of 15.5 ppm at the Runway Apron and 15.8 ppm at the Disposal Pit Area. Xylenes were reported at a maximum concentration of 161 ppm at the Runway Apron and 98.0 ppm at the Disposal Pit Area. A number of PAHs were reported to exceed the laboratory reporting limit at both sites, however, the concentrations are well below the respective cleanup levels. Pesticides were evaluated at the Disposal Pit Area only and DDD and DDT were reported at a maximum concentration of 0.00944 ppm and 0.00597 ppm, respectively.

Groundwater contaminants identified at the Runway Apron during our assessment included DRO, GRO, benzene, toluene, ethylbenzene, xylenes, and a number of PAHs. DRO was reported to range from 0.184 ppm to 1.55 ppm during the sampling of the three existing monitoring wells at the Runway Apron in November 1998, and not in excess of 0.309 ppm to 2.16 ppm during the sampling of the existing and newly installed monitoring wells at the Runway Apron in April 1999. GRO and benzene were reported to exceed the laboratory reporting limit in only one well (RA-MW4) at the Runway Apron with maximum concentrations of 0.29 ppm and 0.00127 ppm, respectively. Toluene, ethylbenzene, and xylenes were reported at maximum concentrations of 0.0163 ppm, 0.00519 ppm, and 0.121 ppm, respectively. A number of PAHs were reported in the samples from Monitoring Wells RA-MW2 and RA-MW3 during the November 1998 sampling event. The reported concentrations of PAHs are well below the respective cleanup levels.

Groundwater contaminants identified at the Disposal Pit Area during our assessment included a number of PAHs and trichloroethylene (TCE). DRO, GRO, and BTEX were not reported to exceed the laboratory reporting limit in the groundwater samples from the Disposal Pit Area. PCBs and pesticides were also reported to not exceed the laboratory reporting limit.

9.5 Discussion of Results

As noted above, Site 2 consists of two distinct investigation areas; the Runway Apron and the Disposal Pit Area. These areas are discussed below.

9.5.1 Runway Apron

The layout of the Runway Apron is shown in Figure 4. Based on our field screening and analytical test results and the results of DOWL's assessment in 1997, soil contamination exceeding cleanup levels is limited to the former AST area and the east end of the culvert. Soil contaminants exceeding the cleanup levels are limited to DRO, benzene, and toluene. Soil concentrations of GRO, ethylbenzene, xylenes, PAHs, PCBs, and lead were not reported to exceed soil cleanup criteria or, in the case of lead, RCRA Hazardous Waste criteria based on toxicity characteristic.

Analytical samples were collected from 17 of the 18 test pits advanced at the site. Four test pits, Test Pits TP1, TP2, TP4, and TP8, contained concentrations of petroleum hydrocarbons exceeding cleanup criteria. In addition, Boring RA-B5 and Monitoring Well RA-MW4 encountered petroleum hydrocarbons exceeding cleanup levels. The samples collected from Test Pits TP1, TP2, and TP4 appear to be consistent with diesel fuel and the impacted soil in Test Pit TP8 appears to be from gasoline or aviation gasoline (AvGas) fuel.

A sample collected from Test Pit TP1 at about 0.5 feet beneath the opening to the eastern end of the buried culvert contained concentrations of DRO exceeding the MAC. Based on field observations and a sample from about 7.0 feet bgs, the impacted soil is localized and confined to the area beneath the east end of the culvert. We estimate 1 to 2 cubic yards of soil exceeding the MAC for DRO at this location.

Based on analytical data from Test Pit TP4 and Boring RA-B5 and field screening and analytical data from DOWL's Monitoring Well MW-1, soil contamination exceeding the appropriate cleanup levels is likely present under most of the former bermed AST area. With the exception of the area surrounding the west end of the culvert (TP2) and the west end of the former berm (TP8 and RA-MW4), the soil contamination underlying the former AST area is estimated to not extend below a depth of approximately 5 feet. However, in the vicinity of Test Pits TP2 and TP8 and Monitoring Well RA-MW4, soil contamination exceeding the cleanup levels for DRO and toluene is estimated to extend to a depth of 15 to 20 feet. Below the former AST area, soil contamination exceeding the appropriate cleanup levels is estimated at approximately 2,300 cubic yards. Based on the analytical results of soil samples collected from Test Pits TP3, TP5, TP6, TP7, and TP9 through TP16 located outside of the former AST area, soil contamination appears to be limited to the former bermed area and the ends of the culvert.

Based on the analytical results of groundwater samples collected from the existing monitoring wells (MW-1, MW-2, and MW-3) on November 8 and 11, 1998, and those collected from the existing and newly installed monitoring wells (RA-MW4 and RA-MW5) on April 2, 1999, groundwater exceeds the cleanup levels for DRO only, and only at Monitoring Well MW-1. Monitoring Well MW-1 was reported to contain 1.55 ppm DRO and 2.16 ppm DRO during the November and April sampling events, respectively. RA-MW4 and a duplicate sample (RA-MW14) collected from the well, contained a maximum of 0.29 ppm GRO, 0.00127 ppm benzene, low levels of toluene, ethylbenzene, and xylenes, and no detectable DRO. The results from Monitoring Well RA-MW5 and an existing well located north of the former AST area did not indicate detectable concentrations of GRO, DRO, BTEX, or PAHs.

9.5.2 Disposal Pit Area

The layout of the Disposal Pit Area is shown on Figure 5. Three monitoring wells were installed in areas of historical material storage, a former quonset hut-type building, and east of an existing large debris disposal area. Of the three monitoring wells (RA-MW6, RA-MW8, and RA-MW9) advanced in the Disposal Pit Area, only one soil sample (MW8-S1), collected from about 2.5 feet bgs in Monitoring Well RA-MW8, contained concentrations of petroleum hydrocarbons above cleanup levels. The sample contained concentrations of benzene slightly exceeding the appropriate cleanup level. Concentrations of DRO, GRO, RRO, toluene, ethylbenzene, and xylenes were also detected, but below the appropriate cleanup levels. Low levels of PAHs, DDD, and DDT were also detected in Sample MW8-S1, but none of the reported concentrations exceed the appropriate cleanup levels. Based on field screening and analytical results, the soil contamination appears limited to the soils above approximately 5 feet, however, the lateral extent of soil contamination has not been defined and may extend deeper at other locations.

Groundwater samples were collected from Monitoring Wells RA-MW6, RA-MW8, and RA-MW9 on April 2, 1999. The samples from Monitoring Wells RA-MW6 and RA-MW8 did not contain detectable concentrations of petroleum hydrocarbons or other hazardous substances. The groundwater sample from Monitoring Well RA-MW9 was reported to contain 0.00968 ppm trichloroethene (TCE) with no other concentrations of petroleum hydrocarbons or other hazardous substances detected. The concentration of TCE in Monitoring Well RA-MW9 exceeds the groundwater cleanup levels.

9.6 Conclusions

Based on the results of our assessment, soil contamination exceeding the appropriate cleanup levels for DRO, benzene, and toluene is located in the vicinity of the former bermed AST containment area and the west and east ends of the culvert. With the exception of the west end of the culvert and west end of the former AST containment area, soil contamination underlying the footprint of the former bermed AST containment area is not expected to extend below a depth of approximately 5 feet. However, at the west end of the culvert and vicinity of Monitoring Well RA-MW4, soil contamination exceeding cleanup levels is estimated to extend to a depth of 15 to 20 feet. Possibly localized soil contamination exceeding the MAC for DRO was encountered at the east end of the culvert. Soil contamination below the former AST area is estimated at approximately 2,300 cubic yards. Of this volume of soil, we estimate one or two cubic yards may exceed the MAC for DRO.

Based on analytical results from November 1998, and April 1999, the groundwater beneath the site is impacted by DRO at concentrations exceeding the cleanup level. Groundwater contamination appears to be limited to the vicinity of Monitoring Well MW-1. No other wells have been reported to exceed the groundwater cleanup levels. At the time of our Phase II assessment activities the groundwater flow direction was toward the northwest at a gradient of approximately 0.0005. The contaminant levels in the groundwater and the groundwater flow direction are expected to vary seasonally, as a result of changes in groundwater level and the stage of the Kuskokwim River. The magnitude of such changes has not been determined. Additionally, an abandoned well was found at the Runway Apron site. This well should be properly decommissioned to prevent the well from acting as a conduit for contaminants to reach the groundwater.

Based on our assessment of the Disposal Pit Area located northwest of the former AST area described above, impacted soil, exceeding the cleanup level for benzene, was encountered in near surface soils at a former material storage area. The lateral extent of soil contamination within this area has not been delineated but, at our boring location, did not appear to extend below a depth of approximately 5 feet.

Groundwater contamination at the Disposal Pit Area consisted of the isolated exceedance of TCE cleanup levels at one well location. The source of the reported contamination, as well as the lateral extent of contamination, is unknown. No other detectable concentrations of contaminants were reported in the impacted well or the other wells. It should be noted, however, that at the time of our Phase II assessment activities the groundwater flow direction was toward the north at a gradient of approximately 0.0002. Our monitoring wells, therefore, are not located downgradient of the partially buried debris observed during the October 1998 site reconnaissance. Due to existing vegetation and site topography, the wells could not be located along the north, south, or west sides of the debris pit. The contaminant levels in the groundwater and the groundwater flow direction are expected to vary seasonally, as a result of changes in groundwater level and the stage of the Kuskokwim River. The magnitude of such changes has not been determined.

10.0 SITE 3A: MAINTENANCE FACILITY BUILDING

10.1 Site Location and Description

The ADOT&PF Maintenance Facility is located on Lot 1, Block 20, Aniak, Alaska, south of the Aniak Airport runway, as shown in Figure 2. The facility consists of a maintenance yard and two buildings, as shown in Figure 6. The southern building is used for storage of road maintenance sand and equipment, and the northern building, the Maintenance Shop, is used for vehicle and equipment maintenance and storage.

10.2 Background Information

Hart Crowser (1994) noted that the original design drawings of the Maintenance Shop show floor drains exiting underground on the south side of the building. Reportedly, the floor drain effluent was directed toward a dry well of unknown design, location, or construction. Hart Crowser excavated two 12-foot deep trenches along the south side of the building in an effort to locate the drain pipe leading to the drywell. The drain pipe was not found and limited samples were collected from the trenches.

Stained surface soils were observed along the exterior of the south side of the Maintenance Shop. The stains appeared to be the result of improper storage of 55-gallon drums containing used oil. Hart Crowser (1994) collected two near surface soil samples, designated Samples DW-5 and DW-8, which exceeded the Level A cleanup criteria for DRO applicable at the time of the 1994 assessment. The locations of the soil samples are shown on Figure 6. Hart Crowser concluded that the impacted soils did not appear to extend below five feet bgs. Hart

Crowser installed Monitoring Well MW-2 adjacent to the southeast corner of the Maintenance Shop. Soil and groundwater samples were collected and did not contain concentrations of petroleum hydrocarbons or hazardous substances exceeding cleanup levels. Concentrations of petroleum hydrocarbons identified by Hart Crowser at the respective boring locations are noted on Figure 6.

To address remediation of the impacted soils identified along the south side of the Maintenance Shop, Hart Crowser repeatedly turned the soil within the impacted area to provide aeration and oxygenation of the subsurface soils. They recommended that this procedure be continued. It was also recommended that the floor sump be replaced with a sealed sump to prevent future discharge through the drains to the drywell. In addition, DOWL (1998) proposed excavation and landfarming of an estimated 83 cubic yards of impacted soil from the south side of the Maintenance Shop. Excerpts from previous site investigation reports are included in Appendix F.

10.3 Summary of Field Assessment

The primary objectives of the field program at the Maintenance Shop consisted of determining the location of the drywell, identifying contaminants associated with the drywell, evaluating the lateral and vertical extent of soil contamination associated with the drywell, collecting additional information at the drum spill site along the south side of the Maintenance Shop, and evaluating the groundwater at the site.

The Maintenance Shop is shown in Figure 6 and Photo 8. In an effort to find the drywell that reportedly existed south of the Maintenance Shop, the floor drains inside the building were explored during our Phase I activities. The drains consist of three 30-inch-square by 40-inch-deep oil/water separators, two 4-inch-diameter floor drains, and three cleanout pipes. The three oil/water separators each have an approximately 5-inch diameter effluent pipe extending west. A Schonstedt MAC-51Bx magnetic and dual frequency pipe and cable locator was used to trace the 5-inch diameter effluent pipes. The pipes appeared to be connected to a single effluent pipe extending toward the southern wall of the building. The line was followed with the Schonstedt locator and the signal was lost at the south wall of the building, suggesting the pipe may have been removed on the outside of the building. ADOT&PF personnel reported that the floor drains no longer drain and may potentially be plugged at the building foundation. Reportedly, the floor drains are pumped out in the spring. In a further attempt to find subsurface piping extending to the drywell, three trenches were advanced south and southeast of the building. The locations of the trenches are shown on Figure 6 and the southernmost trench is shown in Photo 9. A sample, designated MS-TP1-S1, was collected from discolored soils from the trench located south of the building. The drywell or piping leading to the drywell were not discovered. ADOT&PF personnel reported that the drywell might have been removed in the 1980's.

Based on Shannon & Wilson's Phase I investigations and discussions with Ms. Anne Marie Palmieri and Mr. John Halverson of the ADEC, further exploration of the former drywell location during Phase II was cancelled.

A test pit, designated Test Pit MS-TP2, was excavated along the southwestern portion of the building to delineate the western extent of contamination associated with the surface spill at the former drum storage area, documented by Hart Crowser, along the south side of the building. A surface soil sample was also collected from visibly impacted soil.

10.4 Analytical Results

Sample locations and descriptions are included in Table 4.1. The soil analytical results from the Phase I activities at the Maintenance Shop are summarized in Table 4.2. Copies of the analytical results are included in Appendix D.

Soil contaminants identified during our assessment included RRO, DRO, GRO, xylenes, and a number of PAHs. Benzene, toluene, ethylbenzene, HVOs, PCBs, and pesticides were not reported to exceed the laboratory reporting limit. RRO and GRO were evaluated in only one sample with reported concentrations of 60.4 ppm and 0.854 ppm, respectively. DRO was reported to range from 10.5 ppm to 2,480 ppm. BTEX was evaluated in only one sample with xylenes reported at a concentration of 0.0218 ppm. Low levels of the PAHs were reported in two samples at concentrations well below the respective cleanup levels. No groundwater sampling was included in the evaluation of the Maintenance Shop.

10.5 Discussion of Results

Phase I investigative activities at the Maintenance Shop were associated with an apparent surface release along the south side of the Maintenance Shop and a reported dry well located somewhere south of the building. Following an investigation of the floor drain piping on the interior of the building and several exploratory trenches on the south side of the building, the location of the reported dry well remains unknown. Based on the results of our assessment and the results of Hart Crowser's assessment, soil contamination exceeding the cleanup levels is limited to the area along the central and western half of the south end of the building, presumably the result of surface spills from drum storage. According to Hart Crowser's report, the impacted soil along the building was repeatedly turned during their 1994 assessment to promote aeration and oxygenation of the subsurface soils. Analytical results from our sampling indicated surface soils and soils at a depth of 1.2 feet contained 1,630 ppm and 2,480 ppm DRO, respectively. Soil contamination exceeding cleanup levels was limited to DRO. Concentrations of GRO, RRO, BTEX, PAHs, HVOs, PCBs, pesticides, and metals were not reported to exceed cleanup levels or, in the case of arsenic, accepted background concentrations. The volume of impacted soil is estimated at approximately 80 to 90 cubic yards.

10.6 Conclusions

Based on the results of our assessment and Hart Crowser's 1994 assessment, soil contamination exceeding cleanup levels is inferred to be limited to the near surface soils along the south end of the building, presumably the results of surface releases from drums previously stored in this area. Soil contamination appears to be limited to DRO only, neither the results of our assessment nor Hart Crowser's assessment identified other contaminants exceeding the referenced cleanup levels. An estimated 80 to 90 cubic yards of soil is present at this area.

Our investigative activities did not locate the reported dry well at the site. Based on our assessment results, personal communication with ADOT&PF personnel in Aniak, and the results of Hart Crowser's assessment, the dry well has likely been removed. Based on the results of our Phase I assessment and discussions with ADEC, the proposed Phase II activities related to the dry well assessment were not performed. Our assessment did not include the evaluation of groundwater quality underlying the site, however, a groundwater sample from Monitoring Well MW-2, located at the southeast corner of the building, collected by Hart Crowser in 1994 was reported to not contain any contaminants exceeding the groundwater cleanup levels.

11.0 SITE 3B: FORMER AST AREA

11.1 Site Location and Description

The Former AST Area is located on Lots 2A, 2B, and 2C, Block 3, Aniak, Alaska, approximately 1,200 feet northeast of the Maintenance Facility and approximately 570 feet south of the Aniak Airport runway, as shown in Figure 2.

Eight ASTs were previously located at the site, at the approximate locations shown in Figure 7. The ASTs included one 4,200-gallon horizontal diesel AST and one 5,000-gallon vertical gasoline AST, each with dispensers housed in adjacent sheds. The diesel AST was connected to six 20,000-gallon diesel ASTs via an aboveground pipeline. Based on aerial photographs the northernmost 20,000-gallon AST was removed before 1972. The remaining five 20,000-gallon ASTs, the 5,000-gallon AST, and the pipeline were removed in 1994. The 4,200-gallon diesel AST and the dispenser sheds remain on site. The 20,000-gallon ASTs were connected to a barge loading dock on the Kuskokwim River approximately 1,800 feet to the north, via an underground pipeline, addressed below as Site 3c. The route of the pipeline is shown on Figures 8 and 9. As shown in a 1959 aerial photograph, two drum racks were positioned north of the 20,000-gallon ASTs facing northwest-southeast. By 1972, based on an aerial photograph, one of the drum racks was repositioned to face northeast-southwest. By 1982 the drum rack facing northwest-southeast was removed and the other drum rack is still located in the former AST area, but no longer holds drums.

11.2 Background Information

Hart Crowser conducted a site assessment in 1993 at the Former AST Area. During the work they identified petroleum impacted soils south of the 4,200-gallon diesel AST. The findings of the 1993 work resulted in additional site assessment work in 1994.

In 1994, Hart Crowser collected ten soil samples south of the 4,200-gallon diesel AST at depths ranging from 1 to 3 feet bgs. The locations of the samples are shown on Figure 7. The samples were field screened for volatile organics using a PID and for total petroleum hydrocarbons (TPH) using an unknown method and four samples were analyzed by a laboratory for DRO. Samples E-6 and E-8 contained DRO concentrations exceeding the then applicable Level A criteria. Hart Crowser reported the lateral extent of impacted soils south of the AST was delineated by the field screening, and that their Samples E-8, E-9, and E-10, shown in Figure 7, likely represent the outer fringes of the impacted area. The area of impact appeared centered around Sample E-6.

Thirteen soil samples, designated by the prefix "P" in Figure 7, were collected by Hart Crowser beneath the AST pipe valves and areas of distressed vegetation. The samples were field screened and two were submitted for analysis. Sample P-10, collected from a location east of the 4,200-gallon diesel AST, contained 18,000 ppm DRO and 0.180 ppm of trichloroethylene (TCE). The result of field screening suggests that eight of the remaining thirteen samples probably contained petroleum concentrations exceeding the Level A criteria.

Five shallow test pits, designated TP-1 through TP-5 in Figure 7, were excavated north and east of the ASTs by Hart Crowser. Samples were collected, field screened, and three were submitted for analysis. The screening and analytical results supported that petroleum contamination exceeding Level A criteria was present at Test Pits TP-1, TP-2, and TP-3. In addition, three monitoring wells, designated Monitoring Wells MW-1, MW-3, and MW-4, were installed at the site at the locations shown in Figure 7. Soil screening and analytical test results indicated that soil contamination appeared to extend to groundwater at Monitoring Well MW-3. Groundwater samples collected from Monitoring Wells MW-1 and MW-4 did not contain detectable concentrations of DRO, GRO, or BTEX. However, elevated DRO and GRO concentrations were detected in the sample collected from Monitoring Well MW-3. Concentrations of petroleum hydrocarbons identified by Hart Crowser are noted on Figure 7.

Hart Crowser recommended periodic turning of the near surface impacted soils south of the 4,200-gallon AST to support biological degradation of the contaminants. In addition, they recommended bioventing or insitu bioremediation of impacted soils in the unsaturated zone of the AST area following the removal of the ASTs. Excerpts from previous site investigation reports are included in Appendix F.

11.3 <u>Summary of Field Assessment</u>

The locations of concern at the site consisted of the identified soil contamination surrounding and south of the 4,200-gallon diesel AST, the identified TCE contamination northeast of the 4,200-gallon diesel AST, and the soil and groundwater contamination associated with the 20,000-gallon ASTs. The objectives of the field assessment included evaluating the spill area south of the 4,200-gallon AST, evaluating the vertical extent of soil contamination associated with the 4,200-gallon AST, evaluating the lateral and vertical extent of contamination associated with the 20,000-gallon ASTs and a potential surface release, and evaluating the site's groundwater.

11.3.1 Phase I Program

Phase I field activities consisted of evaluating the extent of the soil contamination identified by others in the vicinity of the 4,200-gallon diesel tank and the former 20,000-gallon diesel ASTs. During Phase I activities, eight test pits and eight hand boring were explored at the Former AST Area. In addition, three existing monitoring wells were sampled. The locations of the test pits, hand borings, and Monitoring Wells are shown on Figure 7. The dispenser sheds and 4,200-gallon diesel tank are shown in Photo 10. The footprints of the former ASTs are shown in Photo 11.

Three test pits, Test Pits AST-TP1 (TP1), TP3, and TP12, and one hand boring, Hand Boring TP13, were positioned near the 4,200-gallon diesel AST and the gasoline and diesel dispenser sheds. Test Pit TP3 was positioned north of the 4,200-gallon AST. Test Pit TP1 was located between the AST and the diesel dispenser shed. Test Pit TP12 and Hand Boring TP13 were advanced southwest of the gasoline dispenser shed.

During our October 1998 site reconnaissance, we observed that the former 20,000-gallon ASTs were located in a relatively flat-lying area with a small depression north and parallel to the former ASTs. A small, approximately 2.0 foot high berm, was observed east and south of the former ASTs. It is unknown if the depression and berm were located at the site while the ASTs were in operation. In the event of a release from the ASTs, fuel would most likely settle into the depression paralleling the northern sides of the former ASTs.

Test Pits TP6 and TP7 were advanced in former AST footprints. Three test pits, Test Pits TP8, TP9, and TPBB, and six hand borings, Hand Boring AST-HB1 (HB1), HB2, HB4, HB5, HB15, and HB16, were positioned at locations surrounding the AST footprints.

In addition to the subsurface assessment described above, groundwater samples were collected from the three existing monitoring wells, designated MW-1, MW-3, and MW-4. The locations of the wells are shown on Figure 7.

11.3.2 Phase II Program

During the Phase II program two monitoring wells, Monitoring Wells AST-MW5 and AST-MW6, were installed at the site. Monitoring Well AST-MW5 was placed in the location of the former northernmost AST and was completed as a biovent well. Monitoring Well AST-MW6 was position downgradient of the former ASTs in an attempt to evaluate the extent of the impacted groundwater found in Monitoring Well MW-3 during the Phase I program.

Boring AST-B7 was advanced east of the existing 4,200-gallon AST at the location of the Hart Crowser P-10 sample location, to evaluate the vertical extent of the TCE contamination identified in 1994.

11.4 <u>Analytical Results</u>

Sample locations and descriptions are included in Table 4.1. The soil analytical results from the Phase I and Phase II assessment at the Former AST Area are summarized in Table 4.3. The water sampling log includes groundwater level measurement and sampling and purging data and is included in Table 4.5. The groundwater analytical results are summarized in Table 4.6. Copies of the analytical results are included in Appendix D.

Soil contaminants identified during our assessment included DRO, GRO, toluene, ethylbenzene, xylenes, a number of PAHs, and the pesticides DDE and DDT. Benzene and HVOs were not reported to exceed the laboratory reporting limit. Concentrations of DRO were reported to range from not in excess of 3.64 ppm to 29,400 ppm. Concentrations of GRO were reported to range from not in excess of 0.559 ppm to 110 ppm. Toluene, ethylbenzene, and xylenes were reported at maximum concentrations of 0.118 ppm, 0.395 ppm, and 5.64 ppm, respectively. Low levels of the PAHs were reported in four samples at concentrations well below the respective cleanup levels. The pesticides DDE and DDT were reported to exceed the laboratory reporting limit in one sample with a concentration of 0.0319 ppm and 0.142 ppm, respectively.

Groundwater contaminants identified during our assessment included DRO, GRO, toluene, ethylbenzene, xylenes, and fluoranthene (PAH). Benzene and HVOs were not reported to exceed the laboratory reporting limit in the samples. DRO was reported to range from 0.162 ppm to 17.5 ppm during the sampling of the three existing monitoring wells (MW-1, MW-3, and MW-4) in November 1998, and not in excess of 0.319 ppm to 8.36 ppm during the sampling of the existing and newly installed monitoring wells in April 1999. GRO was reported to exceed the laboratory reporting limit in only Monitoring Well MW-3 during the November 1998 sampling event with a reported concentration of 0.17 ppm. Toluene, ethylbenzene, and xylenes were reported at maximum concentrations of 0.00357 ppm, 0.00183 ppm, and 0.00407 ppm, respectively. Fluoranthene was the only PAH reported to exceed the laboratory reporting limit with a concentration of 0.0269 ppm.

11.5 Discussion of Results

The Former AST Area consists of six former 20,000-gallon ASTs and associated aboveground pipeline, an existing 4,200-gallon diesel AST, a diesel dispenser shed, a gasoline dispenser shed, a former 5,000-gallon gasoline AST, and drum racks, as shown in Figure 7. Eight hand borings, eight test pits, one soil boring, and two monitoring wells were completed and sampled in this area, as shown in Figure 7. Based on the results of our assessment and the results of Hart Crowser's assessment in 1994, soil contamination exceeding the appropriate cleanup levels and MAC cleanup levels is limited to DRO only, presumably the result of piping leaks, dispensing spills, and possible releases from the ASTs.

Our investigation of the area surrounding the existing 4,200-gallon AST and dispenser sheds by three test pits, one boring, and one hand boring results, considered with the results of Hart Crowser's assessment in this area, indicate impacted soil exceeding cleanup levels, and in the case of Hart Crowser's sample location P-10 (18,000 ppm DRO) the MAC, is discontinuously distributed around the existing AST and dispenser sheds and appears to be limited to the near surface soils (2 to 3 feet). Assuming 50 percent of the soil within an approximate area of 2,100 square feet surrounding the existing AST, dispenser sheds, and elevated sample locations is contaminated above the appropriate cleanup levels, approximately 115 cubic yards of contaminated soil is located in this area. Based on the discontinuous nature of site impact and surrounding sample results, the volume of soil exceeding the MAC at Hart Crowser's P-10 sample location is estimated at approximately 5 to 10 cubic yards.

Approximately 60 feet northeast of the existing AST and dispensing sheds is the former location of the 20,000-gallon ASTs. Hart Crowser identified DRO concentrations exceeding cleanup levels and the MAC along the former pipeline corridor adjacent to the ASTs. Much of the sampling was performed at a maximum depth of 1 foot, but several locations identified elevated DRO extending to at least 5 feet. Within the pipeline and AST corridor, the vertical extent of soil contamination was assessed by Test Pits AST-TP6 and AST-TP7, and Monitoring Well AST-MW5. Test Pits TP6 and TP7 were placed in the footprints of two former 20,000-gallon ASTs. The near surface soils (2 to 4 feet) at both test pits contained DRO concentrations exceeding the MAC. Analytical results from Test Pit AST-TP7 at a depth of 8 feet and field screening results from Test Pit AST-TP6 suggest that the soil exceeding the MAC and cleanup levels is limited to a depth of 5 feet and 8 feet, respectively, over much of the AST area. Samples collected from Hand Borings HB1, HB2, HB4, HB5, and HB6 did not contain concentrations of petroleum hydrocarbons exceeding cleanup levels, indicating that releases did not occur along the southern side of the ASTs and the soil contamination noted on the north side of the ASTs was most likely the result of piping and valve spills. Assuming a near-continuous distribution of soil contamination encompassing the former AST and pipeline corridor, we estimate up to 500 cubic yards of near surface soil exceeds the MAC.

Three monitoring wells have been installed within the pipeline and AST corridor, as shown in Figure 7; two by Hart Crowser (MW-3 and MW-4) and one by Shannon & Wilson (AST-MW5). Based on the data from these borings, as well as test pit data described above, soil contamination extending to the zone of water table fluctuation is inferred to be limited to the northernmost AST, at or near Monitoring Well MW-3. Field screening results and field observations at Monitoring Well MW-3 indicate soil contamination extends to the water table, even though DRO was not detected at a depth of 25 to 27 feet. The data from Monitoring Well AST-MW5 indicated 28.9 ppm DRO at a depth of 15 to 17 feet, elevated field screening results at a depth of 20 feet, and 4,490 ppm DRO at a depth of 25 to 27 feet. The distribution of soil contamination at Monitoring Well AST-MW5 indicates that a surface release did not occur at the well location and the impacted soil at 20 feet is the result of lateral spreading from a nearby source. Monitoring Well AST-MW6 was advanced approximately 55 feet northwest (downgradient) of Monitoring Wells MW-3 and AST-MW5. A soil sample from Monitoring Well AST-MW6 from about 2.5 to 4.5 feet bgs contained 725 ppm DRO, but the sample from 20 feet contained only 27.8 ppm DRO. Based on field screening results, the impacted near surface soil is limited to a depth of 5 to 6 feet and may be the result of surface spills from drums that were formerly stored in the area. Excluding the potential volume of soil exceeding the MAC, described above, the results of our assessment and Hart Crowser's assessment suggest that an additional 1,300 cubic yards of soil from the Former AST Area exceeds cleanup levels.

Based on the analytical results of groundwater samples collected from the existing monitoring wells (MW-1, MW-3, and MW-4) on November 10, 1998, and those collected from the existing and newly installed monitoring wells (AST-MW5 and AST-MW6) on April 4, 1999, groundwater contamination exceeding the applicable cleanup levels is limited to DRO only, and appears to be centered around Monitoring Well MW-3. Monitoring Well MW-3 was reported to contain a maximum of 17.5 ppm DRO and 8.36 ppm DRO during the November and April sampling events, respectively. Monitoring Well AST-MW5, installed approximately 15 to 20 feet upgradient of MW-3 was reported to contain 3.21 ppm DRO, while Monitoring Well AST-MW6, installed approximately 55 feet downgradient of MW-3, was reported to contain 0.808 ppm DRO. The groundwater cleanup levels for DRO are exceeded at Monitoring Wells MW-3 and AST-MW5 only. The observed groundwater contamination does not extend beyond Monitoring Well AST-MW6. Although our assessment did not identify other probable areas of groundwater contamination (i.e. soil contamination extending to the groundwater level) other source areas may exist. DRO concentrations in the groundwater at the southern end of the ASTs (0.389 ppm DRO in MW-4) and in the vicinity of the existing AST and dispensing sheds (0.162 ppm DRO in MW-1) may be related to the apparent source area at the northern end of the ASTs. Previous investigators determined a southerly groundwater flow direction in the AST area.

11.6 Conclusions

Based on the results of our assessment and Hart Crowser's assessment, impacted soil exceeding applicable cleanup levels, and in the case of sample location P-10 the MAC, is discontinuously distributed around the existing AST and dispenser sheds and appears to be limited to the near surface soils (2 to 3 feet). Additionally, soil contamination exceeding cleanup levels and, in a number of instances, the MAC, is expected to extend from the former southernmost AST to the former northernmost AST and generally encompass the footprint of the former ASTs to approximately 10 feet beyond the pipeline to the northwest. With the exception of the area around the northernmost ASTs, soil contamination does not appear to extend beyond a depth of approximately 8 feet. However, in the vicinity of the northernmost ASTs, soil contamination is considered to extend to the water table, a depth of approximately 25 to 30 feet. Elevated concentrations of DRO were encountered at the near surface soil in Monitoring Well AST-MW6 but did not exceed cleanup levels. Based on the review of historical aerial photographs and an existing empty drum rack, this area was formerly used to store drums. Concentrations of petroleum hydrocarbons exceeding cleanup levels may be present in the area of the former drum racks.

In the vicinity of the existing AST and dispensing sheds we estimate up to 10 cubic yards of soil exceed the DRO MAC and about 115 cubic yards exceed cleanup levels. At the former AST area to the north we estimate up to 500 cubic yards of soil exceed the MAC for DRO and an additional 1,300 cubic yards exceed the applicable cleanup levels.

Based on analytical results and site-specific groundwater flow direction, impacted groundwater exceeding the cleanup levels for DRO is limited to the area beneath the northernmost USTs and does not extend beyond the location of Monitoring Well AST-MW6. Low levels of DRO were reported in the groundwater at the southern end of the ASTs and in the vicinity of the existing AST and dispensing sheds. At the time of our Phase II assessment activities, the site-specific groundwater flow direction at the Former AST Area was toward the northwest at a gradient of approximately 0.0009. Previous investigations determined a southerly groundwater flow direction. The contaminant levels in the groundwater and the groundwater flow direction are expected to vary seasonally, as a result of changes in groundwater level and the stage of the Kuskokwim River. The magnitude of such changes has not been determined.

12.0 SITE 3C: UNDERGROUND PIPELINE AREA

12.1 Site Location and Description

The subject underground pipeline, reportedly removed in 1994, extended from the six former ASTs at the Former AST Area to a barge loading dock on the Kuskokwim River, approximately 1,800 feet to the north. The pipeline traversed the areas shown in Figures 8 and 9 and reportedly consisted of 4-inch diameter, welded, black iron pipe. The wooded area north of the runway contains residential housing.

12.2 Background Information

The underground pipeline was installed in August 1941 by the United States military to transfer fuel from the barge docking facility on the Kuskokwim River to the 20,000-gallon ASTs, formerly located south of the runway.

Hart Crowser conducted a study in 1994 intended to locate the underground pipeline and assess soil conditions along its route (Hart Crowser, 1994). Hart Crowser reported that the northern section of pipeline from the south side of River Road extending to the barge docking facility could not be located. Fourteen soil borings, designated PL-1 through PL-14 in Figures 8 and 9, were reportedly advanced at existing pipeline valve, joint, and break point locations. The depths of the borings ranged from 4.5 feet to 7.0 feet bgs. One soil sample was collected from the terminal depth of each boring. Each sample was screened and ten samples were submitted for analysis. Samples PL-1, PL-2, and PL-3, collected south of the runway, at locations shown on Figure 8, contained petroleum concentrations exceeding the then applicable Level A criteria. Based on the available information, Hart Crowser speculated that the impacted soils may be the result of a large surficial release of petroleum centered at the northern end of the 20,000-gallon AST area.

Petroleum concentrations exceeding Level A criteria were also identified in Sample PL-10, collected along the pipeline route west of a structure approximately 470 feet north of the north edge of the runway. This sampling point is shown in Figure 9. Concentrations of petroleum hydrocarbons identified by Hart Crowser along the underground pipeline are noted on Figures 8 and 9.

Hart Crowser recommended decommissioning the remaining portion of the pipeline, except for the length beneath the runway, and removing impacted soils. According to ADEC, the entire pipeline was removed in 1994, but soil remediation was not performed. Excerpts from previous site investigation reports are included in Appendix F.

12.3 Summary of Field Assessment

The objectives of the field assessment included the evaluation of the lateral and vertical extent of soil contamination at Hart Crowser's PL-1, PL-2, PL-3, and PL-10 sample locations, evaluation of potential surface releases north of the former 20,000-gallon ASTs, exploration of potential soil contamination along the pipeline route inside the fence surrounding the runway, and evaluation of the groundwater quality underlying the release areas.

12.3.1 Phase I Program

Phase I of the field program along the former pipeline consisted of 13 hand borings and four test pits south of the runway and eleven hand borings and one test pit north of the runway. The test pit and hand boring locations are shown on Figures 8 and 9.

Thirteen hand borings, Hand Borings PL-HB1 (HB1) through HB13, were placed on an approximate 50-foot spaced grid located south of the fence along the south side of the runway. Where possible, hand borings were placed in depressions, where a surface release of fuel would be likely to collect. Test Pit PL-TP2 (TP2) was placed west of the Hart Crowser PL-1 sample location. Two test pits, Test Pits TP1 and TPAA, were placed east of the Hart Crowser PL-2 sample location.

Test Pits TP8 and TP9 were placed south and north of the runway inside the fenced area surrounding the runway, respectively, at points along the former pipeline route.

Eleven hand borings, Hand Borings HB14 through HB20 and HBA through HBD, were placed along the former pipeline route north of the runway, in an effort to locate the Hart Crowser PL-10 sample location.

12.3.2 Phase II Program

Three monitoring wells, Monitoring Wells PL-MW9, PL-MW10, and PL-MW11, were placed south of the runway and Monitoring Well PL-MW12 was placed north of the runway. The locations of the wells were selected based on the results of our Phase I activities and the former Hart Crowser assessment activities and are shown on Figures 8 and 9.

Monitoring Well PL-MW9 was installed adjacent to the Hart Crowser PL-2 sample location, as shown in Photo 12, and Monitoring Well PL-MW10 was installed at the PL-3 location. Two exploratory borings, designated PL-MW10a and PL-MW10b, were advanced near the Monitoring Well PL-MW10 location in an effort to find the impacted soil observed during the Hart Crowser assessment. The borings were approximately 10 feet deep and 10 feet and 20 feet west of the Monitoring Well PL-MW10 location. No samples were collected from the exploratory borings and no evidence of impacted soil was observed. Monitoring Well PL-MW11 was installed west of Monitoring Wells PL-MW9 and PL-MW10 in an effort to evaluate localized groundwater flow direction and the extent of potentially impacted groundwater.

Monitoring Well PL-MW12 was placed north of the runway near the Hart Crowser PL-10 sample location.

12.4 Analytical Results

Sample locations and descriptions are included in Table 4.1. The soil analytical results from the Phase I and Phase II assessment at the Underground Pipeline Area are summarized in

Table 4.4. The water sampling log includes groundwater level measurement and sampling and purging data and is included in Table 4.5. The groundwater analytical results are summarized in Table 4.6. Copies of the analytical results are included in Appendix D.

Soil contaminants identified during our assessment included DRO, GRO, toluene, ethylbenzene, xylenes, a number of PAHs, and the pesticides DDE, DDD, and DDT. Benzene and VOCs were not reported to exceed the laboratory reporting limit. Concentrations of DRO were reported to range from not in excess of 3.77 ppm to 1,120 ppm. Concentrations of GRO were reported to range from not in excess of 1.09 ppm to 118 ppm. Toluene, ethylbenzene, and xylenes were reported at maximum concentrations of 0.134 ppm, 0.418 ppm, and 4.72 ppm, respectively. Low levels of the PAHs were reported in four samples at concentrations well below the respective cleanup levels. The pesticides DDE, DDD, and DDT were reported to exceed the laboratory reporting limit in three samples with maximum concentrations of 0.124 ppm, 0.00725 ppm, and 1.37 ppm, respectively.

Groundwater contaminants identified during our assessment included DRO, GRO, benzene, toluene, ethylbenzene, xylenes, and a number of PAHs. Concentrations of DRO were reported to range from not in excess of 0.326 ppm to 3.39 ppm. Concentrations of GRO were reported to range from not in excess of 0.090 ppm to 0.60 ppm. Benzene was reported to exceed the laboratory reporting limit at one well location (PL-MW9) with a maximum concentration of 0.00651 ppm. Toluene, ethylbenzene, and xylenes were reported at a maximum concentration of 0.00586 ppm and 0.0297 ppm, and 0.0859 ppm, respectively. Low levels of the PAHs were reported in two samples at concentrations well below the respective cleanup levels.

12.5 <u>Discussion of Results</u>

The layout of the area surrounding the former pipeline south of Boundary Road (parallel to the north side of the airport runway) is shown in Figure 8, and the layout of the area surrounding the former pipeline route north of Boundary Road is shown in Figure 9. Based on the results of our assessment, as well as the results of Hart Crowser's assessment, soil contamination exceeding cleanup levels is limited to DRO, although elevated reporting limits for benzene in some of Hart Crowser's samples do not completely rule out the exceedance of benzene cleanup levels. Hart Crowser suggested that the soil contamination identified along the pipeline route north of the ASTs may have been the result of a large surface release from the northernmost ASTs. The results of our assessment do not indicate the presence of widespread soil contamination, which would typically be associated with such a release. Soil contamination along the pipeline route appears to be related to isolated areas of leakage, probably associated with former valve or joint locations.

Our Phase I field activities along the southern portion of the former underground pipeline included a number of hand borings and four test pits, as shown in Figure 8. The samples did not contain concentrations of petroleum hydrocarbons or hazardous substances exceeding cleanup levels.

The objectives of our Phase II activities along the southern portion of the former pipeline route were to evaluate the vertical extent of soil contamination at Hart Crowser's PL-2 and PL-3 sampling locations and to assess the potential for groundwater contamination underlying the site. Based on Hart Crowser's data for sample locations PL-2 and PL-3, concentrations of DRO exceeded the MAC at depths of 4 and 4.5 feet, respectively. Monitoring Well PL-MW9 was installed at the approximate location of Hart Crowser's PL-2 sampling point. Elevated field screening results and an unknown odor were consistently observed in Monitoring Well PL-MW9 to a depth of approximately 17 feet. In an attempt to discover the source of the high PID reading and the unknown odor the sample was from 10 feet was analyzed for VOCs, which were non-detect. The analytical results of the samples from 10, 17.5, and 20 feet indicated only trace concentrations of toluene and xylenes and low concentrations of DRO. Monitoring Well PL-MW10 was installed at the approximate location of Hart Crowser's PL-3 sampling point. A sample from Monitoring Well PL-MW10 at a depth 15 to 17 feet was reported to contain 2,120 ppm DRO and low levels of GRO, toluene, ethylbenzene, and xylenes. A sample from Monitoring Well PL-MW10 at a depth of 20 to 22 feet was reported to not exceed 11 ppm DRO. A downgradient well, Monitoring Well PL-MW11, did not encounter evidence of soil contamination.

Along the northern portion of the former underground pipeline our assessment focused on an apparent source area identified by Hart Crowser as location PL-10. Based on Hart Crowser's data, DRO exceeded the MAC and GRO exceeded cleanup levels at a depth of 4.5 feet. Because the specific location of this sampling point was not known and could not be determined in the field, a number of hand borings were performed and sampled with no indication of the levels observed by Hart Crowser. Based on receipt of additional information regarding the location of PL-10, Monitoring Well PL-MW12 was drilled as close to the former sampling location (approximately 15 feet south) as access allowed. Neither soil analytical or field screening results identified soil contamination.

Based on our assessment results and the results of Hart Crowser's assessment, soil contamination along the former pipeline exceeding cleanup levels and, in the case of Hart Crowser's sampling locations PL-2, PL-3, and Pl-10, the MAC, appears to be primarily limited to isolated locations and the result of valve or joint leaks. Evidence of deep soil contamination was encountered at Monitoring Well PL-MW10, but not at PL-MW9. We estimate that approximately 50 cubic yards of impacted soil exceeding the MAC for DRO is present at the three locations identified by Hart Crowser. Based on limited sampling information, we estimate an additional 100 to 150 cubic yards of soil exceeding the cleanup level is associated with the impacted areas described above.

Based on the groundwater analytical results, groundwater contamination exceeding the cleanup levels is present at Monitoring Wells PL-MW9 and PL-MW11. The groundwater sample and duplicate sample from Monitoring Wells PL-MW9 contained a maximum of 0.60 ppm GRO, 3.39 ppm DRO, 0.00651 ppm benzene, and low levels of toluene, ethylbenzene, and xylenes, exceeding the cleanup level for DRO and benzene. The sample from Monitoring Well PL-MW11 contained 1.51 ppm DRO and low levels of toluene, ethylbenzene, and xylenes, exceeding the cleanup level for DRO. Because the soil data from Monitoring Well PL-MW9 does not identify a probable source at the well location (vicinity of Hart Crowser sampling location PL-2), the source of groundwater contamination is not known. Additionally, the levels of GRO and BTEX identified in the groundwater sample from Monitoring Well PL-MW9 suggest some impact was the result of a gasoline release.

12.6 Conclusions

Based on our assessment results, soil contamination exceeding the cleanup level for DRO and GRO and, in the case of Hart Crowser's sampling locations PL-2, PL-3, and PL-10, the MAC for DRO appears to be primarily limited to isolated locations and the result of valve or joint leaks. Evidence of soil contamination extending to at least 17 feet was encountered at Monitoring Well PL-MW10 (Hart Crowser PL-3 location), but soil contamination was not identified below a depth of 10 feet at PL-MW9 (Hart Crowser PL-2 location). We estimate that the impacted soil exceeding the MAC for DRO includes approximately 50 cubic yards and the remaining volume of soil contamination exceeding cleanup levels is approximately 150 cubic yards.

Based on the groundwater analytical results, groundwater contamination exceeding the cleanup levels is present in the vicinity of Monitoring Wells PL-MW9 and PL-MW11. The groundwater cleanup levels for DRO and benzene are exceeded at Monitoring Well PL-MW9, while the cleanup level for DRO is only slightly exceeded at PL-MW11. The source of groundwater contamination is not known. The levels of GRO and BTEX identified in the groundwater sample from Monitoring Well PL-MW9 differ from those reported in the groundwater samples at the AST area to the south, suggesting that another source (gasoline) is contributing to the groundwater contamination at Monitoring Well PL-MW9. At the time of our Phase II assessment at the Underground Pipeline Area the site-specific groundwater flow direction was towards the west-northwest at an approximate gradient of 0.0009. The contaminant levels in the groundwater and the groundwater flow direction are expected to vary seasonally, as a result of changes in groundwater level and the stage of the Kuskokwim River. The magnitude of such changes has not been determined.

13.0 SITE 4: WAC SITE

13.1 Site Location and Description

The former White Alice Communication (WAC) Site is located approximately 350 feet south of the south edge of the Aniak Airport runway as shown in Figure 2. The existing Aniak Middle School and High School are located on the former WAC Site. Existing remnants of the WAC Site include an AST, antenna foundations, and other features from the historical use of the facility. A site map of the WAC Site is included as Figure 10.

During operation of the WAC Site, a tank farm existed at the facility, reportedly consisting of two approximately 90,000-gallon ASTs, three approximately 10,000-gallon ASTs, and one approximately 7,500-gallon AST. The southernmost 90,000-gallon AST and two approximately 7,500-gallon AST are currently in use at the site. An approximately 5,000-gallon AST and a fuel dispenser exist outside of the bermed tank farm area east of the ASTs.

13.2 Background Information

E&E conducted a site investigation at the WAC Site in 1997. Two surface soil samples, Samples SL01 and SL02 shown in Figure 10, were collected from inside the bermed tank farm area. Sample SL02 was collected adjacent to the southeast side of the remaining 90,000 gallon AST in the vicinity of a valve and contained 13,000 ppm DRO and 833 ppm lead. Sample SL01 was collected adjacent to the southeast side of the former northern 90,000-gallon AST and contained 660 ppm DRO. Sample SL02 also contained 15 ppm selenium which is above the appropriate cleanup criteria. Concentrations of petroleum hydrocarbons and lead identified by E&E at the WAC Site are noted on Figure 10. Excerpts from previous site investigation reports are included in Appendix F.

13.3 Summary of Field Assessment

The objectives of the field assessment included determining the location of a reported culvert through the berm surrounding the southern 90,000-gallon AST, evaluating the lateral and vertical extent of soil contamination inside and outside of the former bermed AST area and existing AST area, and evaluating the site's groundwater.

13.3.1 Phase I Program

Twenty-two hand boring locations were explored at the WAC Site. Six hand borings, designated Hand Borings WAC-HB1 (HB1) through HB3 and HB9 through HB11, were advanced inside the former northern AST berm. Hand Boring HB9 through HB11 were placed surrounding the E&E Sample SL01 location to further evaluate the reported contamination. Hand Borings HB4 though HB8 were advanced outside the former northern AST's berm.

Hand Borings HB12 through HB14 and HB20 and HB21 were placed inside the southern 90,000-gallon AST berm. The hand borings were placed at piping, or valve locations, or in depressions in the soil. Hand Borings HB16 and HB19 were placed outside of the southern berm. Hand Borings HB18a and HB18b were placed east of the bermed area near the piping for two 7,500-gallon ASTs inside a separate bermed area.

A corrugated steel pipe similar to the culvert at the Runway Apron was discovered during our October 1998 site reconnaissance in the sidewall of the berm of the existing 90,000-gallon AST, as shown in Photo 4 and Figure 10. A valve used to drain the inside of the berm surrounding the AST was observed and appeared to be attached to the exposed pipe at the base of the berm. The valve is shown on Photo 13. Hand Boring HB13 was placed at the valve location. Hand Boring HB17 was advanced into the sidewall of the berm between the valve and the exposed end of the culvert. Hand Boring HB15 was placed at the exposed culvert location outside of the bermed area. Cobbles were uncovered at the end of the exposed culvert and extended west, parallel to the berm. A blueprint of the tank farm shows a culvert extending in this direction.

13.3.2 Phase II Program

Five monitoring wells were installed during the Phase II field activities. Monitoring Well WAC-MW1, WAC-MW3, and WAC-MW4 were installed south, west, and east of the existing 90,000-gallon AST, respectively. Monitoring Well WAC-MW4 was placed adjacent to a dispenser shed and an approximately 5,000-gallon AST, as shown in Photo 14 and Figure 10.

Monitoring Well WAC-MW2 was placed in the center of the former 90,000-gallon AST footprint and completed as a biovent well. No liner was encountered during drilling and it is assumed that no liner is beneath the existing 90,000-gallon AST either. Monitoring Well WAC-

MW5 was placed northwest of Monitoring Well WAC-MW2 outside of the bermed area. The well was placed to evaluate the downgradient groundwater quality.

13.4 Analytical Results

Sample locations and descriptions are included in Table 5.1. The soil analytical results from the Phase I and Phase II assessment at the WAC Site are summarized in Table 5.2. The water sampling log includes groundwater level measurement and sampling and purging data and is included in Table 5.3. The groundwater analytical results are summarized in Table 5.4. Copies of the analytical results are included in Appendix D.

Soil contaminants identified during our assessment included DRO, GRO, benzene, toluene, ethylbenzene, xylenes, and a number of PAHs. Concentrations of lead by TCLP were not reported to exceed the laboratory reporting limit. Concentrations of DRO were reported to range from not in excess of 3.73 ppm to 1,720 ppm. Concentrations of GRO were reported to range from not in excess of 0.380 ppm to 204 ppm. Benzene, toluene, ethylbenzene, and xylenes were reported at maximum concentrations of 0.0258 ppm, 0.163 ppm, 1.54 ppm, and 8.59 ppm, respectively. Low levels of the PAHs were reported in three samples at concentrations well below the respective cleanup levels.

Groundwater contaminants identified during our assessment included DRO only. Concentrations of GRO, benzene, toluene, ethylbenzene, xylenes, PAHs, and lead were not reported to exceed the laboratory reporting limit. Concentrations of DRO were reported to range from not in excess of 0.319 ppm to 1.10 ppm.

13.5 Discussion of Results

The WAC Site consists of a 90,000-gallon AST located within a bermed area, a former 90,000-gallon AST location northeast of the existing AST, two 7,500-gallon ASTs, a 5,000-gallon AST and dispenser shed located east of the existing AST, and adjacent buildings, as shown in Figure 10. Phase I and Phase II activities at the WAC Site consisted of the installation and sampling of a number of hand borings to identify potential source areas and the installation and sampling of five monitoring wells to assess the vertical extent of soil contamination and potential presence of groundwater contamination. The results of our sampling indicate petroleum hydrocarbons have impacted the near surface soil within the former and existing AST berm areas, although the levels of DRO do not exceed the proposed Site 4 method 3 soil cleanup level. In addition, Monitoring Well WAC-MW2 was placed in the footprint of the former northern AST and a sample from 7.5 to 9.5 feet bgs contained 1,720 ppm DRO. Samples from 15 and

27.5 feet bgs contained 12.9 ppm DRO and 20.0 ppm DRO, respectively. Based on this data, limited impact to the soils below the former AST has occurred and the levels do not exceed the proposed Site 4 Method 3 soil cleanup level. The remaining soil samples collected from the other four monitoring wells did not contain concentrations of petroleum hydrocarbons or hazardous substances exceeding cleanup criteria.

Based on the results of our assessment and the results of E&E's assessment in 1997, considered with the proposed Site 4 Method 3 soil cleanup levels, soil contaminants exceeding the cleanup levels are limited to DRO and lead. E&E reported a DRO concentration of 13,000 ppm and a lead concentration of 833 ppm from a surface soil sample location adjacent to the existing AST and within the bermed and fenced area. The DRO concentration exceeds the MAC and the lead concentration exceeds the residential soil cleanup level. Because of the current and probable future use of the site as fuel storage and the existing fence surrounding the area, a commercial/industrial classification of the site may be appropriate. The commercial/industrial classification would raise the soil cleanup level for lead to 1,000 ppm, although remediation of the DRO impacted soil would still be necessary. To designate the site as commercial/industrial, institutional controls may be necessary. Additionally, if the DRO impacted soil exceeding the MAC is excavated for treatment, evaluation of the lead content should be performed to determine if it exceeds the RCRA hazardous waste criteria, based on its toxicity characteristic.

Based on groundwater analytical results collected on April 4, 1999, none of the five monitoring wells contained concentrations of petroleum hydrocarbons or lead exceeding the groundwater cleanup criteria. Monitoring Well WAC-MW2 contained 1.10 ppm DRO and no detectable GRO, BTEX, lead, or PAHs. Groundwater samples collected from Monitoring Wells WAC-MW1, WAC-MW3, WAC-MW4, and WAC-MW5 did not contain detectable DRO, GRO, BTEX, lead, or PAHs.

13.6 Conclusions

Based on the soil data obtained during our assessment and the results of E&E's assessment, DRO concentrations exceeding the MAC and elevated lead concentrations are reportedly present in the surface soil within the existing AST berm area and appear to be localized to the area around E&E's SL02 sample location. The results of our analyses did not identify DRO concentrations exceeding the proposed Site 4 Method 3 soil cleanup levels or lead concentrations exceeding the RCRA Hazardous Waste criteria, though our sample locations were not the same as E&E's. We estimate less than 1 cubic yard of impacted soil may exceed the MAC and contain levels of lead which exceed the residential soil cleanup level.

Based on analytical results, the groundwater beneath the site has not been impacted by petroleum hydrocarbons in excess of the cleanup levels. Only Monitoring Well WAC-MW2 reported detectable concentrations of DRO. At the time of our Phase II assessment activities at the WAC Site the site-specific groundwater flow direction was toward the north-northwest at a gradient of approximately 0.0006. The contaminant levels in the groundwater and the groundwater flow direction are expected to vary seasonally, as a result of changes in groundwater level and the stage of the Kuskokwim River. The magnitude of such changes has not been determined.

14.0 REMEDIAL ALTERNATIVES

Based on the results of our subsurface investigation as well as the results of former assessments conducted by others, Shannon & Wilson performed a preliminary evaluation to identify an appropriate remedial approach(s) for the sites. The completeness of the site characterization data was an important factor in identifying appropriate remediation alternatives. While the delineation of soil contamination is considered sufficient at most sites to perform a preliminary evaluation of remedial alternatives, the specific data regarding the viability of in situ venting methods and the seasonal variability of groundwater quality and flow direction are unknown. Other factors influencing the determination of an appropriate remedial approach included the extent and magnitude of identified soil and groundwater contamination, exposure scenarios (ingestion, inhalation, groundwater), location, and cost-effectiveness.

Our preliminary remedial evaluation also considered the data presented in a report by DOWL Engineers entitled *Corrective Action Plan, Alaska Department of Transportation & Public Facilities, Aniak Maintenance Facility, Aniak, Alaska*, dated April 1998. This report included a broad evaluation of various remedial alternatives to address contaminated soil at the four ADOT&PF sites.

14.1 Applicable Soil Remedial Alternatives

Based on site conditions, four remedial alternatives for treating the petroleum hydrocarbon impacted soils were identified as viable options and have been evaluated. The soil remedial alternatives include: 1) excavation of the impacted soils and treatment by thermal desorption, 2) excavation of the impacted soils and treatment in an active bioventing treatment cell, 3) excavation of the impacted soils and treatment in a passive bioventing treatment cell, and 4) natural attenuation with groundwater monitoring.

While risk assessment may be a viable option at some point in the remediation program at the sites, the levels of petroleum hydrocarbons observed at most of the sites are considered to be too high to allow closure by risk assessment at this time. Likewise, in situ methods such as bioventing may be appropriate for the remediation of deep soil contamination or soil contamination remaining below a structure, but insufficient data exists at this time to evaluate the feasibility or cost effectiveness.

14.1.1 Excavation and Treatment by Thermal Desorption

The first potential remedial alternative requires the excavation of the impacted soils. Following excavation, the soils would be processed by thermal desorption technology. Thermal desorption of soil contaminants in a remote site like Aniak is typically performed using a variety of portable equipment. Hot Air Vapor Extraction (HAVE) and Enhanced Thermal Conduction are two similar types of technologies that treat soil within a specially constructed treatment cell. The treatment cell would incorporate the design for long term storage cells including a bermed area lined with a 20-mil petroleum resistant liner, but is actually encapsulated with a heat-resistant cover. Perforated piping spaced throughout the cell would be manifolded to a blower unit that is attached to a burner. Hot air is pumped into the piping system, raising the soil temperatures, and volatilizing the sorbed organic contaminants. The resulting off gas is either recycled through the burner thus capturing the energy of the contaminants and minimizing vapor emissions or treated in a thermal oxidizer.

Advantages of this alternative include: 1) the relatively rapid treatment (around two weeks, maybe longer for fine-grained soils) of petroleum hydrocarbon contaminants; and 2) soils could be placed back into the excavations within a relatively short time period, potentially eliminating the need to backfill with imported material. The disadvantages of this alternative are the relatively high cost to mobilize equipment and perform treatment. Because of the high cost to mobilize equipment, smaller volumes of soil are not cost effective. One contractor has placed a minimum volume at approximately 500 cubic yards. In addition, excavation of soils is necessary, with the practical depth of excavation limited by surrounding buildings, site features, and subsurface conditions. The treatment costs for this alternative are based on thermal treatment costs using Enhanced Thermal Conduction and HAVE.

14.1.2 Excavation and Active Bioventing Treatment Cell

The second potential remedial alternative also incorporates excavation of the impacted soils, however, following excavation, the soils are placed in a long-term biotreatment cell for processing. The biotreatment cell would incorporate the design for long term storage cells including a bermed area lined with a 20-mil petroleum resistant liner and cover. Perforated piping spaced throughout the cell would be manifolded to a blower unit. Forced airflow through the piping is used to oxygenate the soil environment and promote biodegradation, as well as volatilization of the contaminants.

The advantage of this alternative is the typically lower initial cost when compared to thermal desorption. The disadvantages include the excavation limitations described above for thermal desorption and the treatment process may take 5 years or longer of seasonal operation to obtain sufficient reduction in contaminants with on-going monitoring and maintenance costs. Additionally clean fill material must be imported to backfill excavations. Excavation and handling of the soil is another high expense for this option. Due to the remote site and limited equipment availability, soil excavation, transport, and handling are expected to take longer than typical of sites with greater equipment availability. Monitoring costs include annual site visits for assessment and sampling and annual status reports. Maintenance costs include moisture and nutrient addition and treatment cell checks and repairs.

14.1.3 Excavation and Passive Bioventing Cell

The third potential remedial alternative is very similar to the second option. The passive biotreatment cell would incorporate the design for long term storage cells including a bermed area lined with a 20-mil petroleum resistant liner and covered. Perforated piping spaced throughout the cell would be manifolded to a passive venting unit(s), such as turbine-vent risers, used to oxygenate the soil gas and promote biodegradation, as well as volatilization of the contaminants.

The advantages and disadvantages of this alternative are basically the same as described above for active bioventing with typically even lower initial cost than an active bioventing treatment cell.

The disadvantages are that the treatment process may take at least 10 years to obtain sufficient reduction in contaminants with relatively high monitoring and maintenance costs for the remote location over the anticipated treatment time. Monitoring costs include annual site visits for assessment and sampling and annual status reports. Maintenance costs include moisture and nutrient addition and treatment cell checks and repairs.

14.1.4 Natural Attenuation with Groundwater Monitoring

The fourth potential remedial alternative for the treatment of soil contamination includes natural attenuation with groundwater monitoring. For this alternative natural attenuation processes in the unsaturated zone such as biodegradation, sorption, and volatilization are allowed to proceed at natural rates and routine groundwater monitoring is performed to assess the potential for leaching of the contaminants into the groundwater. This alternative is considered appropriate following the removal of soil exceeding the inhalation and ingestion standards. It should be recognized that reductions in the scope of the monitoring program (reduce monitoring at selected wells and frequency) may be appropriate following the establishment of water quality trends.

14.2 Applicable Groundwater Remedial Alternatives

Based on site conditions, three remedial alternatives for treating the petroleum hydrocarbon impacted groundwater were identified as viable options and have been evaluated. The groundwater remedial alternatives include: 1) natural attenuation with groundwater monitoring, 2) air injection (sparging), and 3) injection of solid-phase oxygen releasing compound.

14.2.1 Natural Attenuation with Groundwater Monitoring

The first appropriate remedial alternative for the treatment of groundwater contamination includes natural attenuation with groundwater monitoring. For this alternative natural attenuation processes such as biodegradation, dilution, sorption, and volatilization are allowed to proceed at natural rates and routine groundwater monitoring is performed to assess the effectiveness of the processes. This alternative is considered appropriate for Sites 2, 3b, and 3c because of the apparent limited extent of groundwater contamination observed at the sites and the assumed absence of nearby downgradient receptors. This alternative is considered appropriate with or without source area (impacted soil) reduction and is suitable for an initial remedial evaluation phase where groundwater data is limited.

It should be recognized that reductions in the scope of the monitoring program (reduce monitoring at selected wells and frequency) may be appropriate following the establishment of water quality trends.

14.2.2 Air Injection

The second remedial alternative for the treatment of groundwater contamination is air injection, often referred to as sparging or biosparging. Basically, the remedial technology includes the injection of air below the groundwater level from vertically drilled wells spaced to maintain an overlapping radius of influence for the injected air. The air is injected from a short length of slotted/perforated pipe located a designated distance below the groundwater level. As the air rises to the groundwater surface it strips volatile organics from the water and transports them to the unsaturated zone. Sparging is typically used in conjunction with vapor extraction or bioventing in the vadose zone for vapor control. However, at the remote sites (no adjoining building or structures to collect vapors) injection is an appropriate technology on its own. A secondary benefit of the injected air is the enhancement of dissolved oxygen levels in the groundwater, which promotes biodegradation.

14.2.3 Injection of Solid-Phase Oxygen Releasing Compound

The third alternative for the treatment of groundwater contamination is the injection of a solid-phase oxygen releasing compound into the saturated soils within the plume boundaries. The oxygen releasing compound (ORC, trade name by one manufacturer) is a magnesium peroxide which is formulated to release oxygen at a slow controlled rate when hydrated. ORC is typically injected through small diameter probes as a slurry. The probes are often driven points, potentially eliminating the need for a large drill rig to be mobilized to the site. Following installation, the life-span of the ORC is approximately 6 months, depending upon groundwater concentrations and gradient. This technology requires calculating the quantity of oxygen needed to degrade the contaminants present and injecting an adequate supply of ORC.

14.3 Site-Specific Remedial Alternatives

Based on our review of the above mentioned remedial options and discussions with the ADEC, two levels of cleanup efforts were evaluated. These levels of cleanup effort included the excavation of the soils exceeding the proposed Method 3 soil cleanup levels with treatment by thermal desorption (or similar rapid treatment technology) and the excavation of the soil exceeding the MAC cleanup standards with treatment of the soil by thermal desorption or in an active or passive bioventing treatment cell. Preliminary cost estimates were developed for both of these scenarios. Costs for the treatment of the impacted groundwater were not included because we feel that additional monitoring is necessary before evaluating the necessity for active groundwater cleanup and appropriate remedial alternatives. The groundwater monitoring results available at this time suggest groundwater contamination is limited to the core source areas and has not migrated significantly in a downgradient direction. We, therefore, have estimated costs for groundwater monitoring (four sampling events) for the sites with documented groundwater impact exceeding the groundwater cleanup levels (Sites 2 and 3). The estimated costs for the following remedial options are outlined in Appendix G and summarized below with each discussion.

14.3.1 Site 1: ADOT&PF Building 301

At Site 1 we estimate approximately 60 cubic yards of soil exceed the MAC for DRO and an additional 240 cubic yards of soil exceed the proposed Method 3 soil cleanup levels for DRO and/or benzene. In addition, possibly 100 cubic yards of soil impacted with DDT above the cleanup level have been documented at the site with approximately 60 percent comingled with the petroleum hydrocarbon contamination. These concentrations of DDT and lower reported levels of DDT may be related to the DDT contaminated soil associated with the former Federal Aviation Administration (FAA) cleanup at Building 200. Levels of DDT that may be construed to be associated with a source release were documented by OHM and DOWL at a number of locations which coincide with benzene and DRO impacted soil. Depending upon regulatory determination, the volume of DDT impacted soil regulated by RCRA may greatly exceed the 100 cubic yards estimated to exceed the ADEC cleanup level.

14.3.1.1 DDT Impacted Soil

Remedial alternatives for this site are influenced by the regulatory classification of DDT at the site. We assume, at a minimum, that soils impacted with concentrations of DDT above the ADEC cleanup level will be construed as a RCRA waste, if excavated. In this respect, if removed from the ground, the soil must be either recycled for beneficial use, or disposed of in a permitted hazardous waste treatment, storage, and disposal (TSD) facility. An option to excavating the DDT impacted soil is capping the site.

Because there are no TSD facilities in Alaska, in the later case, removal would require transportation to and disposal in a TSD facility in the lower 48 states. It should be noted that off-site disposal may be necessary if recycling or capping are determined to be unacceptable. The following discussions provide a summary of applicable options for the soils impacted with concentrations of DDT above the ADEC cleanup level.

14.3.1.1.1 Cold Asphalt Emulsion Recycling

This remedial option would entail the use of cold asphalt emulsion recycling as a means to solidify the DDT and petroleum contaminated soils and prevent exposure by reducing the potential for migration of contamination. The cold asphalt recycling process has been recognized as an effective remedial technique for petroleum contaminated soils and it is our opinion that this technology may also be effective in bonding the DDT into the mixture, particularly because of the insoluble nature of DDT in water, and its high solubility in petroleum products. A pilot test/mix design study would need to be performed.

Because the aggregates are generally cold when used, and at the naturally occurring water contents, no heating is required and consequently, no air quality issues would be expected. Cold mixed asphalt is reported to be more flexible and a more self healing mixture than hot mixed asphalt. Cold mixtures generally increase in strength with time.

At the conclusion of its usefulness, the cold asphalt may be treated like any other asphalt product. The beneficial uses of the product could include paving a parking area for the site, use as a landfill cap, subgrade stabilization, or fuel tank diking. The main advantage associated with this remedial option is reduced remediation costs for recycling of the DDT contaminated soil. The disadvantages to this remedial technology are that some liability may remain with the ADOT&PF because the contaminated soils are still located on site and the period of time associated with pilot testing and negotiations that may be required to gain its approval.

Excavation of 100 cubic yards of RCRA regulated DDT impacted soils and cold asphalt emulsion recycling: approximately $195,000.

14.3.1.1.2 Concrete Stabilization

This option would entail encapsulation of the DDT and petroleum contaminated material by mixing it with Portland cement and making concrete. The concrete would then be used to pave a potion of the site or to create some other beneficial end product. It has been reported that this method of encapsulation has worked well with PCB-contaminated soils, and may become an approved method in the near future by the EPA for treating these types of soils. A pilot test/mix design study would need to be performed. If high silt content is present in the soils, the cement may prove to be somewhat brittle, and additional rigorous testing may be warranted prior to implementation.

Excavation of 100 cubic yards of RCRA regulated DDT impacted soils and concrete stabilization: approximately $199,000.

14.3.1.1.3 Disposal at a TSD Facility

The proposed method for off-site disposal of the contaminated soils would involve the excavation of the impacted soils and placement of the soils into reinforced super sacks or other suitable containers. The soils would be transported to a TSD facility in the lower 48 states for treatment and/or disposal. The primary advantage of this approach would be the reduction in liability by removing the soils with unacceptable contaminant concentrations.

The disadvantages of this remedial option are that costs for transportation and disposal at a TSD facility in the lower 48 states are significant. Coordination of activities would be important to meet barge schedules for transport.

Excavation of 100 cubic yards of RCRA regulated DDT impacted soils and disposal at a TSD facility: approximately $465,000.

14.3.1.1.4 Capping the DDT Impacted Soil

Capping the area of the DDT impacted soil which exceeds the ADEC cleanup level for ingestion is an alternative to excavation of the soil. For this alternative, the target area would be capped with a minimum of 2 feet of clean fill material to eliminate the ingestion exposure pathway. The advantage of this alternative is greatly reduced costs when compared to the treatment options presented above. The primary disadvantages of this alternative is that soil exceeding referenced standards has not been remediated or removed from the site and has only been buried deeper to eliminate the ingestion cleanup level. Other disadvantages include capping the impacted soil may create problems for building access or use, and future assessment/cleanup activities will be more difficult. The use of this alternative would require an institutional control for the site stating that the integrity of the cap could not be compromised by digging or grading and that the cap must remain in place and be maintained for an indefinite period of time.

Capping of the DDT impacted area west of Building 301: approximately $24,000.

14.3.1.2 Petroleum Impacted Soil

The regulatory determination of the status of DDT impacted soils which do not exceed the cleanup level will significantly affect the remaining soil at the site. If lower concentrations of

DDT are regulated as a RCRA waste, in situ treatment options or one of the options provided above may need to be explored. Applicable in situ options may include bioventing or enhanced soil heating (steam or hot air injection or electro-magnetic/inductive heating) coupled with vapor extraction. For the purposes of this report, we assume that the petroleum hydrocarbon impacted soils which do not contain concentrations of DDT in excess of the ADEC cleanup level will not be regulated as a RCRA waste. The applicable treatment options include excavation of the 240 cubic yards of soil and treatment within a passive or active bioventing cell or excavation of the 60 cubic yards of soil exceeding the MAC with natural attenuation with groundwater monitoring to address the remaining impacted soil. Due to the relatively small volume of soil, thermal desorption is not considered an available option for the 240 or 60 cubic yards of soil. Based on elevated lead concentrations identified by DOWL at one sample location, characterization of the excavated soil for lead by TCLP may be necessary. The estimated costs for these options are outlined in Appendix G and summarized below.

1) Excavation of 240 cubic yards of non-RCRA soils and treatment within a passive bioventing cell: approximately $144,000.

2) Excavation of 240 cubic yards of non-RCRA soils and treatment within an active bioventing cell: approximately $145,000.

3) Excavation of 60 cubic yards of soil exceeding the MAC and treatment within a passive bioventing cell coupled with natural attenuation with groundwater monitoring (four monitoring events): approximately $134,000.

14.3.2 Site 2: Runway Apron

Below the former AST area at the Runway Apron soil contamination exceeding the proposed Method 3 soil cleanup level is estimated at 2,300 cubic yards. Of this volume of soil, we estimate approximately one or two cubic yards of soil exceed the MAC for DRO. At the Disposal Pit Area located northwest of the former AST area, impacted soil, exceeding the proposed Method 3 soil cleanup level for benzene, was encountered in near surface soil at a former material storage area. The extent of the soil impacted by benzene has not been delineated, but did not extend below a depth of 5 feet at our boring location. Because this area has not been delineated we have not included it in our remedial evaluation.

In our opinion, the most practical remedial alternatives for the 2,300 cubic yards of soil below the former AST area include complete excavation and thermal desorption or complete excavation and treatment in a passive or active bioventing cell. In addition, the most appropriate remedial alternative for the impacted groundwater, at this time, is natural attenuation with groundwater monitoring. The estimated costs for these options are outlined in Appendix G and summarized below.

1) Excavation of 2,300 cubic yards and treatment within a passive bioventing cell coupled with natural attenuation with groundwater monitoring (four monitoring events): approximately $318,000.

2) Excavation of 2,300 cubic yards and treatment within an active bioventing cell coupled with natural attenuation with groundwater monitoring (four monitoring events): approximately $325,000.

3) Excavation of 2,300 cubic yards and thermal desorption coupled with natural attenuation with groundwater monitoring (four monitoring events): approximately $480,000.

14.3.3 Site 3: Maintenance Facility, AST Area, and Underground Pipeline Area

Soil contamination exceeding the proposed Method 3 soil cleanup levels at the Maintenance Facility Building is inferred to be limited to near surface soil along the south end of the building. Soil contamination is limited to DRO and an estimated 80 to 90 cubic yards of impacted soil are present. Based on the 1994 groundwater analytical results from Monitoring Well MW-2, the groundwater has not been impacted. At the former AST Area we estimate approximately 510 cubic yards of soil exceed the DRO MAC and an additional 1,400 cubic yards exceed the applicable cleanup levels. The groundwater below the former AST area has been impacted above cleanup levels. We estimate the impacted soil along the former underground pipeline includes approximately 50 cubic yards of soil exceeding the MAC for DRO and an additional 150 cubic yards of soil exceeding the cleanup levels. The groundwater below a portion of the underground pipeline area has been impacted above cleanup levels. In summary, Site 3 is estimated to contain 560 cubic yards of soil exceeding the MAC, an additional 1,640 cubic yards exceeding cleanup levels, and groundwater contamination below the former AST area and a portion of the underground pipeline.

In our opinion, the remedial alternatives applicable to the soils at this site include complete excavation of the impacted soil and treatment by thermal desorption, active bioventing, or passive bioventing or excavation of the soils exceeding the MAC with natural attenuation with groundwater monitoring to address the remaining impacted soil. Due to the apparent limited extent of groundwater contamination, the most applicable remedial alternative for the groundwater is natural attenuation with groundwater monitoring. The estimated costs for these options are outlined in Appendix G and summarized below.

1) Excavation of 2,200 cubic yards and treatment within a passive bioventing cell coupled with natural attenuation with groundwater monitoring (four monitoring events): approximately $317,000.

2) Excavation of 2,200 cubic yards and treatment within an active bioventing cell coupled with natural attenuation with groundwater monitoring (four monitoring events): approximately $324,000.

3) Excavation of 2,200 cubic yards and thermal treatment coupled with natural attenuation with groundwater monitoring (four monitoring events): approximately $467,000.

4) Excavation of 560 cubic yards and treatment within a passive bioventing cell coupled with natural attenuation with groundwater monitoring (four monitoring events): approximately $197,000.

5) Excavation of 560 cubic yards and treatment within an active bioventing cell coupled with natural attenuation with groundwater monitoring (four monitoring events): approximately $208,000.

6) Excavation of 560 cubic yards and thermal treatment coupled with natural attenuation with groundwater monitoring (four monitoring events): approximately $213,000.

14.3.4 Site 4: WAC Site

Based on the alternative Method 3 soil cleanup level for DRO proposed for Site 4, soil contamination exceeding the proposed soil cleanup level is limited to a sample location on the southeast side of the existing AST. E&E identified soil concentrations of 13,000 ppm DRO and 833 ppm lead in surface soils. Up to 1 cubic yard of soil is estimated to exceed the proposed Site 4 Method 3 soil cleanup level for DRO. The soil also exceeds the residential soil cleanup level for lead. Unless the soil can be managed in place through aeration and oxygenation, the most applicable remedial alternatives for this volume of soil alone is generally considered to be excavation, containerization, and transport to Anchorage for thermal treatment. Because the soil was reported to contain elevated lead concentrations, characterization of the soil for lead by TCLP should be performed, if excavated. To manage the soil in-place and raise the lead cleanup level to 1,000 ppm (commercial/industrial standard), it may also be necessary to designate the site as commercial/industrial. Institutional controls may need to be placed on the site to ensure the site meets the commercial/industrial criteria. Based on the de minimus volume of soil exceeding the cleanup level, management of the soil in place seems to be the most practical remedial alternative. Costs for the removal and disposal of this soil are outlined in Appendix G and summarized below.

Excavation of 1 cubic yard of soil with transport to Anchorage, Alaska for thermal treatment and disposal: approximately $9,000.

15.0 RECOMMENDATIONS

The presence of DDT impacted soils at Site 1, ADOT&PF Building 301, complicate the determination of applicable remedial alternatives for this site. Based on our evaluation of remedial alternatives, capping of the DDT impacted soils, which exceed the ADEC cleanup level and are likely to be classified as a RCRA hazardous waste, is the lower cost alternative. However, the feasibility of this alternative and the acceptance of this alternative by site owners as well as regulators should be explored. The status of the remaining petroleum impacted soils containing lower levels of DDT must be determined prior to identifying the most appropriate remedial alternative. It appears that excavation and treatment within either an active or passive bioventing cell are approximately the same cost, if the remaining soils are not determined to be a RCRA hazardous waste. Ex situ treatment within a treatment cell, of course, depends on treatability results, which indicate the DDT concentrations are not toxic to the indigenous microorganisms. Alternatively, based on the technological capability of HAVE or Enhanced Thermal Conduction units to treat non-RCRA DDT, regulatory approval, and other remedial projects in Aniak, thermal desorption becomes a cost effective option. There appears to be no significant cost savings in excavating only the soils exceeding the MAC and allowing the remaining soil contamination to naturally attenuate.

The lower cost treatment alternative for Sites 2 and 3 is passive bioventing within a cell coupled with natural attenuation with groundwater monitoring. The cost for this alternative is approximately $318,000 for each site, with the assumption that treatment is completed within a 10 year period. A potential phased approach at Site 3 would entail the excavation and treatment of approximately 560 cubic yards of soil exceeding the MAC with the remaining soil contamination addressed by natural attenuation with groundwater monitoring. Although treatment within a passive bioventing cell is the lower cost alternative, thermal desorption is estimated at approximately $16,000 higher and would be the recommended approach due to the rapid completion of soil treatment. Additionally, an abandoned well was found at Site 2 at the

Runway Apron site. This well should be properly decommissioned to prevent the well from acting as a conduit for contaminants to reach the groundwater.

Soil contamination at Site 4 is estimated to be limited to a small volume of soil, on the order of 1 cubic yard and the result of a valve or pipe leak. The recommended remedial alternative for this volume of soil is a maintenance check to ensure that ongoing drips or leaks are not occurring and to treat the soil in-place by aeration. Alternatively, the soil could be treated in conjunction with soils from the other sites, as appropriate. The soil was reported to contain elevated levels of lead and treatment in place may require the site to be designated a commercial/industrial site. This designation may require institutional controls to be placed on the site to ensure the use of the site remains commercial/industrial and secured from the general public. Alternatively, to excavate the soil and transport to Anchorage for treatment, we estimate approximately $9,000.

If remedial action is performed concurrently at multiple sites, thermal desorption becomes a favorable alternative. This is due to the rapid and complete treatment of the contaminated soil and the fact that treatment costs decrease with increased volume. Based on our discussion with contractors, mobilizing equipment to the site is the major expense which limits the cost effective treatment of smaller volumes of soil. If addressed on a site by site basis and as noted above, the least cost remedial alternative for Sites 1, 2, and 3 include passive bioventing coupled with natural attenuation with groundwater monitoring (with the exception of Site 1) for a combined total of about $780,000. As outlined in Appendix G, excavation of the soils at Sites 1, 2, and 3 (4,740 cubic yards) and treatment by thermal desorption are estimated at approximately $748,880.

16.0 CLOSURE/LIMITATIONS

This report was prepared for the exclusive use of our client and their representatives in the study of these sites. The findings we have presented within this report are based on limited research and on the sampling and analysis that we conducted at the subject properties as well as the results of assessment activities conducted by others. The findings should not be construed as a definite conclusion regarding the soil and subsurface water quality at these sites. It is possible that our surface or subsurface tests may have missed some higher levels of petroleum hydrocarbon constituents or other parameters, although our intention was to sample areas likely to be impacted. As a result, the sampling and analyses performed can only provide our best judgment as to the environmental characteristics of these sites, and in no way guarantees that an agency or its staff will reach the same conclusions as Shannon & Wilson, Inc. The data presented in this report should be considered representative of the time of the site assessments.

Changes in the conditions of these sites can occur with passage of time, whether they be due to natural processes or the work of man on these sites. In addition, changes in government codes, regulations, or laws may occur. Because of such changes beyond our control, our observations and interpretations for these sites may need to be revised.

The analyses, conclusions, and recommendations contained in this report are based on site conditions as they presently exist and further assume that the explorations (test pits, borings, and monitoring wells) are representative of the subsurface conditions throughout the corresponding site. If subsurface conditions different from those encountered in the explorations are observed or appear to be present within excavations during construction and/or cleanup activities, advise us at once so that we can review these conditions and reconsider our recommendations, as necessary.

The estimated lateral and vertical extent of contaminated soil, and therefore the estimated quantities of contaminated soil, were based on a limited number of soil borings and analytical data. Unanticipated soil conditions are commonly encountered and cannot be fully determined by merely taking soil samples or drilling soil borings. Such unexpected conditions frequently require additional expenditure be made to attain a properly remediated site. Therefore, our estimated costs for remediation should only be considered as rough order of magnitude. In addition, our estimated costs for remediation are based on information provided by contractors and our experience with similar projects and are presented solely for the purpose of providing a rough order of magnitude comparison between alternatives.

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

We appreciate the opportunity to perform these services. Please call the undersigned if you have questions or comments concerning the contents of this report.

Sincerely,

SHANNON & WILSON, INC.

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