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ENSR Project No.: 9010-003-800/9010-008-800

February 15, 1994

Ms. Marietta Paulus
Operational Contracting/LGCV
P.O. Box 875
Elmendorf AFB, AK 99506-0875

Subject: Task 800 Final Report Deliverable for SERA Phase 1A and 1B Site Assessments

Dear Marietta:

25 copies of the Final Report for SERA Phase 1A and 1B are forwarded for distribution to the 3rd SPTG/CEVR. In addition to the 25 copies, one camera ready hardcopy and Word Perfect 5.1 electronic file diskettes of the Final Report are provided. As required by Delivery Order 5004, the results of the SERA Phase 1B site assessment activities have been merged with the SERA Phase 1A results, and submitted within a single combined report.

The Final Report has incorporated final ADEC comments on the February 1, 1994 version of the Final Report, received by ENSR from the 3rd SPTG/CEVR on February 11, 1994.

The Final Report is a deliverable for Task 800 for Delivery Orders 5000 (SERA 1A) and 5004 (SERA 1B) and are identified as Milestone Nos. 60 and 41 respectively in our current Milestone/Deliverable Schedules.

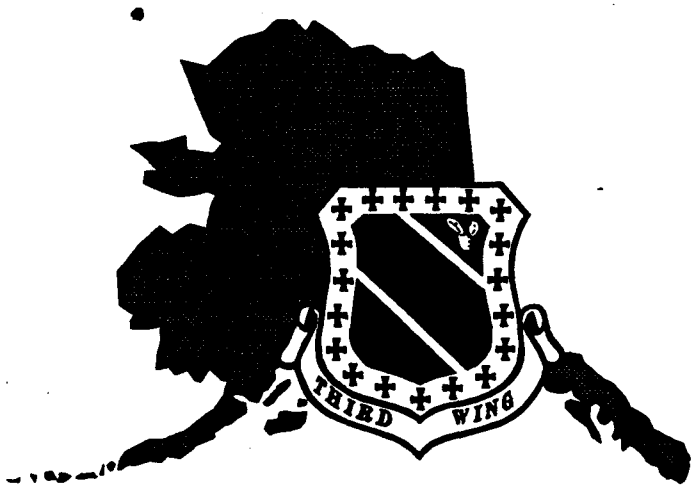
If you have questions, please call us at 561-5700.

Sincerely,

for Jerry Williams
Delivery Order Manager

Chris L. Humphrey, P.E.
Program Manager

Enclosures: a/s
cc: Ellard J Janssen, Anchorage



UNITED STATES AIR FORCE
ELMENDORF AIR FORCE BASE, ALASKA

INSTALLATION RESTORATION PROGRAM

SERA PHASES 1A AND 1B
SITE ASSESSMENT REPORT

FINAL

FEBRUARY 15, 1994

033306

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LIST OF ACRONYMS

AAC	Alaska Administrative Code
AAFES	Army Air Force Exchange Services
ADEC	Alaska Department of Environmental Conservation
ADGGS	Alaska Department of Geological and Geophysical Survey
ADV	Automated Data Validation
AF	Air Force
AFB	Air Force Base
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
ATH	Ambient Temperature Headspace
ATI	Analytical Technologies Inc.
avgas	Aviation Gasoline
B&V	Black & Veatch
bgs	Below ground surface
BH	Borehole
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
C	Celsius
CAP	Civil Air Patrol
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	EPA Contract Laboratory Program
COE	United States Army Corps of Engineers
D&M	Dames and Moore
DC	Drill Cuttings
DRO	Diesel Range Organics
EB	Equipment Blank
ENSR	ENSR Consulting and Engineering
EPA	United States Environmental Protection Agency
EPH	Extractable Petroleum Hydrocarbons
ES	Engineering Science
FAA	Federal Aviation Administration
FD	Field Duplicate
FS	Feasibility Study
GC	Gas Chromatography

LIST OF ACRONYMS (Cont'd)

GC/MS	Gas Chromatograph/Mass Spectrometer
GFAA	Graphite Furnace Atomic Absorption
GPR	Ground Penetrating Radar
GRO	Gasoline Range Organics
HASP	Health and Safety Plan
HLA	Harding Lawson Associates
ICP	Inductively Coupled Plasma Spectroscopy
ID	Inside diameter
IRP	Installation Restoration Program
IRPIMS	Installation Restoration Program Information Management System
J	Data qualifier: analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
JP-4	Jet Fuel
LCS	Laboratory Control Samples
LFI	Limited Field Investigation
LNAPL	Light Nonaqueous Phase Liquid
MB	Method Blank
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
mogas	Motor vehicle gasoline
MRL	Method Reporting Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MSL	Mean Sea Level
OD	Outside diameter
OPTS	Office of Pesticides and Toxic Substances
OU	Operable Units
PCB	Polychlorinated biphenyls
PH	Pumphouse
PID	Photoionization Detector
POL	Petroleum, oil, and lubricants
ppb	Parts per billion
ppm	Parts per million
PVC	Polyvinyl chloride
PZ	Piezometer

LIST OF ACRONYMS (Cont'd)

QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RFI	Remedial Facility Investigation
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RPD	Relative percent difference
SERA	State-Elmendorf Environmental Restoration Agreement
SO	Soil
SOP	Standard Operating Procedures
SOW	Statement of Work
STMP	Storage Tank Management Plan
TAL	Target Analyte List
TB	Trip Blank
TCE	Trichloroethylene
TCL	Target Compound List
TDS	Total dissolved solids
TPH	Total Petroleum Hydrocarbons
U	Data qualifier: Not detected at the reporting limit
UCM	Unresolved complex mixture
UJ	Data qualifier: Not detected at the reporting limit; the reporting limit is an approximate value.
USAF	United States Air Force
USGS	United States Geological Survey
UST	Underground Storage Tank
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
WG	Ground Water
WL	Well
WQ	Water Quality Control Matrix

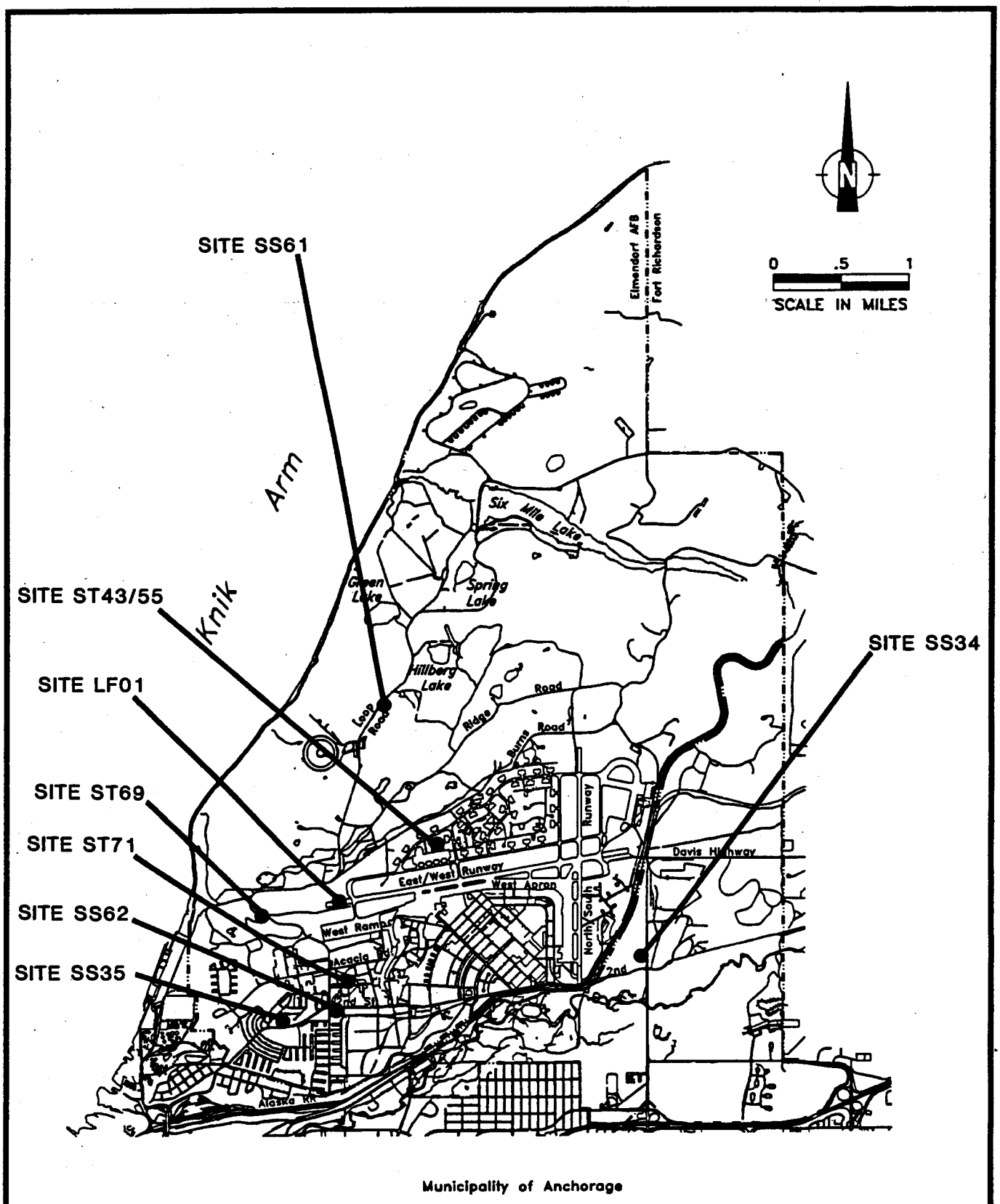
1.0 INTRODUCTION

1.1 Program Description

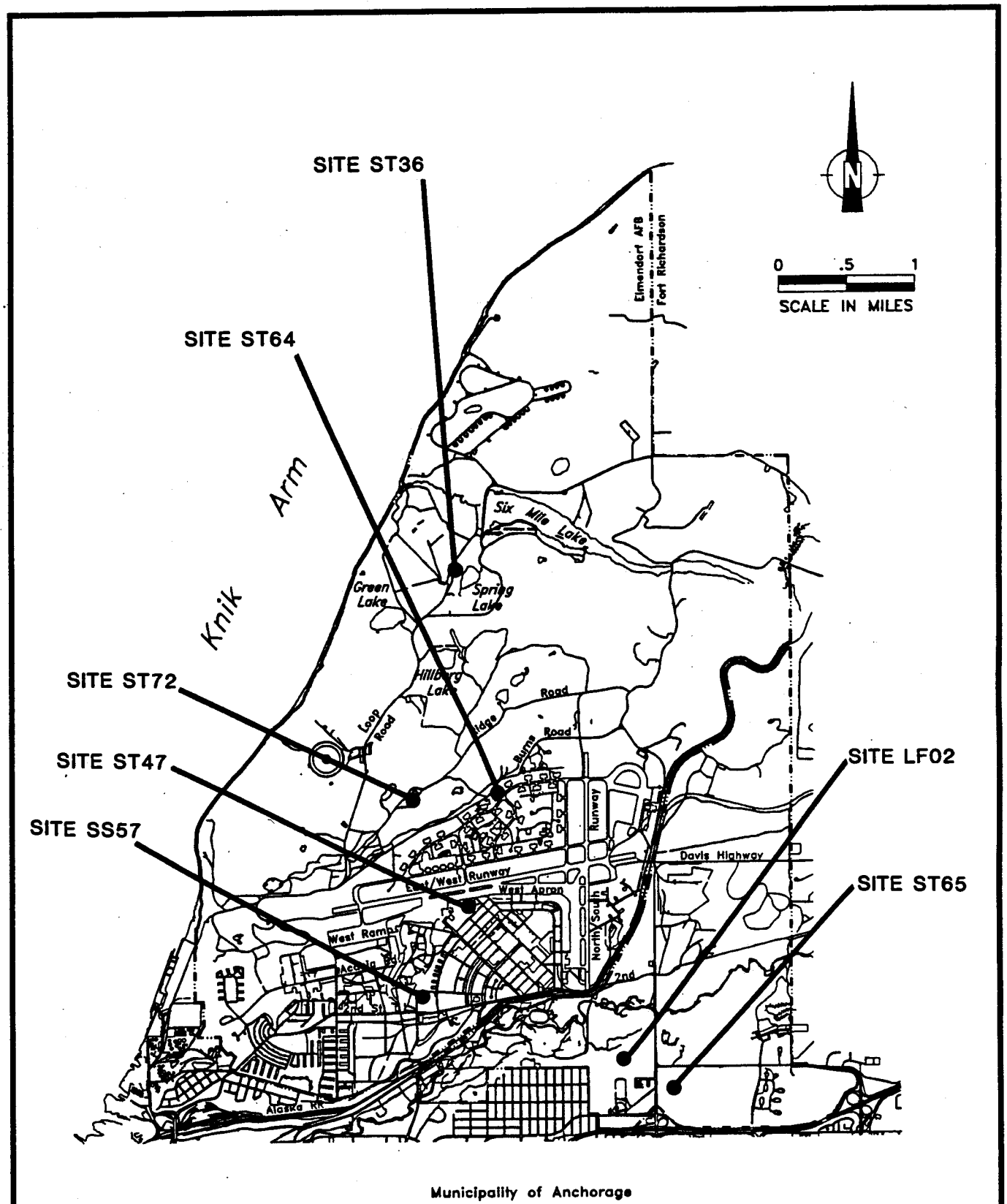
This document comprises a set of site assessment results for 15 SERA Phase 1A and Phase 1B sites at Elmendorf Air Force Base (AFB). The 15 sites are listed below and shown on Figures 1-1 and 1-2:

Site No.	Location
SERA 1A	
ST43/55	Hydrant Refueling Area (formerly designated Pumphouse III)
SS35	Oil-Stained Soil, Paxson Park
SS61	Navy Construction Site
ST69	76-520 Diesel Leak
SS34	Army Air Force Exchange Services (AAFES) Self-Serve Line Leak
SS62	AAFES Service Station
ST71	Leaking Tank, 31-338
LF01	Landfill, West Overrun
SERA 1B	
ST36	Diesel Leak, Vicinity of 62-250
ST47	JP-4 Fuel Leak, Vicinity of 10-875
SS57	Oil-Stained Soil, Vicinity of 32-060
LF02	Landfill/Disposal Site, Vicinity of Boniface Gate
ST64	JP-4 Leak, Vicinity of 42-425
ST65	Diesel Leak, Vicinity of 24-857
ST72	Leaking Tanks, Vicinity of 42-500

The work described here was conducted for the U.S. Air Force (USAF) under a cooperative agreement with the State of Alaska Department of Environmental Conservation (ADEC) addressing the assessment and remediation of solid waste and petroleum, oil, and lubricants (POL) contaminated sites at Elmendorf AFB. This agreement originated in October 1992 and is known as the State-Elmendorf Environmental Restoration Agreement (SERA).



DRAWING: F3605 DRAWN: ABB/SR C/SC: 1:5500 DISK: NET9/93 DATE: 09/22/93 CHECK: D.G.	FIGURE 1-1 COMPOSITE SITE LOCATION MAP SERA PHASE 1A	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800



DRAWING: F3605 DRAWN: ABB/SR C/SC: 1:5500 DISK: NET9/93 DATE: 09/22/93 CHECK: D.G.	FIGURE 1-2 COMPOSITE SITE LOCATION MAP SERA PHASE 1B	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-008-800

This report is based on both the SERA 1A and SERA 1B Work Plans, Health and Safety Plans (HASP), and Quality Assurance Project Plans (QAPP), as approved by ADEC.

Only 15 of the 16 sites proposed for investigation in the SERA Work Plans have been studied during the 1993 field program. Site ST66 was deleted from the investigation when fuel tank removal at the site was postponed until after the end of the 1993 SERA field program. The investigation planned for this site has been deferred until the 1994 SERA field program.

1.2 Objectives

The objectives of these assessments were to investigate POL releases and solid waste sites, and to develop an information base for determining how the sites should be administered. Alternative categories of administration actions include:

- transferred to an Operable Unit (OU) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program for inclusion with a previously identified condition;
- closed outright (no further action);
- closed through a risk assessment process;
- closed based on a leaching assessment;
- cleaned up through natural attenuation; or
- actively cleaned up under a site-specific remediation program.

The assignment to one of the above categories has been recommended after verification of the nature and sources of contamination, delineation of the vertical and areal extent and degree of contamination at each site, and through evaluation of any cross-contamination with other sources.

1.3 Approach

The approach taken to reach the objectives of providing information necessary for a decision of selection for each site administration included preparation and implementation of site-specific work plans. Each site work plan targeted the reported contamination with a program of subsurface investigation designed to determine the areal limits of contamination, a sampling and analytical program to identify the nature and concentration of contaminants, and an evaluation program to assemble and interpret the findings for use in developing the best solution for the elimination of the site as an area of concern to the satisfaction of both the USAF and the State of Alaska.

2.0 FIELD INVESTIGATION METHODS

2.1 General

This section details the field methods and techniques used for soil borings, monitoring well installations, and collection, handling and shipping of samples. A summary of the soil borings and wells installed at the SERA 1A and 1B sites is presented in Table 2.1.

2.2 Field Activities

2.2.1 Underground Utility Locates

Each site was cleared for underground utilities prior to the installation of soil borings, monitoring wells, or other underground work. A Base Civil Engineering Work Clearance Request AF Form 103 was completed for each site and approved by the office of the Chief of Operations prior to initiating work.

2.2.2 Visual Inspection

Visual inspection at and in the vicinity of each site included observations of surficial and subsurface features and conditions.

The surficial inspections included site reconnaissance to assess areas that exhibited unusual soil conditions, stressed vegetation, stained soil, or water with a sheen. Such conditions were noted during the site reconnaissance and marked for attention. Field action may have included relocation of proposed soil boring or monitoring well locations to areas of interest or to avoid underground or overhead utilities.

Subsurface inspections were conducted during the drilling of soil borings and monitoring wells. Optional or additional borings or monitoring wells were added to the field program at several sites to better define the limits of contamination.

Soil samples collected during drilling activities were classified using the Unified Soil Classification System and described by color, texture, moisture content, grain texture, sedimentary features, staining, and odors noted during field activities.

Table 2.1. Summary of Soil Borings and Monitoring Well Installations.

Phase	Site	Soil Borings	Monitoring Wells
		Number Completed	Number Completed
1A	ST43/55	37	3
1A	SS35	--	--
1A	SS61	3	2
1A	ST69	3	3
1A	SS34	4	--
1A	SS62	9	2
1A	ST71	4	2
1A	LF01	--	3[1]
1B	ST36	2	2
1B	ST47	5	1
1B	SS57	0	2
1B	LF02	0	5
1B	ST64	4	3
1B	ST65	2	3
1B	ST72	3	3
	TOTAL	**76**	**34**

[1] Includes two monitoring wells and one piezometer.

Surficial and subsurface observations were recorded in field logbooks or on appropriate forms such as well development or water sampling activity sheets. Photographs were taken at several locations for documentation purposes.

2.2.3 Sample Control

All samples collected during this field investigation were assigned unique field-sample tracking numbers using an alphanumeric numbering system. This system was developed to allow for sample control of a large number of samples. Each sample tracking number consists of a five-segment alphanumeric code that identifies the sampling site and location, the sampled medium, the depth of sample, and the quality control (QC) identifier. The sample numbers were based on the requirements for the USAF Installation Restoration Program Information Management System (IRPIMS). Many of the identifiers were created as outlined in the IRPIMS Data Loading Handbook.

The number system follows:

Location Designation

The sites under investigation have a 2-character code. The codes are as follows:

Site Location	IRPIMS Site I.D.
Site ST43/55, Hydrant Refueling Area	43
Site SS35, Oil-Stained Soil, Paxson Park	44
Site SS61, Navy Construction Site	45
Site ST69, 76-520 Diesel Leak	46
Site SS34, AAFES Self-Serve Line Leak	47
Site SS62, AAFES Service Station	48
Site ST71, Leaking Tank, 31-338	49
Site LF01, Landfill, West Overrun	42
Site ST36, Diesel Leak	56
Site ST47, JP-4 Fuel Leak	55
Site SS57, Oil-Stained Soil	54
Site LF02, Landfill/Disposal Site	53
Site ST64, JP-4 Leak	52
Site ST65, Diesel Leak	51
Site ST72, Leaking Tanks	57

The next four digits represent the location within the sites where the samples were obtained. The following lists the codes that are used in this investigation:

BH-# = Borehole
WL-# = Monitoring Well
PZ-# = Piezometer

The next two digits define the sampling matrix. These codes are detailed in the IRPIMS Data Loading Handbook. Below is a listing of the codes that were used in this investigation:

WG = Groundwater
SO = Soil

The next digits indicate the depth below ground surface (bgs) to the top of the sample collection interval in feet and tenths of feet: e.g., 2.5 or 17.5 (does not apply for water samples).

The next set of digits represents the field sample types. These codes are assigned by IRPIMS in the Data Loading Handbook.

Below is a listing of codes used in this investigation:

FD# = Field Duplicate
N# = Normal Environmental
TB# = Trip Blank
MS# = Matrix Spike

2.2.4 Sample Collection Procedures

2.2.4.1 Subsurface Soil Sampling

Subsurface soils were sampled from each boring. The soil borings were advanced using a truck- or track-mounted, 4.25-inch inside diameter (ID), hollow-stem auger drilling rig. Soil samples were collected using a 2.5-inch ID split-spoon sampler equipped with three or four 6-inch-long stainless steel or brass liners.

Soil samples were generally collected at 2.5-foot intervals above the water table unless ground conditions resulted in no recovery or refusal of the sampler.

After the sampler was driven to the desired depth, the sampler was removed from the borehole and opened. One or two liners were capped and taped, and collected for laboratory analysis. The exact number depended on the type of analysis to be conducted at the boring location. The contents of one liner was placed into a resealable bag for ambient temperature headspace (ATH) analysis. The remaining liner was extracted and used for lithologic description along with the contents of the ATH sample.

The split-spoon sampler was decontaminated between each sample collection event, as described in Section 2.2.5.

Each sample was logged on a chain-of-custody form and all observations were entered onto a boring log. All samples selected for laboratory analysis were labeled and placed in coolers with ice, then transported to the analytical laboratory under proper chain-of-custody protocol.

All soil borings were backfilled with bentonite grout and capped with concrete. A piece of iron was secured in the concrete, flush at ground surface, for future location with a metal detector if necessary.

All cuttings from the soil borings were containerized in steel drums, awaiting laboratory results to determine disposal destination as outlined in Section 2.4.

2.2.4.2 Monitoring Well Installation

Monitoring wells were constructed and completed in the designated borehole(s) at each site. Monitoring wells were constructed of pre-wrapped, Schedule 40 polyvinyl chloride (PVC) screen (0.02-inch) with Schedule 40 PVC riser pipe. The screen and riser pipe are flush-joint, threaded PVC. No PVC glue or solvent was used in the installation.

The bottoms of the screened sections are capped. The screen was generally placed so that approximately 2 to 5 feet of the screen extended above the water table, except where site conditions such as very shallow groundwater precluded this configuration. The screened section was backfilled with #10 - 20 silica sand filter pack material. The sand was placed by slowly pouring it into the annular space between the well casing and the auger. The sand pack was installed to extend approximately 2 feet above the top of the screened interval.

A minimum 2-foot-thick bentonite pellet seal was placed on top of the sand pack. The annulus above the bentonite seal was filled with a bentonite grout.

The wells have been completed with either a flush-mounted, 9-inch manway with watertight covers, and well casings secured with locking, watertight well plugs (expandable plugs), or with an above-grade (approximately 42 inches) locking, 4-inch-diameter protective steel casing. Each well is stamped with the well number or has a brass tag attached with the well number stamped on it. Each well location was set in a 2-foot-diameter or 2-foot by 2-foot square concrete pad approximately 4 inches thick.

2.2.4.3 Monitoring Well Development

Each monitoring well was developed by surging, bailing, and/or pumping. Wells were developed at least 24 hours following completion to allow sufficient time for the concrete to cure. During development, each well volume of purged water was measured for pH, specific conductivity, and temperature. These measurements, and water clarity, were recorded in the field logbooks. Each well was considered developed when:

- The pH, specific conductivity, and temperature readings were all within 10 percent of previous measurement after purging six consecutive borehole volumes, and the discharge was reasonably clean and free of silt, or
- The well was bailed or pumped dry three times in succession.

2.2.4.4 Groundwater Sampling

Each monitoring well was sampled at least 24 hours after well development following the procedures discussed below.

- Prior to any groundwater sampling, wells were measured with an oil-water interface probe or a tape and petroleum detection paste to determine the potential presence and thickness of light, nonaqueous phase liquid products (LNAPL) in the well.
- The static water levels and the total depths of each well were measured.
- At least three well volumes were purged from each well.
- Disposition of produced water is discussed in Section 2.4.

- pH, specific conductivity, and temperature measurements were collected after each well volume was removed. When three consecutive pH, specific conductivity, and temperature measurements were within 10 percent of previous measurement, the well was considered adequately purged.

- All samples were collected using a disposable bailer, or a pump in the case of a production well.

- The following information was collected and recorded each time a well was purged or sampled:

  - The presence of LNAPLs and the thickness of the product;
  - Depth to water and total depth of the well;
  - Visual condition of each well and water purged from the well;
  - Field parameter results: pH, specific conductivity, and temperature; and
  - Amount of water purged.

- Quality control samples were collected at a frequency of 10 percent for field duplicates and at a frequency of 5 percent for matrix spike/matrix spike duplicates (MS/MSD). Trip blanks were included in shipments of water samples scheduled for volatile organic analyses.

- All groundwater samples collected were labeled, stored in a cooler at approximately 4°C, and shipped to the analytical laboratory under chain-of-custody procedures.

2.2.4.5 Soil Vapor Survey

A soil vapor survey for the Paxson Park site (SS35) was conducted employing a Photovac Model 10S50 portable gas chromatograph (GC) to collect and analyze soil gas samples. The probe channel was advanced to approximately 30 inches bgs using a drop hammer. A specially constructed, 36-inch-long, stainless steel probe was then manually inserted into undisturbed soil to a depth of approximately 36 inches bgs.

The probe was attached to the GC using a Teflon™ sample line, and the soil gas was directly injected into the analytical column and analyzed by the GC. Soil vapor data are qualitative and not related to an exact concentration of volatile organic compounds (VOCs) in the soil.

2.2.5 Decontamination

All nondedicated equipment used during the field program was decontaminated prior to and after each use. Drilling, sampling, and monitoring well installation equipment was decontaminated using the following procedures:

- Drill rigs, drill augers, drill bits, and drill rods were steam cleaned prior to use and between borings, except where a boring location was moved a short distance because of auger refusal.

- Sampling equipment--including split spoon samplers, trowels, hand augers, well sounders, steel tapes, water quality probes, bailers, etc.--were cleaned by washing with a potable water and Alconox solution, rinsing with methanol, rinsing with deionized water, and allowed to air dry.

- Casings, screens caps, couplings, and covers were steam cleaned prior to installation, unless the material was in the factory packaging.

- Personal decontamination procedures were implemented as detailed in the HASP.

2.2.6 Sample Processing and Handling

2.2.6.1 Sample Packaging

Plastic bubble wrap was used to line the bottom of shipping coolers and to wrap samples. Completed chain-of-custody forms were placed inside a plastic bag and secured to the inside of the respective coolers. Cold packs were placed with and on top of the samples to maintain sample temperature at approximately 4°C. Coolers were sealed with chain-of-custody tape, and packaging tape was placed around the cooler using a minimum of two full wraps.

2.2.6.2 Sample Shipping

Samples were accompanied by the chain-of-custody forms as detailed above. When a transfer of samples occurred, the chain-of-custody form was completed with the name of the person relinquishing the samples and the signature and date of the person receiving the samples. All shipping documentation has been retained in the project files.

2.2.7 Field Equipment Calibration

All equipment used during the field investigation was calibrated daily in accordance with the manufacturer's instructions. All calibration data, including the numerical value and units of each measurement, were recorded. Equipment was calibrated before and during use if required or if suspected to be out of calibration.

2.2.8 Ambient Temperature Headspace Measurement

Ambient temperature headspace (ATH) measurement was used as a screening method to assist in sample selection for laboratory analysis and for determining the relative amounts of volatile compounds in the soil.

Representative soil samples were collected in resealable bags, sealed, and set aside in a temperature-controlled space (generally, a vehicle) maintained at approximately 60° to 70°F. After reaching ambient temperature, a photoionization detector (PID), calibrated to 100 parts per million (ppm) isobutylene, was used to measure the apparent concentration of volatile compounds. PID readings for each ATH sample were recorded in field logbooks and reported on boring logs.

2.3 Soil and Groundwater Sampling Summary

All subsurface soil samples collected from the borings and monitoring wells installed during this project are summarized in Table 2.2.

All groundwater samples collected from the installed and existing monitoring wells are summarized in Table 2.3.

Additional field duplicate and MS/MSD samples were collected as specified in the QAPP.

2.4 Disposition of Investigation-Derived Wastes

Water produced during drilling, construction, and development of monitoring wells; purged water from sampling of the monitoring wells; and decontamination water was transported to the staging area for conditioning through the on-site conditioning system before discharge to the sanitary sewer system. Discharge water samples were collected from the conditioning system and analyzed in accordance with specifications in the *Basewide Environmental Staging Facility Operation and Maintenance Plan* (USAF 1993d) for the conditioning system. Analyses included total petroleum hydrocarbons (TPH) by U.S. Environmental Protection Agency (EPA Method

Table 2.2. Quantities and Types of Analyses for Soil Samples.

Phase	Site	DRO (Method 8100M)	GRO (Method 8015M)	GRO/BTEX (Methods 8015M/ 8020)	BTEX (Method 8020)	VOC (Method 8240)	Lead (Method 6010)	8 RCRA Metals (Method 6010)
1A	ST43/55	74	--	74	--	--	--	--
1A	SS35[1]	--	--	--	--	--	--	--
1A	SS61	10	--	--	10	--	--	--
1A	ST69	12	--	--	12	--	--	--
1A	SS34	8	--	8	--	--	--	--
1A	SS62	16	--	16	--	5	5	4
1A	ST71	12	--	12	--	--	--	--
1A	LF01	6	6	--	--	6	--	--
1B	ST36	12	--	--	12	--	--	--
1B	ST47	14	--	--	14	--	--	--
1B	SS57	8	--	8	--	--	--	--
1B	LF02	12	12	--	--	12	--	12
1B	ST64	14	--	14	--	--	14	--
1B	ST65	14	--	--	14	--	--	--
1B	ST72	14	--	--	14	--	--	--

[1] Soil vapor survey site.

Key: BTEX = Benzene, toluene, ethylbenzene, and total xylenes.
DRO = Diesel range organics.
GRO = Gasoline range organics.
RCRA = Resource Conservation and Recovery Act.
VOC = Volatile organic compounds.

Table 2.3. Quantities and Types of Analyses for Groundwater.

Phase	Site	DRO (Method 8100M)	GRO (Method 8015M)	GRO/BTEX (Methods 8015M/ 8020)	BTEX (Method 8020)	VOC (Method 8240)	Lead (Method 7421)	8 RCRA Metals (Method 6010)
1A	ST43/55	7	--	7	--	--	--	--
1A	SS35[1]	--	--	--	--	--	--	--
1A	SS61	6	--	--	6	--	--	--
1A	ST69	3	--	--	3	--	--	--
1A	SS34	2	--	2	--	--	--	--
1A	SS62	2	2	--	--	2	--	--
1A	ST71	2	--	2	--	--	--	--
1A	LF01	2	2	--	--	2	--	2
1B	ST36	3	--	--	3	--	--	--
1B	ST47	3	--	--	3	--	--	--
1B	SS57	4	--	4	--	--	--	--
1B	LF02	5	5	--	--	5	--	5
1B	ST64	3	--	3	--	--	3	--
1B	ST65	3	--	--	3	--	--	--
1B	ST72	3	--	--	3	--	--	--

[1] Soil vapor survey site.

Key: BTEX = Benzene, toluene, ethylbenzene, and total xylenes.
DRO = Diesel range organics.
GRO = Gasoline range organics.
RCRA = Resource Conservation and Recovery Act.
VOC = Volatile organic compounds.

418.1 and VOCs by EPA Method 8240. No volatile organic or TPH compounds were detected in the samples analyzed. All soil generated during this investigation (i.e., drill cuttings) was containerized in drums at the time of drilling. The containers of soil were transported to the staging area for storage while awaiting analytical data.

All drums of soil were labeled with a permanent marker listing the date and time of sampling, soil boring or monitoring well location, contents, and the Elmendorf Point-of-Contact with telephone number.

Soil contaminated to levels above the ADEC Level A cleanup criteria for underground storage tank (UST) locations was stockpiled at a location provided by USAF in the landfill area east of the Davis Highway. Sludge or siltation from the water generated during well development and sampling was also stockpiled within the containment. The stockpiled soil was placed in a bermed and lined containment area and covered with plastic sheeting secured so that the stockpile will remain covered. Soil not considered contaminated according to the criteria of Level A of the soil cleanup level matrix was disposed of in the USAF fill area located to the east of the Davis Highway.

2.5 Surveying

Monitoring wells installed or sampled for this investigation have been surveyed by an Alaskan-registered surveyor. All survey data have been established relative to the Municipality of Anchorage datum and the USAF identified benchmark (TTAN7) located on Elmendorf AFB. The vertical datum used for this survey is based on Municipality of Anchorage bench marks CB 9E, E 74, F 74, and leveling through TTAN7. The datum for these bench marks is NGS 1972 adjusted. This control is the same datum used for the 1986 Elmendorf Master Plan. Groundwater flow directions have been calculated based on the data from surveyed well locations and depth to water measurements in the wells at the time of sample collection.

The control survey data are presented in Appendix D.

2.6 SESOIL Modeling

The objective of modeling leachability and groundwater transport at Elmendorf AFB landfills LF01 and LF02 was to determine the likelihood that contaminants, potentially present in the landfills, have migrated or may migrate in the future to the underlying aquifer, resulting in contamination of the aquifer and potential human health risk via consumption of groundwater.

Both on-site groundwater sampling and numerical modeling using an unsaturated zone, chemical fate, and transport model were used in this assessment. Monitoring well sampling was performed to determine the current impact of potential chemical contribution of landfill-derived porewater to the aquifer. Numerical modeling was performed to provide time estimates for potential contaminants to migrate into groundwater and to provide perspective on the system water balance.

Modeling was conducted using compounds representative of those considered to be possibly present in a landfill of this nature. Identification of the content of landfills was not a part of this investigation. Evaluation of groundwater upgradient and downgradient was used as a basis for the model.

The SESOIL unsaturated zone, chemical fate, and transport model was selected for use in this application. The SESOIL model is a Seasonal Soil Compartment Model developed by Bonazountas and Wagner (1984) for the Office of Pesticides and Toxic Substances (OPTS) of the EPA. The SESOIL model estimates the rate of chemical transport/transformation in the soil column in terms of mass and concentration distribution among the soil, water, and air phases in the unsaturated soil zone. The soil column is defined as a compartment that extends from the soil surface through the unsaturated zone to the groundwater table. SESOIL's hydrocycle approach employs an analytic solution of annual "Water Balance Dynamics" (Eagleson 1978) that couples climate, soil, and vegetation of the system through statistically based modeling. SESOIL is capable of simulating multiple soil layers.

The SESOIL model was used to provide estimates of travel time for porewater from former landfills to the groundwater table and of the rate of water flux (i.e., volume/time) to groundwater from each former landfill. SESOIL requires chemical, soil, physical, and climate input parameters. In order to estimate travel time of water through the unsaturated zone, the chemical parameters of a hypothetical tracer were applied. The hypothetical chemical simulated had high solubility in water, low soil adsorption, and a retardation factor of approximately 1.0, so that it moved at approximately the rate of porewater through the unsaturated zone. Thus, it was used to determine the time necessary for water to travel from the landfill to the water table.

3.0 SITE INVESTIGATIONS

3.1 Site ST43/55, Hydrant Refueling Area (IRPIMS Site 43)

3.1.1 Introduction

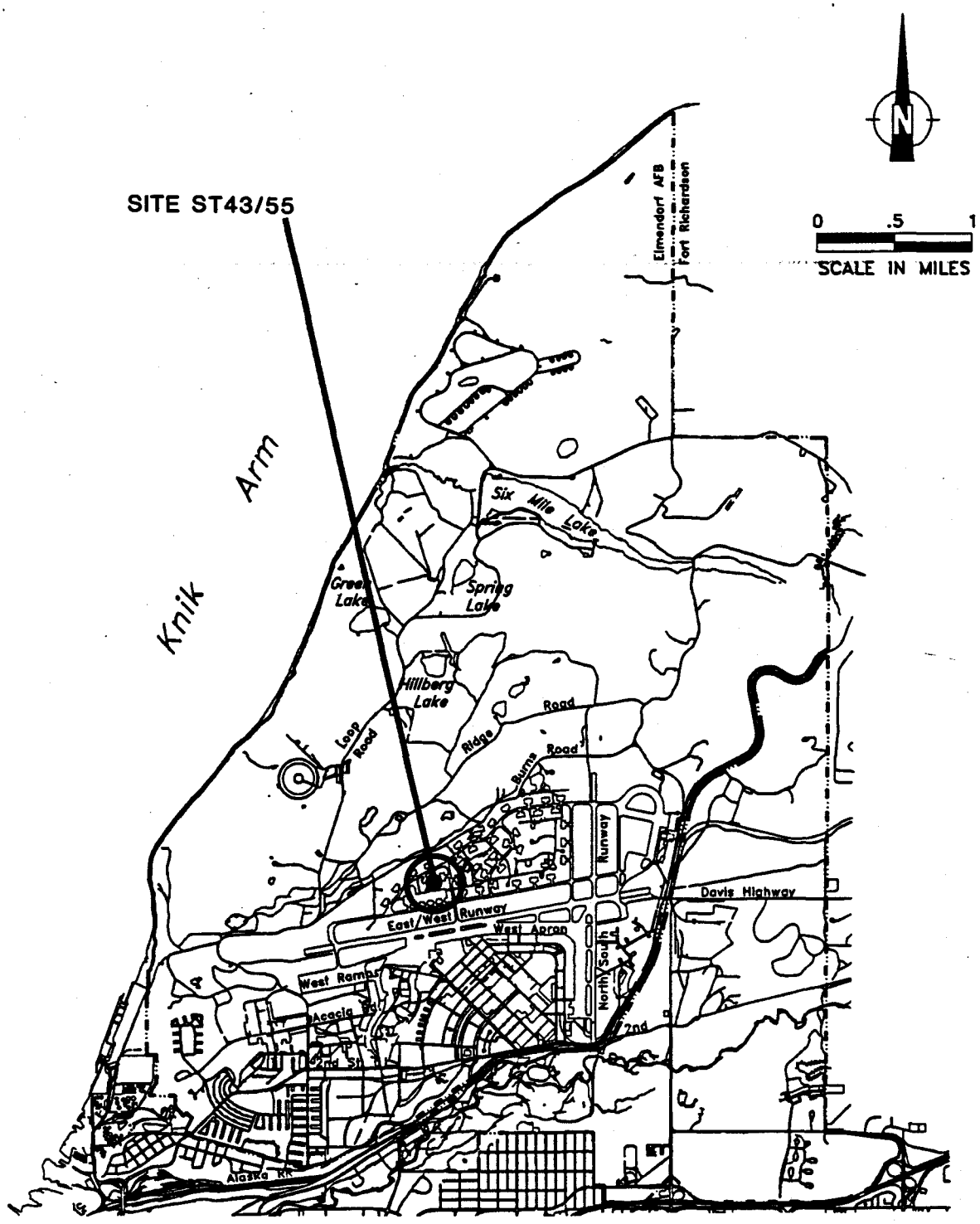
Site ST43/55, the hydrant refueling area, is located on the north side of the east/west runway at Elmendorf AFB. Figure 3-1 presents the general location of the site. The site is comprised of various pumphouse buildings, underground hydrant refueling lines, and parking areas. The area is bounded on the north and west by Taxiway 6, on the east by Taxiway 2, and on the south by Aircraft Ramps A-38, A-39, and A-40 (Figure 3.1-1). The ground surface in this area consists of gravel and grass, asphalt, or concrete.

ST43/55 is located in a glacial outwash area comprised of sand and gravel underlain by the Bootlegger Cove Formation, which includes layers of densely packed silt and clay. Apparently, no prior subsurface investigation has conducted beneath a depth of 40 feet bgs. The majority of previously installed borings and wells were terminated at depths between 25 and 30 feet bgs in sand and silt. The interpreted confining layer has not been reached or confirmed. A review of existing drilling logs for the area indicates coarse sand and gravel underlain by fine sand below approximately 30 feet.

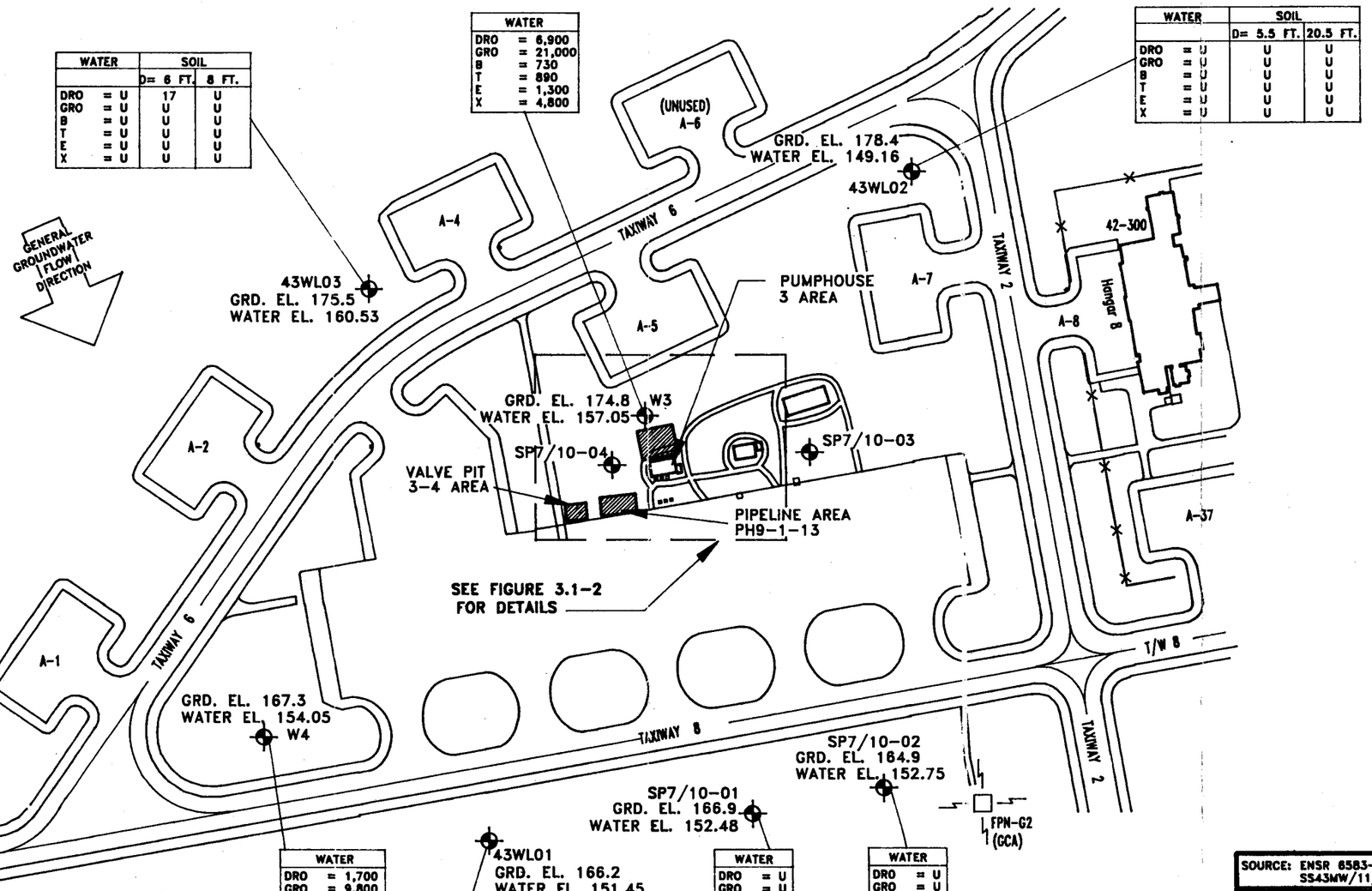
USAF personnel and facility records indicate that Pumphouse III (PH3) has been the location of numerous spills of jet fuel (JP-4) in the past. In 1964, a 50,000-gallon release of JP-4 occurred due to a pump failure. In 1980, a 36,000-gallon release occurred during the refueling of a C-5 aircraft due to a malfunctioning valve on the east side of Pit 3-4. In both cases, the fuel infiltrated the soil before any response could be initiated.

PH3 currently has seven USTs containing JP-8 in use: No. 67 - 25,000 gallons; No. 68 - 50,000 gallons; No. 69 - 50,000 gallons; No. 70 - 50,000 gallons; No. 71 - 50,000 gallons; No. 72 - 50,000 gallons; and No. 73 - 50,000 gallons.

Following the 1980 release, soil in the spill area was excavated to a depth of 13 to 14 feet--the excavation limit of the backhoe. The soil remained saturated with fuel when excavating activities ceased at that limit. An estimated 70 gallons of the spilled fuel was recovered from a manhole located approximately 100 feet from Pit 3-4.



DRAWING: F3605 DRAWN: ABB/SR C/SC: 1:5500 DISK: NET9/93 DATE: 09/22/93 CHECK: D.G.	FIGURE 3.1 LOCATION MAP SITE ST43/55	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800



LEGEND

MONITORING WELL

D = SAMPLE DEPTH
DRO = DIESEL RANGE ORGANICS
GRO = GASOLINE RANGE ORGANICS
B = BENZENE
T = TOLUENE
E = ETHYLBENZENE
X = TOTAL XYLENES
U = UNDETECTED

NOTE: ANALYTICAL WATER RESULTS REPORTED AS µg/l
ANALYTICAL SOIL RESULTS REPORTED AS mg/kg

SOURCE: ENSR 6583-118/ST43SSB.DWG/TNH/5179_2D/9010-003/SS43MW/11/10/93

3RD SPTG/CEVR
ELMENDORF AFB, ALASKA

FIGURE 3.1-1
MONITORING WELL, SOIL BORING LOCATIONS AND ANALYTICAL RESULTS FOR SERA PHASE 1A SITE ST43

DATE: 01/17/94	DRAWN BY: SR/ABB	SCALE: AS SHOWN	DRAWING: ST43MW4
C/SC: 1:300 DISK: 836/93	ENGINEER: C. HUMPHREY	CHECKED: J. WILLIAMS	PROJECT: 9010-003-800

033350

There have been several previous investigations at the site as a part of a remedial investigation (RI) for Operable Unit (OU) 4. These investigations resulted in the installation of six groundwater monitoring wells: W-3, W-4, SP7/10-01 through 04.

The hydrant refueling area dispenses JP-4 (recently converted to JP-8) in the servicing of aircraft. A number of USTs and hydrant underground piping systems are located within this area. Leak testing was in progress during the 1993 field program. The hydrant dispensing system and associated underground pipelines, which run through the area, were tightness-tested for leaks between October and December 1992. Leak tests were conducted to determine the integrity of the hydrant system. Results of these tests indicated that leaks may have occurred at various points along the system.

A soil vapor survey was conducted concurrently with the leak testing along the hydrant system. The soil vapor survey indicated that high levels of petroleum hydrocarbon vapors were present throughout the area. Some were adjacent to suspected leaks, other areas of hydrocarbon vapors were not associated with detected leaks.

The contaminants of concern for the area are diesel range organics (DRO), gasoline range organics (GRO), and benzene, toluene, ethylbenzene, and total xylenes (BTEX).

3.1.2 Objectives

The objectives of the assessment at site ST43/55 were to:

- Assist in locating hydrant line leaks;
- Assess if past releases, spills, and leaks have impacted the soil at the site;
- Investigate the horizontal and vertical extent of any impacted soils; and
- Evaluate if this contamination is impacting the groundwater.

3.1.3 Field Investigation

Three separate sub-sites were investigated at site ST43/55. Valve Pit 3-4, PH9-1-13, and PH3 were each investigated by advancing a series of borings in a grid pattern around each location. Figure 3.1-2 presents the site plan showing sub-site locations with monitoring well and soil borings. Data were also collected from existing wells to help determine the extent of impacted groundwater and site-specific groundwater flow direction.

3.1.3.1 Soil Borings

A total of 37 soil borings were drilled and sampled at site ST43/55. The locations of the soil borings are presented in Figure 3.1-2. A grid of 12 borings was drilled and sampled near the Valve Pit 3-4 area. The borings were advanced to a depth of approximately 20 to 24.5 feet bgs where groundwater was encountered. Three of the borings (43BH04, 43BH05, and 43BH08) were completed as part of a bioventing study being conducted by another USAF contractor.

Eleven borings were drilled and sampled around pipeline area PH9-1-13. The first row of borings north of the leak location were shifted approximately 10 feet north due to the unexpected presence of soil piles in the area of the intended locations. Each boring was advanced to groundwater (approximately 19 to 25 feet bgs).

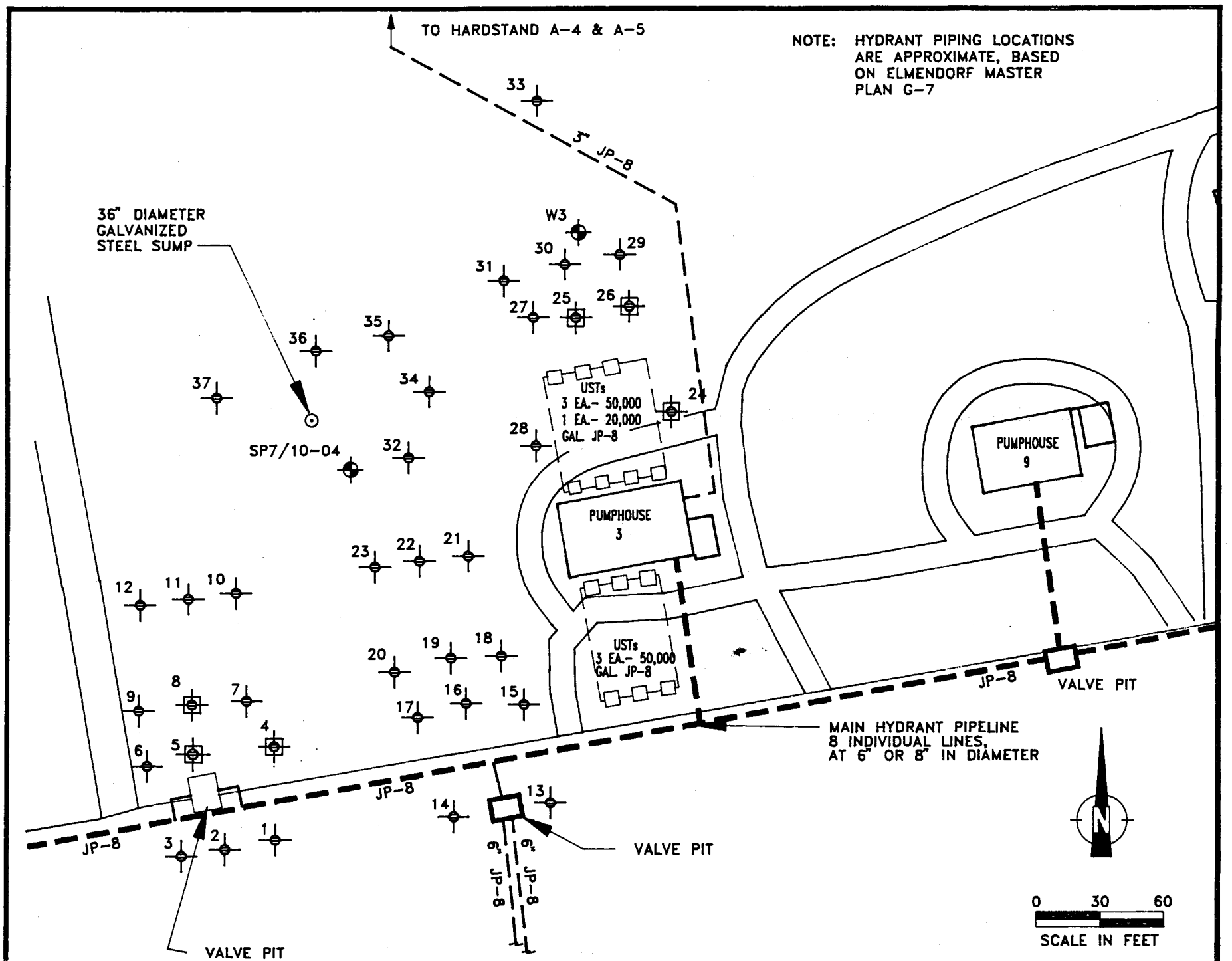
The subsurface of area PH-3 was characterized by drilling and sampling eight borings east, west, and north of the tank locations. Borings were originally planned to be oriented in a 25 ft^2 grid; however, the presence of POL lines and water lines resulted in an irregular configuration. Borings were advanced to approximately 19.5 feet bgs where groundwater was encountered. Boring logs are presented in Appendix A.

Following a preliminary review of the PH3 area analytical data and field screening results, an additional six borings (43BH32 through 43BH37) were drilled and sampled to better define the horizontal extent of impacted soils at the general site location. These borings were also advanced to depths of approximately 19.5 feet bgs, where groundwater was encountered.

Soil samples were laboratory analyzed for the presence of DRO, GRO, and BTEX compounds. The analytical results are presented in Appendix B and summarized in Table 3.1-1.

3.1.3.2 Groundwater Monitoring Well Installation and Sample Collection

Three groundwater monitoring wells were installed in the vicinity of ST43/55 (Figure 3.1-1). Well 43WL01 was installed downgradient between Taxiway 8 and the East-West Runway west of well SP7/10-01 to a depth of 21.1 feet bgs. Well 43WL02 was installed near the intersection of Taxiway 2 and Taxiway 6 to a depth of 29.8 feet bgs. Well 43WL03 was originally drilled 25 feet bgs into clay; however, this boring was abandoned. The well was not installed in this borehole; instead, another boring was advanced approximately 2 feet away to a depth of 11.5 feet bgs, and the well was installed to 11.0 feet bgs based on the interpreted water depth from the original boring. Shallow, fine-grained soil proved to be thicker than anticipated. The well location was relocated to avoid including the fine-grained interval within the screened section of the well. Well construction diagrams are included on the boring logs presented in Appendix A.



BORING	DEPTH IN FEET	DRO	GRO	B	T	E	X	BORING	DEPTH IN FEET	DRO	GRO	B	T	E	X
1	11.0	U	U	U	.063	U	.066	20	3.5	31	80	U	.069	.46	.65
1	18.5	78	150	.047	.73	1.1	5.1	20	18.0	96	960	U	7.4	5.8	31
2	8.5	U	U	U	U	U	U	21	3.5	850	450	.12	.49	.9	2.5
2	16.0	U	U	U	.04	U	.043	21	18.5	390	1,200	1.5	11	8.5	43
3	13.0	U	U	U	.043	U	.041	22	10.5	240	290	.15	.58	.72	1.9
3	18.0	550	1,100J	.54	18J	3.8	52J	22	18.0	1,100	1,600	4	13	17	92
4	5.5	U	U	U	.034	U	.033	23	6.0	U	U	U	U	U	.064
4	16.0	190	160	U	.17	.96	2.9	23	18.0	130	680	U	.67	1.6	11
5	8.5	U	U	U	.063	.035	.2	24	3.5	U	U	U	U	U	.31
5	18.5	810	2,800J	U	26J	28	120J	24	20.5	430	2,400	U	8.5	13	63
6	13.5	U	U	U	U	U	.12	25	18.0	97	36	U	.09	.16	1.3
6	18.0	1,900	16,000J	36	22J	150	550J	25	20.0	740	4,100	.5	22	26	130
7	16.0	57	130	.029	2	68	2	26	18.0	130	250	.083	.62	1.1	7
7	18.0	13	5	U	.034	.046	.093	26	21.0	4,200	11,000	26	140	97	420
8	5.5	U	U	U	U	U	U	27	16.0	U	U	.028	.041	.032	.098
8	18.0	350	1,400J	U	1.7	5.9	16J	27	18.0	290	1,100	.89	5.1	6.5	39
9	8.5	U	U	U	U	U	U	28	3.5	48	51	U	.17	.18	.56
9	18.0	120	770	.3	1	2.2	5.7	28	18.5	U	U	.03	.092	.059	.22
10	6.0	U	U	U	.048	U	.065	29	16	160	700	U	1.8	3.3	22
10	18.0	47	140	.094	.2	.67	3	29	18.5	1,100	3,500	6.1	39	28	140
11	13.5	U	U	U	U	U	U	30	13.0	U	U	U	.062	U	.19
11	18.5	290	1,300	1	2.7	6.3	28	30	18.5	3,100	14,000	23	130	86	470
12	15.5	U	U	U	U	U	.04	31	3.5	11	48	U	.13	.15	.47
12	18.0	1,000	4,900	5.4	15	22	98	31	18.0	420	3,600	5.2	12	25	110
13	11.0	U	U	U	U	U	U	32	16.0	580	1,400	.71	3.1	5.1	28
13	18.5	360	1,700	1.3	29	6.1	24	32	18.5	U	U	U	U	.041	.15
14	18.5	110	130	.13	1.2	.38	1.6	33	11.0	U	U	U	U	U	U
14	20.5	730	1,900	1.8	44	20	81	33	16.0	U	6	U	.055	.055	.22
15	16.0	U	5	.045	.16	.035	.14	34	13.0	U	N/A	U	.047	.036	.074
15	20.5	380	1,300	1.6	24	13	50	34	18.0	2,800	8,500	U	30	50	68
16	13.5	U	8	.091	.16	.044	.12	35	6.0	25	61	U	.045	.28	.28
16	18.0	2,200	42,000	43	1,000	300	1,100	35	18.5	240	1,000	U	.98	U	17
17	13.5	U	U	U	.045	U	.048	36	13.5	U	U	U	.054	.037	.038
17	18.0	2,400	24,000	56	780	200	740	36	16.0	62	100	U	.096	U	1.1
18	15.5	U	U	U	.079	U	.052	37	15.5	170	62	U	.059	U	.65
18	20.0	2,000	15,000	19	400	130	490	37	18.0	1,700	3,400	U	U	U	30
19	6.0	U	U	U	.08	U	.081								
19	16.0	90	34	U	.12	.11	.28								

LEGEND

- MONITORING WELL
- SOIL BORING
- SOIL BORING & BIOVENTING WELL

DRO = DIESEL RANGE ORGANICS
GRO = GASOLINE RANGE ORGANICS
B = BENZENE
T = TOLUENE
E = ETHYLBENZENE
X = TOTAL XYLENES
J = ESTIMATED
U = UNDETECTED

NOTES: 43BH PREFIX OMITTED ON EACH BORING FOR CLARITY

ANALYTICAL SOIL RESULTS REPORTED AS mg/kg

SOURCE: ENSR 6583-118/ENST43.DWG/TNH/5179_2C/9010-003/ST43MW2/11/10/93

3RD SPTG/CEVR ELMENDORF AFB, ALASKA

FIGURE 3.1-2
SOIL BORING LOCATIONS & ANALYTICAL RESULTS FOR SERA PHASE 1A SITE ST43/55

DATE:	DRAWN BY:	SCALE:	DRAWING:
01/12/94	SR/ABB	AS SHOWN	ST43MW3
C/SC: 1:60 DISK: 836/93	ENGINEER: C. HUMPHREY	CHECKED: J. WILLIAMS	PROJECT: 9010-003-800

Table 3.1-1. Summary Table, ST43/55.

Boring/ Well No.	Depth (feet)	Sample Number	DRO (mg/kg)	GRO (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)
Soil Analyses								
43WL01	8.0	43WL01SO8.05N	U	U	U	U	U	U
43WL01	13.5	43WL01SO13.5N	11	U	.09	U	U	.053
43WL02	5.5	43WL02SO5.5N	U	U	U	U	U	U
43WL02	20.5	43WL02SO20.5N	U	U	U	U	U	U
43WL03	6.0	43WL03SO6.0N	17	U	U	U	U	U
43WL03	8.0	43WL03SO8.0N	U	U	U	U	U	U
43BH01	11.0	43BH01SO11.0N	U	U	U	.063	U	.066
43BH01	18.5	43BH01SO18.5N	78	150	.047	.73	1.1	5.1
43BH02	8.5	43BH02SO8.5N	U	U	U	U	U	U
43BH02	16.0	43BH02SO16.0N	U	U	U	.04	U	.043
43BH03	13.0	43BH03SO13.0N	U	U	U	.043	U	.041
43BH03	18.0	43BH03SO18.0N	550	1,100J	.54	18 J	3.8	52 J
43BH04	5.5	43BH04SO5.5N	U	U	U	.034	U	.033
43BH04	16.0	43BH04SO16.0N	190	160	U	.17	.96	2.9
43BH04	16.0	43BH04SO0FD	220	600	U	.79 J	4.1	14 J
43BH05	8.5	43BH05SO8.5N	U	U	U	.063	.035	.2
43BH05	18.5	43BH05SO18.5N	810	2,800J	U	26 J	28	120 J
43BH06	13.5	43BH06SO13.5N	U	U	U	U	U	.12
43BH06	18.0	43BH06SO18.0N	1,900	16,000J	36	22 J	150	550 J
43BH07	16.0	43BH07SO16.0N	57	130	.029	2	68	2
43BH07	18.0	43BH07SO18.0N	13	5	U	.034	.046	.093
43BH08	5.5	43BH08SO5.5N	U	U	U	U	U	U
43BH08	18.0	43BH08SO18.0N	350	1,400J	U	1.7	5.9	16 J
43BH09	8.5	43BH091SO8.5N	U	U	U	U	U	U
43BH09	18.0	43BH09SO18.0N	120	770	.3	1	2.2	5.7
43BH09	18.5	43BH09SO0FD	430	5,800	5.1	11	23	77
43BH10	6.0	43BH10SO6.0N	U	U	U	.048	U	.065
43BH10	18.0	43BH10SO18.0N	47	140	.094	.2	.67	3
43BH10	18.5	43BH10SO18.5MS	250	6,800	6	13	32	140

Table 3.1-1. Summary Table, ST43/55 (Cont'd).

Boring/ Well No.	Depth (feet)	Sample Number	DRO (mg/kg)	GRO (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)
Soil Analyses (Cont'd)								
43BH11	13.5	43BH11SO13.5N	U	U	U	U	U	U
43BH11	18.5	43BH11SO18.5N	290	1,300	1	2.7	6.3	28
43BH12	15.5	43BH12SO15.5N	U	U	U	U	U	.04
43BH12	16.0	43BH12SO0FD	U	U	U	U	U	U
43BH12	18.0	43BH12SO18.0N	1,000	4,900	5.4	15	22	98
43BH13	11.0	43BH13SO11.0N	U	U	U	U	U	U
43BH13	18.5	43BH13SO18.5N	360	1,700	1.3	29	6.1	24
43BH14	18.5	43BH14SO18.5N	110	130	.13	1.2	.38	1.6
43BH14	20.5	43BH14SO20.5N	730	1,900	1.8	44	20	81
43BH15	16.0	43BH15SO16.0N	U	5	.045	.16	.035	.14
43BH15	20.5	43BH15SO20.5N	380	1,300	1.6	24	13	50
43BH16	13.5	43BH16SO13.5N	U	8	.091	.16	.044	.12
43BH16	18.0	43BH16SO18.0N	2,200	42,000	43	1,000	300	1,100
43BH17	13.5	43BH17SO1305N	U	U	U	.045	U	.048
43BH17	18.0	43BH17SO18.0N	2,400	24,000	56	780	200	740
43BH18	15.5	43BH18SO15.5N	U	U	U	.079	U	.052
43BH18	16.0	43BH18SO0FD	U	6	.1	.29	.044	.14
43BH18	20.0	43BH18SO20.0N	2,000	15,000	19	400	130	490
43BH19	6.0	43BH19SO6.0N	U	U	U	.08	U	.081
43BH19	16.0	43BH19SO16.0N	90	34	U	.12	.11	.28
43BH20	3.5	43BH20SO3.5N	31	80	U	.069	.46	.65
43BH20	18.0	43BH20SO18.0N	96	960	U	7.4	5.8	31
43BH21	3.5	43BH21SO3.5N	850	450	.12	.49	.9	2.5
43BH21	18.5	43BH21SO18.5N	390	1,200	1.5	11	8.5	43
43BH22	10.5	43BH22SO10.5N	240	290	.15	.58	.72	1.9
43BH22	11.0	43BH22SO11.0MS	270	24	U	.094	.051	.29
43BH22	18.0	43BH22SO18.0N	1,100	1,600	4	13	17	92
43BH23	6.0	43BH23SO6.0N	U	U	U	U	U	.064
43BH23	18.0	43BH23SO18.0N	130	680	U	.67	1.6	11
43BH23	18.5	43BH23SO0FD	500	2,800	U	5.2	16	90

Table 3.1-1. Summary Table, ST43/55 (Cont'd).

Boring/ Well No.	Depth (feet)	Sample Number	DRO (mg/kg)	GRO (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)
Soil Analyses (Cont'd)								
43BH24	3.5	43BH24SO3.5N	U	U	U	U	U	31
43BH24	20.5	43BH24SO20.5N	430	2,400	U	8.5	13	63
43BH25	18.0	43BH25SO18.0N	97	36	U	.09	.16	1.3
43BH25	18.5	43BH25SO18.5MS/SD	530	2,500	U	9.2	18	92
43BH25	20.0	43BH25SO20.0N	740	4,100	.5	22	26	130
43BH26	18.0	43BH26SO18.0N	130	250	.083	.62	1.1	7
43BH26	21.0	43BH26SO21.0N	4,200	11,000	26	140	97	420
43BH27	16.0	43BH27SO16.0N	U	U	.028	.041	.032	.098
43BH27	18.0	43BH27SO18.0N	290	1,100	.89	5.1	6.5	39
43BH27	18.5	43BH27SO0FD	330	1,400	1	7.1	9.7	54
43BH28	3.5	43BH28SO3.5N	48	51	U	.17	.18	.56
43BH28	18.5	43BH28SO18.5N	U	U	.03	.092	.059	.22
43BH29	16.0	43BH29SO16.0N	160	700	U	1.8	3.3	22
43BH29	18.5	43BH29SO18.5N	1,100	3,500	6.1	39	28	140
43BH30	13.0	43BH30SO13.0N	U	U	U	.062	U	.19
43BH30	13.5	43BH30SO13.5MS/SD	U	U	U	.098	U	.26
43BH30	18.5	43BH30SO18.5N	3,100	14,000	23	130	86	470
43BH31	3.5	43BH31SO3.5N	11	48	U	.13	.15	.47
43BH31	18.0	43BH31SO18.0N	420	3,600	5.2	12	25	110
43BH31	18.5	43BH31SO0FD	510	2,300	2.9	7.8	14	65
43BH32	16.0	43BH32SO16.0N	580	1,400	.71	3.1	5.1	28
43BH32	18.5	43BH32SO18.5N	U	U	U	U	.041	.15
43BH33	11.0	43BH33SO11.0N	U	U	U	U	U	U
43BH33	16.0	43BH33SO16.0N	U	6	U	.055	.055	.22
43BH34	13.0	43BH34SO13.0N	U	NA	U	.047	.036	.074
43BH34	18.0	43BH34SO18.0N	2,800	8,500	U	30	50	68
43BH34	13.5	43BH34SO13.5MS	U	U	U	U	U	.054
43BH35	6.0	43BH35SO6.0N	25	61	U	.045	.28	.28
43BH35	18.5	43BH35SO18.5N	240	1,000	U	.98	U	17

Table 3.1-1. Summary Table, ST43/55 (Cont'd).

Boring/ Well No.	Depth (feet)	Sample Number	DRO (mg/kg)	GRO (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)
Soil Analyses (Cont'd)								
43BH36	13.5	43BH36SO013.5N	U	U	U	.054	.037	.038
43BH36	16	43BH36SO16.0N	62	100	U	.096	U	1.1
43BH37	15.5	43BH37SO15.5N	170	62	U	.059	U	.65
43BH37	16.0	43BH37SO0FD	340	370	U	.36	U	4.5
43BH37	18.0	43BH37SO18.0N	1,700	3,400	U	U	U	30

Well Number	Sample Number	DRO (µg/l)	GRO (µg/l)	B (µg/l)	T (µg/l)	E (µg/l)	X (µg/l)
Water Analyses							
43WL01	43WL01WGN	0.65J	U	7.9	U	0.5	0.7
43WL01	43WL01WGFD	NA	U	25	U	1.7	1.2
43WL02	43WL02WGN	U	U	U	U	U	U
43WL03	43WL03WGN	U	U	U	U	U	U
43WL03	43WL03WGFD	NA	U	U	U	U	U
SP7/10-01	43SP7/10-01WGN	U	U	U	U	U	U
SP7/10-01	43SP7/10-01WGFD	U	U	U	U	U	U
SP7/10-02	43SP7/10-02WGN	U	U	U	U	U	U
W3	43W3WGN	6,900	21,000	730	890	1,300	4,800
W3	43W3WGFD	6,800	NA	NA	NA	NA	NA
W4	43W4WGN	1,700	9,800	59	50	720	2,500
W4	43W4WGFD	1,600	NA	NA	NA	NA	NA

Key:
B = Benzene.
DRO = Diesel range organics.
E = Ethylbenzene.
GRO = Gasoline range organics.
J = Estimated.
NA = Not analyzed.
T = Toluene.
U = Not detected at the method reporting limit.
X = Total xylenes.

Note: See Appendix B for the method reporting limit for each analysis.

The three new wells were developed and sampled as described in Section 2.2.4. Four existing wells (SP-7/10-02, SP-7/10-01, W4, and W3) were also measured and sampled by the procedure described in Section 2.2.4. All groundwater samples were analyzed for DRO, GRO, and BTEX. Analytical results of groundwater sampling are presented in Appendix B and summarized in Table 3.1-1.

3.1.4 Results/Findings

3.1.4.1 Field Observations

Prior to the commencement of drilling activities, the site was inspected for the presence of unmarked utilities, apparent surface staining, and present use of the area surrounding the facilities. The following observations were noted:

- Soils had been previously excavated in the area of the POL lines at Valve Pit 3-4 and site PH9-1-13.
- The unexpected presence of stockpiles of excavated soil at site PH9-1-13 required moving boring locations from those identified in the work plan.
- A galvanized steel sump had been installed northwest of well SP7/10-04. The sump had reportedly been installed to collect free-product from the subsurface soils resulting from a past release. The sump was dry during the site investigations. No written documentation was found regarding the sump.

The subsurface exploration program encountered a grain-supported silty gravel layer extending from the surface to a depth of approximately 5 feet bgs at most of the boring locations. Well-graded gravels and sands were encountered below this layer to the full depths of the borings.

The soils encountered in drilling well 43WL03 were markedly different than those encountered at other locations. Well 43WL03 is located approximately 50 feet south of the southern edge of the Elmendorf Moraine. At this location, a silt layer extends from the surface to a depth of approximately 8.5 feet bgs. A gray, uniform clay was present below the silt layer for the full length of the sampled soils (25 feet bgs). This is interpreted to be the Bootlegger Cove Formation. A green-gray clay was also encountered in well 43WL01 at a depth of 11.0 feet bgs.

This clay may also represent the Bootlegger Cove Formation. A gray clay sample was collected from the drill bit during drilling of boring 43BH05. This may be interpreted as the same clay layer encountered during drilling of wells 43WL01 and 43WL03. One possible interpretation for the

absence of the Bootlegger Cove Formation in borings located between wells 43WL01 and 43WL03 is a possible east-west channel cut through the formation prior to deposition of the overlying outwash materials.

Field PID readings on soil samples were used to help select the samples submitted for laboratory analysis. Field screening results are included on the boring logs presented in Appendix A. Elevated PID readings were recorded from all the locations except from samples collected from 43WL02 and 43WL03.

3.1.4.2 Analytical Results

The results of the laboratory analysis for soil samples are presented in Appendix B and summarized in Table 3.1-1. Concentrations of BTEX, DRO, and GRO were detected in soil samples collected from monitoring well 43WL01 and most of the soil borings. Many of the soil samples had elevated levels of petroleum hydrocarbon compounds that required laboratory dilution of the original sample to quantify the concentration. The sample collected from the 18.0- to 18.5-foot bgs interval of boring 43BH16 had the highest GRO concentration with 42,000 mg/kg. Samples containing high concentrations of GRO also had high concentrations of DRO and BTEX, although DRO concentrations are generally an order of magnitude less than GRO concentrations.

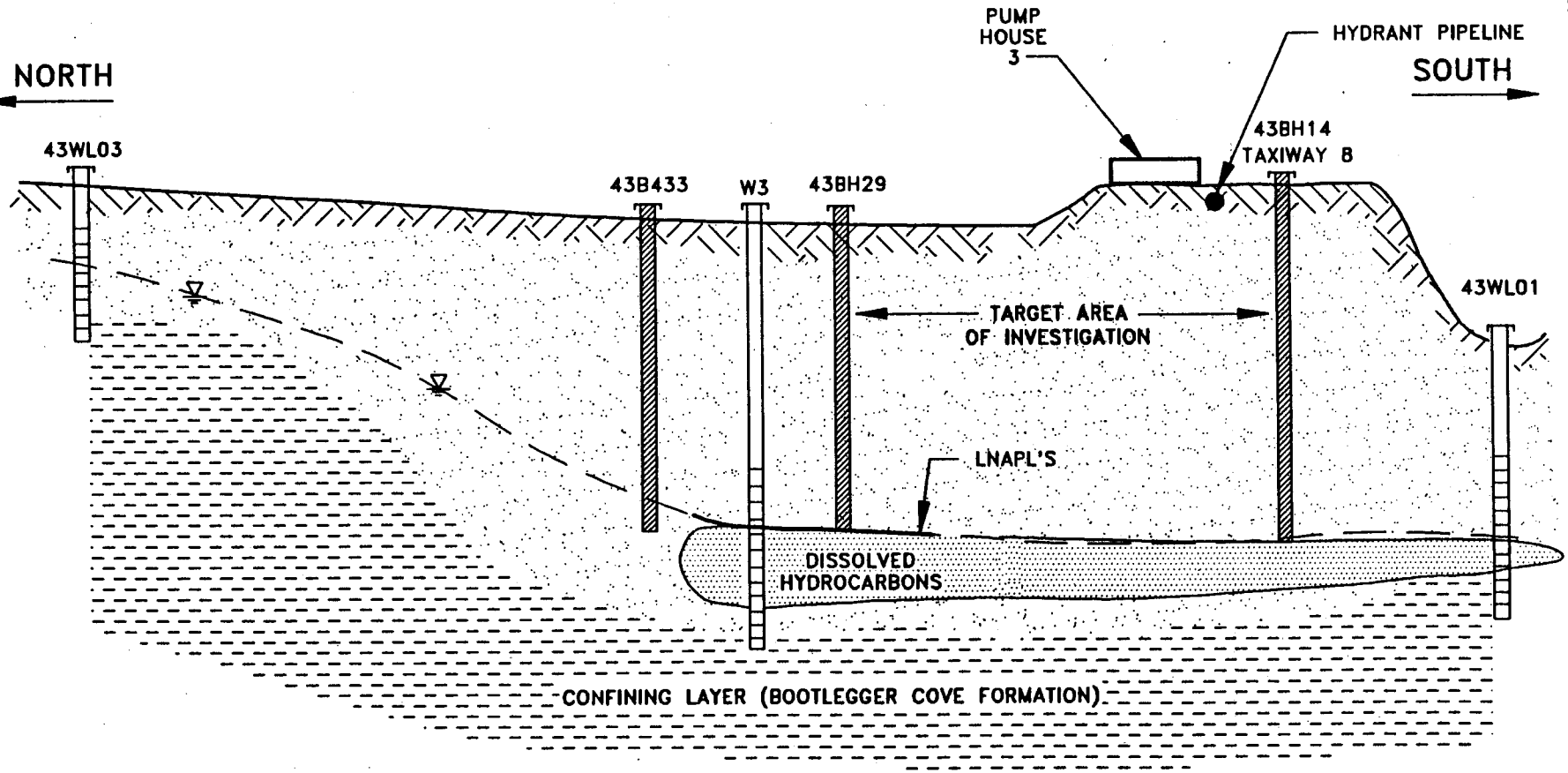
Results of laboratory analysis of groundwater are presented in Table 3.1-1. Detectable concentrations of BTEX, DRO, and GRO were indicated in samples collected from 43WL01, W3, and W4.

3.1.4.3 Conceptual Modeling

A conceptual model of the possible distribution of contamination identified at the site is presented in Figure 3.1-3. The figure is a generalized cross-section from the edge of the Elmendorf Moraine to the area between Taxiway 8 and the East/West Runway.

3.1.4.4 Evaluation of Adequacy/Completeness

The three installed wells were determined to be adequate for the characterization of the condition of groundwater both upgradient and downgradient of the area, and for assessing general groundwater flow direction.



DRAWING: ST43CSM	DRAWN: ABB/SR	FIGURE 3.1-3 CONCEPTUAL SITE MODEL FOR SERA PHASE 1A SITE ST43/55
C/SC: 1:1	DISK: 750/93	3RD SPTG/DEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800
DATE: 11/15/93	CHECK: D.G.	

This investigation was successful in determining that past releases, spills, and/or leaks at and upgradient of site ST43/55 have impacted the soils at the site. This investigation was also successful in determining that this contamination has impacted groundwater. The objective of determining the horizontal and vertical extent of any impacted soils was not successful because the extent of contamination in the soils exceeds the horizontal limits of this investigation. The original Scope of Work did not anticipate soil contamination at the levels that were observed. In order to adequately determine the horizontal extent of contamination, additional soil borings would be required.

3.1.5 Conclusions/Recommendations

3.1.5.1 Soil

Pursuant to the requirements set forth in 18 AAC 75 for non-UST POL sites, a matrix score of 39 was computed for the subject site. Table 3.1-2 presents the matrix score sheet for this site.

A matrix score of 39 requires Level B Cleanup standards. The majority of the soil samples collected from the interval located on or just above the water table indicated DRO, GRO, and BTEX concentrations exceeding cleanup levels.

The impact of releases from any specific location is obscured by the occurrence of concentrations of hydrocarbon compounds in the soils found throughout the site area that exceed cleanup standards. The highest concentration of hydrocarbon compounds was generally found at or just above the water table. The upper 10 to 15 feet of the soils generally showed concentrations within cleanup levels of the analytes with the exception of the soils west of PH3. At this location, samples collected from borings 43BH19 through 43BH22 exhibited high concentrations of the analytes from 3.5 feet bgs to the depth of groundwater (approximately 18 feet bgs) suggesting that the source of the contamination originated near the surface. The reported surface spillage of JP-4, which occurred during filling of the tanks, may have been the source of soil contamination identified in these borings.

The high concentrations of both DRO and GRO suggest multiple sources and that multiple fuels may be present.

Gas chromatography traces obtained from the DRO analysis were interpreted to help identify and differentiate between refined petroleum product types (gasoline, diesel fuel, JP-4, JP-8, motor oil etc.), biogenic hydrocarbons (waxy plant paraffins), or laboratory contamination origin.

Table 3.1-2. Matrix Score Sheet for Site ST43/55.

1. Depth to Subsurface Water		10
< 5 feet	(10)	
5 - 15 feet	(8)	
15 - 25 feet	(6)	
25 - 50 feet	(4)	
> 50 feet	(1)	
2. Mean Annual Precipitation		3
> 40 inches	(10)	
25 - 40 inches	(5)	
15 - 25 inches	(3)	
< 15 inches	(1)	
3. Soil Type (Unified Soil Classification)		10
Clean, coarse-grained soils	(10)	
Coarse-grained soils with fines	(8)	
Fine-grained soils (low OC)	(3)	
Fine-grained soils (high OC)	(1)	
4. Potential Receptors		6
Public well within 1,000 feet, or Private well(s) within 500 feet	(15)	
Municipal/private well within 1/2 mile	(12)	
Municipal/private well within 1 mile	(8)	
No Known well within 1/2 mile	(6)	
No Known well within 1 mile	(4)	
Non-potable groundwater	(1)	
5. Volume of Contaminated Soil		10
> 500 cubic yards	(10)	
100 - 500 cubic yards	(8)	
25 - 100 cubic yards	(5)	
> De Minimus - 25 cubic yards	(2)	
De Minimus	(0)	
	Total	39

Matrix Score		Cleanup level in mg/kg			
		Diesel	Gasoline/Unknown		
		Diesel Range Petroleum Hydrocarbons	Gasoline Range Petroleum Hydrocarbons	Benzene	BTEX
Level A	>40	100	50	0.1	10
Level B	27-40	200	100	0.5	15
Level C	21-26	1,000	500	0.5	50
Level D	<20	2,000	1,000	0.5	100

High concentrations of hydrocarbons were reported in the GRO and DRO ranges from locations 43BH16 at a depth of 18 feet, 43BH17 at a depth of 18 feet, and 43BH18 at a depth of 20 feet. Observation of the DRO chromatographic traces from these samples revealed matching characteristics of individual resolved peaks over an unresolved complex mixture (UCM) in the approximated hydrocarbon range of n-C_6 through n-C_{16}. A specific homologous series of peaks representative of normal alkanes is observed between the approximated hydrocarbon range of n-C_9 through n-C_{16}. Chromatograms were interpreted by comparison to fuel standard chromatograms (gasoline, diesel fuel, JP-4, JP-8, motor oil) analyzed at the laboratory. Interpretation of these chromatograms indicates that the product exhibits the characteristics of a JP-4 fuel. A possibility exists that JP-8 fuel, which is less volatile by comparison to JP-4, has additionally contributed to the product observed in the hydrocarbon range of n-C_9 through n-C_{16}. However, this conclusion is indeterminable because of the similarity in fingerprints of JP-4 and JP-8 within this defined range.

The areal extent of the impacted soils has not been determined. Three possibilities may explain the occurrence of contaminated soils outside the boring locations.

- Initial migration of the contaminants from the leak locations was vertical until reaching the water table, where the light, nonaqueous phase liquids (LNAPLs) migrated laterally in all directions.

- Episodes of rising and falling of the water table may have caused a smear zone of hydrocarbon compounds trapped in the pore spaces of the soils within the zone between seasonal high and low water table elevation.

- Another possibility is the presence of an off-site source. Lateral transport and dispersion of the dissolved constituents may be occurring, resulting in high concentrations of hydrocarbon compounds at the water table depth.

3.1.5.2 Groundwater

Three-point analysis of the groundwater flow direction at the site suggests that the flow vectors are curved rather than linear. Flow direction was determined using water table elevations recorded from wells 43WL01, 43WL02, and 43WL03. The direction is to the southeast, generally perpendicular to the direction of the Elmendorf Moraine along an average gradient of 0.015 ft/ft. A second three-point analysis was made using water table elevations from wells 43WL01, 43WL02, and W4 to determine the groundwater flow direction using a third measuring point located further from the moraine. The groundwater flow direction was determined to be to the

south-southeast with an average gradient of 0.0065 ft/ft using these data. These variations suggest that flow vectors are curved.

The highest concentrations of DRO and BTEX compounds in groundwater were found in samples collected from well W3. Fluid levels collected prior to sampling the well indicate a separate-phase product thickness of 1.1 feet. No other wells sampled at this site had a measurable product thickness. Floating product was reduced from the initially measured 1.1 feet to a heavy sheen after bailing 2 gallons. Product continued to flow into the well during bailing at a rate to maintain a heavy sheen, although no measurable thickness was seen following the first four bailer loads. A total of 9 gallons was bailed from the well prior to collection of a groundwater sample for laboratory analysis. The current thickness of product in the well is not known. The results of the laboratory analysis of groundwater samples taken from wells 43WL01, W3, and W4 indicate concentrations of benzene above State and Federal maximum contaminant levels (MCLs) for drinking water. Wells W3 and W4 also have concentrations of other BTEX compounds exceeding MCLs.

The results of this investigation suggest that upgradient, or possibly cross-gradient, sources are contributing to groundwater contamination.

3.1.6 Follow-up Actions

The extent of the petroleum-hydrocarbon impacted soils has not been determined. Most of the soil contamination is related to the zone of seasonal groundwater level fluctuation. Due to the probability of undefined upgradient sources, further investigation should be initiated to identify any undefined source contributing to groundwater contamination at this site.

Further investigation of the groundwater and identification of the source(s) is warranted. Potential source areas include piping associated with seven USTs at PH3, fuel hydrant system hardstands to the north, and upgradient USTs at the Aerial Port Squadron. Testing the integrity of the PH3 piping system should be conducted and possibly additional borings could be installed to evaluate other upgradient sources. Of the three areas investigated, the PH3 area has not been fully characterized.

No further action could be assigned to the Valve Pit 3-4 and pipeline area PH9-1-13 areas of site ST43/55.

3.2 Site SS35, Paxson Park (IRPIMS Site 44)

3.2.1 Introduction

Site SS35, Paxson Park, is located on Juniper Drive (2nd Street) in the southwestern quadrant of Elmendorf AFB. The site location map is presented in Figure 3.2. The site area was a military housing complex that was demolished prior to development as a park. Paxson Park was included on the POL site list after POL odor was noted and stained soil reported by workers installing subsurface water line in 1988. The exact locations where odor and/or stained soil were observed have not been determined.

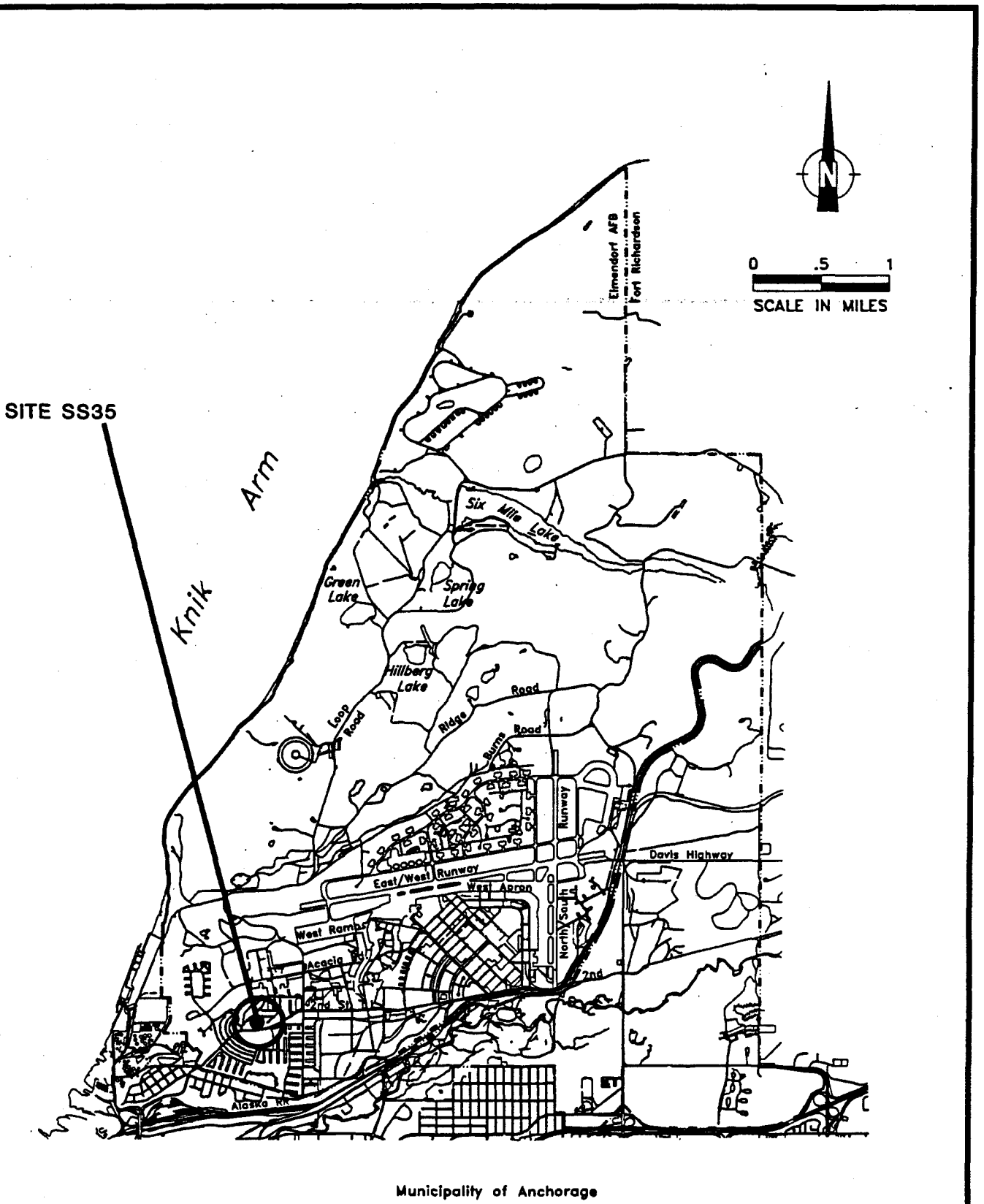
3.2.2 Field Investigation

A soil vapor survey was performed to assess whether VOCs were present near the surface and to measure their relative concentrations. VOCs that have leaked from tanks or pipelines or have been spilled onto the ground usually have a vapor phase that migrates throughout the pore spaces of adjacent soil. A portable gas chromatograph (GC) equipped with a sampling probe was used to analyze this vapor phase and record relative VOC levels. Sample points were located in statistically identified and strategic locations based on the reported area excavated at the time of reports of odors and staining. Sample locations are presented in Figure 3.2-1.

Samples of the soil gases were collected and analyzed at the Paxson Park site using a Photovac 10S50 portable GC fitted with an encapsulated capillary column. A specially constructed 0.25-inch outside diameter sampling probe was manually inserted to a depth of 48 inches for each sample location except 44WSL03.5N and 44SL08S03.5N, where the maximum sample depth was 42 inches.

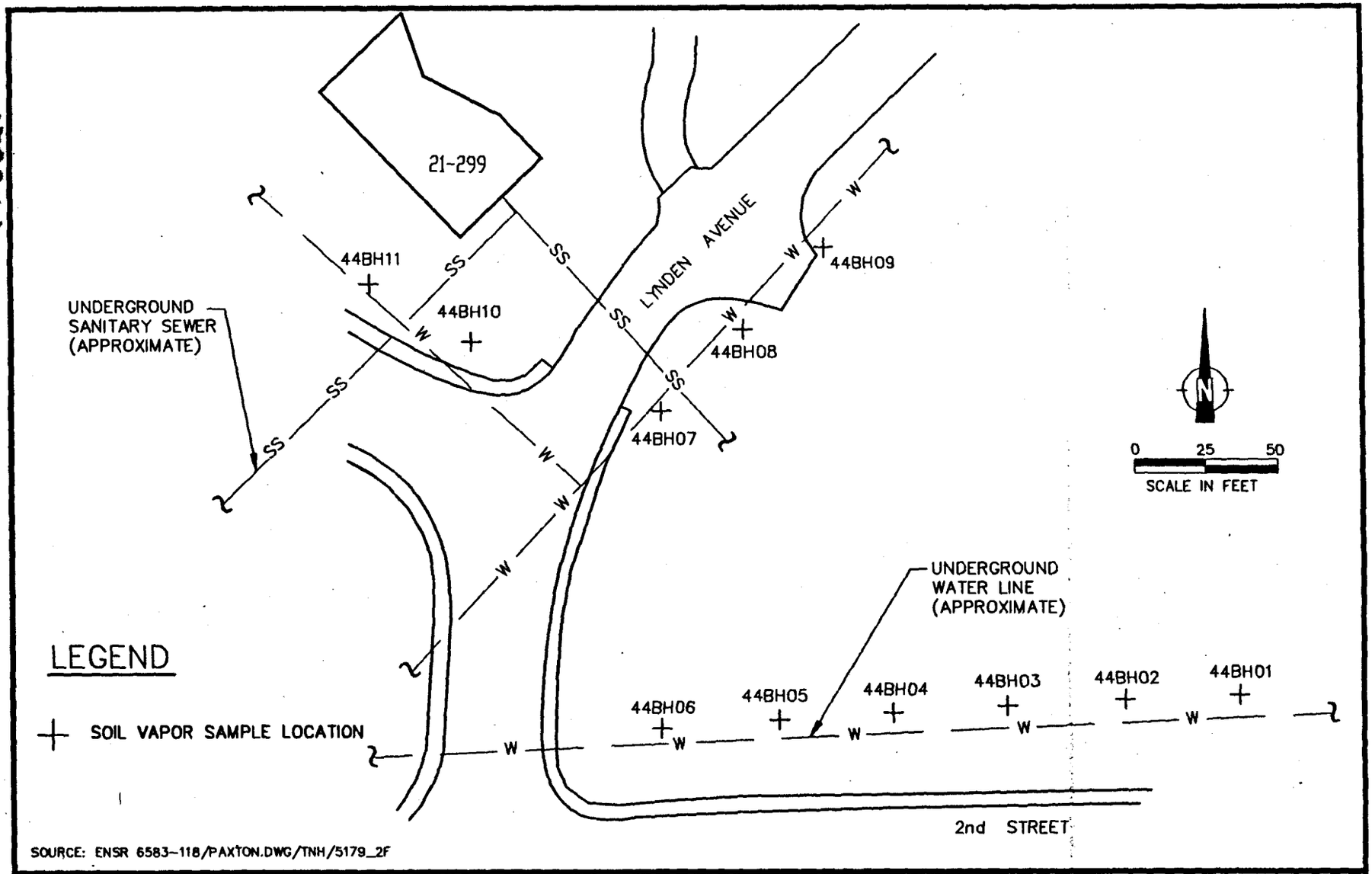
Probe channels were advanced to a maximum depth of 36 inches. The sample probe (0.25-inch outside diameter [OD] stainless steel tubing with intake slots) was then hand driven to the sampling depth into fresh, undisturbed soil. The probe was then connected to the GC by a 0.125-inch outside diameter by 20-foot-long section of inert Teflon™ tubing.

Prior to sample analysis, a standard consisting of diesel fuel in air was analyzed to optimize the GC's response to the suspected target contaminant. Analysis of the diesel fuel standard also provided a fingerprint comparison between the various peaks present in the standard and those in the suspected contaminant. Ambient air blanks were analyzed after calibrations to ensure minimal artifact carryover from the diesel fuel standard.



Municipality of Anchorage

DRAWING: F3605 DRAWN: ABB/SR C/SC: 1:5500 DISK: NET9/93 DATE: 09/22/93 CHECK: D.G.	FIGURE 3.2 LOCATION MAP SITE SS35	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800



DRAWING: SS35MW	DRAWN: ABB/SR	FIGURE 3.2-1 SOIL VAPOR SURVEY LOCATIONS FOR SERA PHASE 1A SITE SS35
C/SC: 1:50	DISK: 751/93	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800
DATE: 11/05/93	CHECK: C.H.	

One sample duplicate (co-located sampling location) and one background sample were also collected.

3.2.3 Results/Findings

Based on data obtained from numerous similar soil vapor studies, relative concentration categories have been determined and are listed below.

Category	Range
Trace	≤ 5 Volt-seconds
Low	5 to 100 Volt-seconds
Moderate	100 to 1,000 Volt-seconds
High	> 1,000 Volt-seconds

A total of 13 sampling points (see Figure 3.2-1) were analyzed at the Paxson Park site. In Table 3.2-1, the recorded VOC level (in volt-seconds) at each sampling location and the overall relative ranking are presented.

Each sample chromatogram was carefully compared to the diesel fuel standard and interpreted to determine whether peaks present in the standard were also present in the soil vapor at the various sampling locations. The standard was designed to show most of the peaks that would be present in the suspected target contaminant, although specific identification of each constituents was not possible.

Interpretation of the sample chromatograms indicates very few direct peak comparisons with the diesel fuel standard. Further, for the samples that did indicate peaks similar to those found in the standard, their magnitude was negligible relative to the standard.

A quality control (QC) duplicate is a sample collected and analyzed from a co-located point adjacent to the original sample. It is not uncommon to see volt-second levels of the QC duplicate quite different from the levels of the original sample.

While the values for sample 44SL11SO4.ON and the QC duplicate were different, the results from both analyses placed them in the same relative concentration range of the low/moderate categories, thereby showing methods and analytical repeatability.

Table 3.2-1. Soil Vapor Survey Results.

Sample ID	Gas Chromatograph Reading (Volt-Seconds)	Relative Ranking
44SL01S04.0N	55.7	Low
44SL02S04.0N	28.2	Low
44SL03S04.0N	37.4	Low
44SL04S03.5N	53.5	Low
44SL05S04.0N	51.4	Low
44SL06S04.0N	85.4	Low
44SL07S04.0N	74.94	Low
44SL08S03.5N	91.3	Low
44SL09S04.0N	87.1	Low
44SL10S04.0N	338.7	Moderate
44SL11S04.0N	145.6	Moderate
44SL11S04.0N-D*	55.5	Low
44SL12S04.0N	76	Low

* Duplicate sample.

Sampling locations 44SL10S04.ON and 44SL11S04.ON indicated moderate levels of VOCs, although all the remaining sample locations indicated low levels of VOCs present in the soil vapor. The locations where moderate levels of VOCs were detected were in a parking area adjacent to Building No. 21-299 (across Lyndon Avenue, west of the park site). Sample location 44SL12S04.ON was designated a background sample and was located in a grassy area west of Lyndon Avenue, approximately 200 feet south of Building No. 21-299. The background sample indicated low levels of VOCs present in the soil vapor. All of the remaining samples were located at the Paxson Park site (adjacent to buried water lines) and indicated low levels of VOCs.

3.2.3.1 Evaluation of Adequacy/Completeness

The objective of this assessment was to determine the potential presence of hydrocarbon-contaminated soil and to assess the extent of contamination by use of a soil vapor survey. The assessment met the objectives of the study by defining areas with low and moderate concentrations of hydrocarbon compounds (VOCs) in the near-surface soils.

3.2.4 Conclusions/Recommendations

Nine of the soil vapor points were located at site SS35 (east of Lyndon Avenue) adjacent to potential subsurface migration pathways. None of the locations sampled indicated elevated levels of VOCs present in the soil vapor. The slightly elevated (moderate) levels of VOCs in the parking area of Building No. 21-299 can be attributed to surface spillage of oils and fuels from vehicles. The background sample located west of the park provided low VOC levels consistent with those found in the park.

The dry, loose soil conditions encountered during the study were conducive to collecting reliable soil vapor data.

No further action is recommended for site SS35.

3.3 Site SS61, Navy Construction Site (IRPIMS Site 45)

3.3.1 Introduction

The Navy Construction site, SS61*, was built in 1943 as a vehicle maintenance facility. Wastes from the site may have included waste oil, solvents, paints, and fuels. No records for past waste streams were found. The area is included as a part of OU4 under CERCLA. In 1992, the original building was demolished and the naval facility was constructed. Figure 3.3 presents the site location. Figure 3.3-1 presents the site area and the location of the new building.

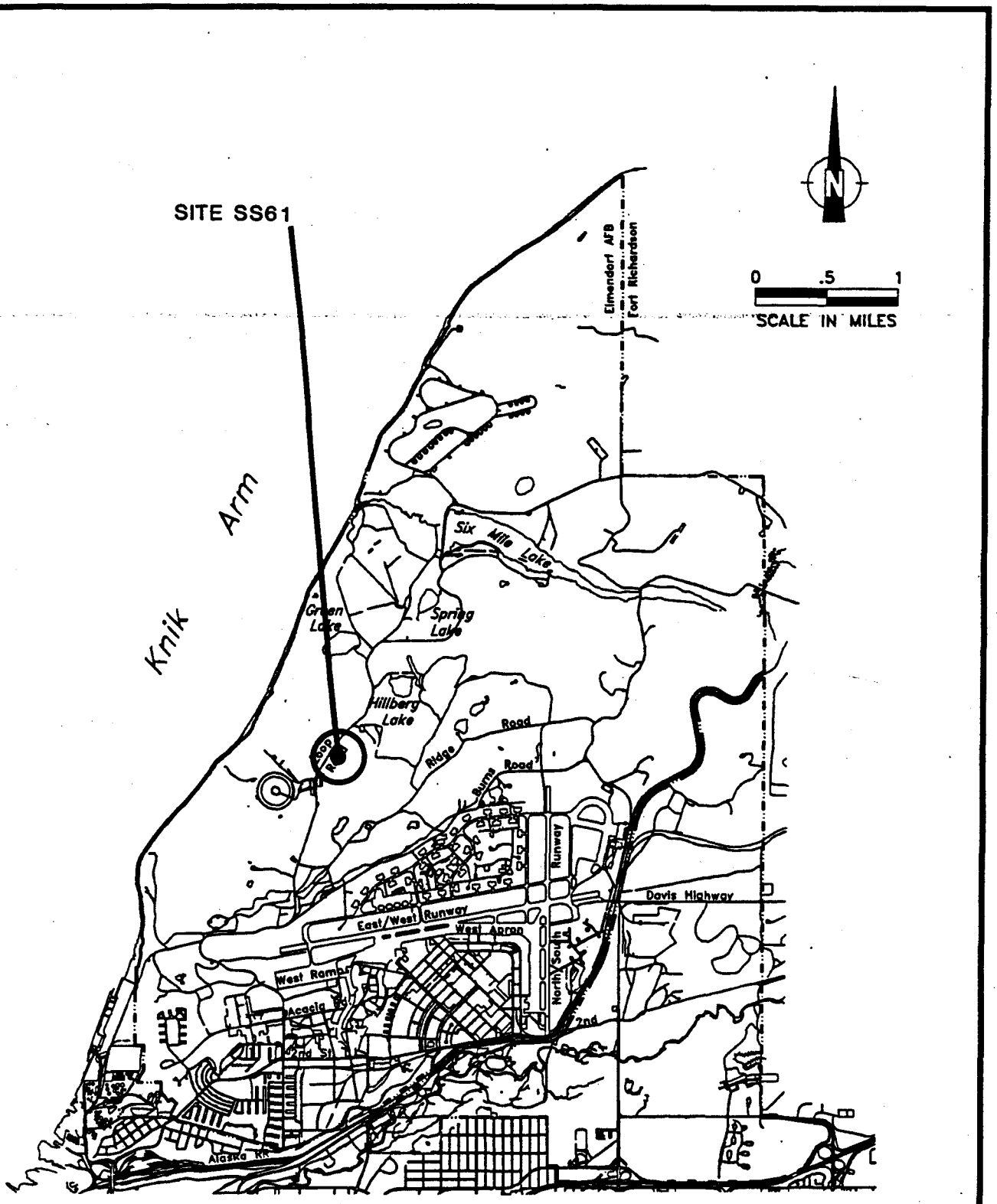
The site is located on the Elmendorf Moraine. The near-surface soils of the Elmendorf Moraine are loess, glacial till, alluvium, and/or an organic soil.

In August 1990, the U.S. Army Corp of Engineers (COE) installed seven soil borings and two monitoring wells (AP-3602 and AP-3606) at the site. The purpose of the COE investigation was to determine the potential chemical contamination and to characterize the soil engineering properties for the new building. In February 1991, the COE installed an additional soil boring and two additional monitoring wells (AP-3566 and AP-3567) to assist in this investigation.

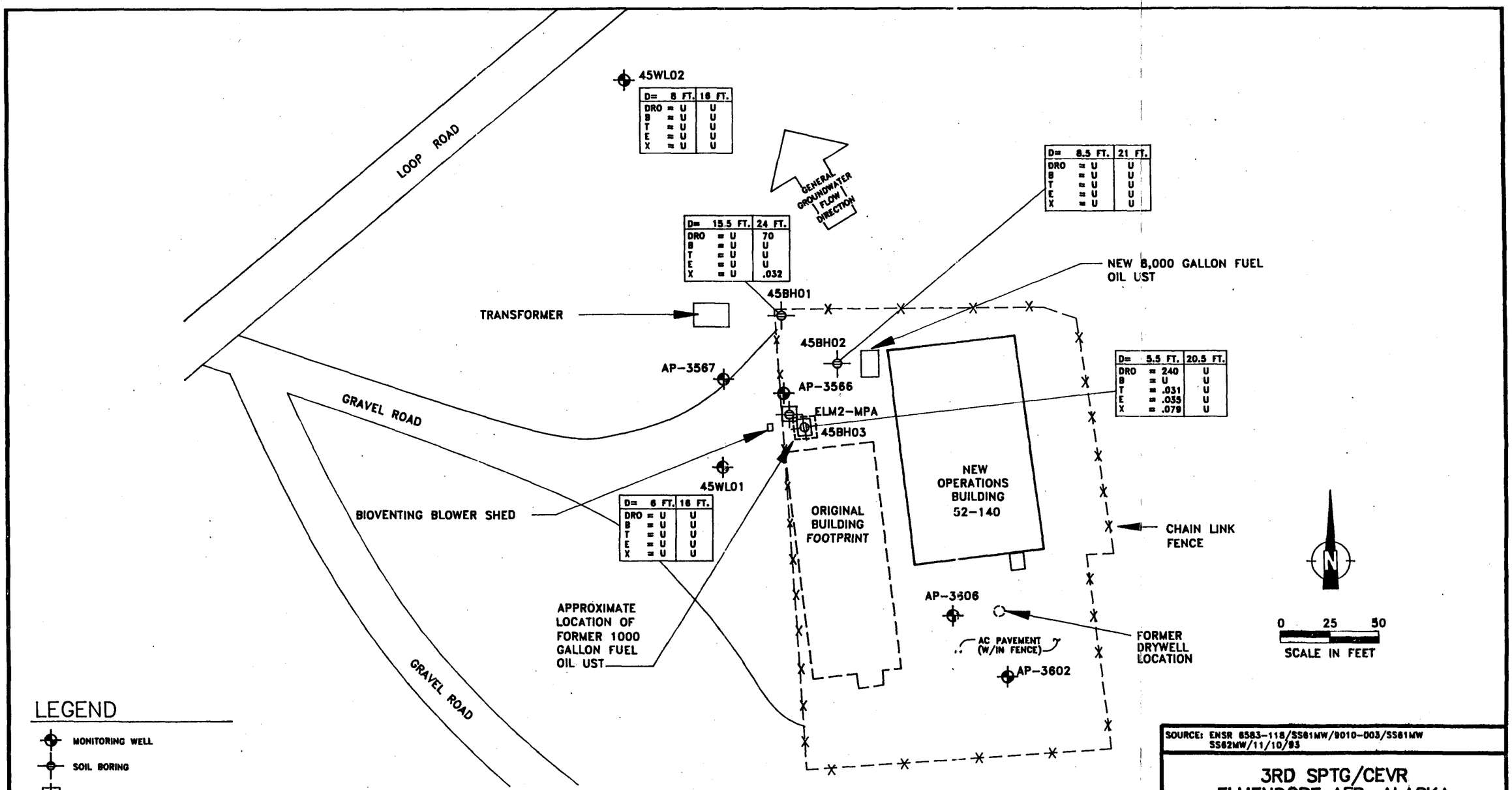
In September 1991, the COE installed one soil boring, one monitoring well, and one test pit at the site to investigate a dry well and the extent of contamination downgradient from the dry well, as well as sampling two surface stains noted at the site. High concentrations (up to 1,300 mg/kg) of lead were detected at all sampling locations from the excavation. Volatile compounds such as chlorobenzene (5,100 µg/kg) and m- and o-Dichlorobenzene were detected at concentrations of 12,000 and 36,000 µg/kg from the stained soil collected from the surface near the tank. The dry well at the original building site received drainage from a floor drain in the oil changing pit.

In September 1992 during excavation of the foundation for the new naval building, a pipe was encountered exiting the foundation of the old vehicle maintenance building. USAF collected soil samples from along and below the pipe to determine the type and extent of contamination encountered. Analytical results of the soil samples indicated that diesel contamination was present at the exposed end of the pipe. DRO was reported at 4,600 mg/kg with the chromatograph matching a typical weathered diesel fuel pattern. The dry well and clay pipe were addressed under OU7 Limited Field Investigation (LFI) conducted for site SS63 also at this location. The report discussing these investigation is in progress.

* Also known as Building 52-140 and Classic Owl.



DRAWING: F3605 DRAWN: ABB/SR C/SC: 1:5500 DISK: NET9/93 DATE: 09/22/93 CHECK: D.G.	FIGURE 3.3 LOCATION MAP SITE SS61	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800



LEGEND

- MONITORING WELL
- SOIL BORING
- SOIL BORING & BIOVENTING WELL

DRO = DIESEL RANGE ORGANICS
B = BENZENE
T = TOLUENE
E = ETHYLBENZENE
X = TOTAL XYLENES
U = UNDETECTED

NOTES: ANALYTICAL SOIL RESULTS REPORTED AS mg/kg

SOURCE: ENSR 8583-118/SS61MW/9010-003/SS61MW SS62MW/11/10/93

3RD SPTG/CEVR
ELMENDORF AFB, ALASKA

FIGURE 3.3-1
SOIL BORING LOCATIONS & ANALYTICAL RESULTS FOR SERA PHASE 1A SITE SS61

DATE: 01/12/94	DRAWN BY: SR/ABB	SCALE: AS SHOWN	DRAWING: SS61MW2
C/SC: 1:50 DISK: 836/93	ENGINEER: C. HUMPHREY	CHECKED: J. WILLIAMS	PROJECT: 9010-003-800

033376

The facility had a 1,000-gallon heating oil UST that was removed in 1992 at the time of the building demolition. The tank was in poor condition, with corrosion along the bottom. Extractable petroleum hydrocarbon (EPH) results from soil samples collected from the tank excavation ranged from 5,300 to 14,000 mg/kg.

These previous investigations determined that petroleum contamination was present in the soil and groundwater surrounding both the dry well and the UST location.

In 1992, a geophysical survey and soil boring study were conducted at the site as part of the OU4 LFI. The geophysical study employed ground-penetrating radar (GPR) to locate any unknown dry wells or pipes that may lead away from the building. The investigation found:

- One structure southeast of the original building, which is thought to be the dry well being investigated as part of OU4.
- Two possible buried tanks, one identified as the heating oil UST and the other northeast of the original vehicle maintenance building. The heating oil UST was removed in 1992, and no tank was reported northeast of the original building while excavating for the new naval building.
- One pipe leading to a T-shaped structure north of the original building.

During the LFI, a soil boring was installed at the location of the dry well identified during the geophysical study. The boring was drilled to 5 feet bgs. The results of the laboratory analysis indicated that low levels of DRO were present. No other hydrocarbon compounds were detected.

3.3.2 Objectives

The objectives of this assessment at the Navy Construction site were to:

- Assess the extent of releases to the soil from the removed 1,000-gallon heating oil UST at the site;
- Assess if these releases have impacted groundwater at the site; and
- Assess groundwater flow direction and gradient at the site.

3.3.3 Field Investigation

3.3.3.1 Soil Borings

A total of five soil borings were drilled and sampled at site SS61 (Figure 3.3-1). Boring 45BH03 was located directly above the former UST location. Boring 45BH02 was located adjacent to the northwest corner of the new UST location and boring 45BH01 was located downgradient from both of the UST locations to assess the presence of contaminants migrating downgradient from the former and present UST locations. Boring 45BH04 (or ELM2-MPA) was installed as part of a separate bioventing treatability study being conducted by USAF. Soil borings were advanced to a maximum depth of 27 feet bgs. Soil samples were analyzed for DRO and BTEX compounds. Boring logs are presented in Appendix A.

3.3.3.2 Groundwater Monitoring Well Installation and Sample Collection

Two groundwater monitoring wells were installed at the site (Figure 3.3-1A). Well 45WL01 was installed southwest of the former UST location to a depth of 22.3 feet bgs. Well 45WL02 was installed downgradient of the former UST location to a depth of 19.4 feet bgs. Monitoring wells were constructed by the methods described in Section 2.2.4. Monitoring well construction diagrams are included on the boring logs presented in Appendix A.

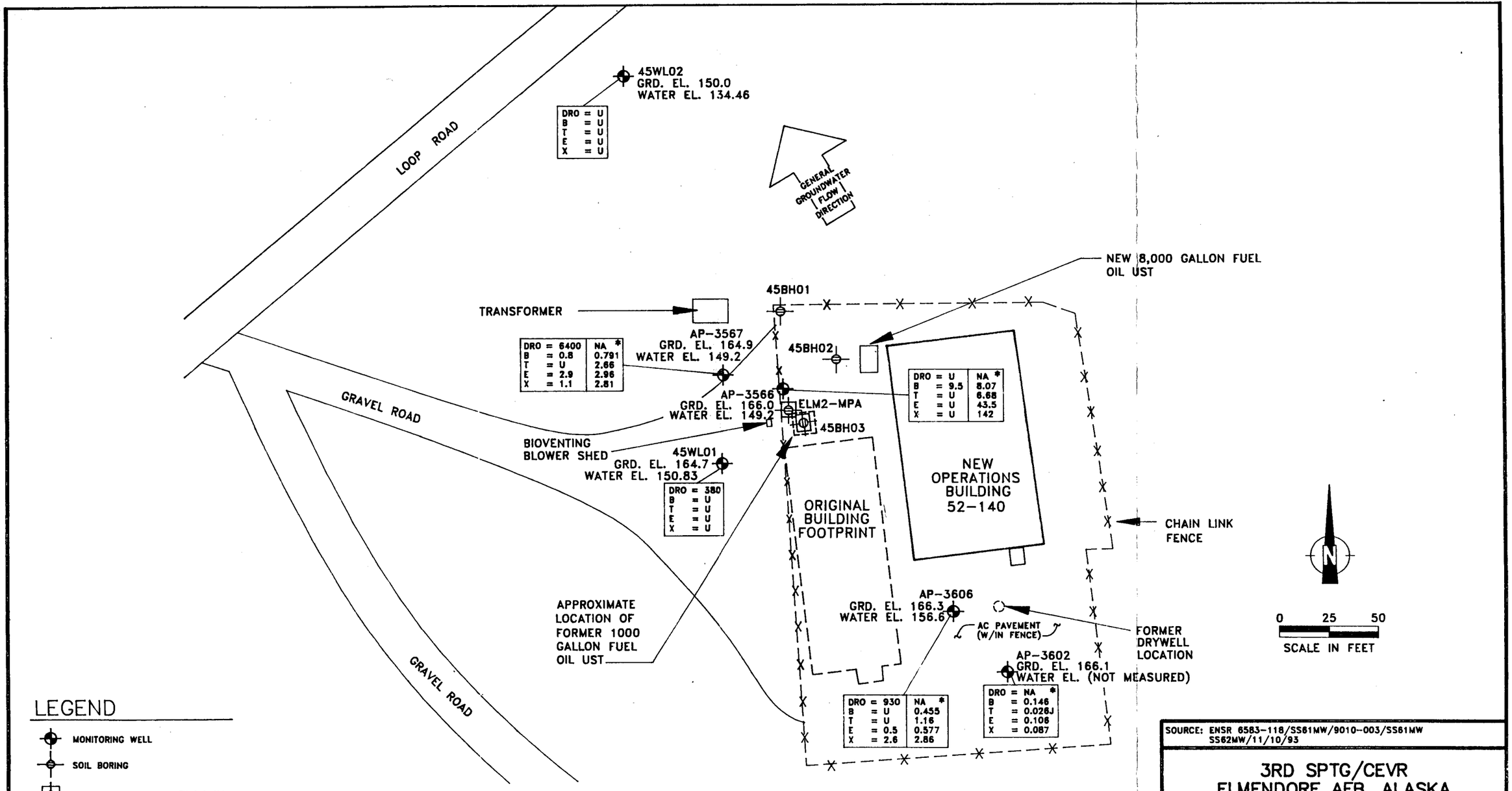
Groundwater monitoring wells 45WL01 and 49WL02 were developed and sampled as described in Section 2.2.4. Three existing wells (AP3566, AP3606, and AP3567) were also sampled by the same procedures. Existing well AP-3602 was planned to be sampled; however, the casing was distorted a short distance from the top, preventing operation of the sampling apparatus. All groundwater samples were analyzed for DRO, GRO, and BTEX. A later round of groundwater samples was collected and analyzed for VOCs.

3.3.4 Results/Findings

3.3.4.1 Field Observations

Prior to the commencement of drilling activities, the site was inspected for the presence of unmarked utilities, apparent surface staining, and present usage of the grounds surrounding the facility. The following observations were noted:

- The new operations building is surrounded on all sides by a new asphalt parking lot/drive.



LEGEND

- MONITORING WELL
- SOIL BORING
- SOIL BORING & BIOVENTING WELL

DRO = DIESEL RANGE ORGANICS
B = BENZENE
T = TOLUENE
E = ETHYLBENZENE
X = TOTAL XYLENES
J = ESTIMATED
U = UNDETECTED
NA = NOT ANALYZED

NOTES: ANALYTICAL WATER RESULTS REPORTED AS µg/l

SOURCE: ENSR 6583-118/SS61MW/9010-003/SS61MW SS62MW/11/10/93

3RD SPTG/CEVR ELMENDORF AFB, ALASKA

FIGURE 3.3-1A
MONITORING WELL LOCATIONS & ANALYTICAL RESULTS FOR SERA PHASE 1A SITE SS61

DATE:	DRAWN BY:	SCALE:	DRAWING:
01/17/94	SR/ABB	AS SHOWN	SS61MW3
C/SC: 1:50 DISK: 838/93	ENGINEER: C. HUMPHREY	CHECKED: J. WILLIAMS	PROJECT: 9010-003-800

- The land surface slopes to the northwest.

- Based on water level measurements taken from installed and existing wells, groundwater flow was interpreted to be to the northwest.

The subsurface exploration program at well 45WL01 encountered silt interbedded with sand and gravel to a depth of approximately 17.5 feet bgs where a grain-supported silty gravel was encountered. Soils encountered in 45WL02 were principally well-graded gravels and grain-supported silty gravels. Soils encountered in the borings were mainly silts and silty gravels. Wood fibers were noted in samples collected from 5 to 12 feet bgs from boring 45BH03.

Field PID readings on soil samples were used to help select samples for laboratory analysis. Field screening results are included on the boring logs presented in Appendix A. PID readings taken during sampling of boring 45BH01 were erratic and are considered unreliable (either 0 or > 2,500 units); therefore, the instrument was recalibrated prior to sampling of the next boring. Elevated PID readings were recorded from samples collected from 45BH01, 45BH02, and 45BH03.

3.3.4.2 Analytical Results

The results of laboratory sample analyses are presented in Appendix B and summarized on Figures 3.3-1 and 3.3-1A, and in Table 3.3-1. Analyses of soil samples collected from wells 45WL01 and 45WL02 did not detect concentrations of any of the analytes. The soil sample collected from boring 45BH01 at a depth of 24 feet bgs had a DRO concentration of 70 mg/kg and a total xylene concentration of 0.032 mg/kg. Soil from boring 45BH03 had low levels of BTEX compounds and a DRO concentration of 240 mg/kg at a depth of 5.5 to 6.0 feet bgs. Analyses of soil samples collected from 45BH02 did not detect concentrations of any of the contaminants of concern.

Analysis of the groundwater sample from upgradient well AP-3606 detected low levels of BTEX and DRO compounds. The groundwater sample analyzed from well AP-3566 indicated a benzene concentration of 9.5 µg/l and low levels of total BTEX and DRO compounds. Well AP-3567 also had low levels of BTEX and DRO compounds. Analysis of the groundwater sample collected from well 45WL01 indicated a DRO concentration of 0.93 mg/l.

Table 3.3-1. Summary Table, SS61.

Boring/ Well No.	Depth (feet)	Sample Number	DRO (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)
Soil Analyses							
45WL01	6.0	45WL01SO6.0N	U	U	U	U	U
45WL01	16.0	45WL01SO16.0N	U	U	U	U	U
45WL02	8.0	45WL02SO8.0N	U	U	U	U	U
45WL02	16.0	45WL02SO16.0N	U	U	U	U	U
45BH01	15.5	45BH01SO15.5N	U	U	U	U	U
45BH01	16.0	45BH01SO0FD	U	U	U	U	U
45BH01	24.0	45BH01SO24.0N	70	U	U	U	.032
45BH02	8.5	45BH02SO8.5N	U	U	U	U	U
45BH02	21.0	45BH02SO21.0N	U	U	U	U	U
45BH03	5.5	45BH03SO5.5N	240	U	.031	.035	.079
45BH03	20.5	45BH03SO20.5N	U	U	U	U	U

Well Number	Sample Number	DRO (µg/l)	B (µg/l)	T (µg/l)	E (µg/l)	X (µg/l)
Water Analyses						
45WL01	45WL01WGN	380	U	U	U	U
45WL02	45WL02WGN	U	U	U	U	U
45AP3566	45AP3566WGN	U	9.5	U	U	U
45AP3606	45AP3606WGN	930	U	U	0.5	2.6
45AP3567	45AP3567WGN	6400	0.8	U	2.9	1.1

Key:
B = Benzene.
DRO = Diesel range organics.
E = Ethylbenzene.
T = Toluene.
U = Not detected at the method reporting limit.
X = Total xylenes.

Note: See Appendix B for the method reporting limit for each analysis.

3.3.5 Conceptual Modeling

The results of the laboratory analysis and field screening suggest that the subsurface soil located at the former UST location has DRO concentrations implying a release has occurred. The elevated concentration of DRO in soil does not extend to the depth where groundwater was encountered. The soil sample collected from 24.0 feet bgs (just above where water was encountered in boring 45BH01 has a 70 mg/kg DRO concentration, suggesting that lateral migration of contaminants may be occurring. Vertical migration of contaminants may have been inhibited by the clay layer underlying the tank at a depth of 10 feet bgs. PID readings are elevated in soils overlying this layer and are diminished at and below this layer. The contaminants may have migrated laterally, along the surface of the clay layer, to the location of 45BH01, where the clay layer is not encountered, allowing downward migration to continue to the water table where contaminants were found. Groundwater contamination could have possibly occurred during construction when several of the existing wells were damaged. The conceptual site model for this site is presented in Figure 3.3-2.

Three-point analysis of the groundwater elevations collected from wells 45WL01, 45WL02, and AP3606 indicate that flow is to the northwest.

3.3.5.1 Evaluation of Adequacy/Completeness

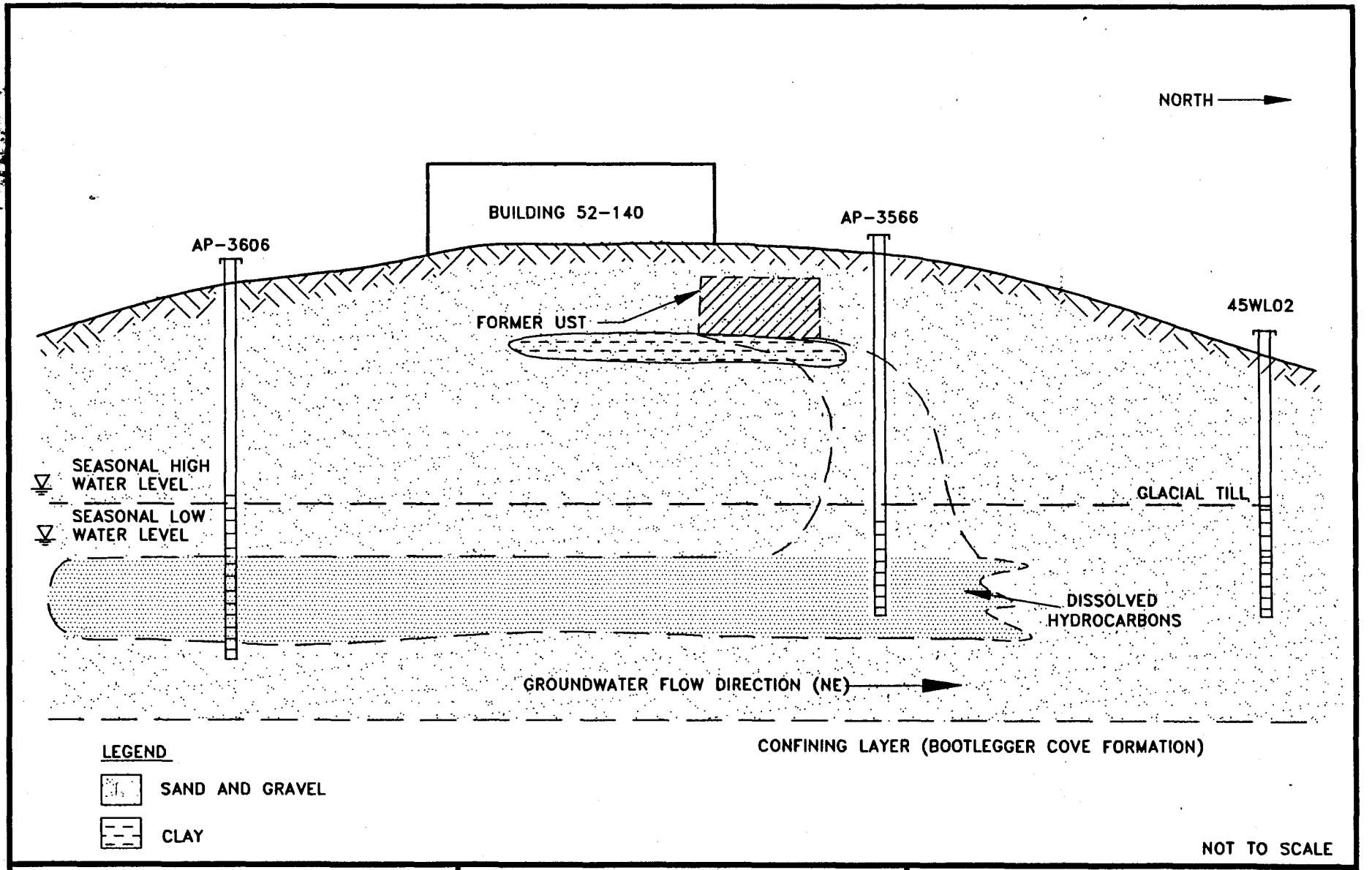
The presence and concentrations of DRO and BTEX compounds in the soil samples collected directly over the former UST location confirm that a release has occurred. The presence of low levels of DRO and total xylenes in the deep sample collected from 45BH01 and the absence of these compounds in the soil samples collected from the other borings and wells adequately define the limits of impacted soils.

Groundwater flow direction and gradient were determined, and the results of the groundwater sampling analysis revealed the extent of impacted groundwater. The location of the wells in relation to the groundwater flow direction has adequately characterized the condition of groundwater as it enters the site and the condition of the water as it moves downgradient from the former UST location.

3.3.6 Conclusions/Recommendations

3.3.6.1 Soil

Pursuant to 18 AAC 75 requirements, a matrix score of 38 was computed for the site. Table 3.3-2 presents the matrix score sheet for site SS61.



DRAWING: SS61CSM	DRAWN: ABB/SR	FIGURE 3.3-2 CONCEPTUAL SITE MODEL FOR SERA PHASE 1A SITE SS61
C/SC: 1:1	DISK: 793/93	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800
DATE: 11/09/93	CHECK: C.H.	

Table 3.3-2. Matrix Score Sheet for Site SS61.

1. Depth to Subsurface Water		10
< 5 feet	(10)	
5 - 15 feet	(8)	
15 - 25 feet	(6)	
25 - 50 feet	(4)	
> 50 feet	(1)	
2. Mean Annual Precipitation		3
> 40 inches	(10)	
25 - 40 inches	(5)	
15 - 25 inches	(3)	
< 15 inches	(1)	
3. Soil Type (Unified Soil Classification)		8
Clean, coarse-grained soils	(10)	
Coarse-grained soils with fines	(8)	
Fine-grained soils (low OC)	(3)	
Fine-grained soils (high OC)	(1)	
4. Potential Receptors		12
Base Well 8, 500 feet upgradient		
Public well within 1,000 feet, or		
Private well(s) within 500 feet	(15)	
Municipal/private well within 1/2 mile	(12)	
Municipal/private well within 1 mile	(8)	
No Known well within 1/2 mile	(6)	
No Known well within 1 mile	(4)	
Non-potable groundwater	(1)	
5. Volume of Contaminated Soil		5
> 500 cubic yards	(10)	
100 - 500 cubic yards	(8)	
25 - 100 cubic yards	(5)	
> De Minimus - 25 cubic yards	(2)	
De Minimus	(0)	
	Total	38

Matrix Score		Cleanup level in mg/kg			
		Diesel	Gasoline/Unknown		
		Diesel Range Petroleum Hydrocarbons	Gasoline Range Petroleum Hydrocarbons	Benzene	BTEX
Level A	>40	100	50	0.1	10
Level B	27-40	200	100	0.5	15
Level C	21-26	1,000	500	0.5	50
Level D	<20	2,000	1,000	0.5	100

A matrix score of 38 requires Level B cleanup standards. The soil sample collected from the 5.5-foot bgs interval during drilling of 45BH03 exceeded the cleanup level for DRO. DRO concentrations in soil samples collected from all other locations were below the cleanup level.

The areal extent of contaminated soils is limited to the distance between boring 45BH03 and all other boring locations. The fine-grained nature of the shallow subsurface soils is likely to have limited the extent of lateral migration of contaminants. The absence of hydrocarbons in the soil sample collected from 20.5 feet bgs from boring 45BH03 indicates that vertical migration of contaminants has not reached groundwater directly beneath the suspected location of the former UST. The presence of low levels of DRO and total xylenes from the soil sample collected from 24 feet bgs during drilling of boring 45BH01 may be the result of lateral and vertical migration of contaminants originating from the former UST location.

For the purposes of this study, the extent of soil contamination and the limits of impacted groundwater have been satisfactorily characterized.

3.3.6.2 Groundwater

Based on three-point analysis of the measured groundwater elevations, groundwater flow is interpreted to be to the northwest along an average gradient of 0.045 ft/ft.

The absence of detectable concentrations of DRO and BTEX in the downgradient well (45WL02) suggests that groundwater contamination had not migrated off-site at the time the samples were collected. The presence of hydrocarbon compounds in the upgradient well (AP-3606) indicates that an upgradient source potentially related to construction activities and/or SS63 is responsible for low levels of hydrocarbon compounds in groundwater. The groundwater sample collected from well AP-3566 had a benzene concentration of 9.5 µg/l, which exceeds the Federal and State MCL of 5 µg/l. The sample also had low levels of other BTEX compounds and DRO. The groundwater samples analyzed from well AP-3567 had lower levels of BTEX and DRO than those detected in well AP-3566 located just upgradient of well AP-3567. The presence of hydrocarbon compounds in well AP-3567 and AP-3566 suggest that groundwater may have been affected by the leak in the former UST. These results may indicate that natural attenuation is occurring or contaminant migration has not fully reached the location of well AP-3567. Following this study, a round of water samples from wells AP-3606, AP-3567, and AP-3566 were collected at site SS61 as part of OU7 investigation activities for site SS63, which is also located at this facility.

3.3.7 Follow-up Actions

Groundwater monitoring should continue to assess whether off-site migration of contaminants is occurring.

Currently, a pilot bioventing study is being conducted at the site by USAF. The application of this technology should remediate the contaminated soils to concentrations less than the ADEC cleanup levels. If cleanup levels are not met using this technique, other approaches should be considered.

A successful bioventing application may preclude the need to remediate groundwater; however, remediation alternatives should be assessed if soil contamination is not remediated. If off-site migration of impacted groundwater is not occurring and the source of contamination is eliminated, natural attenuation could be considered a feasible alternative.

Other potential sources of contamination at this location have been investigated under the LFI for OU7 and are reported separately.

3.4 Site ST69, 76-520 Diesel Leak (IRPIMS Site 46)

3.4.1 Introduction

Site ST69 is located on Loop Road at Building 76-520 (Figure 3.4), which houses electrical equipment used to assist aircraft in performing instrument landings on the east-west runway. The site is located approximately 0.5 mile west of the West Overrun. The site is bordered to the south and west by a predominantly hardwood forest, to the north by Loop Road, and to the east by the runway field (Figure 3.4-1).

A 500-gallon diesel fuel spill reportedly occurred between 1989 and 1990. An incomplete incident report recounts a 50-gallon motor vehicle gasoline (mogas) spill on 22 April 1991 caused by a ruptured standpipe from a former UST located north of Building 76-520. The size of this UST has not been determined. It was reported that this spill was easily cleaned up due to snow and frozen ground, and no infiltration into soil or groundwater occurred. According to the incident report, the UST was removed at the time of the spill cleanup. Presently, there are no active or inactive USTs at the site.

The spill report does not indicate whether the UST contained mogas or diesel fuel. Surface soil samples were collected from the area of the spill. Subsurface soil samples were apparently collected from the UST excavation. Groundwater encountered during excavation was also sampled. A hydrocarbon sheen was noticed on the groundwater during removal of the UST, according to the spill report. No documentation has been found that details the locations of the soil samples collected or the results of the sampling. No closure report was found.

3.4.2 Objectives

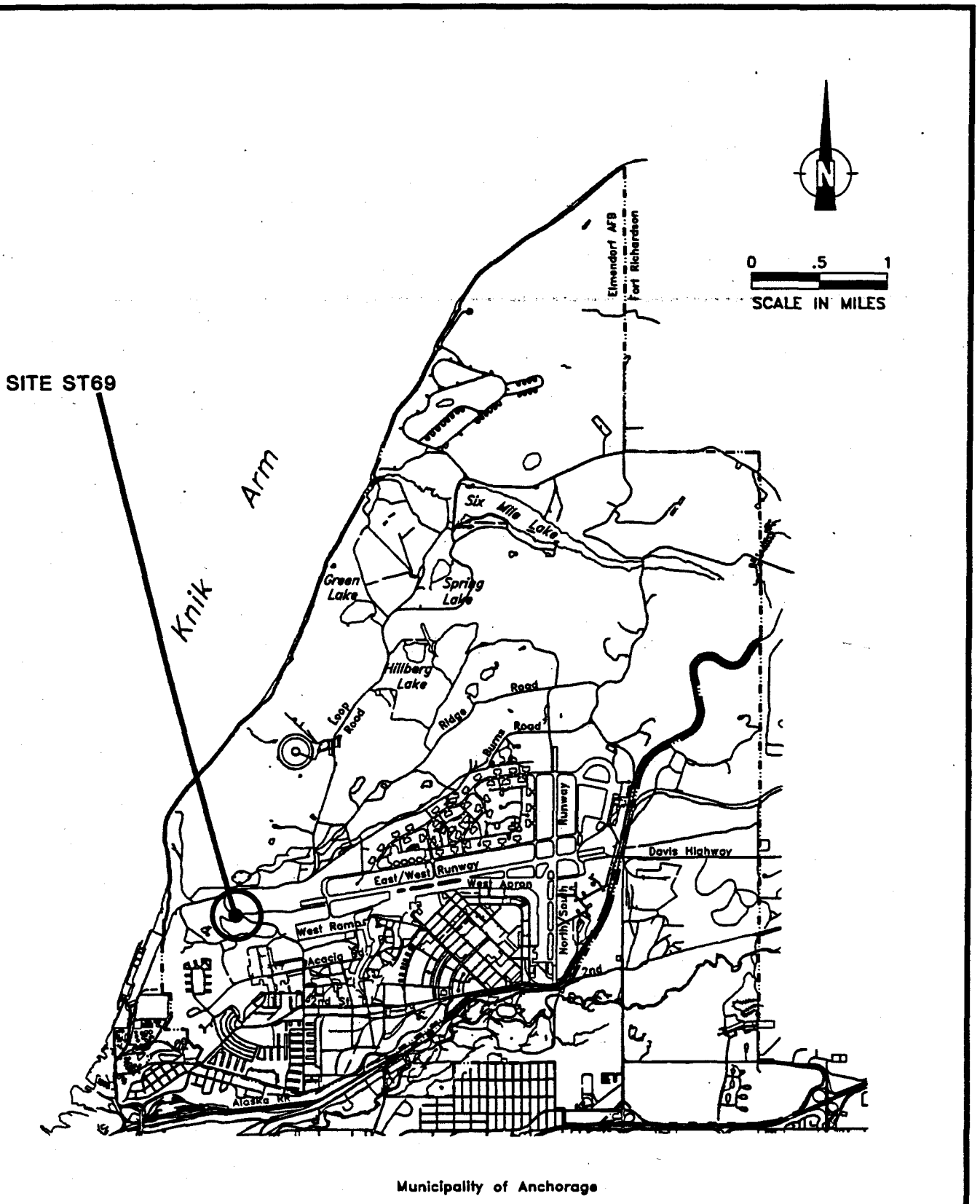
The objectives of the assessment at site ST69 were to:

- Assess the horizontal and vertical extent of contamination, and
- Assess whether groundwater contamination has resulted from this spill.

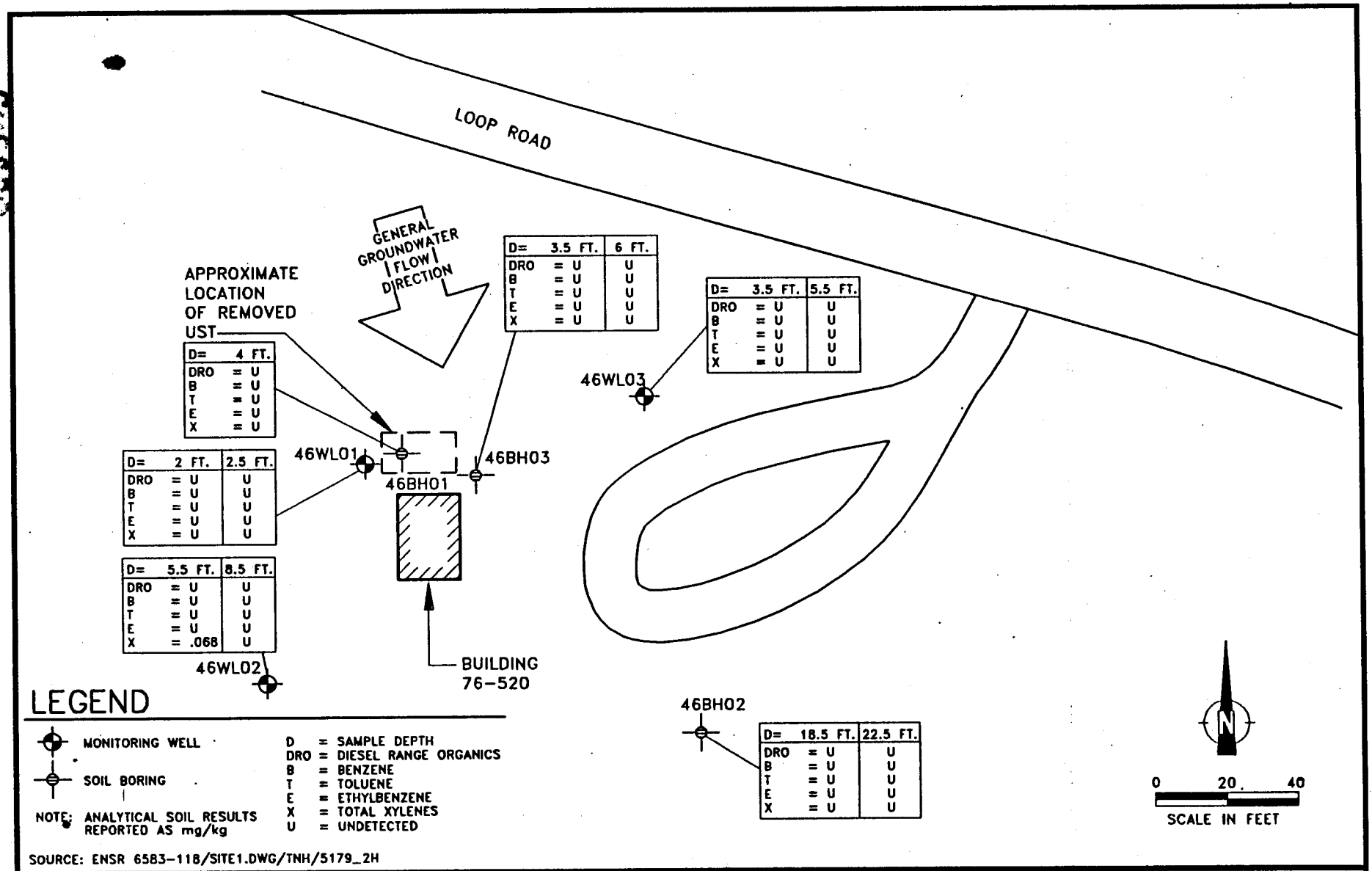
3.4.3 Field Investigation

3.4.3.1 Soil Borings

A total of three soil borings were drilled and sampled at site ST69 (Figure 3.4-1). Boring 46BH01 was drilled and sampled through the backfill material in the former UST excavation to a depth of 6.5 feet bgs where groundwater was encountered. Boring 46BH02 was originally planned to



DRAWING: F3605 DRAWN: ABB/SR C/SC: 1:5500 DISK: NET9/93 DATE: 09/22/93 CHECK: D.G.	FIGURE 3.4 LOCATION MAP SITE ST69	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800



LEGEND

- MONITORING WELL
- SOIL BORING

NOTE: ANALYTICAL SOIL RESULTS REPORTED AS mg/kg

D = SAMPLE DEPTH
DRO = DIESEL RANGE ORGANICS
B = BENZENE
T = TOLUENE
E = ETHYLBENZENE
X = TOTAL XYLENES
U = UNDETECTED

SOURCE: ENSR 6583-118/SITE1.DWG/TNH/5179_2H

DRAWING: ST69MW	DRAWN: ABB/SR	FIGURE 3.4-1 SOIL BORING LOCATIONS & ANALYTICAL RESULTS FOR SERA PHASE 1A SITE ST69
C/SC: 1:40	DISK: 751/93	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800
DATE: 01/13/94	CHECK: C.H.	

be a well location; however, groundwater was not encountered after drilling to a depth of 24.5 feet bgs into silt.

Boring 46BH03 was installed after a review of the data collected during installation of the other borings and wells. Boring 46BH03 was installed to assess the condition of native soils adjacent to the excavation perimeter. Groundwater was encountered at a depth of 6.28 feet in this boring. Boring logs for this site are presented in Appendix A. Soil samples were analyzed for DRO and BTEX compounds.

3.4.3.2 Groundwater Monitoring Well Installation and Groundwater Sample Collection

Three groundwater monitoring wells were installed at site ST69 (Figure 3.4-1A). Well 46WL01 was installed to a depth of 12 feet bgs. Well 46WL02 was shifted west of the originally planned location where the water table aquifer was not encountered after drilling 24.5 feet bgs into silt. The well was installed downgradient of the former UST location to a depth of 14.8 feet bgs. Well 46WL03 was installed upgradient of the former UST location to a depth of 13.1 feet bgs.

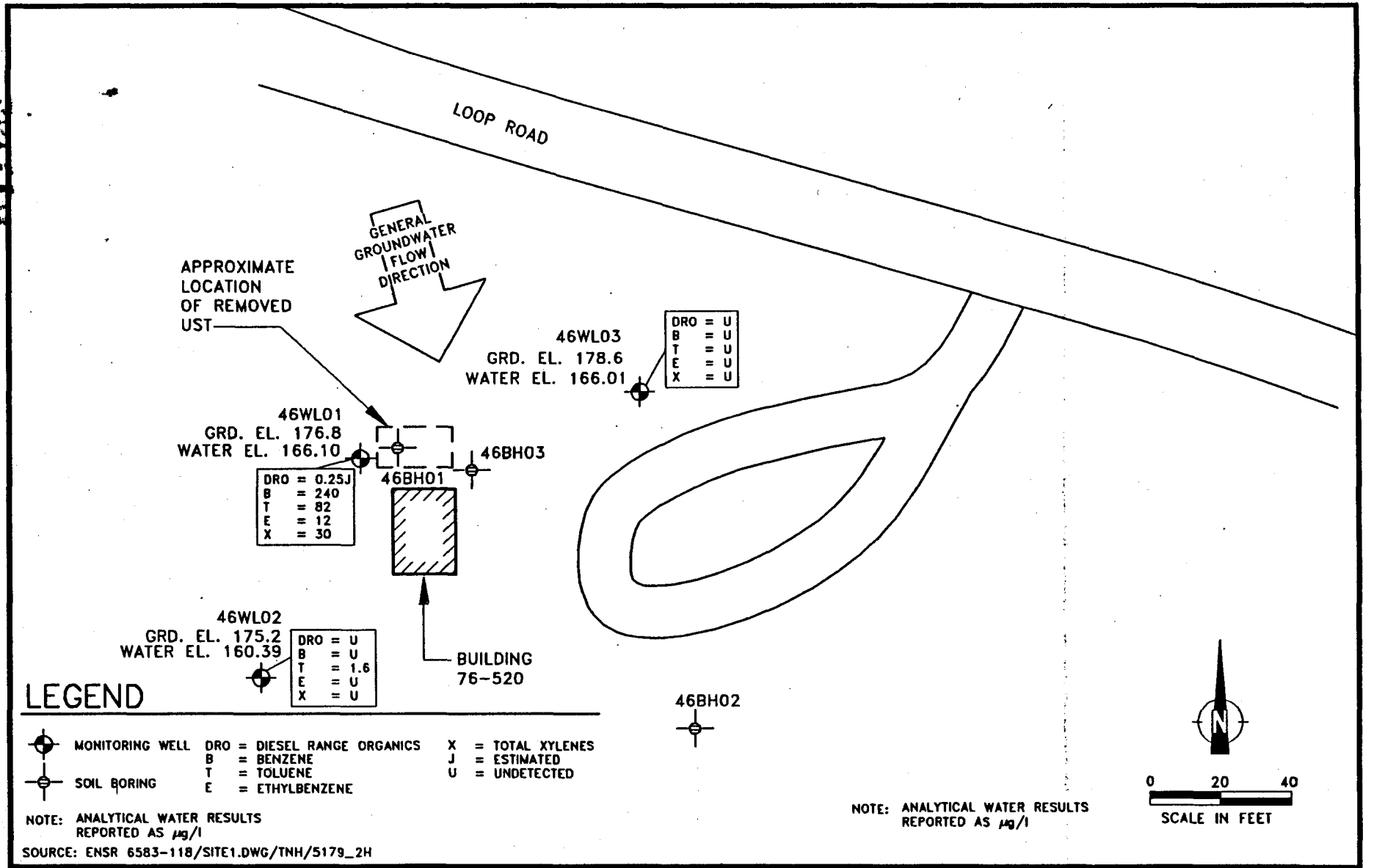
The groundwater monitoring wells were developed and sampled as described in Section 2.2.4. The samples were analyzed for DRO and BTEX. Well construction diagrams are included on the boring logs presented in Appendix A.

3.4.4 Results/Findings

3.4.4.1 Field Observations

Prior to the commencement of drilling activities, the site was inspected for the presence of unmarked utilities, apparent surface staining, and present utilization of the grounds surrounding the former UST location. The following observations were noted:

- The building is located south (possibly downgradient) of OU2.
- Groundwater seepage was apparent between Loop Road and the former UST location.
- An east-west open ditch approximately 15 feet south of 46WL02 provides for surface water drainage of the area.



NOTE: ANALYTICAL WATER RESULTS REPORTED AS µg/l

SOURCE: ENSR 6583-118/SITE1.DWG/TNH/5179_2H

DRAWING: ST69MW2	DRAWN: ABB/SR	FIGURE 3.4-1A MONITORING WELL LOCATIONS & ANALYTICAL RESULTS FOR SERA PHASE 1A SITE ST69
C/SC[illegible]1:40	DISK: 838/93	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800
DATE: 01/12/94	CHECK: C.H.	

The subsurface exploration program encountered a silty gravel backfill in the former UST location. The native soil noted while drilling 46BH03 was a brown silt to a depth of 7.5 feet bgs. Groundwater was encountered at a depth of approximately 6.25 feet bgs. The soil types encountered during drilling of well 46WL01 included a silty gravel to a depth of 2.5 feet bgs where a fine to medium, moderately sorted sand overlies a stiff gray silt located at approximately 12 feet bgs. Samples logged during drilling of well 46WL02 consisted of silt with a high organic content at the surface grading to a silty sand at 7.5 feet bgs. At 10 feet bgs, the soils became a well-graded, gravelly fine to coarse sand. The soils logged during drilling of boring 46BH02 were different than those characterized from the other borings/wells with a stiff silt extending from the surface to 24.5 feet bgs. The drastic change in lithology within the site may be explained by post-depositional incising of the clay layer by stream erosion. The stream channels were later filled in by alluvial or fluvial coarse-grained deposits. Another possible explanation is that native soils were removed during construction of nearby Loop Road and Building 76-520 (Figure 3.4-1).

Field PID readings on soil samples were used to help select the samples for laboratory analysis. Field screening results are included on the boring logs presented in Appendix A. None of the samples recorded greater than background PID readings.

3.4.4.2 Analytical Results

The results of laboratory analyses of soil samples are presented on Figure 3.4-1 and in Table 3.4-1. The soil sample collected from 5.5 feet bgs in boring 46WL02 had a trace of toluene at a concentration of 0.068 mg/kg. No other soil samples had detectable quantities of the targeted analytes.

The results of laboratory analyses of groundwater samples are presented on Figure 3.4-1A and in Table 3.4-1. The sample collected from well 46WL01 had a benzene concentration of 240 µg/l, which exceeds State and Federal MCLs for primary drinking water. The groundwater sample collected from well 46WL02 had a toluene concentration of 1.6 µg/l, which was also found in the trip blank suggesting possible laboratory contamination. No other targeted analytes were detected from well 46WL02. Analyses of groundwater samples collected from 46WL03 did not detect hydrocarbon compounds.

3.4.4.3 Conceptual Modeling

The conceptual model for this site is presented in Figure 3.4-2. The results of the subsurface soil sampling indicate that the subsurface soils have not been affected by the release from the former UST.

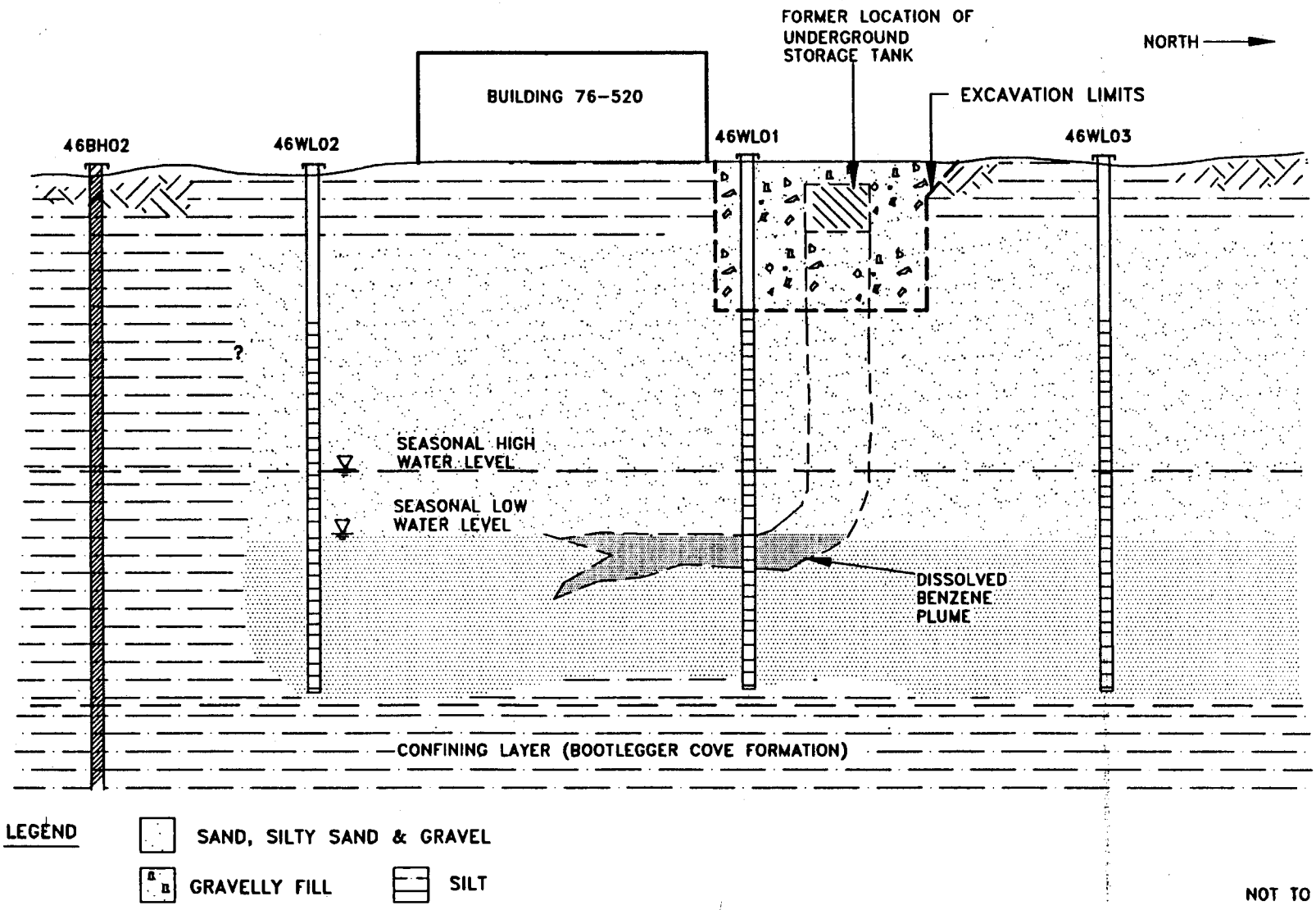
Table 3.4-1. Summary Table, ST69.

Boring/ Well No.	Depth (feet)	Sample Number	DRO (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)
Soil Analyses							
46WL01	2.0	WL01SO2.0N	U	U	U	U	U
46WL01	2.5	46WL01SO2.5N	U	U	U	U	U
46WL02	5.5	46WL02SO5.5N	U	U	U	U	.068
46WL02	6.0	46WL02SO0FD	U	U	U	U	U
46WL02	8.5	46WL02SO8.5N	U	U	U	U	U
46WL03	3.5	46WL03SO3.5N	U	U	U	U	U
46WL03	5.5	46WL03SO5.5N	U	U	U	U	U
46WL03	6.0	46WL03SO6.0MS/S	NA	U	U	U	U
46BH01	4.0	46BH01SO4.0N	U	U	U	U	U
46BH02	18.5	46BH02SO18.5N	U	U	U	U	U
46BH02	22.5	46BH02SO22.5N	U	U	U	U	U
46BH03	3.5	46BH03SO3.5N	U	U	U	U	U
46BH03	6.0	46BH03SO6.0N	U	U	U	U	U

Well Number	Sample Number	DRO (µg/l)	B (µg/l)	T (µg/l)	E (µg/l)	X (µg/l)
Water Analyses						
46WL01	46WL01WGN	.25J	240	82	12	30
46WL02	46WL02WGN	U	U	1.6	U	U
46WL03	46WL03WGN	U	U	U	U	U
46WL03	46WL03WGFD	NA	U	U	U	U

Key: B = Benzene.
DRO = Diesel range organics.
E = Ethylbenzene.
J = Estimated.
NA = Not analyzed.
T = Toluene.
U = Not detected at the method reporting limit.
X = Total xylenes.

Note: See Appendix B for the method reporting limit for each analysis.



DRAWING: ST69CSM C/SC: 1:1 DATE: 11/12/93	DRAWN: ABB DISK: 794/93 CHECK: C.H.	FIGURE 3.4-2 CONCEPTUAL SITE MODEL FOR SERA PHASE 1A SITE ST69	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800

Three-point analysis of the groundwater elevations in wells 46WL01 through 46WL03 indicate that groundwater flow is to the south-southeast. Concentrations of hydrocarbon compounds were detected in well 46WL01, which is adjacent to the former UST location.

3.4.4.4 Evaluation of Adequacy/Completeness

The soils within and surrounding the excavation perimeter were satisfactorily characterized, meeting the objective of determination of the extent of contaminated soils. The wells have not fully characterized the groundwater flow conditions in the area of the former UST location. The localized contamination found and the interpreted groundwater gradient together present inconsistencies.

3.4.5 Conclusions/Recommendations

3.4.5.1 Soil

Pursuant to the requirements set forth in 18 AAC 78 for UST sites, a matrix score of 25 was computed for the subject site. The matrix score sheet for site ST69 is presented in Table 3.4-2.

A matrix score of 25 requires Level C cleanup standards. None of the soil samples exhibited hydrocarbon concentrations exceeding cleanup levels. The absence of hydrocarbon compounds in the soil samples surrounding the former UST location suggests that the cleanup efforts made at the time the tank was removed successfully prevented soil contamination.

3.4.5.2 Groundwater

Based on three-point analysis of groundwater elevations measured from the three new well installations (46WL01 through 46WL03), groundwater flow is interpreted to be to the south-southeast. The average groundwater gradient was calculated to be 0.0836 ft/ft. The presence of elevated levels of benzene in the groundwater sample collected from 46WL01 confirm that hydrocarbon compounds did reach the water table; however, the absence of these compounds from the groundwater sample collected from downgradient well 46WL02 indicates that impacted groundwater is confined to the immediate vicinity of the tank. The absence of hydrocarbon compounds in the sample collected from the upgradient well (46WL03) indicates that potential upgradient sources of groundwater contamination are not affecting site ST69.

Table 3.4-2. Matrix Score Sheet for Site ST69.

1. Depth to Subsurface Water		
< 5 feet	(10)	10
5 - 15 feet	(8)	
15 - 25 feet	(6)	
25 - 50 feet	(4)	
> 50 feet	(1)	
2. Mean Annual Precipitation		
> 40 inches	(10)	
25 - 40 inches	(5)	
15 - 25 inches	(3)	3
< 15 inches	(1)	
3. Soil Type (Unified Soil Classification)		
Clean, coarse-grained soils	(10)	
Coarse-grained soils with fines	(8)	8
Fine-grained soils (low OC)	(3)	
Fine-grained soils (high OC)	(1)	
4. Potential Receptors		
Public well within 1,000 feet, or		
Private well(s) within 500 feet	(15)	
Municipal/private well within 1/2 mile	(12)	
Municipal/private well within 1 mile	(8)	
No Known well within 1/2 mile	(6)	
No Known well within 1 mile	(4)	4
Non-potable groundwater	(1)	
5. Volume of Contaminated Soil		
> 500 cubic yards	(10)	
100 - 500 cubic yards	(8)	
25 - 100 cubic yards	(5)	
> De Minimus - 25 cubic yards	(2)	
De Minimus	(0)	0
	Total	25

Matrix Score		Cleanup level in mg/kg			
		Diesel	Gasoline/Unknown		
		Diesel Range Petroleum Hydrocarbons	Gasoline Range Petroleum Hydrocarbons	Benzene	BTEX
Level A	>40	100	50	0.1	10
Level B	27-40	200	100	0.5	15
Level C	21-26	1,000	500	0.5	50
Level D	<20	2,000	1,000	0.5	100

Local deviation in the groundwater flow in this area could be better characterized with additional monitoring wells. However, this effort would appear excessive to address the limited extent of contamination found during the investigation of ST69.

3.4.6 Follow-up Actions

The subsurface soils do not exhibit hydrocarbon concentrations requiring remedial efforts. The concentration of benzene and BTEX compounds in the groundwater immediately around the former tank location is greater than established Federal and State MCLs. Prior to a review of possible groundwater remediation alternatives, the hydrogeologic properties of the shallow unconfined aquifer (such as hydraulic conductivity, thickness, etc.) could be determined. These properties may be used for determining remedial system design if appropriate. The limited extent of groundwater contamination and steep groundwater gradient in the coarse-grained soil of the site suggest that the contamination should have been dispersed and attenuated naturally by this time.

An additional round of groundwater sampling should be conducted to confirm this.

3.5 Site SS34, AAFES Self-Serve Line Leak (IRPIMS Site 47)

3.5.1 Introduction

Site SS34, an Army Air Force Exchange Service (AAFES) self-serve station, is located on the Davis Highway just north of 2nd Street, on Elmendorf AFB (Figure 3.5). The site is comprised of an attendant booth (Building 33-395) and four gas pump islands. Four 10,000-gallon mogas USTs, Tank Nos. 395A, 395B, 395C, and 395D, provide fuel to the pump islands. In January 1991, a 5,000-gallon discrepancy was noted in the station's fuel inventory. A subsequent investigation determined that a release had occurred from one of the feed lines.

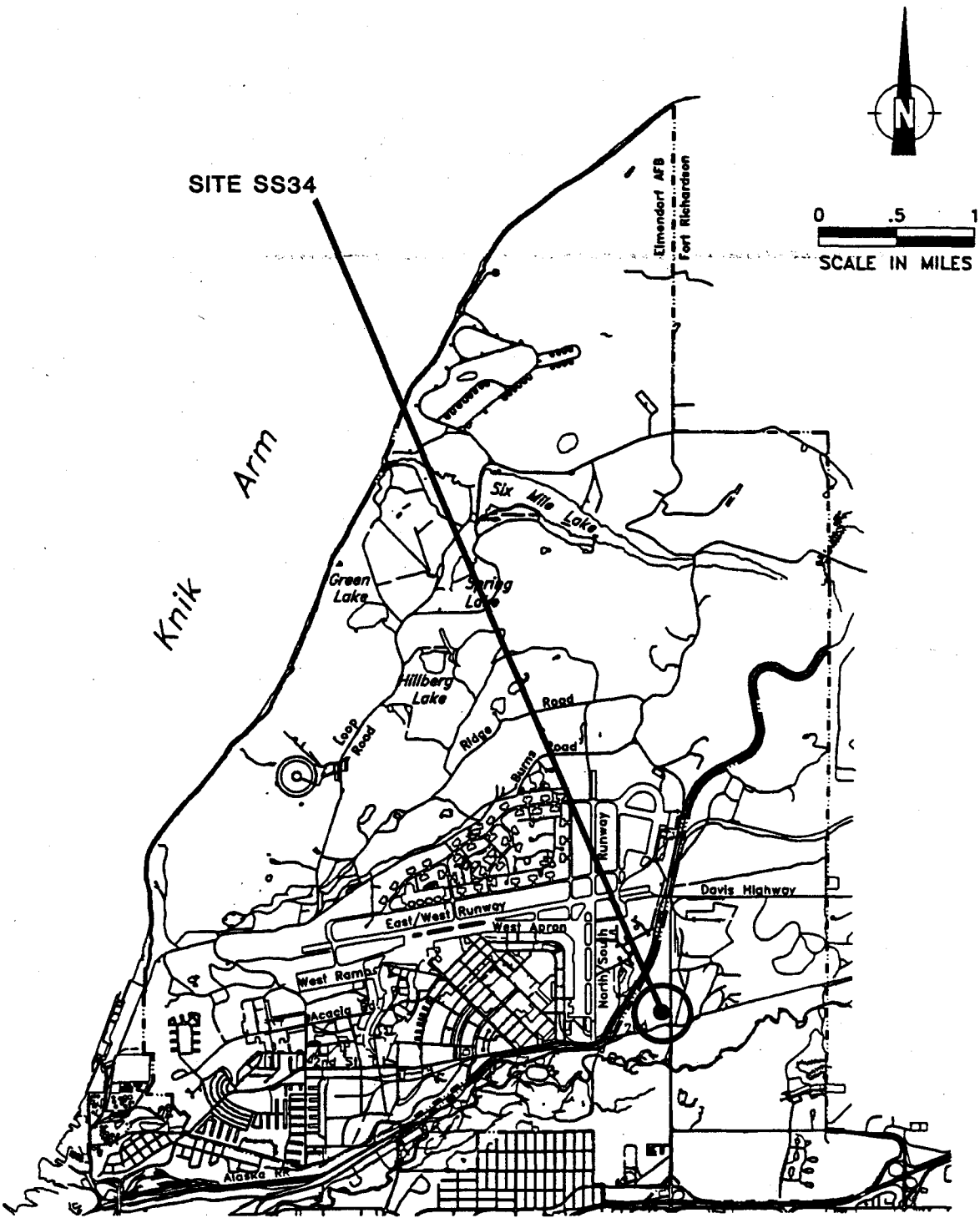
A review of historical aerial photographs indicated that the area of the service station was predominantly undeveloped woodland prior to its construction in 1978. Currently, the land surrounding the service station remains woodland. The land across the Davis Highway is the site of three former landfills that are currently being investigated as OU1 under CERCLA. The results of that investigation are available in the FY 92 Remedial Investigation/Feasibility Study (RI/FS) for OU1 (finalized in January 1994).

The service station serves cars and trucks, and has historically distributed both regular leaded and unleaded gasoline. Currently, only unleaded gasoline is sold.

Upgradient and downgradient wells were installed at the site prior to this investigation to determine the potential of groundwater contamination downgradient of OU1. These wells are shown on Figure 3.5-1A.

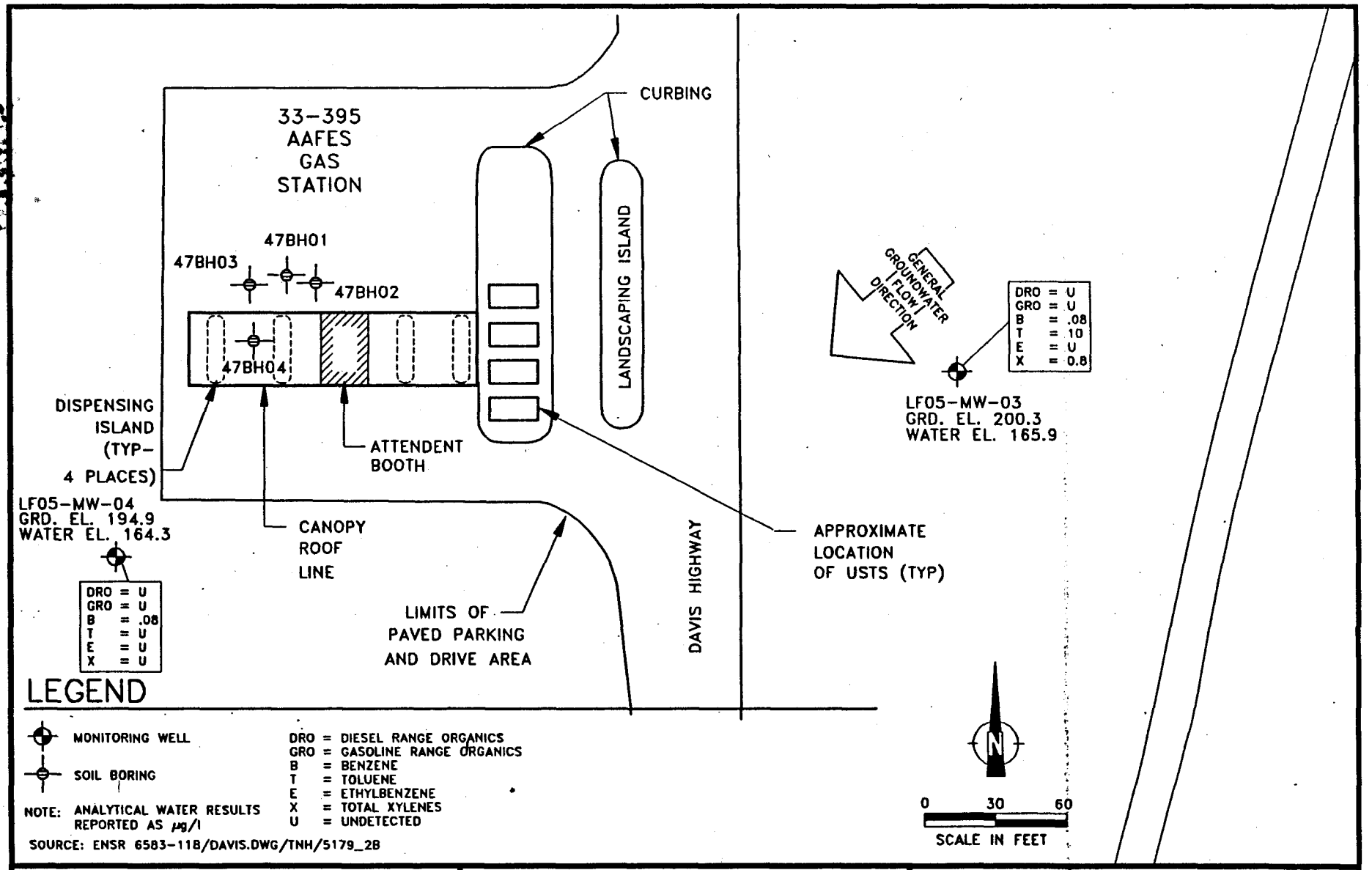
At the time that the fuel inventory discrepancy was noted, an investigation was undertaken to determine if a release had occurred and, if so, the source of the release. Excavation activities were carried out along the pipelines leading from the USTs on site to the pumps. These activities uncovered a cracked joint in the pipeline leading to the gas pump island on the northwest side of the attendant booth. At that time, the visibly contaminated soil was removed and a sample was collected from the area of the release. No information was available on the exact sample location or on the removal of the soil. Laboratory results indicated low levels of TPH and BTEX in the sample.

Notations in the files indicated that further excavation was done at this site. The extent of the excavation activities is unknown.



Municipality of Anchorage

DRAWING: F3605 DRAWN: ABB/SR C/SC: 1:5500 DISK: NET9/93 DATE: 09/22/93 CHECK: D.G.	FIGURE 3.5 LOCATION MAP SITE SS34	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800



DRAWING: SS34MW	DRAWN: ABB/SR	FIGURE 3.5-1A MONITORING WELL LOCATIONS & ANALYTICAL RESULTS FOR SERA PHASE 1A SITE SS34
C/SC: 1:60	DISK: 751/93	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800
DATE: 01/13/94	CHECK: C.H.	

In 1991, upgradient and downgradient monitoring wells were installed at the site as part of an investigation of OU1 for the purpose of determining the extent that the mogas leak had contributed to the contamination found downgradient of OU1. Available data from OU1 was reviewed to determine the impact OU1 has upon SS34.

3.5.2 Objectives

The objectives for the assessment of this site were to determine the nature and extent of soil contamination from this spill and whether there was a contribution to the groundwater contamination from this release. A records search and site reconnaissance were conducted to identify historical and current conditions that may potentially affect soil and groundwater at site SS34.

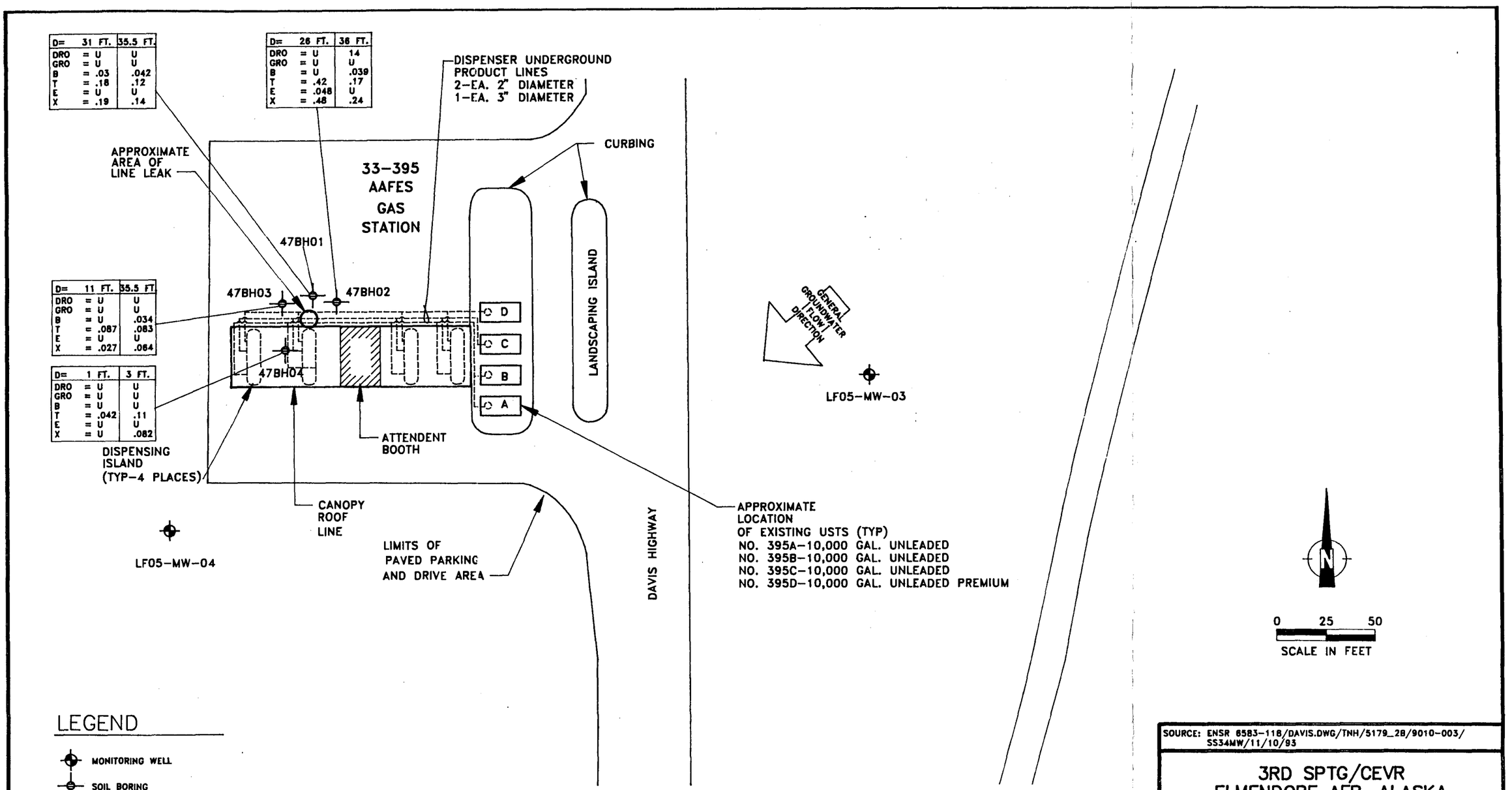
3.5.3 Field Investigations

3.5.3.1 Soil Borings

A total of four soil borings were drilled and sampled at this site (Figure 3.5-1). The location of borings 47BH01, 47BH02, and 47BH03 were shifted approximately 5 feet west of the original work plan locations to avoid contact with fuel supply lines between the storage tanks at the northern end of the facility at the gas pumps. The borings were drilled and sampled as discussed in Section 2.2.4. The borings were installed to a depth of 37 feet bgs where groundwater was encountered. Boring logs are presented in Appendix A.

Boring 47BH04 was located under a canopy extending between the attendant booth and the southern gas-pump island. A Minuteman portable drill rig, equipped with a 2.5-inch OD solid-stem auger, was used to advance this boring. The rig was unable to advance more than 3.5 feet after 3 hours of continuous drilling due to large cobbles in the subsurface soils. The boring was drilled and sampled to a maximum depth of 3.5 feet bgs. Soil samples were analyzed for DRO, GRO, and BTEX.

It was impractical to move the location of 47BH04 due to nearby buried fuel piping and required additional concrete drive pad cutting.



LEGEND

- MONITORING WELL
- SOIL BORING

D = SAMPLE DEPTH
DRO = DIESEL RANGE ORGANICS
GRO = GASOLINE RANGE ORGANICS
B = BENZENE
T = TOLUENE
E = ETHYLBENZENE
X = TOTAL XYLENES
U = UNDETECTED

NOTE: ANALYTICAL SOIL RESULTS REPORTED AS mg/kg

COPIED

SOURCE: ENSR 6583–118/DAVIS.DWG/TNH/5179_2B/9010–003/SS34MW/11/10/93

3RD SPTG/CEVR ELMENDORF AFB, ALASKA

FIGURE 3.5–1
SOIL BORING LOCATIONS & ANALYTICAL RESULTS FOR SERA PHASE 1A SITE SS34

DATE:	DRAWN BY:	SCALE:	DRAWING:
01/12/94	SR/ABB	AS SHOWN	SS34MW2
C/SC: DISK: 1:50 836/93	ENGINEER: C. HUMPHREY	CHECKED: J. WILLIAMS	PROJECT: 9010–003–800

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3.5.3.2 Groundwater Sample Collection

Two previously existing groundwater monitoring wells were installed as part of an investigation of OU1 located east of site SS34. Well LF05-MW-03 is located upgradient (east) of the site across the Davis Highway. Well LF05-MW-04 is located downgradient of the site. Groundwater samples were collected from these wells as described in Section 2.2.4. The samples were analyzed for DRO, GRO, and BTEX. Boring logs presented in Appendix A.

3.5.4 Results/Findings

3.5.4.1 Field Observations

Prior to the commencement of drilling activities, the site was inspected for the presence of unmarked utilities, apparent surface staining, and present usage of the grounds surrounding the leak location. The following observations were noted.

- The area of investigation was paved with asphalt.
- The area between the gas pumps has a canopy approximately 15.5 feet high and a concrete surface between the pumps.
- The fuel lines between the storage tanks and the gas pumps were not marked, limiting possible drilling locations.

The subsurface exploration program encountered well-graded gravels to a depth of approximately 21 feet bgs where a moderately graded sand layer continued to a depth of 25 feet bgs. The unconsolidated sediments underlying the sand layer consist of a sandy gravel. The soils are typical of an alluvial outwash terrain.

Field PID readings on soil samples were used to help select the samples for laboratory analysis. Field screening results are presented on boring logs in Appendix A. Elevated PID readings were recorded from samples collected while drilling borings 47BH01, 47BH02, and 47BH03.

3.5.4.2 Analytical Results

The results of the laboratory analyses are presented in Appendix B and summarized on Figures 3.5-1 and 3.5-1A, and in Table 3.5-1. Low levels of BTEX compounds were detected in both soil samples collected from boring 47BH01; however, the analysis did not reveal detectable concentrations of DRO or GRO. The soil samples collected from borings 47BH02 and 42BH03

Table 3.5-1. Summary Table, SS34.

Boring/ Well No.	Depth (feet)	Sample Number	DRO (mg/kg)	GRO (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)
Soil Analyses								
47BH01	31.0	47BH01SO31.0N	U	U	.03	.18	U	.19
47BH01	35.5	47BH01SO31.0N	U	U	.042	.12	U	.14
47BH02	26.0	47BH02SO26.0N	U	U	U	.42	.048	.48
47BH02	35.5	47BH01SO35.5N	U	U	U	.056	U	.049
47BH02	36.0	47BH01SO0FD	14	U	.039	.17	U	.24
47BH03	11.0	47BH01SO11.0N	U	U	U	.087	U	.027
47BHO3	35.5	47BH01SO35.5N	U	U	.034	.083	U	.064
47BH04	1.0	47BH01SO1.0N	U	U	U	.042	U	U
47BH04	3.0	47BH01SO3.0N	U	U	U	.11	U	.062

Well Number	Sample Number	DRO (µg/l)	GRO (µg/l)	B (µg/l)	T (µg/l)	E (µg/l)	X (µg/l)
Water Analyses							
47LF05MW04	47LF05MW04WGN	U	U	0.8	U	U	U
47LF05MW03	47LF05MW03WGN	U	U	0.8	10	U	0.8

Key: B = Benzene.
DRO = Diesel range organics.
E = Ethylbenzene.
GRO = Gasoline range organics.
T = Toluene.
U = Not detected at the method reporting limit.
X = Total xylenes.

Note: See Appendix B for the method reporting limit for each analysis.

also had low levels of BTEX compounds. Soil samples collected from 47BH04 had trace concentrations of toluene and total xylenes.

The results of the groundwater analysis indicated the presence of benzene, toluene, and total xylenes in groundwater samples collected from well LF05-MW-03. Benzene was the only analyte detected in the sample collected from well LF05-MW-04.

3.5.4.3 Conceptual Modeling

The results of the laboratory analysis and field screening of soil samples collected from the borings indicate that low levels of BTEX compounds are present in all the locations where soil samples were collected. The concentrations of contaminants remains relatively stable with depth. The conceptual site model for this site is presented in Figure 3.5-2.

According to the Basewide Monthly Water Level Data Package for June 1993, groundwater flow direction at site SS34 is to the west-southwest. Benzene is present in the groundwater entering the site at a concentration of 0.8 µg/l and exiting the site at a concentration of 0.8 µg/l.

3.5.4.4 Evaluation of Adequacy/Completeness

The levels of hydrocarbon compounds in the soil suggest that the effect of the release from the gasoline supply pipe leak has been minimal with no contribution to groundwater contamination. The close proximity of the soil boring locations to the line leak location has adequately characterized the condition of the soils near the source.

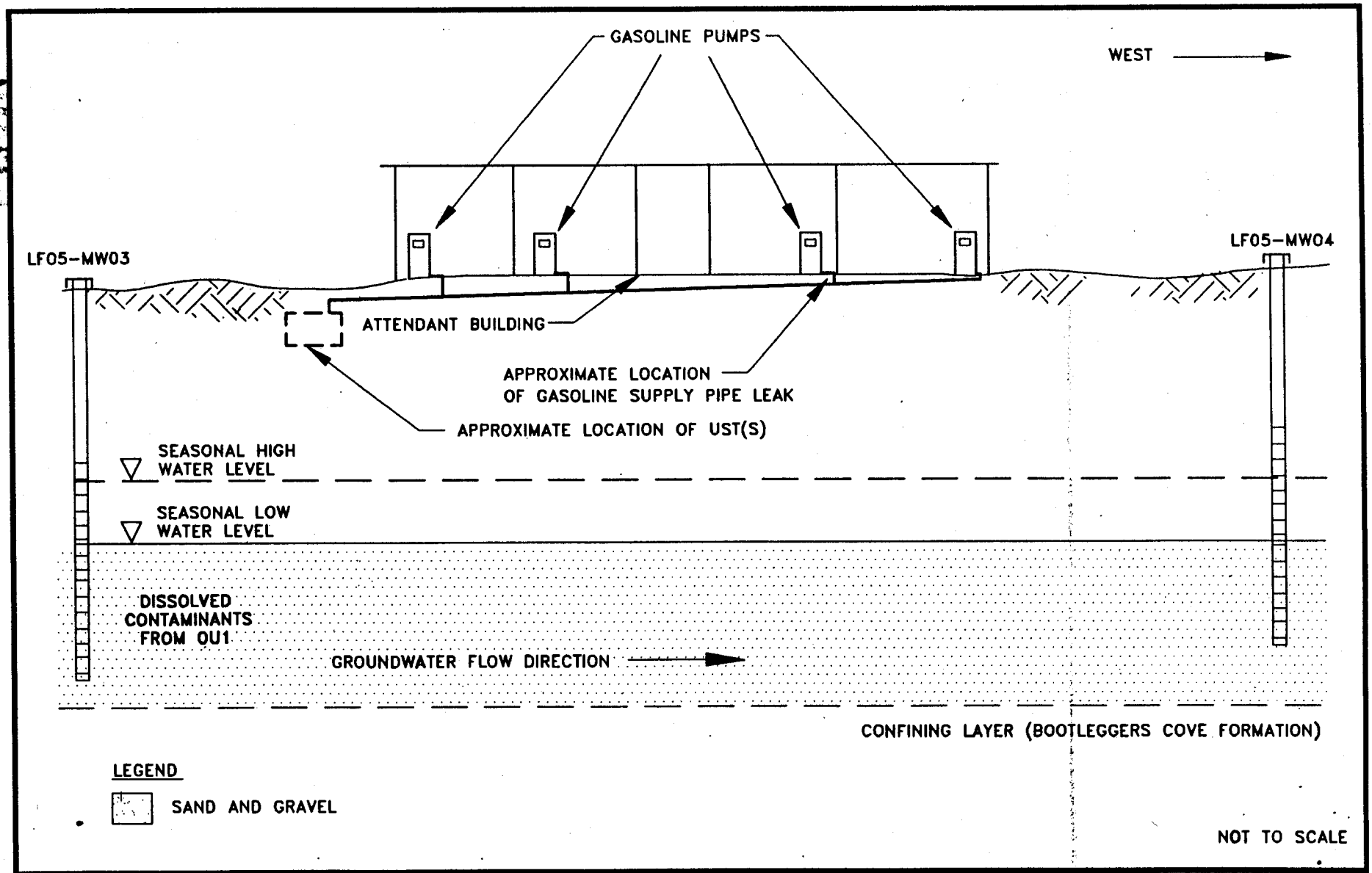
The upgradient and downgradient wells have satisfactorily assessed the condition of the groundwater entering and exiting the site.

The objectives of the site investigation have been successfully met.

3.5.5 Conclusions/Recommendations

3.5.5.1 Soil

Pursuant to 18 AAC 75 requirements for POL sites, a matrix score of 39 was computed for the subject site. The matrix score sheet for site SS34 is presented in Table 3.5-2.



DRAWING: SS34CSM	DRAWN: ABB/SR	FIGURE 3.5-2 CONCEPTUAL SITE MODEL FOR SERA PHASE 1A SITE SS34
C/SC: 1:1	DISK: 754/93	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800
DATE: 11/09/93	CHECK: C.H.	

Table 3.5-2. Matrix Score Sheet for Site SS34.

1. Depth to Subsurface Water		
< 5 feet	(10)	10
5 - 15 feet	(8)	
15 - 25 feet	(6)	
25 - 50 feet	(4)	
> 50 feet	(1)	
2. Mean Annual Precipitation		
> 40 inches	(10)	
25 - 40 inches	(5)	
15 - 25 inches	(3)	3
< 15 inches	(1)	
3. Soil Type (Unified Soil Classification)		
Clean, coarse-grained soils	(10)	10
Coarse-grained soils with fines	(8)	
Fine-grained soils (low OC)	(3)	
Fine-grained soils (high OC)	(1)	
4. Potential Receptors		
Base Well 23, 1,400 feet downgradient		
Public well within 1,000 feet, or		
Private well(s) within 500 feet	(15)	
Municipal/private well within 1/2 mile	(12)	
Municipal/private well within 1 mile	(8)	8
No Known well within 1/2 mile	(6)	
No Known well within 1 mile	(4)	
Non-potable groundwater	(1)	
5. Volume of Contaminated Soil		
> 500 cubic yards	(10)	
100 - 500 cubic yards	(8)	8
25 - 100 cubic yards	(5)	
> De Minimus - 25 cubic yards	(2)	
De Minimus	(0)	
	Total	39

Matrix Score		Cleanup level in mg/kg			
		Diesel	Gasoline/Unknown		
		Diesel Range Petroleum Hydrocarbons	Gasoline Range Petroleum Hydrocarbons	Benzene	BTEX
Level A	>40	100	50	0.1	10
Level B	27-40	200	100	0.5	15
Level C	21-26	1,000	500	0.5	50
Level D	<20	2,000	1,000	0.5	100

A matrix score of 39 requires Level B cleanup standards. None of the soil samples contained concentrations of the analytes exceeding ADEC cleanup standards. The soils adjacent to the leak location have been adequately characterized for hydrocarbon compounds, and the levels as detected do not require a remedial effort.

3.5.5.2 Groundwater

Based on the Basewide Monthly Water Level Data Package for June 1993, groundwater flow is to the west-southwest. Well LF05-MW-03 is interpreted to be upgradient of the subject site and well LF04-MW-04 is downgradient. According to the analytical results of groundwater samples, a plume of dissolved BTEX compounds is emanating from an upgradient source. Of those analytes detected in the groundwater sample from the upgradient well, only benzene was detected in the downgradient well (LF05-MW-04). These results suggest that attenuation may be occurring to the compounds with the exception of benzene, which was detected at the same concentration as the upgradient well. No evidence has been found to suggest that the leak in the gasoline line has contributed to groundwater contamination.

3.5.6 Follow-up Actions

The assessment of site SS34 determined that concentrations of hydrocarbon compounds in the subsurface soils do not exceed ADEC cleanup levels, and groundwater has not been affected by the release. No further action is required.

3.6 Site SS62, AAFES Service Station (IRPIMS Site 48)

3.6.1 Introduction

Site SS62, the AAFES Service Station, is located at Building 21-876 on the corner of Juniper Drive (2nd Street) and Fig Street. Figure 3.6 presents the general site location. Figure 3.6-1 presents the site-specific location. The site is bordered by a package store (Building 21-870) and car wash to the south, the vehicle maintenance shop (Building 21-900) to the north, a paved parking lot and Building 21-889 to the east, and the shoppette (Building 21-875) to the west.

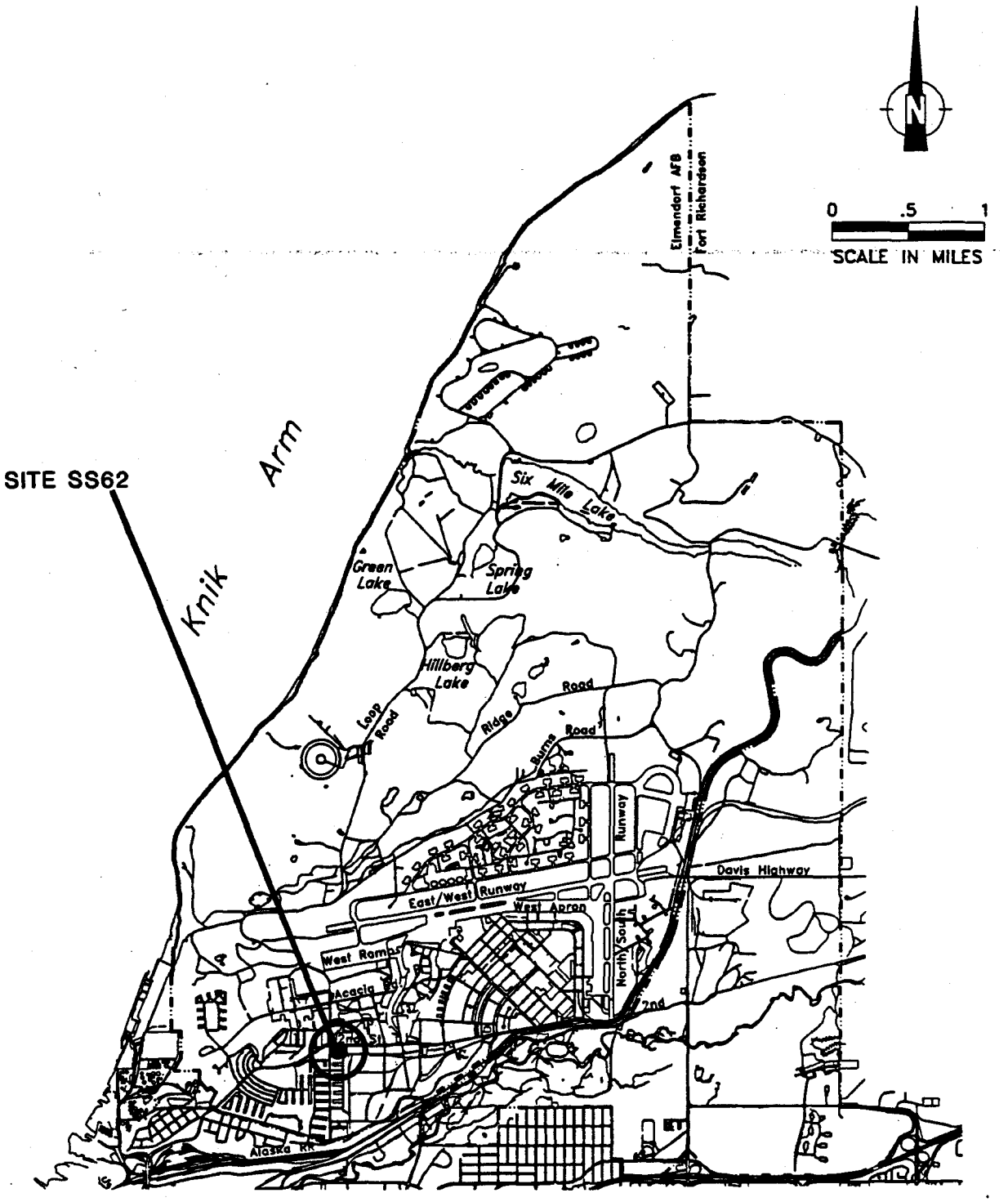
The AAFES site reportedly had two waste oil tanks (1,500 [Tank No. 876A] and 500 [Tank No. 876B] gallons) installed in 1963. Four 6,000-gallon gasoline tanks (Tank Nos. 876A through 876D) and one 10,000-gallon diesel fuel tank (Tank No. 876E) were installed in 1975. In the fall of 1990, some or all of the USTs were tightness tested. No leaks were reported. During UST replacement in fall 1990, the contractor discovered hydrocarbon- contaminated soil around several of the USTs. The diesel UST and the four gasoline and two waste oil USTs were removed.

During excavation activities, contaminated soil was encountered at various locations around the site. Contaminated soil at the western waste oil UST site was excavated to a depth of 18 feet bgs, which was the excavation limit of the backhoe. Contaminated soil deeper than 18 feet was not excavated.

Five new USTs (Tank Nos. 876F through 876J) were installed to replace the seven tanks that were removed. The tank replacement report states that limited contamination was found near the junction of the east wall of the garage and the south wall of Building 21-876. It is not known if contaminated soil was removed. The report speculated that soil contamination may exist along the entire east wall of Building 21-876.

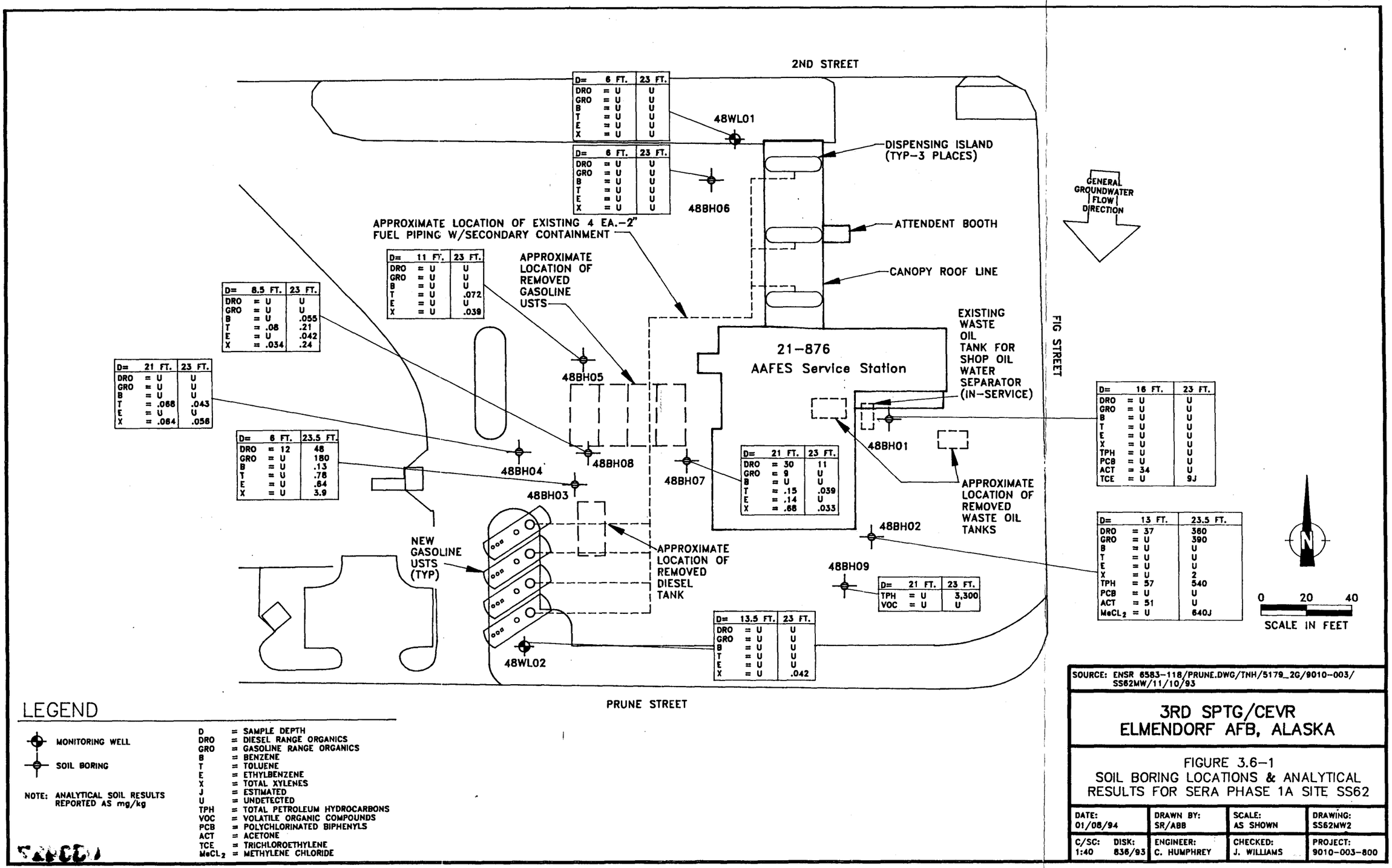
During excavation for the five replacement USTs, contaminated soil having a gasoline odor was identified along most of the northern edge of the excavation. Contamination in this area was reported from the top of the excavation to a depth of 15 feet bgs. The contaminated soil was removed from the northern end to facilitate the installation of a new fuel tank. Contaminated soil reportedly remains within the eastern half of the northern end from the surface to the bottom of excavation. Contaminated soil was also encountered from the fuel dispensing island approximately 20 feet west of Building 21-876.

The contaminated soil was moved to the Elmendorf contaminated soil area for ultimate remediation or disposal.



Municipality of Anchorage

DRAWING: F3605 DRAWN: ABB/SR C/SC: 1:5500 DISK: NET9/93 DATE: 09/22/93 CHECK: D.G.	FIGURE 3.6 LOCATION MAP SITE SS62	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800



LEGEND

- MONITORING WELL
- SOIL BORING

NOTE: ANALYTICAL SOIL RESULTS REPORTED AS mg/kg

D	= SAMPLE DEPTH
DRO	= DIESEL RANGE ORGANICS
GRO	= GASOLINE RANGE ORGANICS
B	= BENZENE
T	= TOLUENE
E	= ETHYLBENZENE
X	= TOTAL XYLENES
J	= ESTIMATED
U	= UNDETECTED
TPH	= TOTAL PETROLEUM HYDROCARBONS
VOC	= VOLATILE ORGANIC COMPOUNDS
PCB	= POLYCHLORINATED BIPHENYLS
ACT	= ACETONE
TCE	= TRICHLOROETHYLENE
$MeCL_2$	= METHYLENE CHLORIDE

SOURCE: ENSR 6583-118/PRUNE.DWG/TNH/5179_2G/9010-003/SS62MW/11/10/93

3RD SPTG/CEVR
ELMENDORF AFB, ALASKA

FIGURE 3.6-1
SOIL BORING LOCATIONS & ANALYTICAL RESULTS FOR SERA PHASE 1A SITE SS62

DATE: 01/08/94	DRAWN BY: SR/ABB	SCALE: AS SHOWN	DRAWING: SS62MW2
C/SC: 1:40 DISK: 836/93	ENGINEER: C. HUMPHREY	CHECKED: J. WILLIAMS	PROJECT: 9010-003-800

033417

3.6.2 Objectives

The objectives of the assessment were to:

- Assess the horizontal and vertical extent of soil contamination;
- Assess if soil contamination in the area of the former western waste oil UST includes polychlorinated biphenyls (PCBs) and/or trichloroethylene (TCE); and
- Assess if contamination from this site contributes to groundwater contamination.

3.6.3 Field Investigation

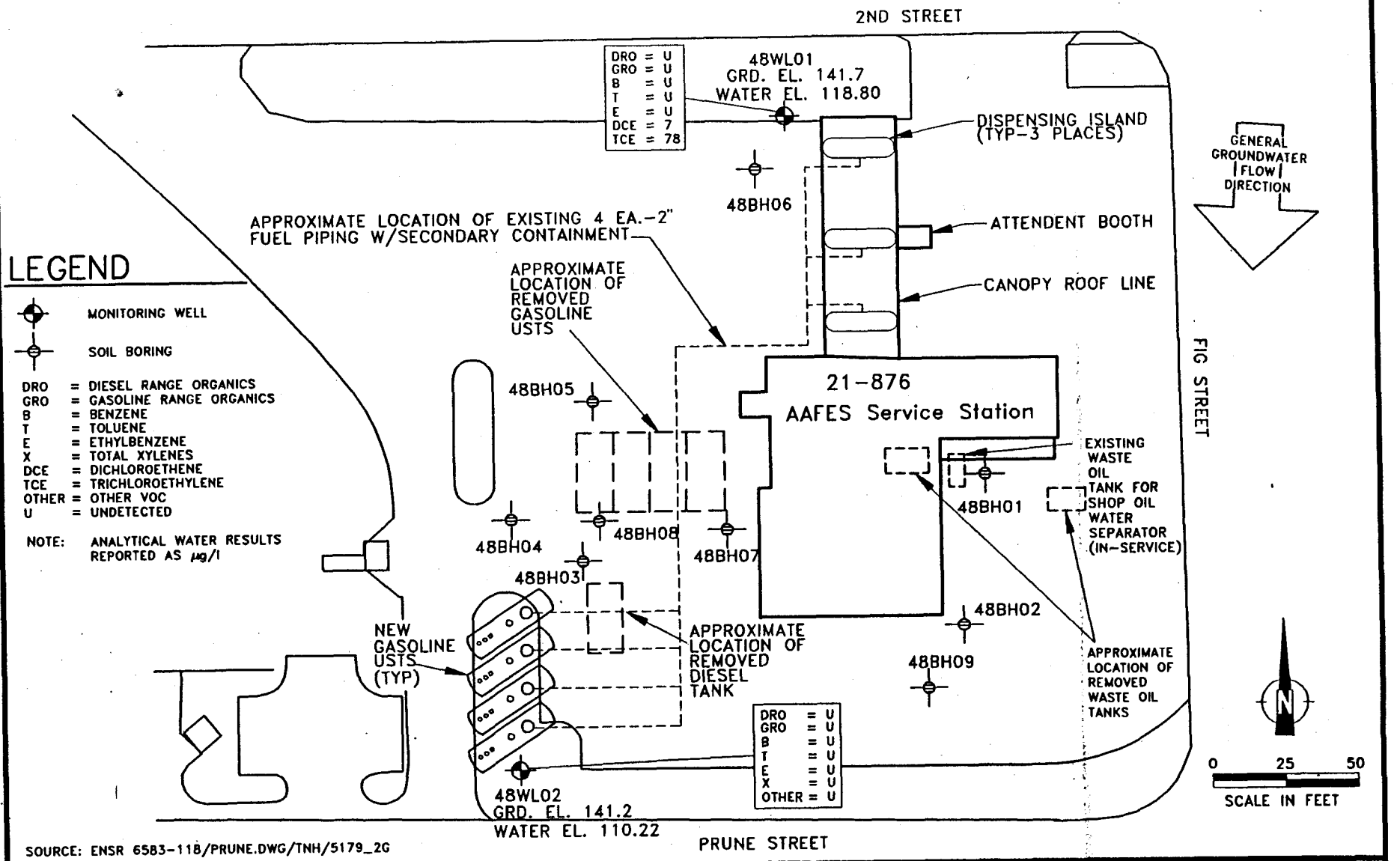
3.6.3.1 Soil Borings

A total of nine soil borings were drilled and sampled at site SS62 and are shown on the site map presented in Figure 3.6-1. Borings 48BH01 and 48BH02 were drilled and sampled to evaluate if subsurface soils contained hydrocarbon compounds resulting from a potential leak in the former western waste oil tank. After review of field screening and preliminary analytical laboratory results, a third boring (48BH09) was drilled in this area to better define the extent of impacted soils. Four borings (48BH04, 48BH05, 48BH07, and 48BH08) were advanced around the perimeter of the former gasoline tanks west of the AAFES service station. Boring 48BH03 was drilled and sampled near the northern edge of the former diesel tank excavation. Boring 48BH06 was installed to investigate the condition of soils near the northern gas pumps. All borings were advanced to the depth where groundwater was encountered, approximately 24.5 feet bgs. Boring logs are presented in Appendix A.

The soil samples collected while drilling borings 48BH01 and 48BH02 were analyzed for DRO, GRO, BTEX, PCBs, TPH, and VOCs. Soil samples collected from borings 48BH03 through 48BH08 were analyzed for DRO, GRO, and BTEX. Soil from 48BH09 was analyzed for TPH and VOCs.

3.6.3.2 Groundwater Monitoring Well Installation and Sample Collection

Two groundwater monitoring wells were installed at site SS62 (Figure 3.6-1A). Well 48WL01 (the upgradient well) was drilled to a depth of 31 feet bgs. The well was set at 29.1 feet bgs with a depth to groundwater of 23 feet bgs. Well 48WL02 was drilled to a depth of 29 feet bgs with the screen set to 26.8 feet bgs. Groundwater was encountered approximately 23.5 feet bgs.



SOURCE: ENSR 6583-118/PRUNE.DWG/TNH/5179_2G

DRAWING: SS62MW	DRAWN: ABB/SR	FIGURE 3.6-1A MONITORING WELL LOCATIONS & ANALYTICAL RESULTS FOR SERA PHASE 1A SITE SS62
C/SC: 1:50	DISK: 751/93	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800
DATE: 01/09/94	CHECK: C.H.	

Groundwater monitoring well construction diagrams are included on the boring logs presented in Appendix A.

Groundwater monitoring wells 48WL01 and 48WL02 were developed and sampled as described in Section 2.2.4. The samples were analyzed for DRO, GRO, and VOCs.

3.6.4 Results/Findings

3.6.4.1 Field Observations

Prior to the commencement of drilling activities, the site was inspected for the presence of unmarked utilities, apparent surface staining, and present usage of the grounds surrounding the former UST locations. The following observations were noted:

- The building is surrounded on all sides by an asphalt parking lot/drive.
- Several boring locations were in front of garage doors, requiring work to be completed during nonbusiness hours.

The subsurface exploration program encountered well-graded gravels with well-graded, fine-to-medium sand layers.

Field PID readings on soil samples were used to help select the samples for laboratory analysis. Field screening results are included on the boring logs presented in Appendix A. Elevated PID readings were recorded from borings 48BH02, 48BH03, 48BH07, and 48BH09.

3.6.4.2 Analytical Results

Results of the laboratory analysis program are presented in Appendix B and summarized on Figures 3.6-1 and 3.6-1A, and in Table 3.6-1. Soil samples collected from borings 48BH02, 48BH03, and 48BH09 indicated high concentrations of hydrocarbon compounds. Samples submitted for analysis from the boring locations around the storage tank excavation perimeters showed low levels of BTEX compounds and low levels of DRO and GRO. None of the samples analyzed for PCBs indicated concentrations above the laboratory detection limits. VOC analysis of several samples indicated low concentrations of acetone and methylene chloride; however, these compounds are frequently interpreted as laboratory contaminants when their concentrations are less than 10 times the concentration found in the associated method blank. TCE was detected at an estimated concentration of 9 mg/kg in the soil sample collected from boring 48BH01 at a depth of 23.0 feet bgs.

Table 3.6-1. Summary Table, SS62.

Boring/ Well No.	Depth (feet)	Sample Number	DRO (mg/kg)	GRO (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)	Other Compounds (mg/kg)
Soil Analyses									
48WL01	6.0	48WL01SO6.0N	U	U	U	U	U	U	NA
48WL01	6.5	48WL01SO6.5MS/SD	U	U	U	U	U	.036	NA
48WL01	23.0	48WL01SO23.0N	U	U	U	U	U	U	NA
48WL02	13.5	48WL02SO13.5N	U	U	U	U	U	U	NA
48WL02	23.0	48WL02SO23.0N	U	U	U	U	U	.042	NA
48WL02	23.5	48WL02SO0FD	U	U	U	U	U	U	NA
48BH01	15.5	48BH01SO15.5N	NA	NA	NA	NA	NA	NA	U
48BH01	16.0	48BH01SO16.0N	U	U	U	U	U	U	ACT - 34
48BH01	23.0	48BH01SO23.0N	U	U	U	U	U	U	TCE - 9J
48BH02	13.0	48BH02SO13.0N	37	U	U	U	U	U	TPH - 57 ACT - 51
48BH02	13.5	48BH02SO0FD	NA	NA	NA	NA	NA	NA	TPH - 60 ACT - 47
48BH02	23.5	48BH02SO23.5N	360	390	U	U	U	2	TPH - 540 $MeCL_2$ - 640J
48BH03	6.0	48BH03SO6.0N	12	U	U	U	U	U	NA
48BH03	23.5	48BH03SO23.5N	48	180	.13	.78	.64	3.9	NA
48BH04	21.0	48BH04SO21.0N	U	U	U	.068	U	.064	NA
48BH04	23.0	48BH04SO23.0N	U	U	U	.043	U	.056	NA
48BH05	11.0	48BH05SO11.0N	U	U	U	U	U	U	NA
48BH05	23.0	48BH05SO23.0N	U	U	U	.072	U	.039	NA
48BH06	6.0	48BH06SO6.0N	U	U	U	U	U	U	NA
48BH06	23.0	48BH06SO23.0N	U	U	U	U	U	U	NA
48BH07	21.0	48BH07SO21.0N	30	9	U	.15	.14	.68	NA

Table 3.6-1. Summary Table, SS62 (Cont'd).

Boring/ Well No.	Depth (feet)	Sample Number	DRO (mg/kg)	GRO (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)	Other Compounds (mg/kg)
Soil Analyses (Cont'd)									
48BH07	23.0	48BH07SO23.0N	11	U	U	.039	U	.033	NA
48BH07	23.5	48BH07SO0FD	39	U	U	.12	U	.21	NA
48BH08	8.5	48BH08SO8.5N	U	U	U	.08	U	.034	NA
48BH08	23.0	48BH08SO23.0N	U	U	.055	.21	.042	.24	NA
48BH09	21.0	48BH09SO21.0N	NA	NA	U	U	U	U	VOCs - U TPH - U
48BH09	23.0	48BH09SO23.0N	NA	NA	U	U	U	U	VOCs - U TPH - 3,300

Well Number	Sample Number	DRO (µg/l)	GRO (µg/l)	B (µg/l)	T (µg/l)	E (µg/l)	X (µg/l)	Other Compounds (µg/l)
Water Analyses								
48WL01	48WL01WGN	U	U	U	U	U	U	T 1,2-DCE - 7 TCE - 78
48WL02	48WL02WGN	U	U	U	U	U	U	U
48WL01	48WL01FB	NA	NA	U	1	U	U	U

Key:
- ACT = Acetone.
- B = Benzene.
- DRO = Diesel range organics.
- E = Ethylbenzene.
- GRO = Gasoline range organics.
- J = Estimated.
- $MeCL_2$ = Methylene chloride.
- NA = Not analyzed.
- T = Toluene.
- TCE = Trichloroethylene.
- T 1,2-DEC = Trans 1,2-dichloroethene.
- TPH = Total petroleum hydrocarbons.
- U = Not detected at the method reporting limit.
- VOCs = Other volatile organic compounds.
- X = Total xylenes.

Note: See Appendix B for the method reporting limit for each analysis.

Soil samples analyzed from 48BH04 and 48BH05 had trace detections of toluene and total xylenes. Samples collected from 48BH05 did not have detectable concentrations of any of the targeted analytes. Boring 48BH07 had detectable concentrations of toluene, ethylbenzene, xylenes, DRO, and GRO. Boring 48BH08 also had detectable concentrations of BTEX.

The analytical results of the groundwater samples indicated the presence of trans 1,2-dichloroethene and TCE in well 48WL01. No other targeted analytes were detected in the groundwater samples.

3.6.4.3 Conceptual Modeling

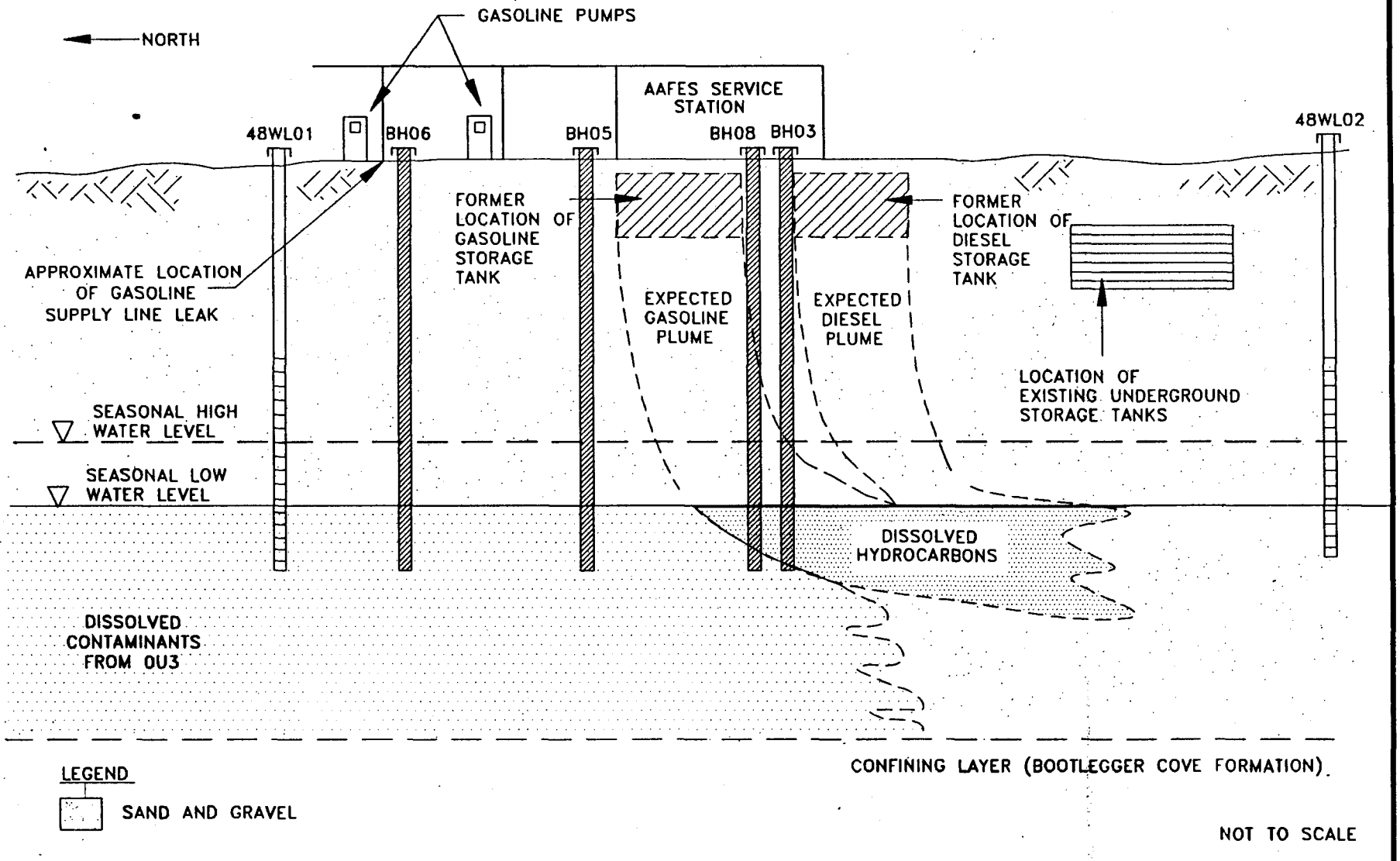
A conceptual site model for the west side of this site is presented in Figure 3.6-2. The soils located around the diesel and gasoline tanks show a high concentration of hydrocarbon compounds. Sample concentrations generally decrease with distance from the area between the former gasoline tank location and the new tank location. The results of the groundwater analysis indicate the presence of TCE in the groundwater at the north, upgradient end of the site.

A conceptual site model for the east side of the site is presented in Figure 3.6-3. Hydrocarbon compounds were detected in samples collected from borings located south of the former western waste oil tank. Field screening results from boring 48BH02 suggest that the impacted soils are encountered beginning at a depth of 12.5 feet bgs and continue to the groundwater table 24.5 feet bgs. The depth is interpreted to be just below the bottom of the waste oil tank. The impacted zone narrows to a small interval located at or just above the water table in boring 48BH09.

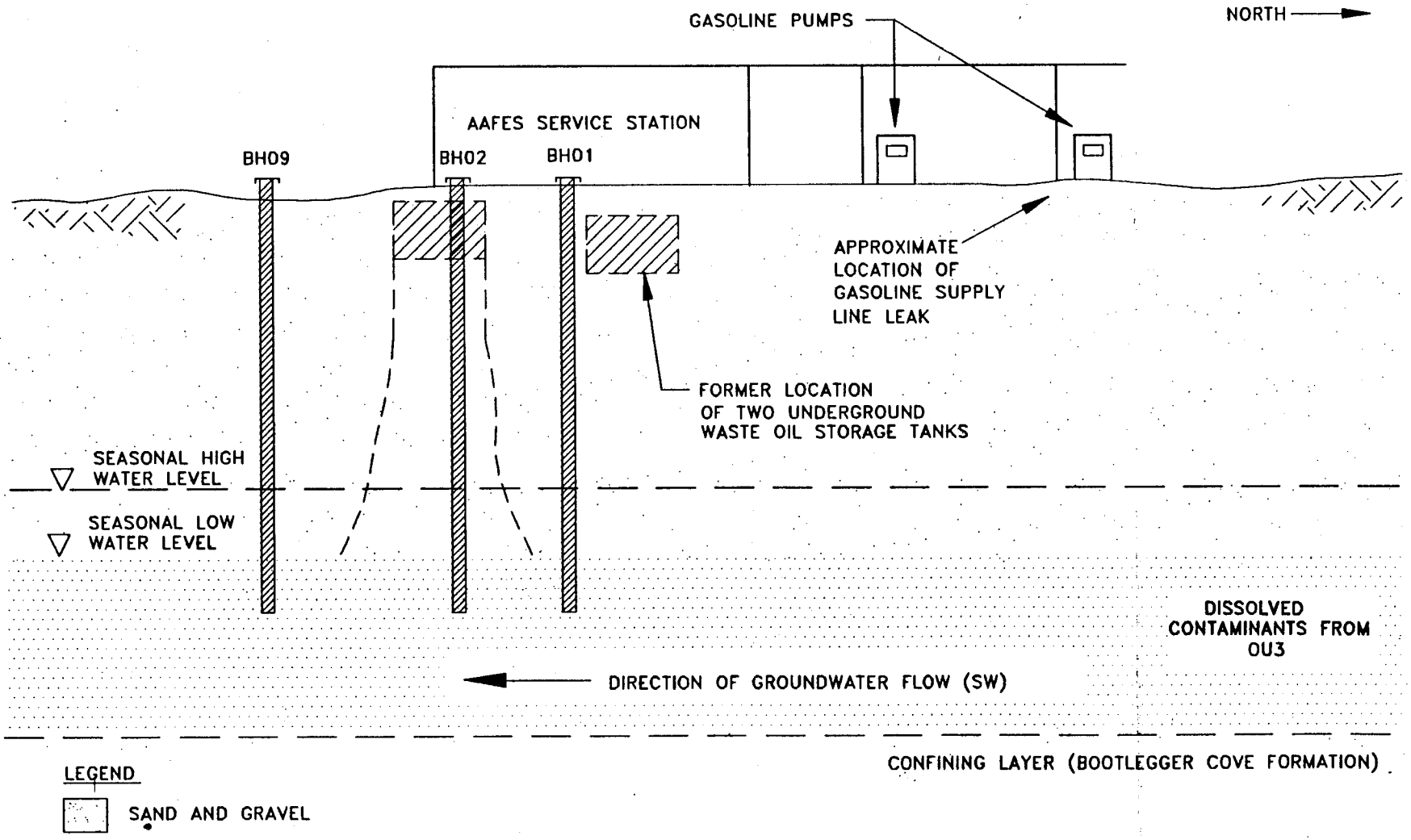
3.6.4.4 Evaluation of Adequacy/Completeness

The soils surrounding the former tank locations have been assessed and the extent of impacted soils have been approximated.

The groundwater quality at the north and south ends of the site were assessed. Interpretation of the Basewide Monthly Water Level Data Package for June 1993 indicates that groundwater flow is from north to south. The well placements adequately characterize the condition of the groundwater entering and exiting the site. The objectives of the site assessment have been met.



DRAWING: SS62CSM2	DRAWN: ABB/SR	FIGURE 3.6-2 CONCEPTUAL SITE MODEL FOR SERA PHASE 1A SITE SS62 FACING EAST
C/SC: 1:1	DISK: 750/93	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800
DATE: 01/12/94	CHECK: C.H.	



DRAWING: SS62CSM	DRAWN: ABB/SR	FIGURE 3.6-3 CONCEPTUAL SITE MODEL FOR SERA PHASE 1A SITE MODEL OF SS62 FACING WEST	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800
C/SC: 1:1	DISK: 752/93		
DATE: 01/11/94	CHECK: CH		

3.6.5 Conclusions/Recommendations

3.6.5.1 Soil

Pursuant to 18 AAC 78 and 18 AAC 75 requirements, a matrix score of 39 was computed for the site. The matrix score sheet for site SS62 is presented in Table 3.6-2.

A matrix score of 39 requires Level B cleanup standards. Soil samples collected in the smear zone at 23.5 feet bgs from both borings 48BH02 and 48BH03 had concentrations of GRO exceeding cleanup levels. The sample collected at the same interval from 48BH02 also exceeded cleanup levels for DRO. The high concentration of TPH recorded at 23.5 feet bgs from boring 48BH09 suggests that these soils are also impacted and probably represent a continuation of the contamination found in the soils from 48BH02.

The northern extent of soil contamination resulting from the former western waste oil tank leak is limited to an area between 48BH01 and 48BH02, and extends south past the location of boring 48BH09. The eastern limit is unknown, and the western limit is located between boring 48BH07 and 48BH02.

No PCBs were detected in the soil samples collected from around the former waste oil tanks. TCE was detected at a trace concentration (approximated) in the soil sample collected from 48BH01 at a depth of 23.0 feet bgs. This sample was collected from the approximate depth of the groundwater table and may represent TCE dissolved in the groundwater. Any chlorinated compounds present are related to OU3 investigations.

Acetone was also detected in the sample collected at 16 feet bgs from 48BH01 but was not detected in the 15.5-foot-bgs sample, suggesting it may be a laboratory contaminant. Acetone was detected in the samples collected from 13 feet bgs in 48BH02 and the associated field duplicate. Methylene chloride was detected in the soil sample taken from 23.5 feet bgs from boring 48BH02. The presence of these common laboratory contaminants in the soil samples is not conclusive evidence that the compounds are actually present in the subsurface soils.

The extent of contaminated soil in the area of the former fuel USTs is limited to an area defined by borings 48BH04, 48BH08, and well 48WL02. The only sample exceeding cleanup levels from this area was collected from a depth of 23.5 feet bgs from boring 48BH03. GRO exceeded the cleanup level in this sample, indicating that a release of gasoline may have occurred.

Table 3.6-2. Matrix Score Sheet for Site SS62.

1. Depth to Subsurface Water		
< 5 feet	(10)	10
5 - 15 feet	(8)	
15 - 25 feet	(6)	
25 - 50 feet	(4)	
> 50 feet	(1)	
2. Mean Annual Precipitation		
> 40 inches	(10)	
25 - 40 inches	(5)	
15 - 25 inches	(3)	3
< 15 inches	(1)	
3. Soil Type (Unified Soil Classification)		
Clean, coarse-grained soils	(10)	10
Coarse-grained soils with fines	(8)	
Fine-grained soils (low OC)	(3)	
Fine-grained soils (high OC)	(1)	
4. Potential Receptors		
Public well within 1,000 feet, or		
Private well(s) within 500 feet	(15)	
Municipal/private well within 1/2 mile	(12)	
Municipal/private well within 1 mile	(8)	8
No Known well within 1/2 mile	(6)	
No Known well within 1 mile	(4)	
Non-potable groundwater	(1)	
5. Volume of Contaminated Soil		
> 500 cubic yards	(10)	
100 - 500 cubic yards	(8)	8
25 - 100 cubic yards	(5)	
> De Minimus - 25 cubic yards	(2)	
De Minimus	(0)	
	Total	39

Matrix Score		Cleanup level in mg/kg			
		Diesel	Gasoline/Unknown		
		Diesel Range Petroleum Hydrocarbons	Gasoline Range Petroleum Hydrocarbons	Benzene	BTEX
Level A	>40	100	50	0.1	10
Level B	27-40	200	100	0.5	15
Level C	21-26	1,000	500	0.5	50
Level D	<20	2,000	1,000	0.5	100

3.6.5.2 Groundwater

Basewide water level data indicate groundwater flow direction is from north to south.

Detectable concentrations of TCE and trans 1,2-dichloroethene were measured in the groundwater sample collected from well 48WL01. These compounds may be migrating from an upgradient source such as OU3. The absence of these compounds from well 48WL02, located downgradient, suggests that the former tanks are not the source of groundwater TCE contamination.

3.6.6 Follow-up Actions

A third well should be installed south of 48BH09 to assess if POL contaminants from the former western waste oil tank are impacting groundwater and migrating off site.

The site requires further investigation at the former waste oil tank location to assess the western and eastern extent of soil contamination. The impact of the release on groundwater also needs to be assessed.

The former gasoline tank area should be considered for risk assessment. The interpreted extent of the contaminated soils suggests that the leak affected a small area and groundwater was not affected.

3.7 Site ST71, Leaking Tank at Building 31-338 (IRPIMS Site 49)

3.7.1 Introduction

Site ST71 is located south of the east-west runway off Elm Street (Figure 3.7). The site is comprised of the vehicle maintenance shop building (31-338), which provides vehicle maintenance services to USAF refueling vehicles (Figure 3.7-1). The site was investigated because of contamination noted during the removal of a 500-gallon JP-4 fuel tank in 1992.

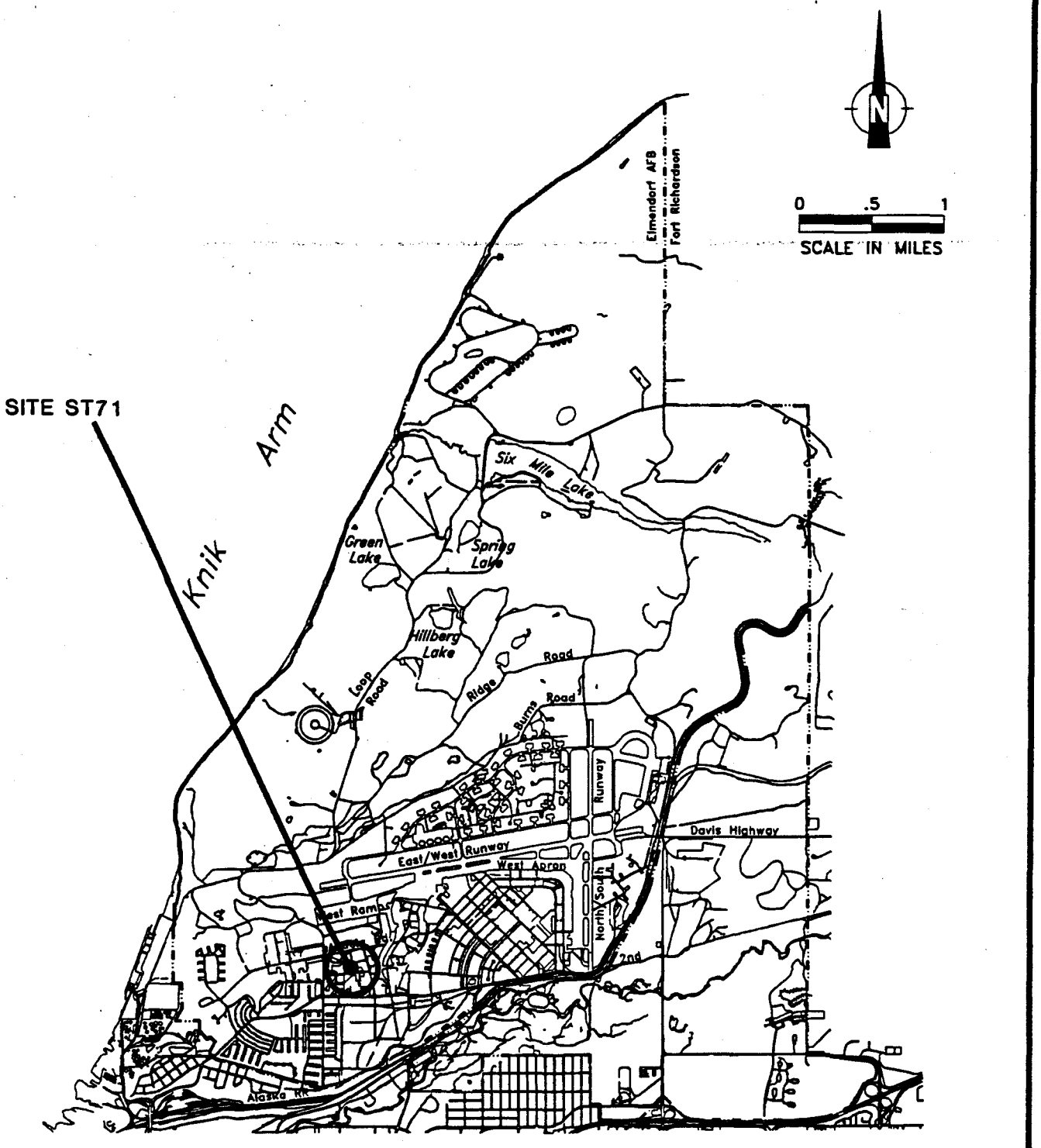
The land surrounding site ST71 is used in conjunction with the USAF flight line. Adjacent properties are Building 31-326 to the west and buildings 31-341, 31-342, 31-343, and 31-345 to the north.

Aerial photographs indicate that the area has been developed since the 1950s. Available records show that construction of the vehicle maintenance shop building was completed in 1952. Currently, the building is used for vehicle maintenance services. Past uses of the building have been consistent with the present day activities. Vehicle maintenance activities generate waste fuels, primarily diesel and JP-4, but also engine oil and hydraulic fluid.

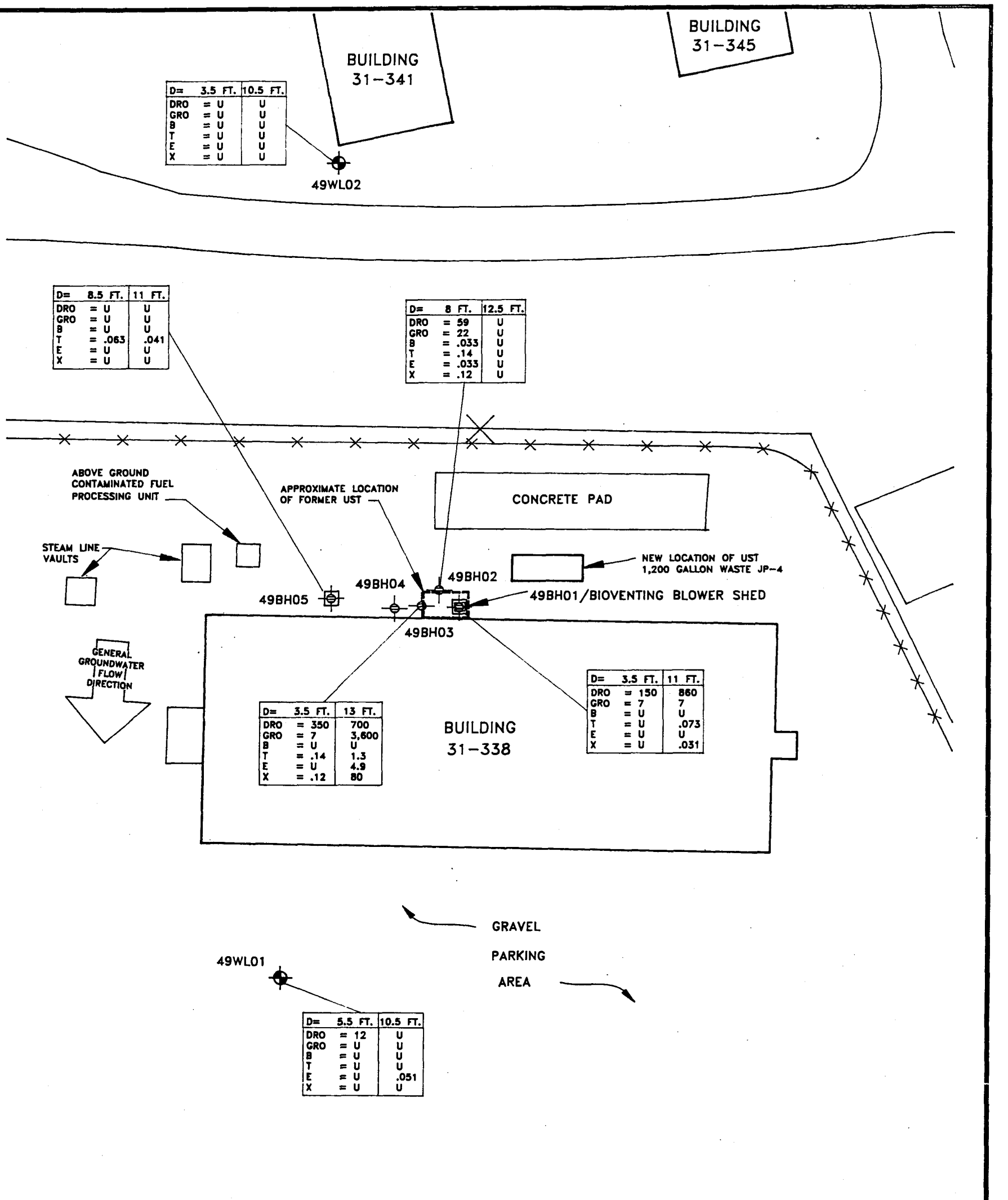
A 500-gallon UST was connected to a drain leading from an elevated stall in a vehicle maintenance bay. The elevated stall, with a floor drain discharging to the UST, is designed to receive jet fuel from changing fuel filters and draining lines on the fuel servicing trucks. This stall was not intended to be used for general vehicle maintenance. This tank was removed in August 1992 and replaced with a 1,200-gallon UST. At the time of removal, visual evidence of contamination was noted in the excavation. The contamination appeared to originate at the vent pipe, which was disconnected at the elbow. Observations made at the time of excavation report that the pipe appeared to have been disconnected for a long period of time.

A removal report referenced test borings installed during 1988 that indicated contamination. No confirmation of these borings could be found in facility records. A tank-tightness test was conducted in 1990. The test indicated that the UST was not leaking; however, at the time of removal, contamination was noted. Three soil samples were collected at the time the UST was removed. These samples were submitted for TPH and EPH analyses. Results ranged from 6,890 to 14,400 mg/kg TPH and 1,670 to 9,700 mg/kg EPH for the three samples.

There is no estimate of the amount of fuel that may have been released from this tank system. In the past, the UST was emptied whenever it appeared full. An estimate made in 1992 by the tank custodian was that the UST was emptied every 2 or 3 months. It was also reported that



DRAWING: F3605 DRAWN: ABB/SR C/SC: 1:5500 DISK: NET9/93 DATE: 09/22/93 CHECK: D.G.	FIGURE 3.7 LOCATION MAP SITE ST71	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800



LEGEND

- MONITORING WELL
- SOIL BORING
- SOIL BORING & BIOVENTING WELL

D = SAMPLE DEPTH
DRO = DIESEL RANGE ORGANICS
GRO = GASOLINE RANGE ORGANICS
B = BENZENE
T = TOLUENE
E = ETHYLBENZENE
X = TOTAL XYLENES
U = UNDETECTED

NOTE: ANALYTICAL SOIL RESULTS REPORTED AS mg/kg

SOURCE: ENSR 6583-118/ST-71.DWG/TNH/5179_2I/9010-003/ST71MW/11/10/93

3RD SPTG/CEVR
ELMENDORF AFB, ALASKA

FIGURE 3.7-1
SOIL BORING LOCATIONS & ANALYTICAL RESULTS FOR SERA PHASE 1A SITE ST71

DATE:	DRAWN BY:	SCALE:	DRAWING:
01/17/94	SR/ABB	AS SHOWN	ST71MW2
C/SC: 1:40 DISK: 839/93	ENGINEER: C. HUMPHREY	CHECKED: J. WILLIAMS	PROJECT: 9010-003-800

within a day after the tank was observed to be full, the level was noted to have dropped, suggesting the disconnected vent pipe as the source of the leak. No records were ever maintained as to the amount of fuel put into the tank.

3.7.2 Objectives

The objectives of the site ST71 assessment were to:

- Examine the nature and the horizontal and vertical extent of soil contamination; and
- Evaluate if groundwater has been impacted by hydrocarbon releases from this site.

3.7.3 Field Investigation

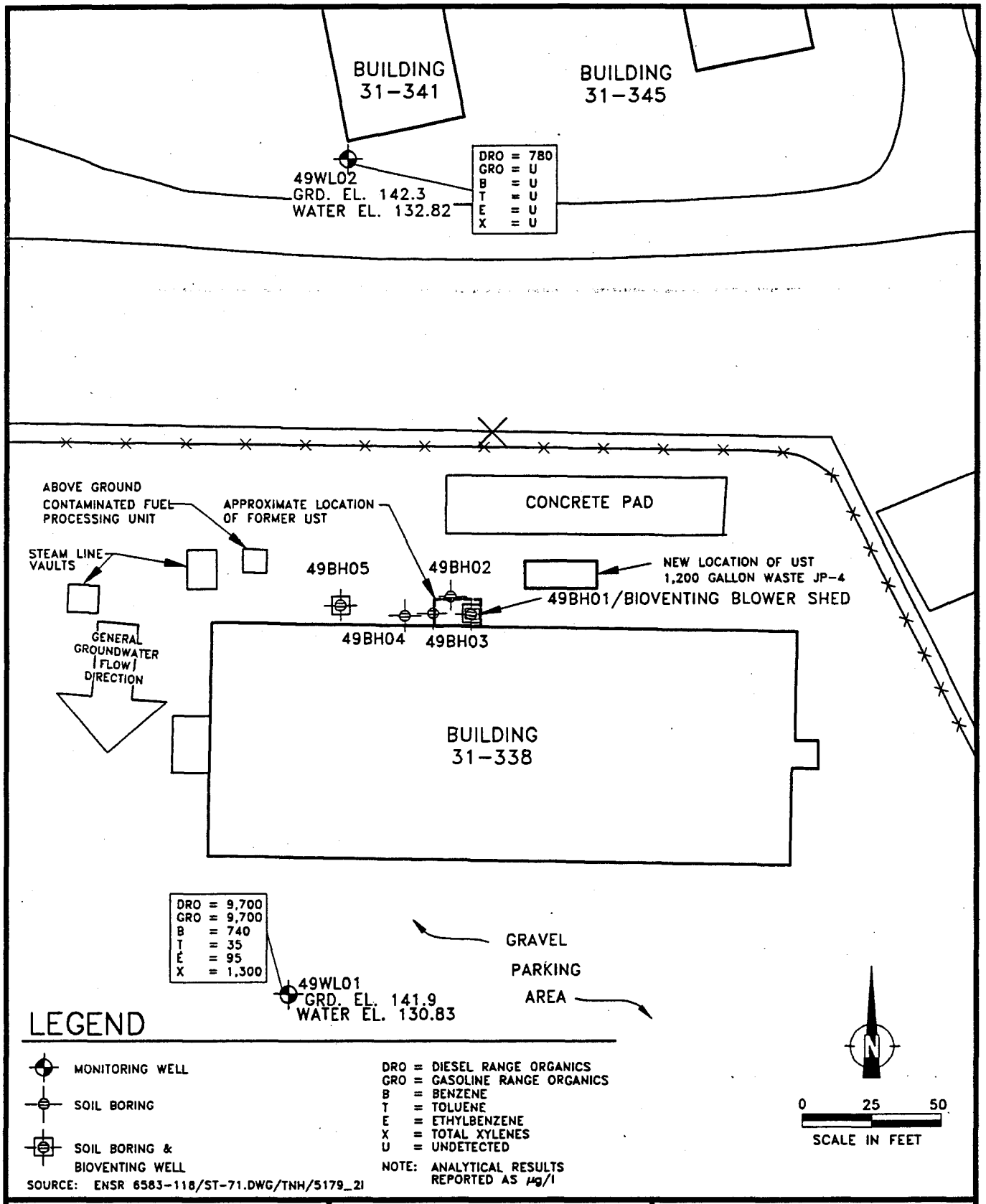
3.7.3.1 Soil Borings

Five soil borings were drilled and sampled at site ST71. The locations of the soil borings are shown on the site map presented in Figure 3.7-1. Three soil borings were advanced around the perimeter of the former UST location. An additional boring (49BH04) was advanced as a monitoring point in a separate study being conducted for a bioventing system. After a review of field screening and preliminary laboratory analytical results of soil samples collected from borings 49BH01 through 49BH03, boring 49BH05 was installed adjacent to the north wall of the vehicle maintenance shop building west of the previous borings, and soil samples were collected for laboratory analysis. Borings were advanced to a maximum depth of 15 feet bgs where groundwater was encountered. Boring logs are presented in Appendix A. The soil samples were analyzed for DRO, GRO, and BTEX.

3.7.3.2 Groundwater Monitoring Well Installation and Sample Collection

Two groundwater monitoring wells were installed at the site (Figure 3.7-1A). Well 49WL01 was installed downgradient of the former UST location to a depth of 18.5 feet bgs. Well 49WL02 was installed upgradient of the former UST location to a depth of 17.4 feet bgs. Monitoring well construction diagrams are included on the boring logs presented in Appendix A.

Groundwater monitoring wells 49WL01 and 49WL02 were developed and sampled as described in Section 2.2.4. The samples were analyzed for DRO, GRO, and BTEX.



DRAWING: ST71MW DRAWN: ABB/SR C/SC: 1:50 DISK: 751/93 DATE: 01/17/94 CHECK: C.H.	FIGURE 3.7-1A MONITORING WELL LOCATIONS AND ANALYTICAL RESULTS FOR SERA PHASE 1A SITE ST71	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800

3.7.4 Results/Findings

3.7.4.1 Field Observations

Prior to the commencement of drilling activities, the site was inspected for the presence of unmarked utilities, apparent surface staining, and present usage of the grounds surrounding the former UST location. The following observations were noted:

- The vehicle maintenance shop building is surrounded on all sides by a gravel parking lot/drive.
- Surface staining was apparent on the ground north of the west end of the building's north wall.
- Tanker trucks and trailers containing JP-4 or other fuel are frequently parked on the gravel lot south and west of the vehicle maintenance shop building

The subsurface exploration program encountered well-graded gravels and sands to the full depth of approximately 18.5 feet bgs. Groundwater was encountered at depths between 11 feet and 12 feet bgs.

Field PID readings on soil samples were used to help select the samples for laboratory analysis. Field screening results are included on the boring logs presented in Appendix A. Elevated PID readings were recorded from soil samples collected from well 49WL01, and borings 49BH02 and 49BH03.

3.7.4.2 Analytical Results

The results of the laboratory analysis are presented in Appendix B and summarized on Figures 3.7-1 and 3.7-1A, and in Table 3.7-1. Detectable concentrations of GRO (7 mg/kg) were found in both soil samples analyzed from 49BH01. DRO was also present at concentrations of 150 and 860 mg/kg at 3.5 feet and 11.0 feet bgs, respectively. Boring 49BH02 had trace amounts of BTEX compounds in the sample collected from 8.0 feet bgs; however, concentrations of BTEX compounds were below the detection limit in the 12.5-foot-bgs sample. The shallow interval also had a DRO concentration of 59 mg/kg and a GRO concentration of 22 mg/kg.

Samples collected from boring 49BH03 revealed the presence of elevated concentrations of DRO from 3.5 to 13.0 feet bgs and a GRO concentration of 3,600 mg/kg at 13.0 feet bgs. Analytical data from 49BH04 were collected by another contractor as part of a pilot bioventing study and

Table 3.7-1. Summary Table, ST71.

Boring/ Well No.	Depth (feet)	Sample Number	DRO (mg/kg)	GRO (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)
Soil Analyses								
49WL01	5.5	49WL01SO5.5N	12	U	U	U	U	U
49WL01	10.5	49WL01SO10.5N	U	U	U	U	.051	U
49WL02	3.5	49WL02SO3.5N	U	U	U	U	U	U
49WL02	10.5	49WL02SO10.5N	U	U	U	U	U	U
49BH01	3.5	49BH01SO3.5N	150	7	U	U	U	U
49BH01	11.0	49BH01SO11.0N	860	7	U	.073	U	.031
49BH02	8.0	49BH02SO8.0N	59	22	.033	.14	.033	.12
49BH02	12.5	49BH02SO12.5N	U	U	U	U	U	U
49BH03	3.5	49BH03SO3.5N	350	7	U	.14	U	.12
49BH03	13.0	49BH03SO13.0N	700	3600	U	1.3	4.9	80
49BH03	13.5	49BH03SO0FD	1,600	3200	U	1.5	4.7	61
49BH05	8.5	49BH05SO8.5N	U	U	U	.063	U	U
49BH05	11.0	49BH05SO11.0N	U	U	U	.041	U	U

Well Number	Sample Number	DRO (µg/l)	GRO (µg/l)	B (µg/l)	T (µg/l)	E (µg/l)	X (µg/l)
Water Analyses							
49WL01	49WL01WGN	9,700	9,700	740	35	95	1,300
49WL02	49WL02WGN	780	U	U	U	U	U

Key:
B = Benzene.
DRO = Diesel range organics.
E = Ethylbenzene.
GRO = Gasoline range organics.
T = Toluene.
U = Not detected at the method reporting limit.
X = Total xylenes.

Note: See Appendix B for the method reporting limit for each analysis.

were not included in this assessment. Results from analysis of the soil samples collected from 49BH05 showed toluene concentrations of 0.063 and 0.041 mg/kg at depths of 8.5 and 11.0 feet bgs, respectively. Soil samples collected from 49WL01 and 49WL02 indicated low or nondetectable concentrations of the target analytes.

Groundwater samples collected from well 49WL01 indicated the following concentrations (in µg/l); benzene-740, ethylbenzene-95, toluene-35, total xylenes-1300, GRO-9700, and DRO-9700. The groundwater samples collected from 49WL02 showed 780 µg/l of DRO.

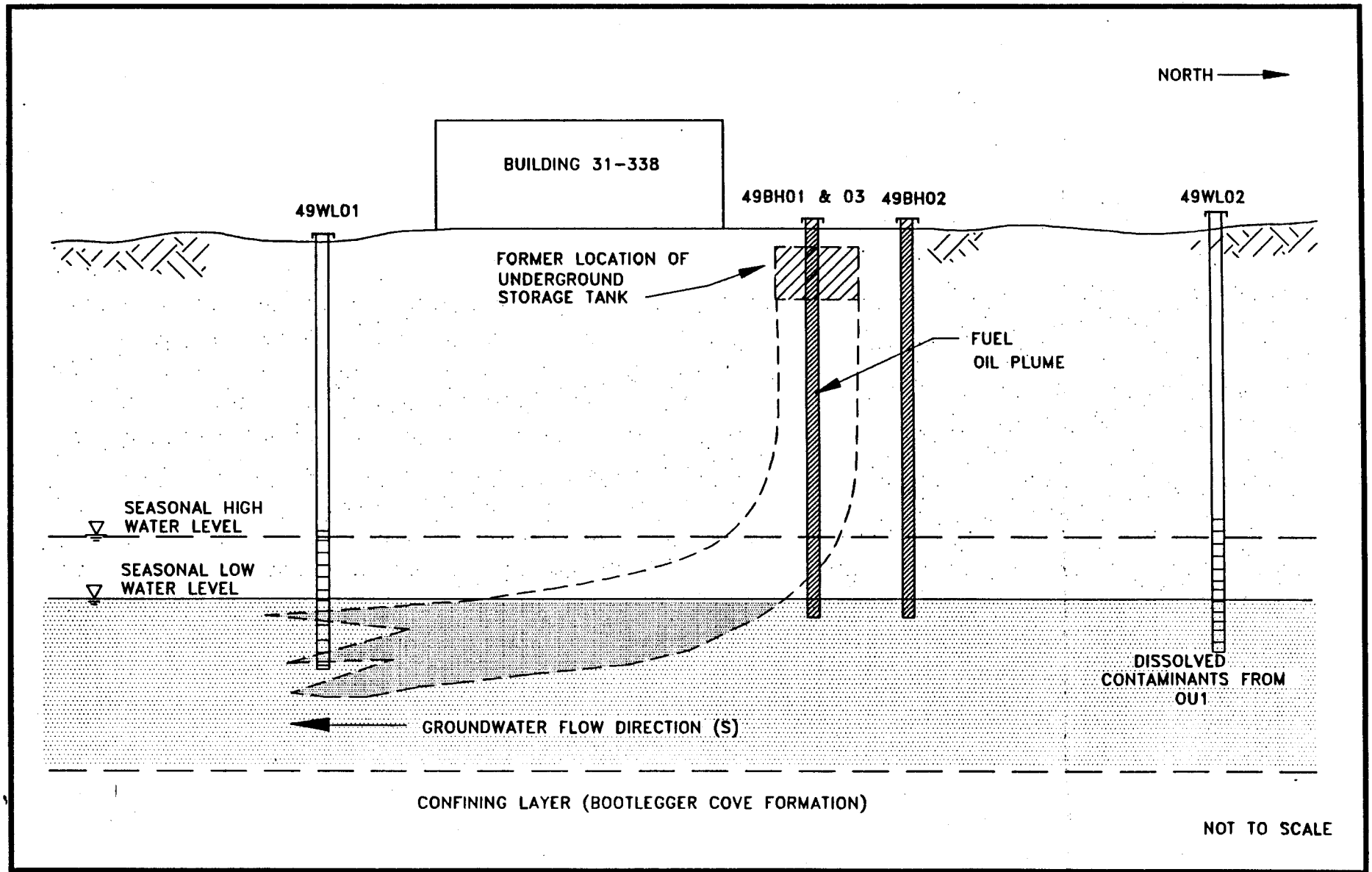
3.7.4.3 Conceptual Modeling

The results of the laboratory analysis and field screening suggest that the subsurface soils on the east and west sides of the former UST contain appreciable concentrations of hydrocarbon compounds. Significantly higher concentrations of the analytes are found in samples collected from the interval at or just above the groundwater table. A conceptual site model for this site is presented in Figure 3.7-2. The analysis of the groundwater samples does not suggest that hydrocarbon compounds are migrating to the subject site; however, the elevated concentrations of hydrocarbon compounds detected in the downgradient well suggest that groundwater has been affected by the suspected leak in the former UST and that a plume of dissolved-phase hydrocarbons is migrating to the south-southwest.

Based on the Basewide Monthly Water Level Data Package for September 1993, which depicts the groundwater flow direction in this area, well 49WL01 is directly downgradient of the former UST location. A three-point analysis of groundwater flow direction was conducted using water table elevations from wells 49WL01, 49WL02, and 48WL02 (the nearest accessible wells with survey data). The results of this analysis indicated a groundwater flow direction somewhat more westerly than the Basewide data.

3.7.4.4 Evaluation of Adequacy/Completeness

The presence of elevated concentrations of hydrocarbon compounds in the soil samples collected from the east and west sides of the former UST location indicate that a release occurred from the former UST. The decrease in concentration of the compounds in the soil samples collected from 49BH05 help to define the limit of the impacted soil. The extent of the impacted soils has been adequately defined northeast and west of the former UST location; however, the southern extent of contaminated soils has been assumed to be approximately the same as to the north and extends under the building.



DRAWING: ST71CSM C/SC: 1:1 DATE: 11/12/93	DRAWN: ABB/SR DISK: 794/93 CHECK: D.G.	FIGURE 3.7-2 CONCEPTUAL SITE MODEL FOR SERA PHASE 1A SITE ST71

3RD SPTG/CEVR
ELMENDORF AFB, ALASKA
PROJECT 9010-003-800

The presence of hydrocarbon compounds in well 49WL01 suggests that a plume of hydrocarbon compounds is emanating from the former UST location. The presence of groundwater contamination from on-site sources has been identified.

3.7.5 Conclusions/Recommendations

3.7.5.1 Soil

Pursuant to 18 AAC 78 requirements, a matrix score of 37 was computed for the subject site. The matrix score sheet for site ST71 is presented in Table 3.7-2

A matrix score of 37 requires Level B cleanup standards. Soil samples collected from boring 49BH03 contained concentrations of all targeted compounds above cleanup levels, with the exception of benzene. DRO concentrations in the soil sample collected from 11.0 feet bgs in boring 49BH01 also exceeded cleanup levels.

The trace quantities of toluene and absence of other compounds in samples collected from boring 49BH05 confine the western limits of impacted soils to a location between borings 49BH03 and 49BH05. Based on the conceptual model presented in Figure 3.7-2, the eastern extent of soil contamination is interpreted to be similar to the western limit. The presence of low levels of hydrocarbon compounds in samples collected from boring 49BH02 limits the northern extent of impacted soils to a location between the former UST location and boring 49BH02. The southern extent of impacted soils is uncertain but is interpreted to extend under the vehicle maintenance shop building. Contaminated soils extend to a depth of approximately 12 feet bgs, where groundwater is encountered.

3.7.5.2 Groundwater

Based on three-point analysis of groundwater elevations using both on-site wells and well 48WL02 (the nearest accessible well with survey data), groundwater flow is interpreted to be to the west-southwest. The average gradient is approximately 0.0175 ft/ft.

The concentration of benzene in the downgradient well (49WL01) exceeds both State and Federal MCLs for drinking water. The suspected leak in the former UST is a likely cause of the groundwater contamination. It is possible that nonpoint sources, such as leaks in fuel tanker trucks that frequently park in the immediate vicinity of well 49WL01, may have contributed to groundwater contamination. Based upon the laboratory results of groundwater samples collected from well 49WL02, the presence of upgradient sources of groundwater contamination in the nearby vicinity of the subject site is unlikely.

Table 3.7-2. Matrix Score Sheet for Site ST71.

1. Depth to Subsurface Water		
< 5 feet	(10)	10
5 - 15 feet	(8)	
15 - 25 feet	(6)	
25 - 50 feet	(4)	
> 50 feet	(1)	
2. Mean Annual Precipitation		
> 40 inches	(10)	
25 - 40 inches	(5)	
15 - 25 inches	(3)	3
< 15 inches	(1)	
3. Soil Type (Unified Soil Classification)		
Clean, coarse-grained soils	(10)	10
Coarse-grained soils with fines	(8)	
Fine-grained soils (low OC)	(3)	
Fine-grained soils (high OC)	(1)	
4. Potential Receptors		
Public well within 1,000 feet, or		
Private well(s) within 500 feet	(15)	
Municipal/private well within 1/2 mile	(12)	
Municipal/private well within 1 mile	(8)	
No Known well within 1/2 mile	(6)	6
No Known well within 1 mile	(4)	
Non-potable groundwater	(1)	
5. Volume of Contaminated Soil		
> 500 cubic yards	(10)	
100 - 500 cubic yards	(8)	8
25 - 100 cubic yards	(5)	
> De Minimus - 25 cubic yards	(2)	
De Minimus	(0)	
	Total	37

Matrix Score		Cleanup level in mg/kg			
		Diesel	Gasoline/Unknown		
		Diesel Range Petroleum Hydrocarbons	Gasoline Range Petroleum Hydrocarbons	Benzene	BTEX
Level A	>40	100	50	0.1	10
Level B	27-40	200	100	0.5	15
Level C	21-26	1,000	500	0.5	50
Level D	<20	2,000	1,000	0.5	100

3.7.6 Follow-up Actions

Currently, a pilot bioventing study is being conducted at the site by USAF. The application of this technology should remediate the contaminated soils to concentrations less than the ADEC cleanup levels. If cleanup levels are not met using this technique, other approaches should be considered.

The ongoing bioventing program at this site should remediate the contaminated soil.

Groundwater monitoring should be continued to evaluate the effectiveness of the bioventing program in reducing contaminant levels in water downgradient of the former UST location.

A successful bioventing application may preclude the need to remediate groundwater; however, remediation alternatives should be assessed if soil contamination is not remediated. If off-site migration of impacted groundwater is not occurring and the source of contamination is eliminated, natural attenuation could be considered a feasible alternative.

3.8 Site LF01, Landfill, West Overrun (IRPIMS Site 42)

3.8.1 Introduction

LF01 is the site of the former landfill. Available records indicate that the landfill was used during the construction phase of Elmendorf AFB (1938-1941). Figure 3.8 presents the general location of LF01. Material disposed at the site consisted of hard fill, construction rubble, and general refuse. The landfill was overlain by the west overrun of the east-west runway in the mid-1940s (Figure 3.8-1).

The site is within the alluvial outwash plain associated with stream deltas from glacial meltwater. The soils within the outwash plain are mainly sand and gravel. The Elmendorf Moraine is located approximately 1,500 feet north of the site and is composed of loess, glacial till, alluvium, and/or organic soils.

A search of USAF documents produced little information on the former landfill. There are no site drawings or incident records for the landfill. Historic aerial photography was reviewed and used to estimate the size of LF01.

3.8.2 Objectives

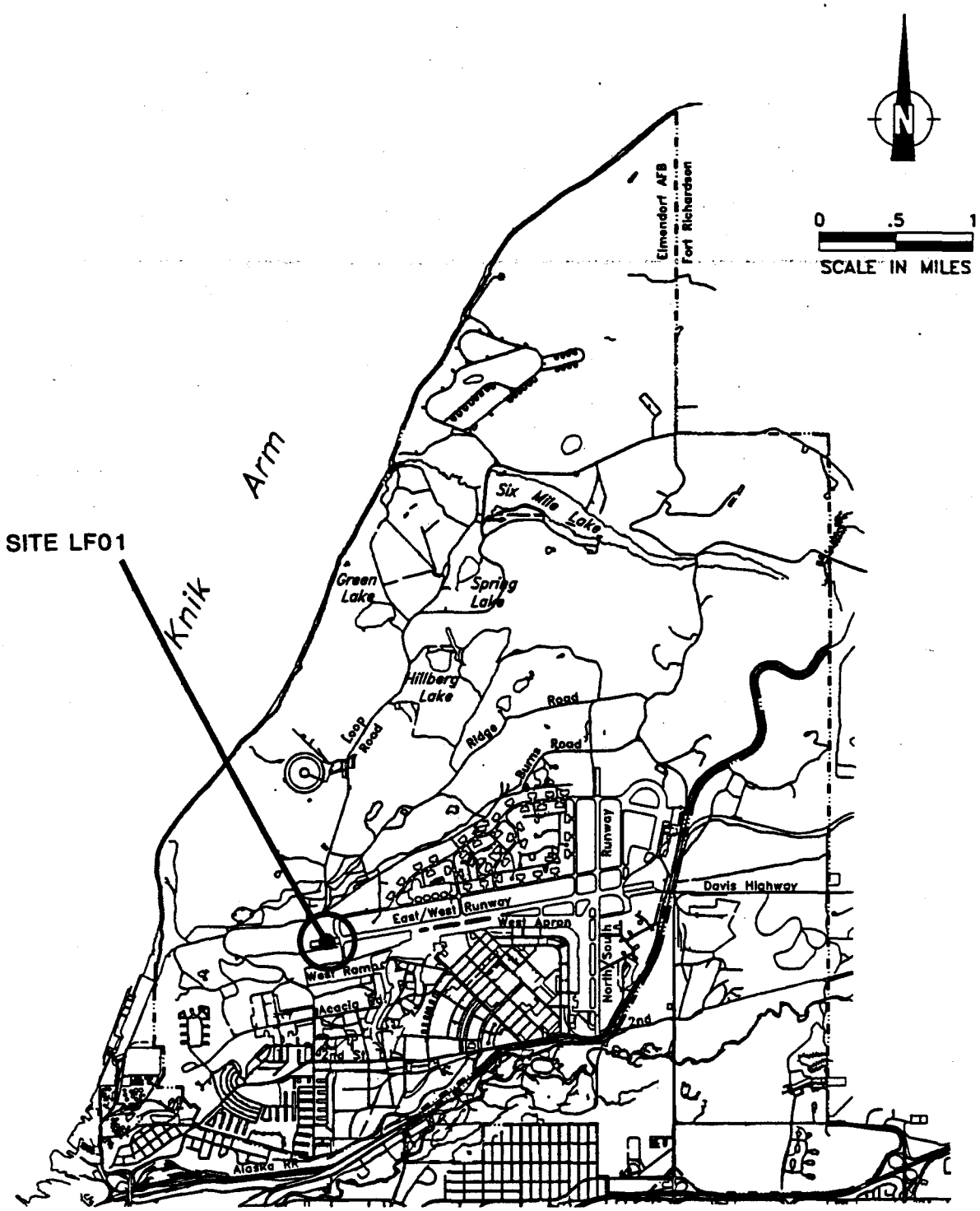
The objectives for assessment at the site were to:

- Evaluate if the former landfill is a source of groundwater contamination, and
- Evaluate if the potential exists for contaminants to migrate into groundwater.

3.8.3 Field Investigation

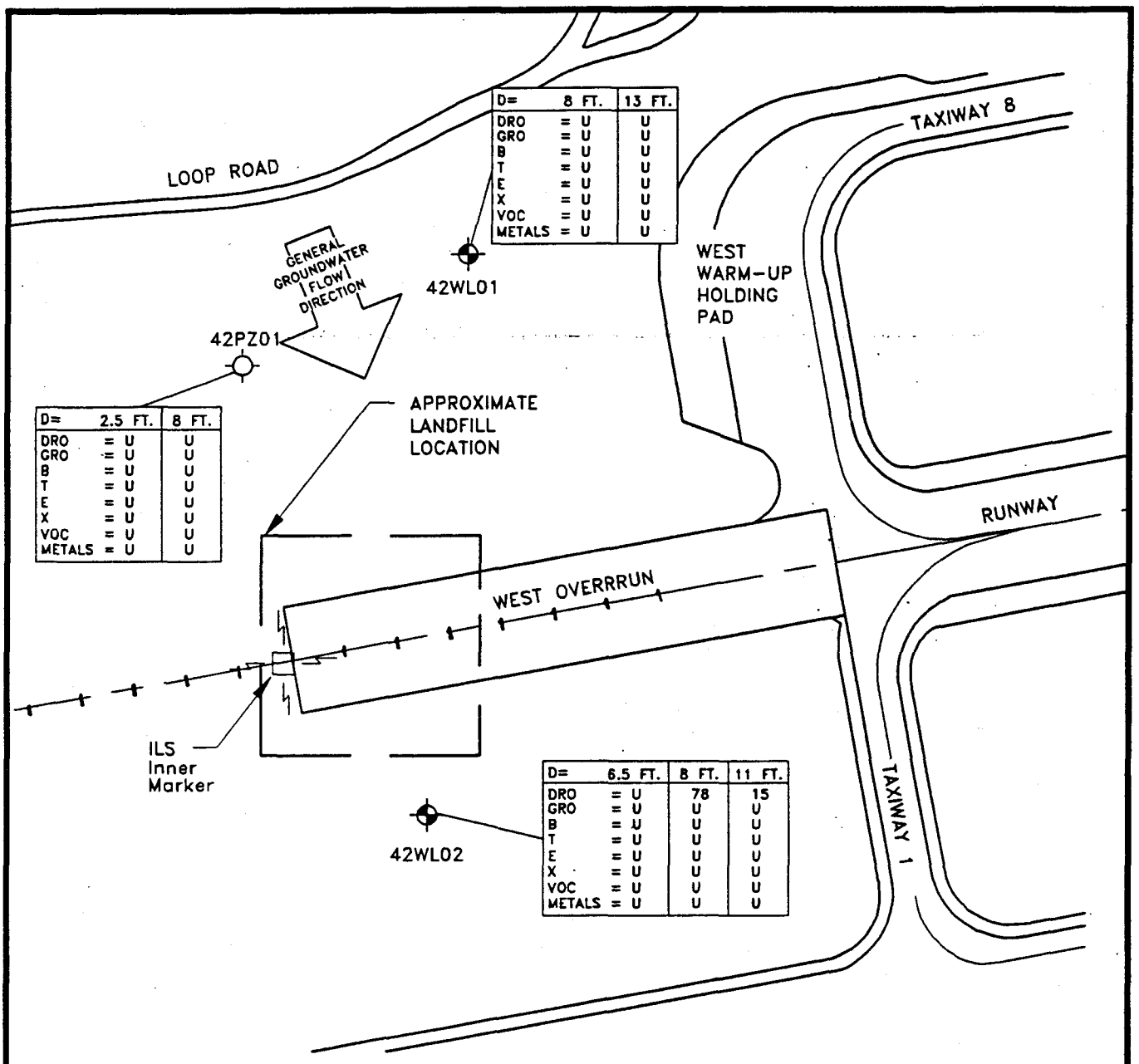
3.8.3.1 Piezometer Installation

One piezometer was installed to a depth of 10.3 feet bgs to collect groundwater elevation data. The groundwater elevation data were used to evaluate the groundwater gradient and flow direction in the area near the former landfill. The piezometer was installed and soil samples were collected in accordance with the methodologies presented in Section 2.2.4. The collected samples were analyzed for DRO, GRO, and VOCs. The piezometer construction diagram is included on the boring logs for LF01 presented in Appendix A.



Municipality of Anchorage

DRAWING: F3605 DRAWN: ABB/SR C/SC: 1:5500 DISK: NET9/93 DATE: 09/22/93 CHECK: D.G.	FIGURE 3.8 LOCATION MAP SITE LF01	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800



LEGEND

- MONITORING WELL
- PIEZOMETER

NOTE: ANALYTICAL SOIL RESULTS REPORTED AS mg/kg

D = SAMPLE DEPTH
DRO = DIESEL RANGE ORGANICS
GRO = GASOLINE RANGE ORGANICS
B = BENZENE
T = TOLVENE
E = ETHYLBENZENE
X = TOTAL XYLENES
VOC = VOLATILE ORGANIC COMPOUNDS
U = UNDETECTED

N

0 150 300
SCALE IN FEET

SOURCE: ENSR 6583-118/OVERRUN.DWG/TNH/5179_2E

DRAWING: LF01MW	DRAWN: ABB/SR	FIGURE 3.8-1 SOIL BORING LOCATIONS & ANALYTICAL RESULTS FOR SERA PHASE 1A SITE LF01
C/SC: 1:300	DISK: 751/93	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800
DATE: 01/13/94	CHECK: D.G.	

3.8.3.2 Groundwater Monitoring Well Installation and Sample Collection

Two groundwater monitoring wells were installed in the vicinity of the site. Well 42WL01 was installed upgradient of the former landfill location to a depth of 20.9 feet bgs. Well 42WL02 was installed downgradient of the former landfill location to a depth of 18.4 feet bgs. Monitoring well construction diagrams are included on the boring logs presented in Appendix A. Monitoring wells were installed, developed, and sampled in accordance with methodologies as presented in Section 2.2.4 of this report.

Groundwater samples were analyzed for VOCs (EPA Method 8020), GRO, DRO, and Resource Conservation and Recovery Act (RCRA) metals. Results of groundwater analyses are shown in Figure 3.8-1A.

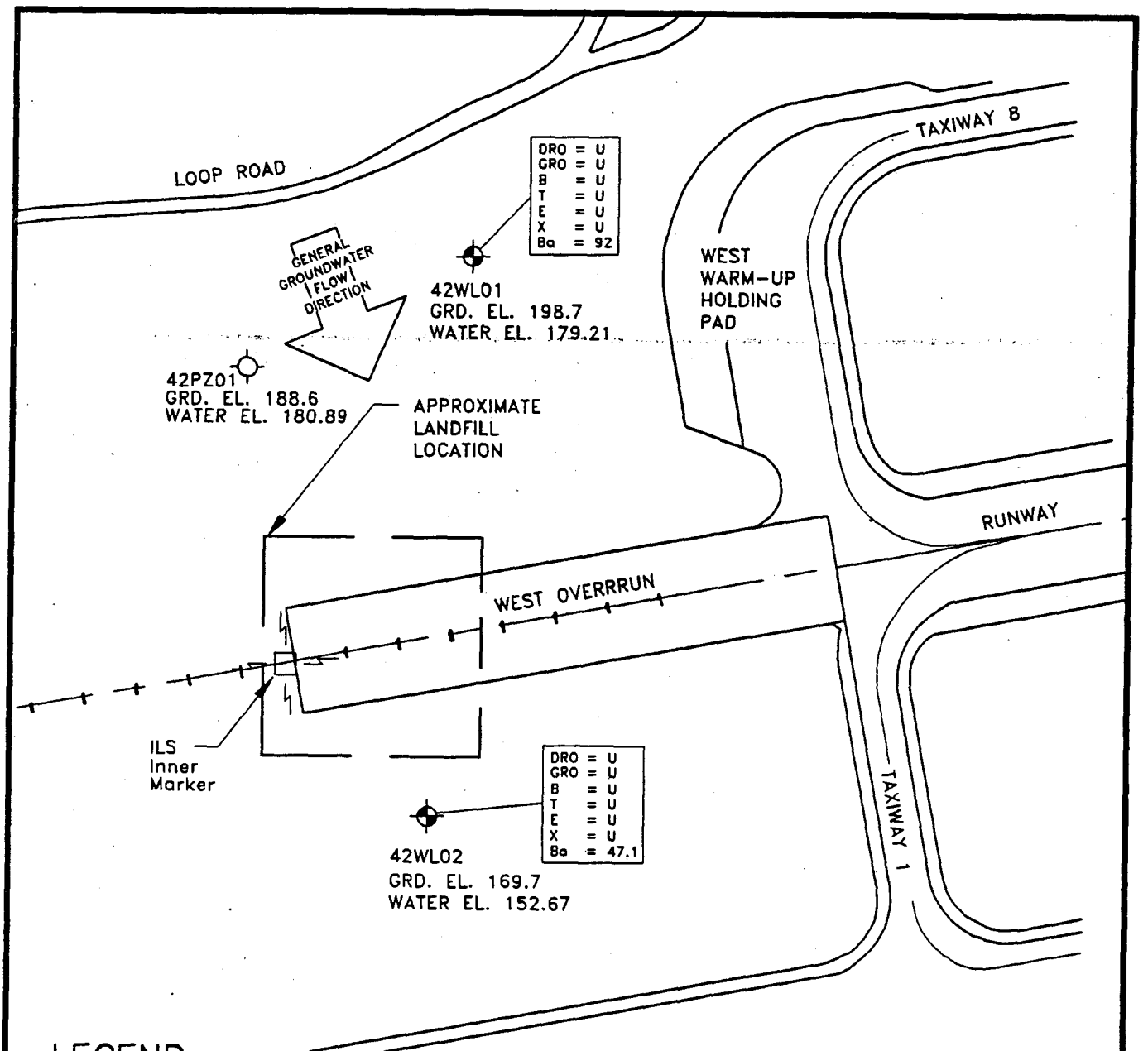
3.8.4 Results/Findings

3.8.4.1 Field Observations

Prior to the commencement of drilling activities, the site was inspected for the presence of unmarked utilities, apparent surface staining, and present usage of the grounds surrounding the former landfill location. The following observations were noted:

- Surface run-off from an area of higher elevation located to the north is somewhat diverted to the east along the northern edge of the landfill location.
- The surface of most of the landfill is covered with asphalt. The edges of the landfill are covered with grass.
- The landfill is overlain by the west overrun of the east-west runway.
- Lightpoles have been installed on the landfill surface.

The subsurface exploration program encountered well-graded, fine to coarse grained sands interbedded with silt and clay layers during the installation of piezometer 42PZ01. A blue-gray clay up to 4.5 feet thick was encountered at a depth of 6 feet bgs during drilling of 42WL01. Soil types encountered during drilling of well 42WL02 were predominantly medium to coarse grained silty sands with a 2-inch thick clay lens at approximately 3.7 feet bgs.



LEGEND

- MONITORING WELL
- PIEZOMETER

DRO = DIESEL RANGE ORGANICS
GRO = GASOLINE RANGE ORGANICS
B = BENZENE
T = TOLUENE
E = ETHYLBENZENE
X = TOTAL XYLENES
Ba = BARIUM
U = UNDETECTED

NOTE: ANALYTICAL WATER RESULTS REPORTED AS µg/l

SOURCE: ENSR 6583-118/OVERRUN.DWG/TNH/5179_2E

N

0 150 300

SCALE IN FEET

DRAWING: LF01MW2 DRAWN: ABB/SR C/SC: 1:300 DISK: 839/93 DATE: 01/17/94 CHECK: D.G.	FIGURE 3.8-1A MONITORING WELL, PIEZOMETER LOCATIONS & ANALYTICAL RESULTS FOR SERA PHASE 1A SITE LF01	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800

033448

3.8.4.2 Analytical Results

The results of the laboratory analysis are presented in Appendix B and summarized on Figures 3.8-1 and 3.8-1A, and in Table 3.8-1. The soil samples collected from 8 and 11 feet bgs from well 42WL02 had detectable concentrations of DRO. None of the soil samples had detectable concentrations of GRO. Methylene chloride was detected in most of the soil samples; however, the method blank also detected the compound, suggesting laboratory contamination.

DRO, GRO, and VOCs were not detected in the groundwater samples. Analyses of RCRA metals indicated only barium was present in detectable concentrations.

3.8.4.3 Conceptual/SESOIL Modeling

Monitoring wells were placed upgradient and downgradient of site LF01 to quantify the potential chemical contribution of the landfill to the aquifer. This assessment is based on the assumption that any difference in constituent concentrations between upgradient and downgradient wells would be likely due to porewater leaching through the former landfill and into the aquifer.

Based on a comparison of upgradient and downgradient groundwater quality, the groundwater sampling results indicate that there is no significant contaminant contribution resulting from the former landfill. No VOCs were detected in wells either upgradient or downgradient of site LF01. Comparisons between upgradient and downgradient sampling well results are summarized below.

Comparison of metals concentrations in groundwater between wells 42WL01 (upgradient) and 42WL02 (downgradient) shows a decrease in most metals, including calcium, magnesium, and manganese. The following metals were detected at higher levels in the downgradient well; aluminum (+17.8 µg/l), iron (+10.1 µg/l), and zinc (+0.3 µg/l). All of these variations likely reflect normal variations in groundwater quality and/or analytical uncertainty. Laboratory results of metals are presented in Appendix B.

Comparison between upgradient and downgradient wells indicates very minor differences in groundwater quality. When changes are evident, the magnitude is small and downgradient concentrations are lower than upgradient concentrations for some metals. No significant source of either organic or inorganic contaminants is apparent.

Table 3.8-1. Summary Table, LF01.

Boring/ Well No.	Depth (feet)	Sample Number	DRO (mg/kg)	GRO (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)	Other Compounds (mg/kg)
Soil Analyses									
42WL01	8.0	42WL01SO8.0N	U	U	U	U	U	U	U
42WL01	13.0	42WL01SO13.0N	U	U	U	U	U	U	U
42WL02	6.5	42WL01SO6.5N	U	U	U	U	U	U	U
42WL02	6.5	42WL01SO6.5MS	U	U	U	U	U	U	U
42WL02	8.0	42WL01SO8.0N	78	U	U	U	U	U	U
42WL02	8.0	42WL01SO8.0FD	U	U	U	U	U	U	U
42WL02	11.0	42WL01SO11.0N	15	U	U	U	U	U	U
42PZ01	2.5	42WL01SO2.5N	U	U	U	U	U	U	U
42PZ01	8.0	42WL01SO8.0N	U	U	U	U	U	U	U

Well Number	Sample Number	DRO (µg/l)	GRO (µg/l)	B (µg/l)	T (µg/l)	E (µg/l)	X (µg/l)	Other Compounds (µg/l)
Water Analyses								
42WL01	42WL01WGN	U	U	U	U	U	U	U
42WL01	42WL03WGFD2	NA	U	U	U	U	U	U
42WL02	42WL02WGN	U	U	U	U	U	U	U

Well Number	Sample Number	As (µg/l)	Ba (µg/l)	Cd (µg/l)	Cr (µg/l)	Pb (µg/l)	Hg (µg/l)	Se (µg/l)	Ag (µg/l)
Water Analyses - Metals									
42WL01	42WL01WGN	U	92	U	U	U	U	U	U
42WL02	42WL02WGN	U	47.1	U	U	U	U	U	U
42WL02	42WL02WGFD6	U	48.6	U	U	U	U	U	U

See key on next page.

Table 3.8-1. Summary Table, LF01 (Cont'd).

Key:	Ag	=	Silver.
	As	=	Arsenic.
	B	=	Benzene.
	Ba	=	Barium.
	Cd	=	Cadmium.
	Cr	=	Chromium.
	DRO	=	Diesel range organics.
	E	=	Ethylbenzene.
	GRO	=	Gasoline range organics.
	Hg	=	Mercury.
	NA	=	Not analyzed.
	Pb	=	Lead.
	Se	=	Selenium.
	T	=	Toluene.
	U	=	Not detected at the method reporting limit.
	X	=	Total xylenes.

Note: See Appendix B for the method reporting limit for each analysis.

Numerical Modeling

Whereas no impacts are apparent to groundwater quality from the former landfill, the potential exists that landfill-derived contaminants have yet to migrate through the unsaturated zone. Numerical modeling using SESOIL was performed to establish expected breakthrough times for landfill porewater to reach groundwater and to determine a mass flux of porewater from the former landfill to groundwater. If significant contaminant concentrations had been detected downgradient of the site, SESOIL could have been used to establish breakthrough times and mass fluxes to groundwater for detected contaminants.

The modeling results indicate that the former landfill porewater is expected to reach groundwater in one to several months at the landfill site. This is largely due to the short distance from the bottom of the landfill to the groundwater table (approximately 6 feet). Therefore, if significant concentrations of contaminants were present in the landfill, they would likely have reached the aquifer many years ago.

Groundwater flow calculations were made to estimate travel time of groundwater beneath the former landfill to the downgradient monitoring wells. These calculations are based on Darcy's law and require hydraulic gradient information obtained from the monitoring wells (depth to groundwater and x-y location) and hydraulic conductivities estimated from soil type information obtained in the boring logs. At site LF01, the average groundwater velocity is estimated to be 1,200 ft/yr, and the distance from the edge of the landfill to a downgradient monitoring well is approximately 200 feet. So, the travel time of groundwater from beneath the landfill to the monitoring well is estimated to be 2 months.

Considering the SESOIL porewater travel time estimates and the Darcy groundwater flow travel time estimates, the total travel time for porewater from the former landfill to downgradient well 42WL02 is expected to be approximately 4 months. This estimate further supports the conclusion that if significant concentrations of contaminants were present in the former landfill, they would likely have entered the aquifer.

Dilution of porewater from site LF01 into the aquifer is of interest in estimating potential contaminant concentrations in groundwater. A dilution factor estimate provides an upper bound on how much of a contaminant could enter the groundwater without being detected in significant concentrations. A groundwater dilution factor for the landfill was calculated based on unsaturated zone water flux estimates from SESOIL and groundwater volumetric flow rate estimates from Darcy's law calculations. A dilution factor of 30 was obtained for site LF01.

These factors indicate that concentrations of contaminants in porewater from the former landfill would be effectively divided by 30 after entering the aquifer, assuming complete mixing in groundwater.

The former landfill was created approximately 50 years ago. If significant concentrations of contaminants were going to enter the aquifer, it seems very likely, based on the SESOIL modeling results, that they would have done so long ago. Since no significant contributions were detected in groundwater sampling, it seems likely that the material currently remaining in the landfill is not soluble and will not likely impact groundwater quality in the future.

3.8.4.4 Evaluation of Adequacy/Completeness

The objective of this project was to assess if the former landfill is contributing to groundwater contamination and if potential exists for contaminants to migrate to groundwater. This study has adequately characterized the condition of the groundwater entering the site and exiting the site, and assessed the potential for vertical migration of contaminants through the landfill. The objectives of this study have been met.

3.8.5 Conclusions/Recommendations

3.8.5.1 Soil

The concentrations of DRO found in the soils located downgradient of the site (from well 42WL02) suggest that some source of DRO exists. The concentrations of these compounds are well below Level A cleanup standards and therefore do not require remedial efforts. The actual presence of methylene chloride in the samples is unlikely, as the method blank also contained the compound. The concentrations of metals in the soils do not exceed normal concentrations for surficial soils in Alaska.

3.8.5.2 Groundwater

Based on three-point analysis of the water table elevations measured from the two wells and one piezometer located at the site, groundwater flow is interpreted to be to the south-southeast along an average gradient of 0.0355 ft/ft.

The results of the SESOIL numerical modeling indicate that the potential for migration of contaminants from the landfill is high if sources of high concentrations of contaminants exist. The results of the groundwater sampling analysis indicate that groundwater quality is not adversely affected by the landfill.

3.8.6 Follow-up Actions

No further action is required. The results of this investigation indicate the landfill is not presently affecting the quality of the groundwater. Based on the objectives of this investigation, the potential for the landfill to impact human health or the environment is low; therefore, no further action is warranted.

3.9 ST36, Diesel Leak (IRPIMS Site 56)

3.9.1 Introduction

ST36, the site of a diesel leak, is located on a hilltop to the west of Spring Lake on the north end of Elmendorf AFB (Figure 3.9). ST36 is on the west side of a radar control Building (62-250), north of an emergency generator Building (62-255), and northwest of site ST66 (Figure 3.9-1). An UST (Tank No. 250) of unknown capacity and age currently services Building 62-250 with heating oil via underground piping.

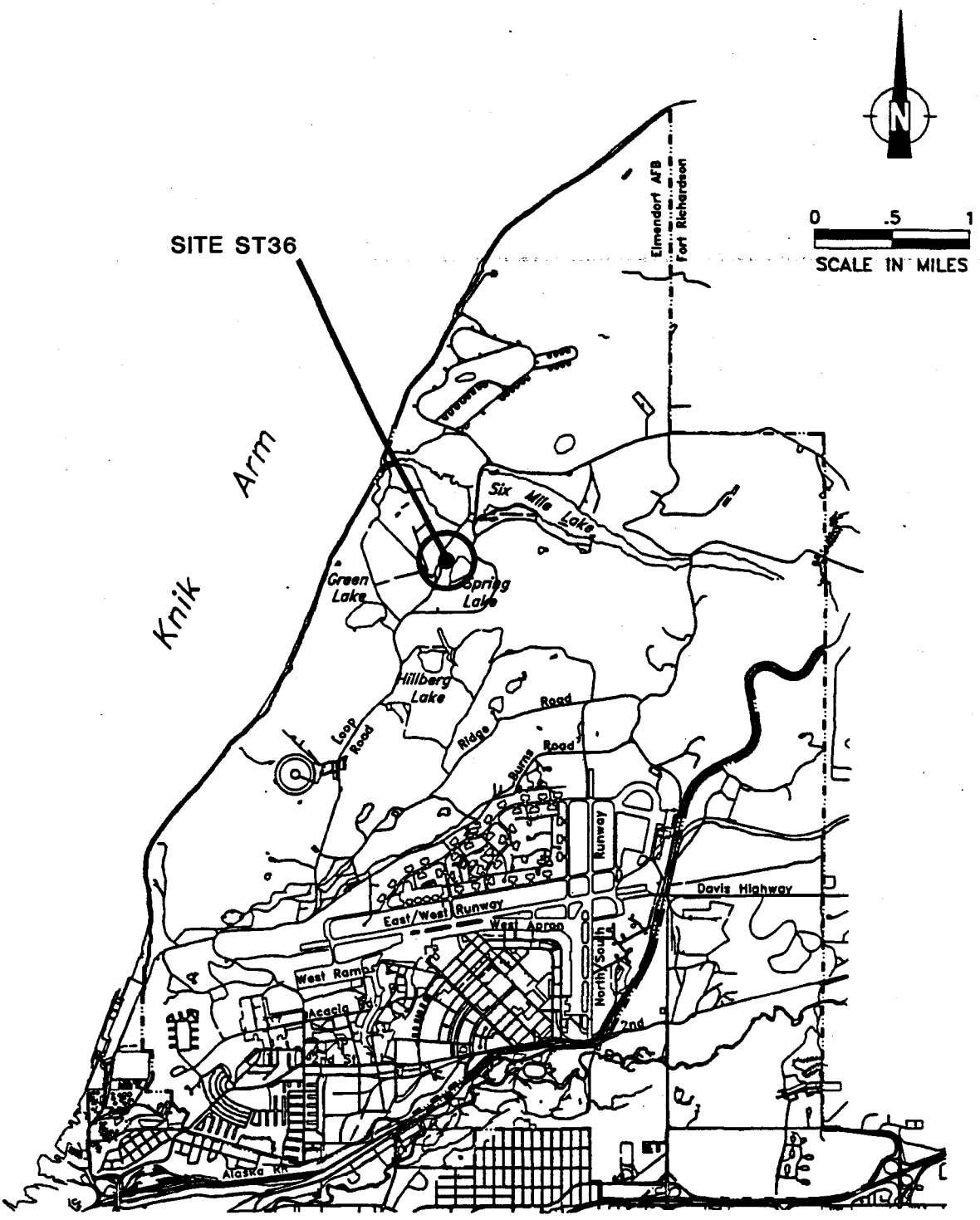
ST36 is located on a kame deposit within the Elmendorf Moraine, and is in typical kame and kettle glacial topography. Several shallow test pits excavated in 1950 uncovered a thin organic layer overlying about 1 to 1.5 feet of sandy silt over a cobble and gravel layer.

On 17 May 1988, according to USAF records, a heating oil leak resulted from a failed cap elbow in the piping system connecting the UST to Building 62-250. Workers collected eight 55-gallon drums of contaminated soil from this location, primarily from above the UST, before cleanup activities were halted due to rain. The remaining work was scheduled for the next day, although no report of final cleanup was found. A domestic water supply well (Base Well 27), located near the tank, showed low levels of hydrocarbons (70 parts per billion [ppb]) in a water sample collected 2 days after the leak was noticed. The detection of low levels of chlorinated compounds was likely related to chlorination of the well, which occurred at about the time of the spill and a short time before sampling. Analyses of samples collected quarterly from this well since that time have not detected hydrocarbons. Quarterly monitoring is being conducted under a potable water surveillance program managed by Elmendorf Bioenvironmental Engineering. Details regarding the depth, construction, and completion of Base Well 27 were not available from the existing records at Elmendorf AFB, U.S. Geological Survey (USGS), and Alaska Department of Geological and Geophysical Survey (ADGGS).

3.9.2 Objectives

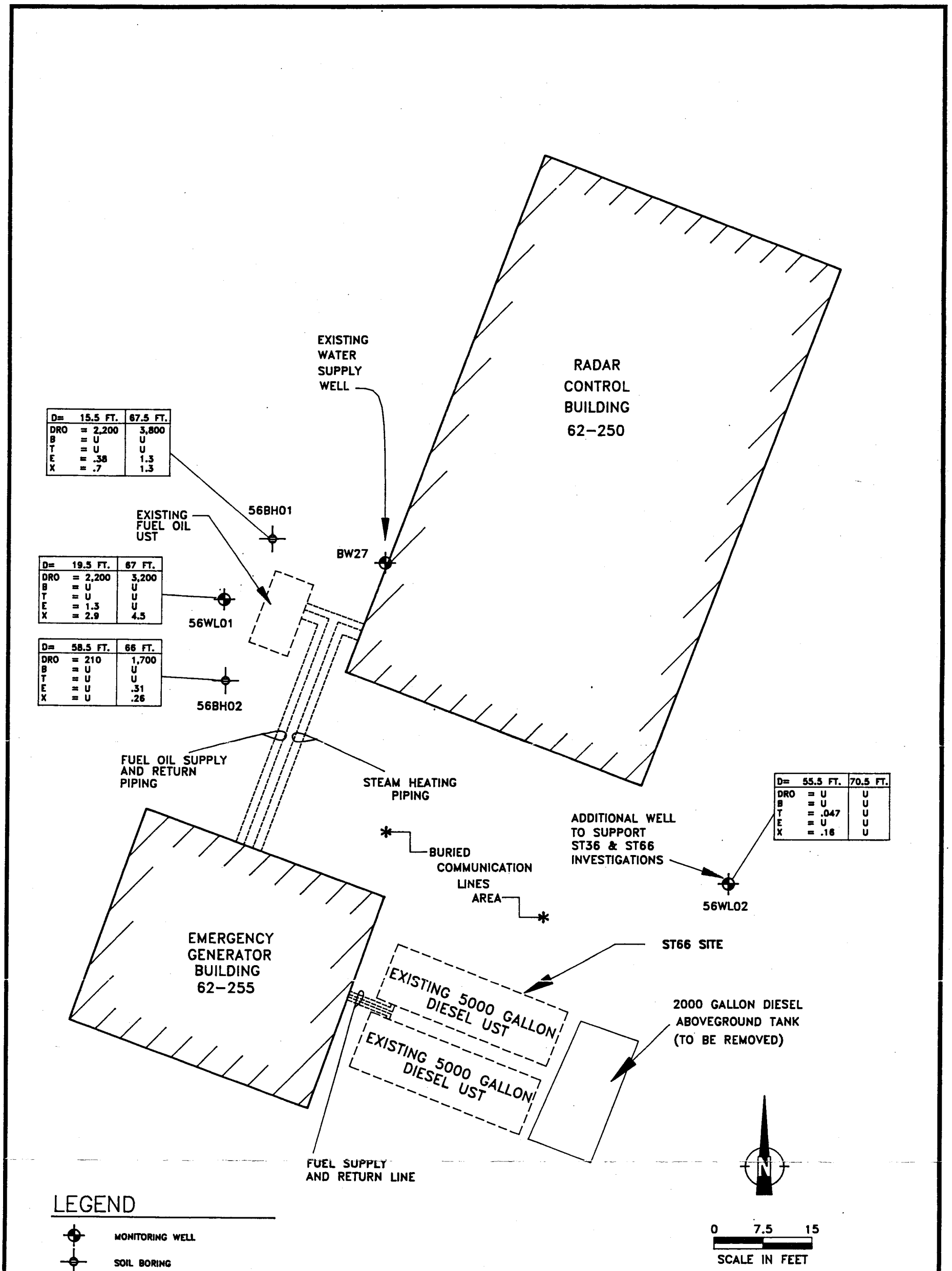
The objectives of the ST36 site assessment were to:

- Evaluate the horizontal and vertical extent of petroleum contamination in the soil;
- Assess whether the groundwater has been contaminated;
- Evaluate the site groundwater gradient; and
- Evaluate the potential for contamination of the water supply well.



Municipality of Anchorage

DRAWING: F3605 DRAWN: ABB/SR C/SC: 1:5500 DISK: NET9/93 DATE: 09/22/93 CHECK: D.G.	FIGURE 3.9 LOCATION MAP SITE ST36	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-008-800



LEGEND

- MONITORING WELL
- SOIL BORING
- LOCATION OF UST

D = SAMPLE DEPTH
DRO = DIESEL RANGE ORGANICS
GRO = GASOLINE RANGE ORGANICS
B = BENZENE
T = TOLUENE
E = ETHYLBENZENE
X = TOTAL XYLENES
U = UNDETECTED
NOTES: ANALYTICAL RESULTS REPORTED AS mg/kg

SOURCE: ENSR 6583–118/EST66.DWG/TNH/5179_3F/9010–003/ST36MW/11/10/93

3RD SPTG/CEVR
ELMENDORF AFB, ALASKA

3.9–1
SOIL BORING LOCATIONS AND ANALYTICAL RESULTS FOR SERA PHASE 1B SITE ST36

DATE:	DRAWN BY:	SCALE:	DRAWING:
01/12/93	SR/ABB	AS SHOWN	ST36MW2
C/SC: 1:15 DISK: 837/93	ENGINEER: C. HUMPHREY	CHECKED: J. WILLIAMS	PROJECT: 9010–008–800

3.9.3 Field Investigation

3.9.3.1 Soil Borings

A total of two soil borings were drilled and sampled at the site. The location of the soil borings is shown on the site map presented in Figure 3.9-1. A third boring was to be drilled east of the UST location between the UST and Building 62-250; however, the presence of underground utilities prohibited the installation of this boring. The borings were advance to a depth of 67.5 feet bgs where groundwater was encountered. Soil samples were analyzed for DRO and BTEX. Boring logs are presented in Appendix A.

3.9.3.2 Groundwater Monitoring Wells Installation and Sample Collection

Two groundwater monitoring wells were installed in the vicinity of the site (Figure 3.9-1A). Well 56WL01 was installed approximately 10 feet west of the UST location to a depth of 72.1 ft bgs. Well 56WL02 was installed east of Building 62-250 to a depth of 76.2 ft bgs. Monitoring well construction diagrams are included on the boring logs presented in Appendix A.

Groundwater monitoring wells 56WL01 and 56WL02 were developed and sampled as described in Section 2.2.4. The samples were analyzed for DRO and BTEX.

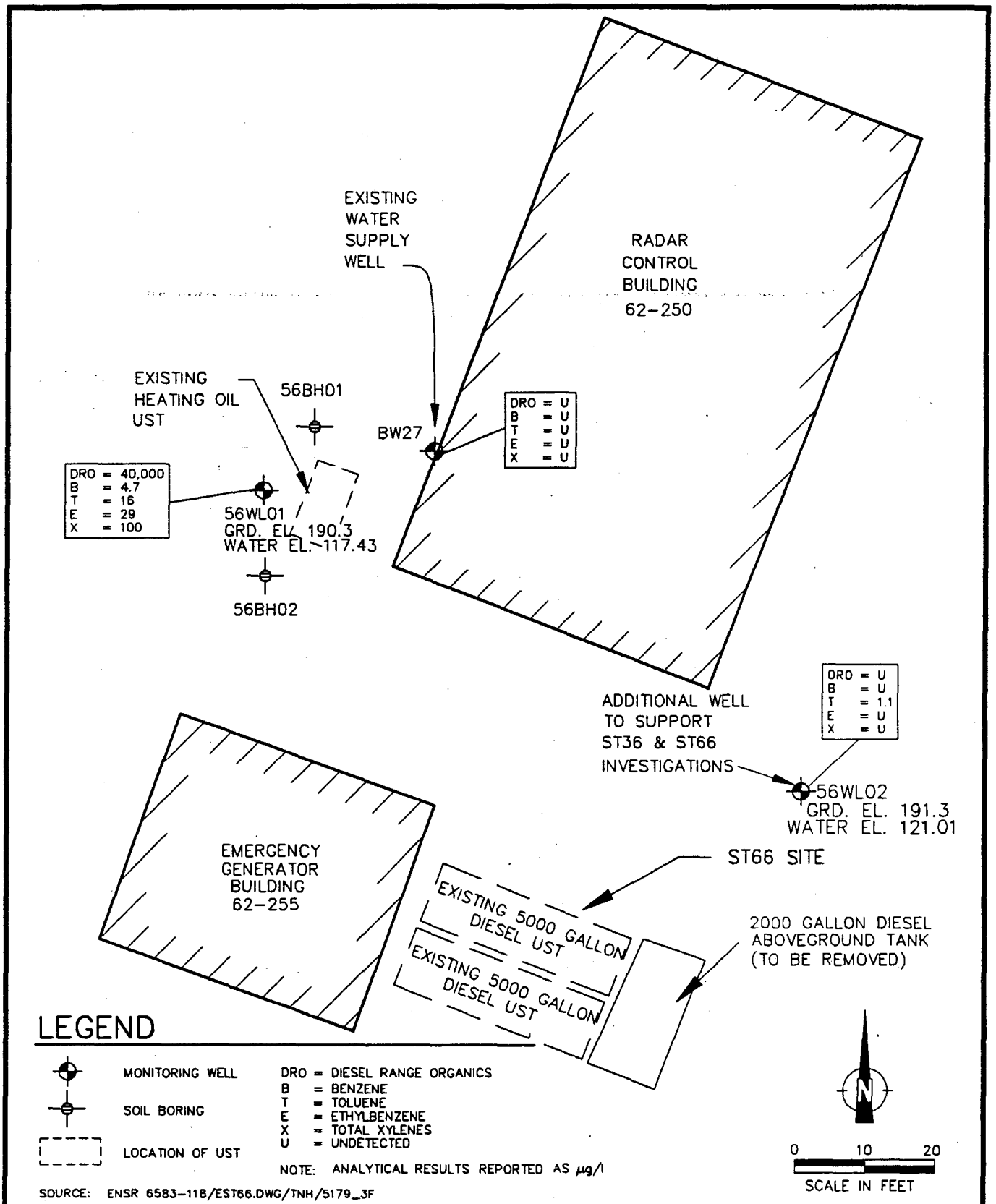
3.9.4 Results/Findings

3.9.4.1 Field Observations

Prior to the commencement of drilling activities, the site was inspected for the presence of unmarked utilities, apparent surface staining, and present usage of the grounds surrounding the UST location. The following observations were noted:

- The fill pipe is located on the west side of the tank and extends approximately 6 inches above the ground surface.
- The water supply well for the facility is located approximately 20 feet east of the UST location.

Subsurface exploration encountered extreme changes in lithology between the boring/well locations located around the UST and well 56WL02. The subsurface soils located below the UST location include a tan, clayey silt with gravel to a depth of approximately 11 feet bgs. Below the silt layer, well-graded gravels were found interbedded with well-graded sands to the full depth



SOURCE: ENSR 6583-118/EST66.DWG/TNH/5179_3F

DRAWING: ST36MW DRAWN: ABB/SR C/SC: 1:20 DISK: 753/93 DATE: 01/17/94. CHECK: D.G.	FIGURE 3.9-1A MONITORING WELL LOCATIONS AND ANALYTICAL RESULTS FOR SERA PHASE 1B SITE ST36	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-008-800

of 72 feet bgs. The lithology encountered during drilling of well 56WL02 consisted of a silt layer extending from the surface to a depth of 7.5 ft bgs. The soils beneath the silt layer are well-graded sands to a depth of 15 ft bgs, where the sands become interbedded with silt. At a depth of 17.5 feet bgs, a clayey silt is encountered that extends to a depth of 67.5 feet bgs. At 65 feet bgs, the silt includes traces of fine gravel within the fine matrix. The soils consisted of poorly graded fine sands grading to well-graded sands from a depth of 67.5 feet bgs to the bottom of the boring at 77.5 feet bgs.

Field PID readings on soil samples were used to help select the samples for laboratory analysis. Field screening results are included on the boring logs presented in Appendix A. Elevated PID readings were recorded from soil samples collected from both borings and from well 56WL01.

3.9.4.2 Analytical Results

The results of the laboratory analyses are presented in Appendix B and summarized on Figures 3.9-1 and 3.9-1A, and in Table 3.9-1. The results of the soils analysis indicate that moderate concentrations of total xylenes and high concentrations of DRO were detected in soil samples collected from 56BH01, 56BH02, and 56WL01. Benzene was not detected in any of the soil samples. Soils collected from 55.5 feet bgs in well 56WL02 contained traces of toluene and total xylenes; DRO was not detected. The sample collected from 70.5 feet bgs did not have detectable concentrations of the targeted analytes.

The groundwater sample collected from Base Well 27 did not have measurable concentrations of hydrocarbon compounds. The groundwater sample collected from well 56WL01 had detectable concentrations of BTEX compounds and 40,000 µg/l of DRO. Groundwater collected from 56WL02 did not have a detectable concentration of DRO; however, toluene was detected at a concentration of 1.1 µg/l.

3.9.4.3 Conceptual Modeling

The conceptual site model for this site is presented in Figure 3.9-2. Soils located near the tank location have been impacted by the release, and the contaminants have migrated to the water table. Groundwater in the unconfined aquifer below the tank has high concentrations of dissolved hydrocarbons. Groundwater at the east end of the site also contains dissolved hydrocarbons that may be related to another source.

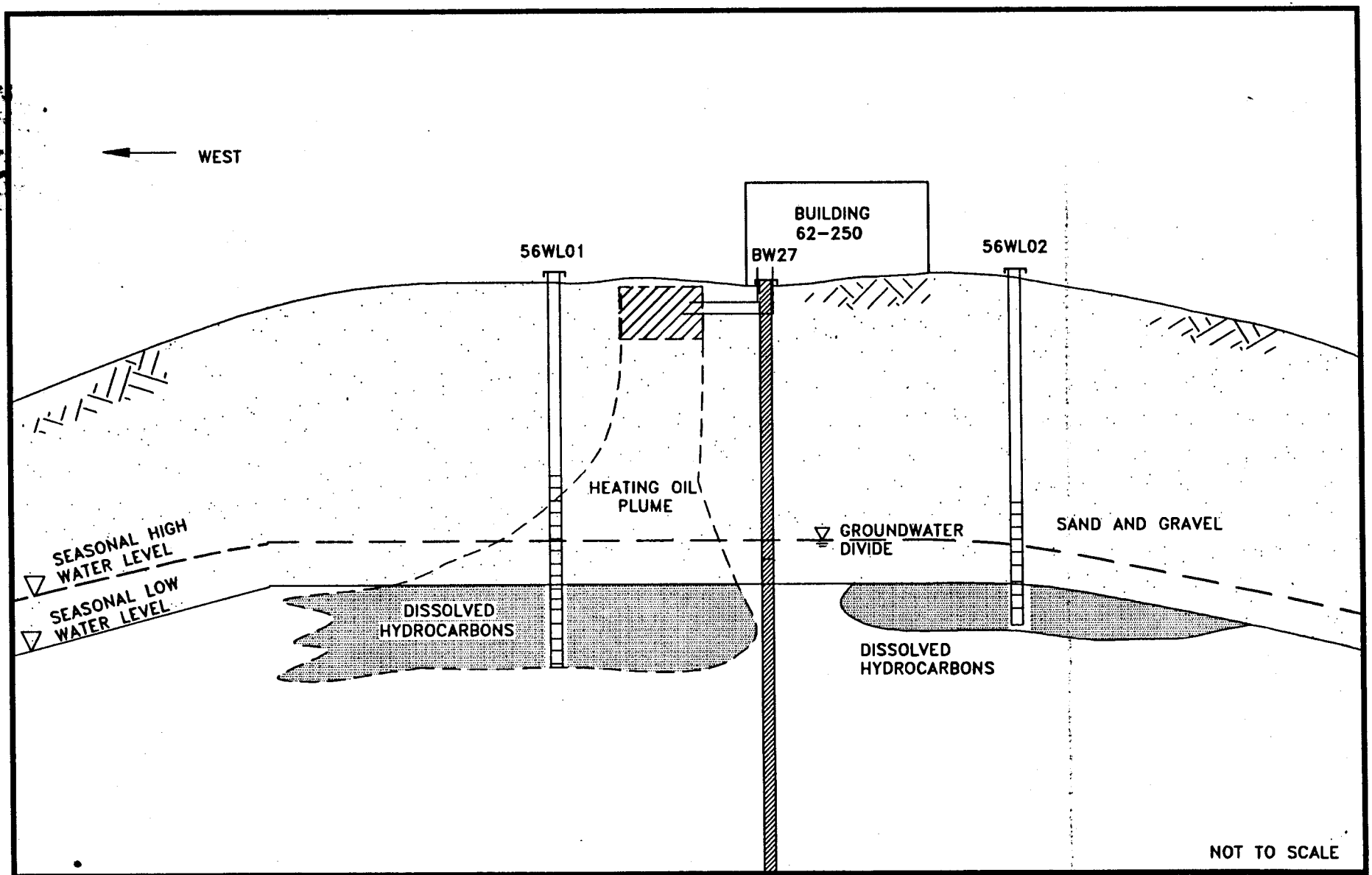
Table 3.9-1. Summary Table, ST36.

Boring/ Well No.	Depth (feet)	Sample Number	DRO (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)
Soil Analyses							
56BH01	15.0	56BH01SO15.0N	2,200	U	U	.38	.7
56BH01	67.5	56BH01SO67.5N	3,800	U	U	1.3	1.3
56BH02	58.5	56BH02SO58.5N	210	U	U	U	U
56BH02	66.0	56BH02SO66.0N	1,700	U	U	.31	.26
56WL01	19.5	56WL01SO19.5N	2,200	U	U	1.3	2.9
56WL01	20.0	56WL01SO0FD	3,700	U	U	U	2
56WL01	67.0	56WL01SO67.0N	3,200	U	U	U	4.5
56WL02	55.5	56WL02SO55.5N	U	U	.047	U	.16
56WL02	70.5	56WL02SO70.5N	U	U	U	U	U

Well Number	Sample Number	DRO (µg/l)	B (µg/l)	T (µg/l)	E (µg/l)	X (µg/l)
Water Analyses						
56WL01	56WL01WGN	40,000	4.7	16	29	100
56WL02	56WL02WGN	U	U	1.1	U	U
56WL02	56WL0WGFD	U	U	U	U	U
BW27	56WLBW27WGN	U	U	U	U	U

Key: B = Benzene.
DRO = Diesel range organics.
E = Ethylbenzene.
T = Toluene.
U = Not detected at the method reporting limit.
X = Total xylenes.

Note: See Appendix B for the method reporting limit for each analysis.



DRAWING: ST36CSM	DRAWN: ABB/SR	FIGURE 3.9-2 CONCEPTUAL SITE MODEL FOR SERA PHASE 1B SITE ST36
C/SC: 1:1	DISK: 758/93	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-008-800
DATE: 11/10/93	CHECK: C.H.	

3.9.4.4 Evaluation of Adequacy/Completeness

The soils surrounding the heating oil tank have been adequately characterized for the presence of hydrocarbons. The areal extent of the impacted soils has been assessed, and the depth of contaminant migration has been determined to extend to groundwater.

The presence of hydrocarbons in the unconfined aquifer below the tank location has been confirmed, and the condition of the drinking water for the facility has been assessed. An additional well is required to evaluate the groundwater gradient and direction of contaminant migration. The two wells planned for investigation of site ST66 may provide the necessary data in the planned 1994 program.

Depending on the remedy agreed to for addressing contamination at this site, additional data may or may not be required.

3.9.5 Conclusions/Recommendations

3.9.5.1 Soil

Pursuant to 18 AAC 75 requirements, a matrix score of 43 was computed for the site. The matrix score sheet for site ST36 is presented in Table 3.9-2

A matrix score of 43 requires Level A cleanup standards. The estimated volume of the contaminated soil is over 500 yd^3 based on the locations of borings and wells drilled during this investigation.

Soil samples collected from 56WL01, 56BH01, and 56BH02 had concentrations of DRO exceeding the Level A cleanup standards. The soil samples collected from 56WL02 have hydrocarbon concentrations that are below Level A cleanup standards.

3.9.5.2 Groundwater

The water table elevations measured in wells 56WL01 and 56WL02 were 120.94 feet and 120.4 feet above mean sea level (MSL), respectively, at depths of approximately 67 and 71 feet bgs. The direction of groundwater flow is uncertain as the site is located on top of a roughly circular kame deposit. The UST is likely to be located approximately above the groundwater divide for the hill.

Table 3.9-2. Matrix Score Sheet for Site ST36.

1. Depth to Subsurface Water		
< 5 feet	(10)	10
5 - 15 feet	(8)	
15 - 25 feet	(6)	
25 - 50 feet	(4)	
> 50 feet	(1)	
2. Mean Annual Precipitation		
> 40 inches	(10)	
25 - 40 inches	(5)	
15 - 25 inches	(3)	3
< 15 inches	(1)	
3. Soil Type (Unified Soil Classification)		
Clean, coarse-grained soils	(10)	
Coarse-grained soils with fines	(8)	8
Fine-grained soils (low OC)	(3)	
Fine-grained soils (high OC)	(1)	
4. Potential Receptors		
Base Well 27, on site		
Public well within 1,000 feet, or		
Private well(s) within 500 feet	(15)	
Municipal/private well within 1/2 mile	(12)	12
Municipal/private well within 1 mile	(8)	
No Known well within 1/2 mile	(6)	
No Known well within 1 mile	(4)	
Non-potable groundwater	(1)	
5. Volume of Contaminated Soil		
> 500 cubic yards	(10)	10
100 - 500 cubic yards	(8)	
25 - 100 cubic yards	(5)	
> De Minimus - 25 cubic yards	(2)	
De Minimus	(0)	
	Total	43

Matrix Score		Cleanup level in mg/kg			
		Diesel	Gasoline/Unknown		
		Diesel Range Petroleum Hydrocarbons	Gasoline Range Petroleum Hydrocarbons	Benzene	BTEX
Level A	>40	100	50	0.1	10
Level B	27-40	200	100	0.5	15
Level C	21-26	1,000	500	0.5	50
Level D	<20	2,000	1,000	0.5	100

The release from the UST has affected the unconfined aquifer below the tank location. The concentrations of BTEX compounds dissolved in the water collected from well 56WL01 exceed State and Federal MCLs.

Dissolved hydrocarbons were not detected in Base Well 27 during this sampling episode.

3.9.6 Follow-up Actions

A site investigation of site ST66, located within 75 feet of this site, is to be conducted upon removal of two diesel USTs and a 500-gallon aboveground diesel tank. Two additional wells will be installed at site ST66. The water table elevations from these wells may allow for three-point analysis of the groundwater flow direction. The groundwater flow direction can then be used to determine the direction of contaminant migration.

Sampling of Base Well 27 and the monitoring wells should continue to determine if the drinking water has been affected by the release and if concentrations of contaminants dissolved in the groundwater are changing.

Following the site ST66 investigation, remedial technologies should be reviewed to diminish the concentrations of hydrocarbons in the soils at site ST36.

3.10 ST47, JP-4 Fuel Line Leak (IRPIMS Site 55)

3.10.1 Introduction

Site ST47 (formerly known as site SP-12) is the location of suspected contaminated soil reportedly caused by a 1,000-gallon JP-4 fuel line leak in 1971 (CH_2M Hill 1991). The leak and suspected contaminated soil are located north of Fire Station No. 1 (Building 10-875), which is located south of the east-west runway. Figure 3.10 provides the general site location of ST47 at Elmendorf AFB, and Figure 3.10-1 is the site map.

Elmendorf AFB documents indicate that the spilled fuel and associated contaminated soil were removed in 1983 (ES 1983) and disposed at source D7, a base landfill (CH_2M Hill 1991) ST47 was judged during Phase I of the Installation Restoration Program (IRP) in 1983 to have a low potential for contamination and no potential for water contaminant migration.

A records search and site reconnaissance have been conducted to identify historical and current conditions that may potentially affect soil and groundwater at ST47.

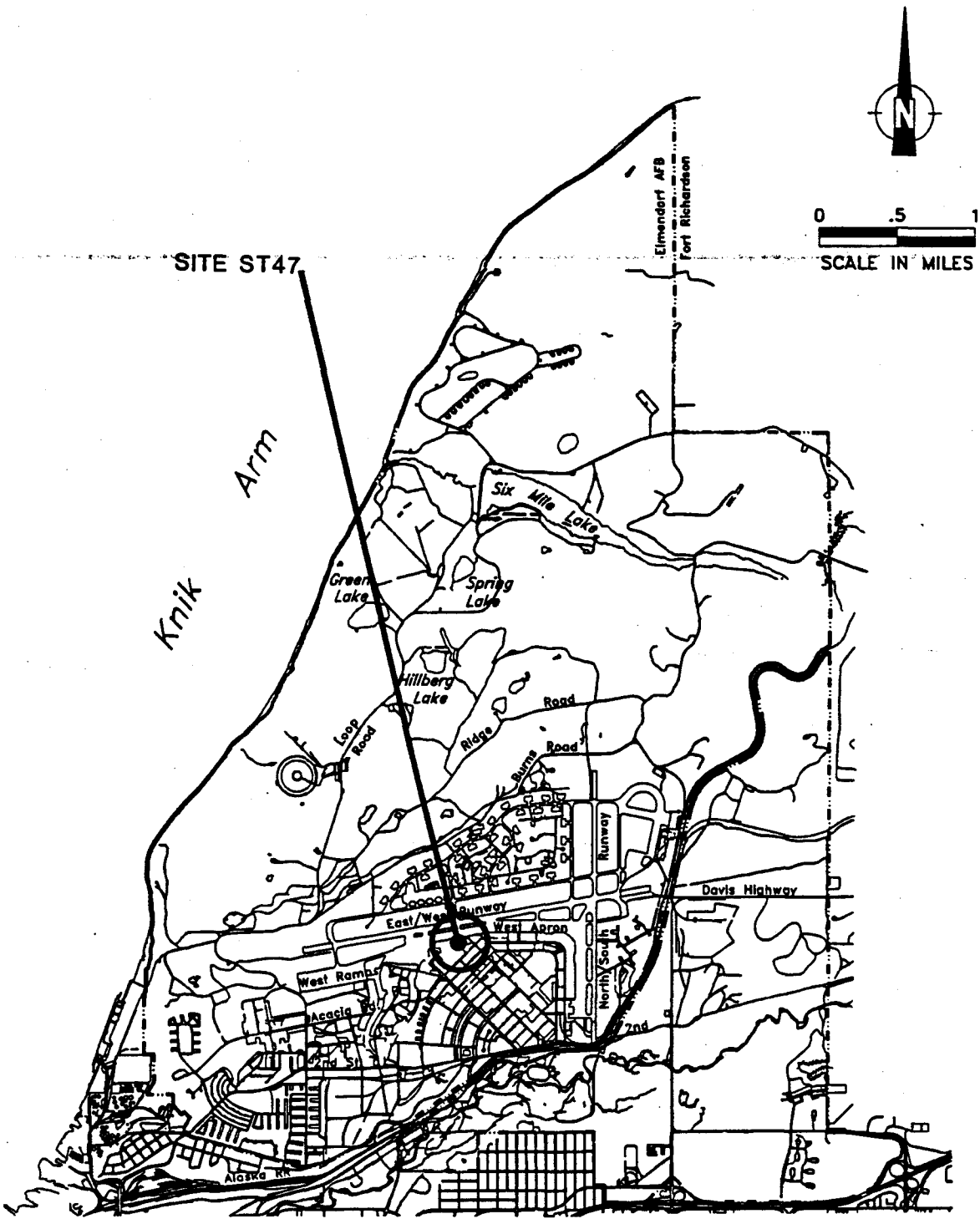
One monitoring well (W-9) was installed at the site in 1986 and sampled during Phase II, Stage 1, of the IRP. Based on the analysis of the hydraulic data, a second monitoring well (GW-3A) was installed in 1987 during Phase II, Stage 2, of the IRP, approximately 350 feet downgradient (southwest) of W-9. The monitoring wells are shown in Figure 3.10-1.

Monitoring well W-9 was installed at ST47 to a depth of 42 feet bgs in sand and gravel. Low levels (110 mg/l) of oil and grease were reported for a sample from this well (D&M 1986).

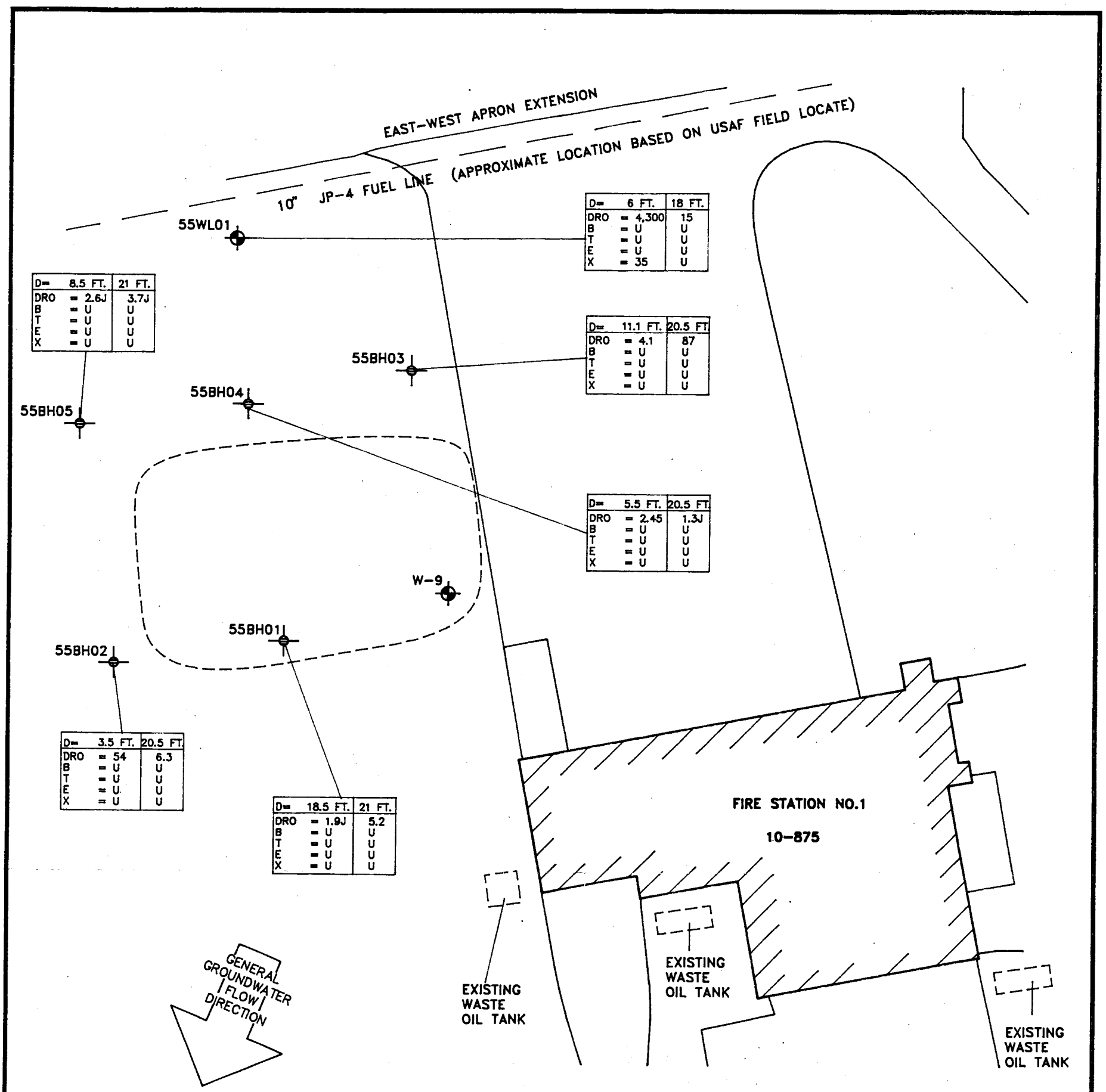
Monitoring well GW-3A was installed during Phase II, Stage 2, of the IRP and is located hydraulically downgradient of well W-9 (D&M 1988). During Phase II of the IRP, nonpurgeable (semivolatile) aromatics and petroleum hydrocarbons (0.1 mg/l) were detected in well GW-3A. The well was installed to confirm the presence of suspected contamination within this site, and to determine the magnitude of the contamination and the potential for migration.

Recommendations during the Phase II, Stage 2, IRP effort included reanalyzing the groundwater for total dissolved solids (TDS), total petroleum hydrocarbons (TPH), pH, temperature, and specific conductivity.

ADEC prepared a RCRA Facility Assessment Report (1988), which included site ST47. ADEC recommended that further study was warranted and that the site needed to be included in the Ship Creek investigation of the Remedial Facility Investigation (RFI). This investigation was used



DRAWING: F3605 DRAWN: ABB/SR C/SC: 1:5500 DISK: NET9/93 DATE: 09/22/93 CHECK: D.G.	FIGURE 3.10 LOCATION MAP SITE ST47	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-008-800



LEGEND

- MONITORING WELL
- SOIL BORING
- APPROXIMATE JP-4 FUEL LINE LEAK

D = SAMPLE DEPTH
DRO = DIESEL RANGE ORGANICS
B = BENZENE
T = TOLUENE
E = ETHYLBENZENE
X = TOTAL XYLENES
J = ESTIMATED
U = UNDETECTED
NOTE: ANALYTICAL RESULTS REPORTED AS mg/kg

SOURCE: ENSR 6583-118/ST47.DWG/TNH/5179_3C/9010-003/ST47MW/11/10/93

3RD SPTG/CEVR
ELMENDORF AFB, ALASKA

FIGURE 3.10-1
SOIL BORING LOCATIONS AND ANALYTICAL RESULTS FOR SERA PHASE 1B SITE ST47 (SP-12)

DATE:	DRAWN BY:	SCALE:	DRAWING:
01/12/94	SR/ABB	AS SHOWN	ST47MW2
C/SC: 1:50 DISK: 753/93	ENGINEER: C. HUMPHREY	CHECKED: J. WILLIAMS	PROJECT: 9010-008-800

to determine the source and extent of contamination associated with Ship Creek and the surrounding area (D&M 1988). No results were determined at that time.

Harding Lawson Associates (HLA) conducted a reconnaissance of site ST47 (January 1988) as part of the Remedial Investigation/Feasibility Study (RI/FS) and found no visual evidence of contamination.

During the Phase III, Stage 3, Work Plan (HLA 1988), a field investigation was conducted to provide information for the preparation of a comprehensive remedial action plan. Subsurface soil investigations were not conducted at ST47 during this field investigation, but groundwater samples were collected from monitoring wells W-9 and GW-3A. Petroleum hydrocarbons were detected in both wells. In addition, it was determined during this investigation that neither well was directly downgradient of the spill (B&V 1990). This investigation concluded that site ST47 was adequately characterized and assigned a no-further-action status to the site.

The EPA provided technical review comments on the Phase III, Stage 3, RI/FS (B&V 1990) to Elmendorf AFB regarding ST47 and made several recommendations to further analyze this site to determine the sources of contamination or possible contamination.

3.10.2 Objectives

The specific objectives of the ST47 site assessment were to:

- Assess sources of contamination,
- Incorporate existing data into a conceptual site model, and
- Incorporate existing data to help define the extent and migration of contamination.

3.10.3 Field Investigation

3.10.3.1 Soil Borings

A total of five soil borings were drilled and sampled at site ST47. Soil boring and groundwater monitoring well locations are indicated on the site map presented in Figure 3.10-1. The borings were advanced to a depth of 20 to 24.5 feet bgs where groundwater was encountered. Boring logs are presented in Appendix A. The collected samples were analyzed for DRO and BTEX.

3.10.3.2 Groundwater Monitoring Well Installation and Sample Collection

One groundwater monitoring well was installed north of the boring locations and roughly 20 feet south of the approximate location of the suspected JP-4 leak (Figure 3.10-1A). Well 55WL01 was installed to a depth of 26.7 feet bgs. The well construction diagram is included on the boring log presented in Appendix A.

Well 55WL01 was developed and sampled as described in Section 2.2.4. Groundwater monitoring wells GW-3A and W-9 were also sampled as part of this investigation. Well W-9 was sampled using an existing Waterra™ Pump installed in the well. Well GW-3A was sampled as described in Section 2.2.4. All samples were analyzed for DRO and BTEX.

3.10.4 Results/Findings

3.10.4.1 Field Observations

Prior to the commencement of drilling activities, the site was inspected for the presence of unmarked utilities, apparent surface staining, and present usage of the grounds surrounding the subject site. The following observation was noted:

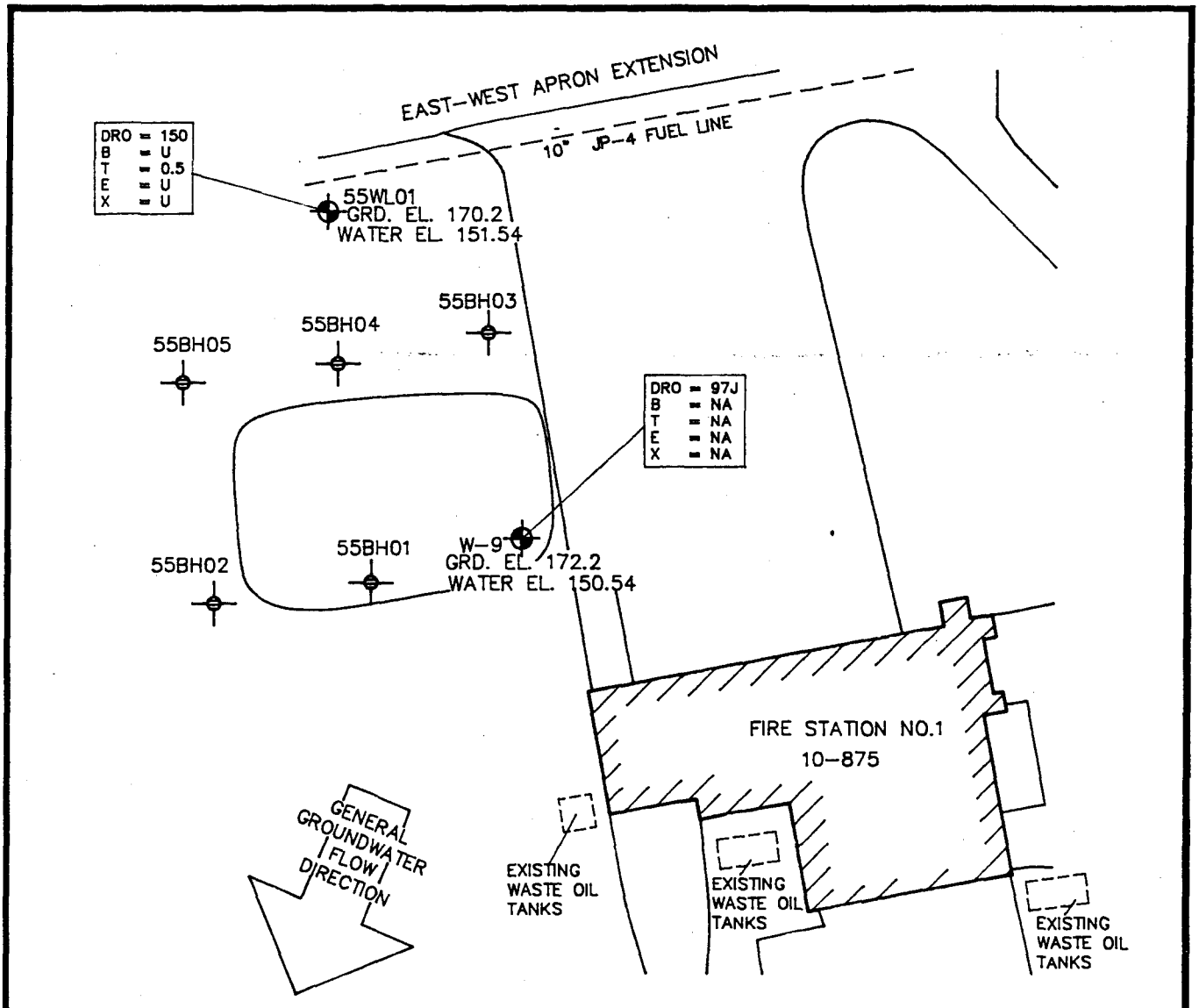
- The POL line is located less than 50 feet south of the east-west apron extension.

The subsurface exploration program encountered sand and gravel to the full depth of the borings (approximately 25 feet bgs). Groundwater was encountered approximately 25 feet bgs.

Field PID readings on soil samples were used to help select the samples for laboratory analysis. Field screening results are included on the boring logs presented in Appendix A. Elevated PID readings were recorded for soil samples collected from well 55WL01.

3.10.4.2 Analytical Results

The results of the laboratory analysis are presented in Appendix B and summarized on Figures 3.10-1 and 3.10-1A, and in Table 3.10-1. Concentrations of DRO were detected in soil samples collected from borings 55BH01, 55BH02, and 55BH03. The soil sample collected from 55WL01 at a depth of 6.0 feet bgs had a DRO concentration of 4,300 mg/kg.



LEGEND

- MONITORING WELL
- SOIL BORING
- APPROXIMATE JP–4 FUEL LINE LEAK

DRO = DIESEL RANGE ORGANICS
B = BENZENE
T = TOLUENE
E = ETHYLBENZENE
X = TOTAL XYLENES
J = ESTIMATED
U = UNDETECTED
NA = ESTIMATED
NOTE: ANALYTICAL RESULTS REPORTED AS µg/l

SOURCE: ENSR 6583–118/ST47.DWG/TNH/5179_3C

DRAWING: ST47MW DRAWN: ABB/SR C/SC: 1:80 DISK: 753/93 DATE: 01/12/94 CHECK: CH	FIGURE 3.10–1A MONITORING WELL LOCATIONS AND ANALYTICAL RESULTS FOR SERA PHASE 1B SITE ST47 (SP–12)	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010–008–800

Table 3.10-1. Summary Table, ST47.

Boring/ Well No.	Depth (feet)	Sample Number	DRO (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)
Soil Analyses							
55WL01	6.0	55WL01SO6.0N	4,300	U	U	U	35
55WL01	18.0	55WL01SO18.0N	15	U	U	U	U
55WL01	18.5	55WL01SO0FD	1.5J	U	U	U	U
55BH01	18.5	55BH01SO18.5N	1.9J	U	U	U	U
55BH01	21.0	55BH01SO21.0N	5.2	U	U	U	U
55BH02	3.5	55BH02SO3.5N	54	U	U	U	U
55BH02	20.5	55BH02SO20.5N	6.3	U	U	U	U
55BH03	11.1	55BH03SO11.1N	4.1	U	U	U	U
55BH03	20.5	55BH03SO20.5N	87	U	U	U	U
55BH04	5.5	55BH04SO5.5N	2.4J	U	U	U	U
55BH04	20.5	55BH04SO20.5N	1.3J	U	U	U	U
55BH05	8.5	55BH05SO8.5N	2.6J	U	U	U	U
55BH05	21.0	55BH05SO21.0N	3.7J	U	U	U	U

Well No.	Sample Number	DRO (µg/l)	B (µg/l)	T (µg/l)	E (µg/l)	X (µg/l)
Water Analyses						
55WL01	55WL01WGN	150	U	0.5	U	U
GW3A	55WLGW3AWGN	110	U	U	U	U
W9	55WLW9WGN	97J	NA	NA	NA	NA

Key: B = Benzene.
DRO = Diesel range organics.
E = Ethylbenzene.
J = Estimated.
NA = Not analyzed.
T = Toluene.
U = Not detected at the method reporting limit.
X = Total xylenes.

Note: See Appendix B for the method reporting limit for each analysis.

Laboratory analysis of the groundwater sample collected from well 55WL01 showed a trace of toluene (0.5 µg/l) and a DRO concentration of 150 µg/l. Observation of the chromatographic trace reveals trace resolved peaks in the approximated hydrocarbon range of n-C_{20} through n-C_{34}.

These peaks do not appear to be water-soluble components of gasoline, diesel, or jet fuels because of the observed hydrocarbon range. The range observed suggests background levels characteristic of long-chained hydrocarbons from natural biological activity or plant wax paraffins.

Analysis of the sample collected from existing well GW-3A showed a DRO concentration of 110 µg/l, and no BTEX compounds were detected above the method reporting limits. The presence of DRO in the groundwater sample collected from existing well W-9 was noted; however, the concentration was below the detection limit. BTEX analysis was not performed on the groundwater sample collected from W-9.

3.10.4.3 Conceptual Modeling

The conceptual site model is presented in Figure 3.10-2. The greatest concentrations of hydrocarbons were in the soils located 6 feet bgs from well 55WL01, which is upgradient of the suspected leak location.

The concentrations of the dissolved hydrocarbons in the groundwater sample collected from downgradient well GW-3A are approximately the same as the concentrations in upgradient well 55WL01.

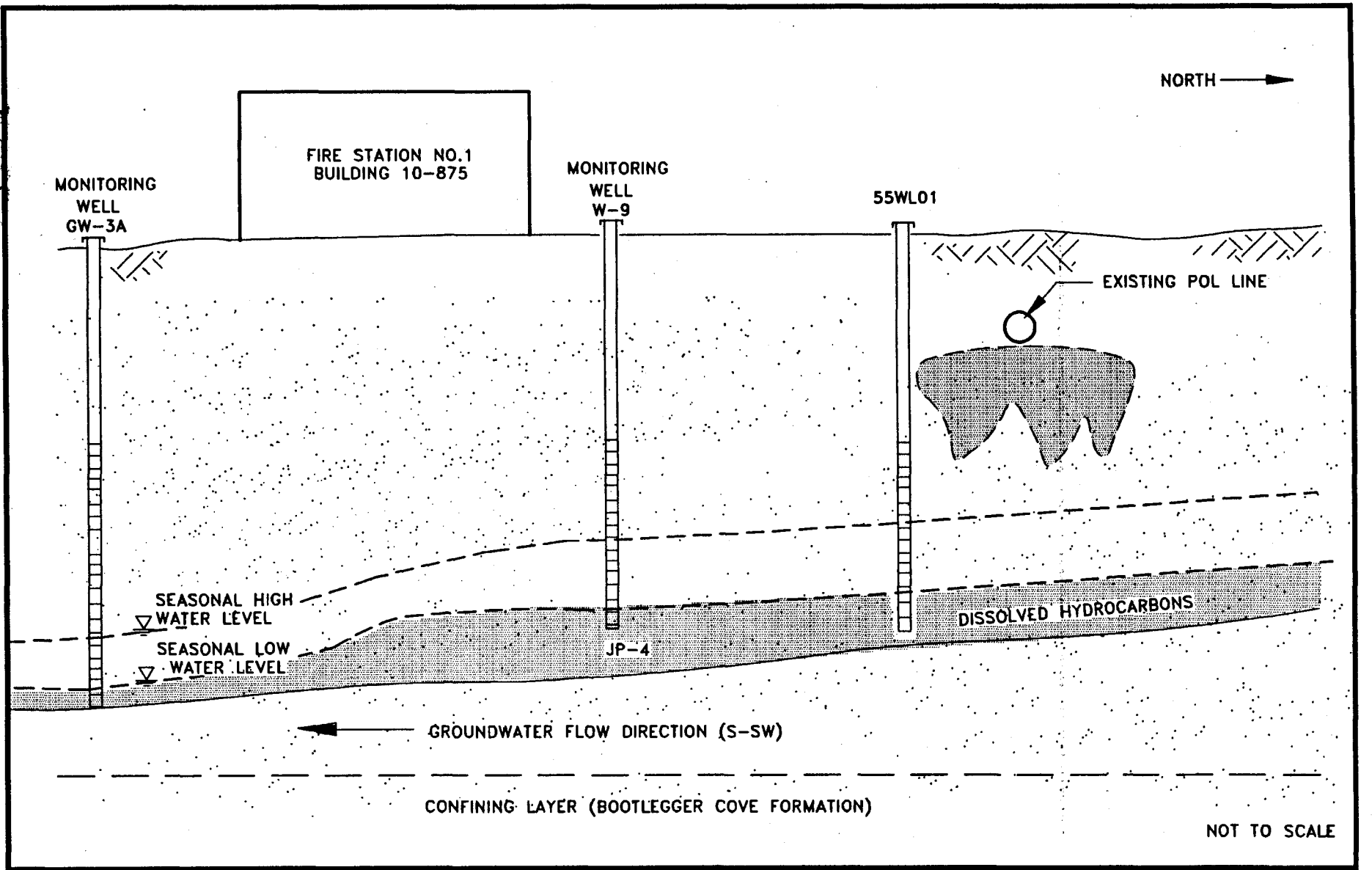
3.10.4.4 Evaluation of Adequacy/Completeness

The location of impacted soils at this site has not been adequately defined. Soils were sampled at the listed locations and a well was installed upgradient of the existing wells to assess the presence of contaminants migrating to the site from off-site sources. The site assessment has not identified the source(s) of groundwater contamination.

3.10.5 Conclusions/Recommendations

3.10.5.1 Soil

Pursuant to 18 AAC 75 requirements for non-UST petroleum sites, a matrix score of 37 was computed for the site. Table 3.10-2 presents the matrix score rating for site ST47.



DRAWING: ST47CSM C/SC: 1:1 DATE: 11/10/93	DRAWN: ABB/SR DISK: 757/93 CHECK: C.H.	FIGURE 3.10-2 CONCEPTUAL SITE MODEL FOR SERA PHASE 1B SITE ST47	3RD SPTG/CEVR. ELMENDORF AFB, ALASKA PROJECT 9010-008-800

Table 3.10-2. Matrix Score Sheet for Site ST47.

1. Depth to Subsurface Water		
< 5 feet	(10)	8
5 - 15 feet	(8)	
15 - 25 feet	(6)	
25 - 50 feet	(4)	
> 50 feet	(1)	
2. Mean Annual Precipitation		
> 40 inches	(10)	3
25 - 40 inches	(5)	
15 - 25 inches	(3)	
< 15 inches	(1)	
3. Soil Type (Unified Soil Classification)		
Clean, coarse-grained soils	(10)	10
Coarse-grained soils with fines	(8)	
Fine-grained soils (low OC)	(3)	
Fine-grained soils (high OC)	(1)	
4. Potential Receptors		
Base Well 16, 1,700 feet down/cross-gradient		8
Public well within 1,000 feet, or		
Private well(s) within 500 feet	(15)	
Municipal/private well within 1/2 mile	(12)	
Municipal/private well within 1 mile	(8)	
No Known well within 1/2 mile	(6)	
No Known well within 1 mile	(4)	
Non-potable groundwater	(1)	
5. Volume of Contaminated Soil		
> 500 cubic yards	(10)	8
100 - 500 cubic yards	(8)	
25 - 100 cubic yards	(5)	
> De Minimus - 25 cubic yards	(2)	
De Minimus	(0)	
	Total	37

Matrix Score		Cleanup level in mg/kg			
		Diesel	Gasoline/Unknown		
		Diesel Range Petroleum Hydrocarbons	Gasoline Range Petroleum Hydrocarbons	Benzene	BTEX
Level A	>40	100	50	0.1	10
Level B	27-40	200	100	0.5	15
Level C	21-26	1,000	500	0.5	50
Level D	<20	2,000	1,000	0.5	100

A matrix score of 37 requires Level B cleanup standards. The soil samples collected from borings 55BH02 and 55BH03 had trace concentrations of DRO. One soil sample collected from 6 feet bgs during drilling of well 55WL01 exceeded the cleanup level for DRO. As this sample was collected from more than 15 feet above the water table, the presence of these compounds is not likely the result of migration from off-site sources.

Gas chromatography traces obtained from the DRO analysis were interpreted to help identify and differentiate between refined petroleum product types (gasoline, diesel fuel, JP-4, JP-8, motor oil etc.), biogenic hydrocarbons (waxy plant paraffins), or laboratory contamination origin.

Interpretation of DRO results should be approached with some caution, since the analysis targets all extractable organic compounds between defined hydrocarbon ranges with a nonspecific universal detector. The sum of the resolved saturated and aromatic compounds and UCM contribute to the total response and fingerprint trace observed. Interpretation of the fingerprint trace (chromatogram) is subjective in identifying detected compounds as refined petroleum products, biogenic hydrocarbons, or field- and laboratory-introduced contamination.

Observation of the chromatographic trace from 55WL01 at a depth of 6.0 feet reveals two distinct fingerprint areas for interpretation. The area from the approximated hydrocarbon range of n-C_{20} through n-C_{34} is characteristic of a motor oil. A large UCM was observed at the hydrocarbon range that matched a comparison to laboratory motor oil library standards.

The second area from the approximated hydrocarbon range of n-C_{10} through n-C_{18} exhibited resolved peaks over a UCM. The characteristic homologous series of individual resolved peaks representative of normal alkanes in diesel and jet fuels are absent. Rather a "ragged" trace is observed that may suggest the natural processes of evaporation, biodegradation, and photo-oxidation to the observed product. Interpretation of the product is indeterminable.

The presence of the elevated concentration of DRO in the soils near a POL line may be explained by any of three possibilities:

- Another source of soil contamination exists.
- The excavated soils did not extend to the location of well 55WL01.
- The original suspected leak location was misidentified.

3.10.5.2 Groundwater

Groundwater table elevations from the three sampled wells at the site were used to determine the direction and gradient of groundwater flow. The flow direction is interpreted to be to the southeast along an average gradient of 0.0027 ft/ft.

The concentrations of DRO and toluene dissolved in the groundwater at the upgradient well location (55WL01) are very similar to the concentrations measured from the downgradient well location (GW-3A). The DRO concentration of the groundwater sample collected from well W-9 was also approximately the same as the samples collected from the other wells.

The source of the dissolved hydrocarbons in the groundwater is most likely located upgradient from well 55WL01 and is most likely the fire training area (FT23) under investigation in OU4.

3.10.6 Follow-up Actions

No soil contamination above the cleanup levels was found in the area designated as ST47. Elevated levels of DRO in soil from the upgradient well location may indicate a different source. Low-level groundwater contamination does not appear to be consistent with water-soluble components of fuels. No further action should be required for groundwater and soil associated with ST47; however, further investigation to identify the source of DRO in soil from well 55WL01 could be initiated.

Leak testing of the hydrant system in this area should be performed to evaluate this system as a potential source.

3.11 SS57, Oil-Stained Soil (IRPIMS Site 54)

3.11.1 Introduction

SS57 is located on the southeast corner of Maple and 3rd streets (Figure 3.11). The site is south of the POL parking lot, southwest of Building 10-300, east of Hangar 5 (Building 32-060), and north of Building 22-040 (Figure 3.11-1). The ground surface of the site is covered with grass and is surrounded on the north, east, and west by grass fields.

Two monitoring wells exist cross-gradient to the site. Monitoring well IS-8-01 is located on the southwest corner of Hangar 5, west of the site, and monitoring well OU5-MW04 is located at the southeast corner of 2nd Street and L Street, southeast of SS57.

In May 1989, the COE conducted a field investigation, drilling 12 soil borings from 5 to 50 feet in depth (Figure 3.11-1). From these borings, 22 soil samples were collected for on-site ATH analysis with a photoionization gas chromatograph. The samples were analyzed for BTEX. It should be noted that only benzene was used for a calibration standard; therefore, the qualification and quantification of the other aromatic compounds are only estimates.

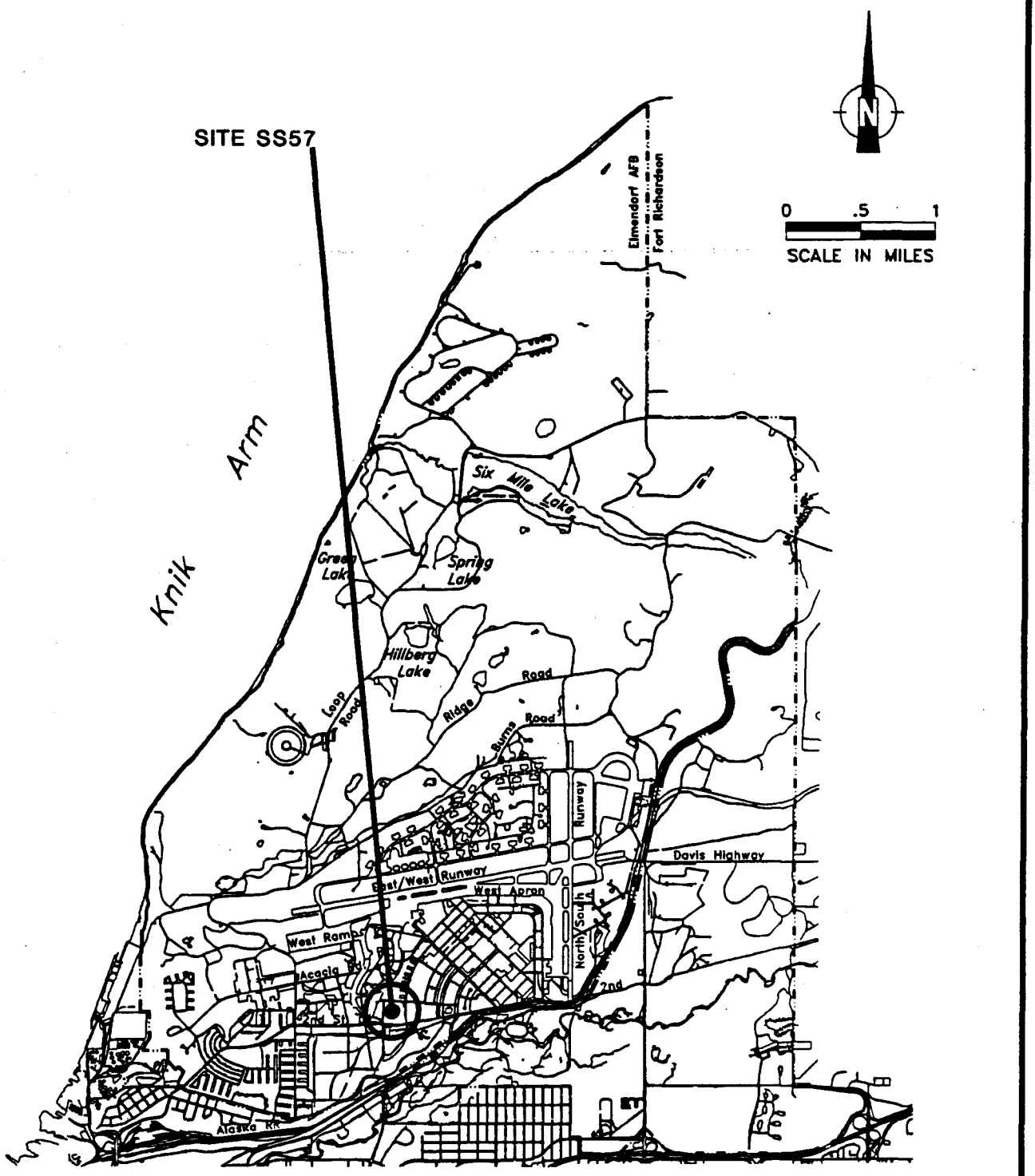
The 1989 field investigation results indicated that BTEX concentrations ranged from undetected to 151 ppm. The highest concentrations occurred at between 15- and 25-foot depths around the northeast section of the site. Soil samples from 0 to 10 feet deep did not contain any significant aromatic hydrocarbon concentrations, suggesting that a spill may have occurred upgradient (as groundwater is assumed to flow from north to south at this location).

The path of an assumed contaminant plume, migrating from the north in and below the capillary fringe, would flow toward Ship Creek. The potential source of this assumed plume is an area just south of the Snow Barn and thought to be related to FT23.

3.11.2 Objectives

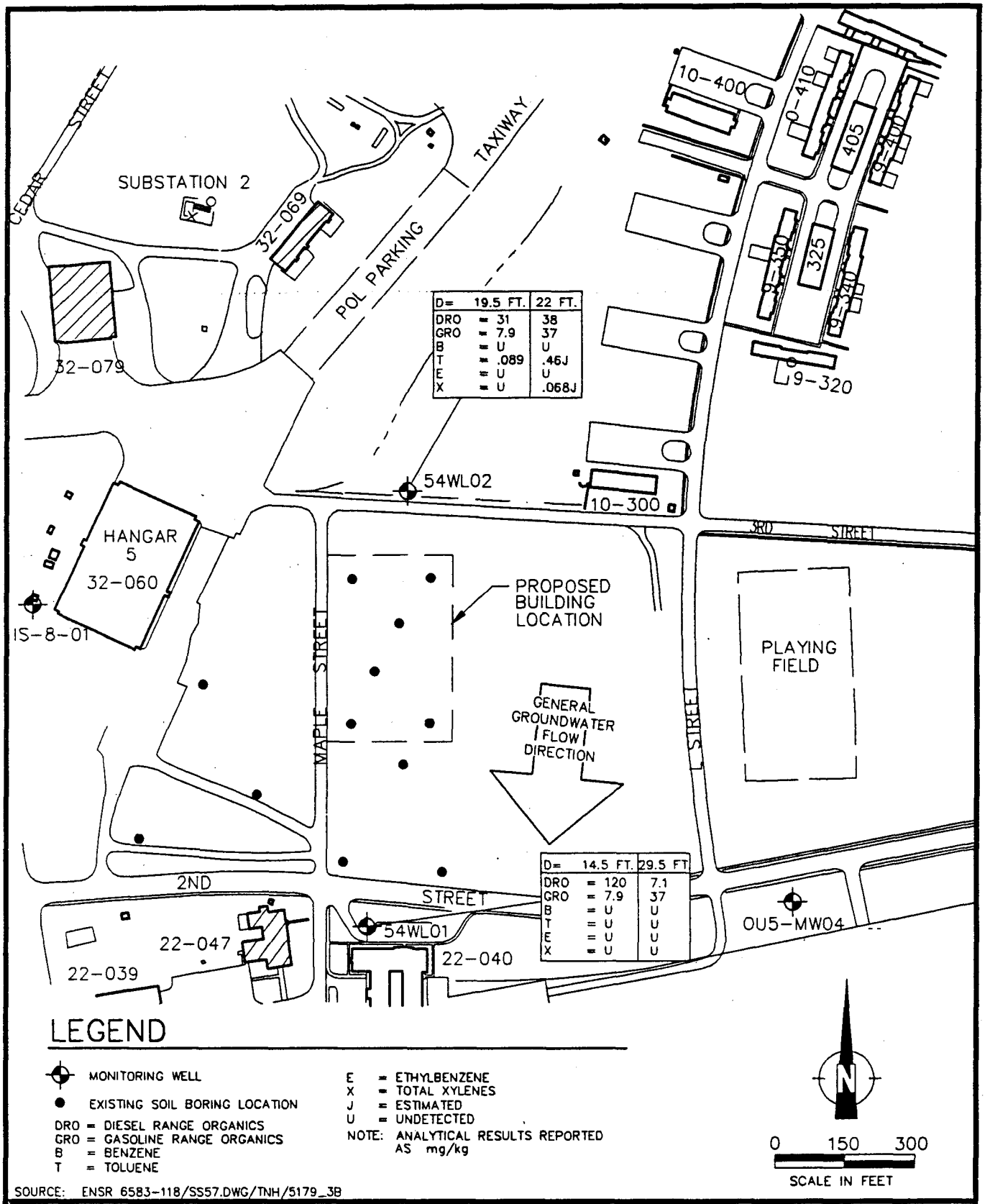
The objectives for site assessment at SS57 were to:

- Confirm previously reported contamination,
- Assess the likelihood of an off-site source as the cause of contamination, and
- Assess whether hydrocarbon-impacted soils are contributing to the groundwater contamination.



Municipality of Anchorage

DRAWING: F3605 DRAWN: ABB/SR C/SC: 1:5500 DISK: NET9/93 DATE: 09/22/93 CHECK: D.G.	FIGURE 3.11 LOCATION MAP SITE SS57	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-008-800



SOURCE: ENSR 6583-118/SS57.DWG/TNH/5179_3B

DRAWING: SS57MW DRAWN: ABB/SR C/SC: 1:300 DISK: 751/93 DATE: 01/12/94 CHECK: D.G.	FIGURE 3.11-1 SOIL BORING LOCATIONS AND ANALYTICAL RESULTS FOR SERA PHASE 1B SITE SS57	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-008-800

3.11.3 Field Investigation

The proposed building area at site SS57 is located in an open grass- and tree-covered field. One monitoring well was installed on the north perimeter of the site and one was installed near the south end. Data were collected from existing wells east and west of the site, OU5-MW04 and IS-08 respectively, to determine the site-specific groundwater gradient and assess the potential of an off-site source of contamination. The site plan with monitoring well and former soil boring locations is presented as Figure 3.11-1.

3.11.3.1 Soil Borings

Two soil borings were advanced to groundwater and then converted to monitoring wells numbered 54WL01 and 54WL02, located south and north of the COE borings. Soil samples collected at 14.5 and 19.5 feet bgs in 54WL01 and at 19.5 and 22 feet bgs in 54WL02 were submitted for analysis. The soil samples were analyzed for DRO, GRO, and BTEX. The boring logs are presented in Appendix A.

3.11.3.2 Groundwater Monitoring Well Installation and Sample Collection

Monitoring well locations are shown on Figure 3.11-1A. Monitoring well 54WL01 was advanced to a total depth of 32 feet bgs; monitoring well 54WL02 was completed at a total depth of 24.5 feet bgs. Groundwater was encountered at 29 feet bgs in 54WL01 and at 19 feet bgs in 54WL02. Monitoring well construction diagrams are included in Appendix A.

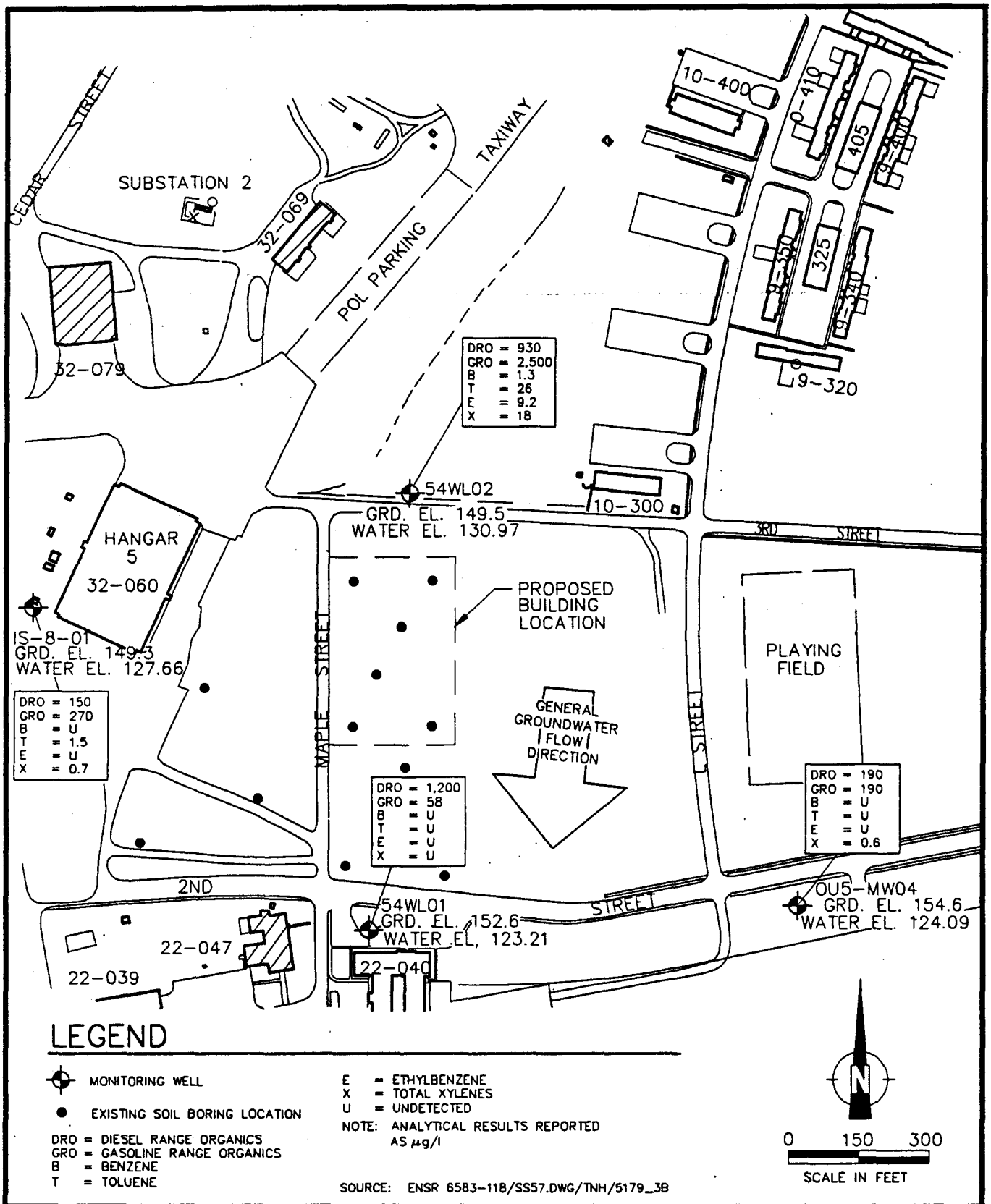
The monitoring wells were developed and sampled as described in Section 2.2.4. The groundwater samples were analyzed for GRO, DRO, and BTEX. Two existing monitoring wells were also sampled.

3.11.4 Results/Findings

3.11.4.1 Field Observations

Prior to the commencement of drilling activities, the site was inspected for the presence of unmarked utilities, apparent surface staining, and present usage of the surrounding area. The following observations were noted:

- Monitoring well 54WL01 is located in a well-landscaped island surrounded by a paved parking area. No staining was evident in the soil or pavement areas.



DRAWING: SS57MW2 DRAWN: ABB/SR C/SC: 1:300 DISK: 848/93 DATE: 01/12/94 CHECK: C.H.	FIGURE 3.11-1A MONITORING WELL LOCATIONS AND ANALYTICAL RESULTS FOR SERA PHASE 1B SITE SS57	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-008-800

- Monitoring well 54WL02 is surrounded by fields with no evident staining in the vicinity. The well is situated between a grass-lined drainage ditch and 3rd Street. An unnamed creek runs north of and perpendicular to the drainage ditch. Both the ditch and the creek were dry at the time of the investigation.

Lithology changes between monitoring wells were noted during drilling. The well in the south, 54WL01, consisted predominantly of sandy gravels and gravelly sands. Elevated PID recordings were sporadic throughout the soil column, although no staining was evident. Monitoring well 54WL02 was predominantly silty sand grading to clayey silt to where groundwater was encountered in a sandy gravel. The PID field screening detected no hydrocarbons except immediately above groundwater at 19 feet bgs. Elevated PID recordings were encountered in the sandy gravels and visible staining was noted. The clayey silt immediately above the saturated gravel was bluish-gray, very soft, slightly plastic, and contained a substantial amount of shell fragments less than 2 mm in size.

3.11.4.2 Analytical Results

The results of the laboratory analysis are presented in Appendix B and summarized on Figures 3.11-1 and 3.11-1A, and in Table 3.11-1. The analysis of soil obtained from 54WL01 did not detect levels of BTEX or GRO above the method reporting limit; an elevated concentration of DRO was detected in a sample obtained at 14.5 feet bgs.

Soil samples from 54WL02 indicated elevated concentrations of toluene at 19.5 and 22 feet bgs, respectively, and 0.068 mg/kg of total xylenes in the 22-foot-bgs sample. Both samples also contained low levels of GRO and DRO.

BTEX was not detected above the method reporting limit in groundwater samples obtained from well 54WL01. Moderate concentrations of all BTEX analytes were detected in well 54WL02. Low levels of total xylenes were detected in existing wells IS-8-01 and OU5-MW04, and toluene was detected in IS-8-01. Moderate to high concentrations of GRO and DRO were detected in groundwater samples from all four wells.

3.11.4.3 Conceptual Model

The conceptual model for site SS57 is presented in Figure 3.11-2. Basewide data indicate groundwater flow to the south-southwest. Soils obtained from 54WL02 in the northern section of the site have low to moderate levels of BTEX, GRO, and DRO increasing with depth, and soils collected from 54WL01 in the south have elevated levels of DRO only. Soil samples analyzed

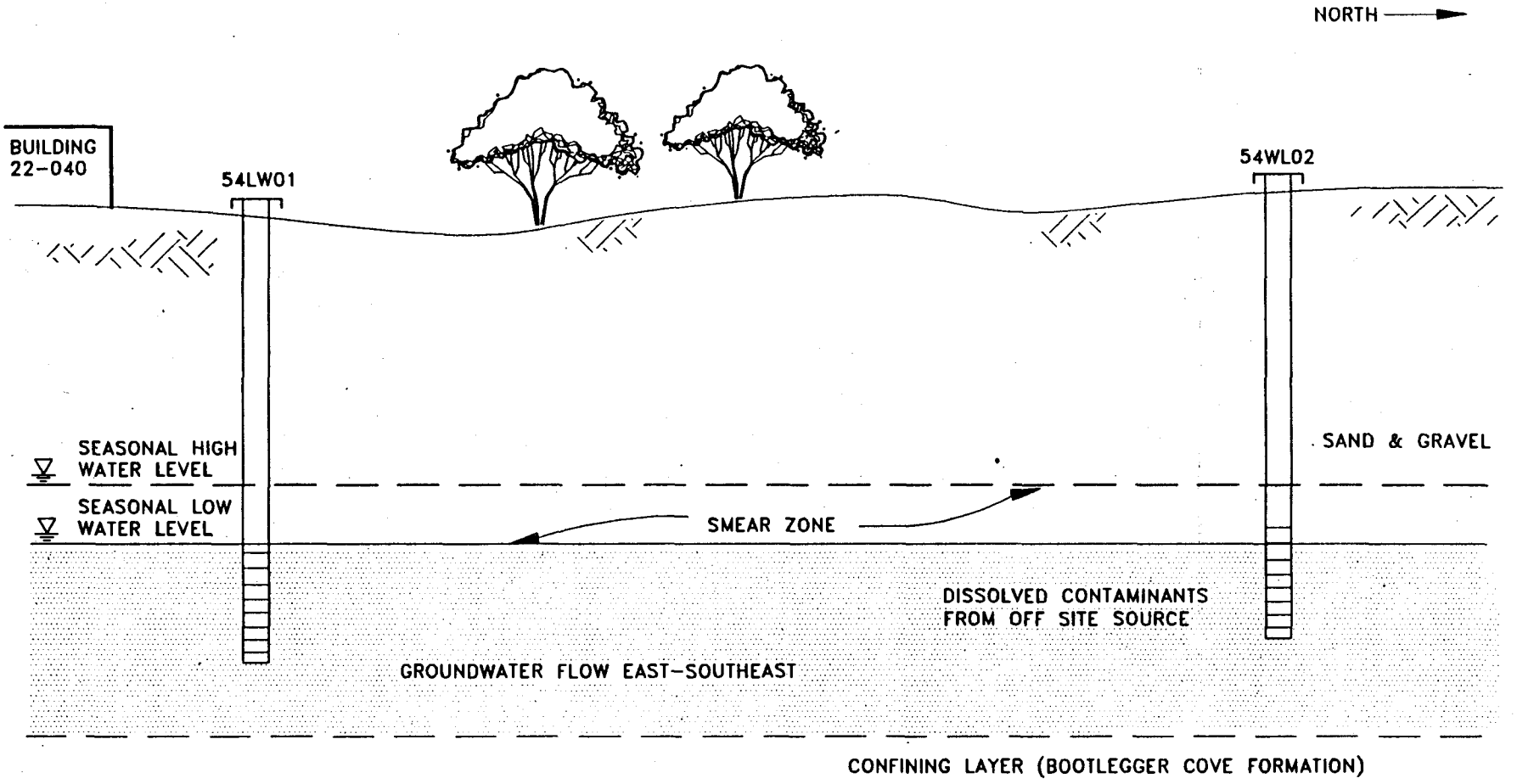
Table 3.11-1. Summary Table, SS57.

Boring/ Well No.	Depth	Sample Number	DRO (mg/kg)	GRO (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)
Soil Analyses								
54WL01	14.5	54WL01SO14.5N	120	U	U	U	U	U
54WL01	29.5	54WL01SO29.5N	7.1	U	U	U	U	U
54WL02	19.5	54WL02SO19.5N	31	7.9	U	.089	U	U
54WL02	22.0	54WL02SO22.0N	38	37	U	.46J	U	.068J

Well No.	Sample Number	DRO (µg/l)	GRO (µg/l)	B (µg/l)	T (µg/l)	E (µg/l)	X (µg/l)
Water Analyses							
54WL01	54WL01WGN	1,200	58	U	U	U	U
54WL02	54WL02WGN	930	2,500	1.3	26	9.2	18
MW04	54WL045MW4WGN	190	190	U	U	U	0.6
IS-8-01	54WLIS08WGN	150	270	U	1.5	U	0.7

Key: B = Benzene.
DRO = Diesel range organics.
E = Ethylbenzene.
GRO = Gasoline range organics.
J = Estimated.
T = Toluene.
U = Not detected at the method reporting limit.
X = Total xylenes.

Note: See Appendix B for the method reporting limit for each analysis.



NOT TO SCALE

DRAWING: SS57CSM	DRAWN: ABB/SR	FIGURE 3.11-2 CONCEPTUAL SITE MODEL FOR SERA PHASE 1B SITE SS57
C/SC: 1:1	DISK: 756/93	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-003-800
DATE: 11/15/93	CHECK: C.H.	

during the previous investigation verified soil contamination in the field between 54WL01 and 54WL02. Concentrations of dissolved hydrocarbons have been detected in groundwater samples from all four wells with elevated DRO levels in well 54WL01 and GRO in well 54WL02. A contaminant plume appears to originate north of the area of investigation and is transported via groundwater to impact the lower soils on the site. The potential also exists for a separate source of DRO near the vicinity of 54WL01 as concentrations were detected in both soil and water.

3.11.4.4 Evaluation of Adequacy/Completeness

The site assessment at site SS57 has confirmed that contaminated groundwater is flowing onto the site from the north and flowing away from the site to the south. The contaminated groundwater is implicated in the soil contamination in the smear zone found by the COE borings. No significant soil contamination was found in the samples analyzed from the wells

3.11.5 Conclusions and Recommendations

3.11.5.1 Soil

Pursuant to 18 AAC 75 requirements for non-UST petroleum sites, a matrix score of 33 was computed for the subject site. The matrix score sheet for SS57 is presented in Table 3.11-2.

A matrix score of 33 requires Level B cleanup standards. All soil samples analyzed were below the Level B cleanup standards.

The impact of any specific release is undefined as is the source, although groundwater appears to be the mode of contaminant transport. The highest concentration of hydrocarbon compounds is generally at or just above the groundwater. Surface soils appear to be unaffected with the exception of soils at 54WL01, which indicate elevated concentrations of DRO near surface.

The areal extent of impacted soils has not been determined. Possible explanations for the subsurface impacted soil would be:

- Initial migration of the contaminants from the source location was vertical until reaching the groundwater, which transported the LNAPL laterally.

- Episodes of seasonal high and low water table elevation caused a smear zone of hydrocarbon compounds trapped in pore spaces within the soil.

Table 3.11-2. Matrix Score Sheet for Site SS57.

1. Depth to Subsurface Water		
< 5 feet	(10)	
5 - 15 feet	(8)	
15 - 25 feet	(6)	6
25 - 50 feet	(4)	
> 50 feet	(1)	
2. Mean Annual Precipitation		
> 40 inches	(10)	
25 - 40 inches	(5)	
15 - 25 inches	(3)	3
< 15 inches	(1)	
3. Soil Type (Unified Soil Classification)		
Clean, coarse-grained soils	(10)	
Coarse-grained soils with fines	(8)	8
Fine-grained soils (low OC)	(3)	
Fine-grained soils (high OC)	(1)	
4. Potential Receptors		
Base Well 52, 7.5 miles cross-gradient		
Public well within 1,000 feet, or		
Private well(s) within 500 feet	(15)	
Municipal/private well within 1/2 mile	(12)	
Municipal/private well within 1 mile	(8)	
No Known well within 1/2 mile	(6)	6
No Known well within 1 mile	(4)	
Non-potable groundwater	(1)	
5. Volume of Contaminated Soil		
> 500 cubic yards	(10)	10
100 - 500 cubic yards	(8)	
25 - 100 cubic yards	(5)	
> De Minimus - 25 cubic yards	(2)	
De Minimus	(0)	
	Total	33

Matrix Score		Cleanup level in mg/kg			
		Diesel	Gasoline/Unknown		
		Diesel Range Petroleum Hydrocarbons	Gasoline Range Petroleum Hydrocarbons	Benzene	BTEX
Level A	>40	100	50	0.1	10
Level B	27-40	200	100	0.5	15
Level C	21-26	1,000	500	0.5	50
Level D	<20	2,000	1,000	0.5	100

3.11.5.2 Groundwater

Basewide groundwater data indicate flow direction is to the south-southwest in the site area.

The highest concentrations of BTEX and GRO were found in 54WL02 followed by IS-8-01 indicating a potential source northwest of Hangar 5. Elevated levels of DRO were found in 54WL01, potentially indicating a separate, unrelated source.

3.11.6 Follow-up Actions

The groundwater contamination associated with this site has been included in OU3-related investigations. No further action should be required for site SS57.

3.12 LF02, Landfill/Disposal Site (IRPIMS Site 53)

3.12.1 Introduction

Site LF02 is located on a historical landfill/disposal site reported to have been used between 1940 and 1942. Based on a 1950 historical aerial photograph, LF02 is located in the vicinity of the Boniface Gate and the Federal Aviation Administration (FAA) Air Traffic Control Center (see Figures 3.12 and 3.12-1). Material reportedly disposed at the landfill/disposal site consisted of hard fill, construction rubble, scrap metal, and general refuse. No cover was applied at the site. The former landfill has been overgrown with trees and dense vegetation since the mid-1950s based upon aerial photographs dating back to 1950.

Groundwater at the site is approximately 28 feet bgs at the top of the bluff. The site is part of the bluff, which is a portion of the Ship Creek valley.

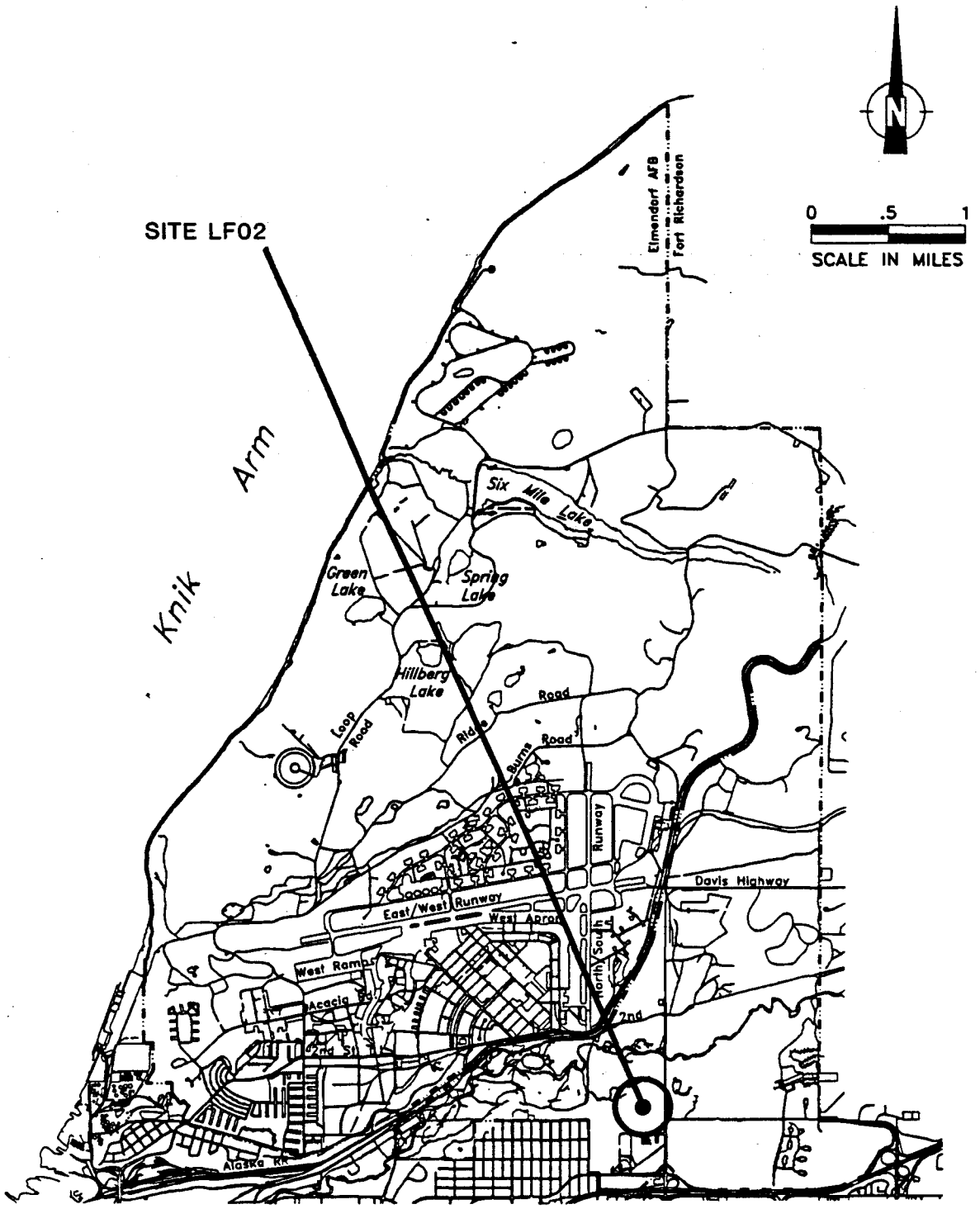
A records search of Elmendorf AFB environmental documents was conducted to examine the site history and current conditions that may affect soil and groundwater conditions at site LF02.

Past investigations have not been conducted close enough to the site to allow for accurate comparison of the conditions at the site.

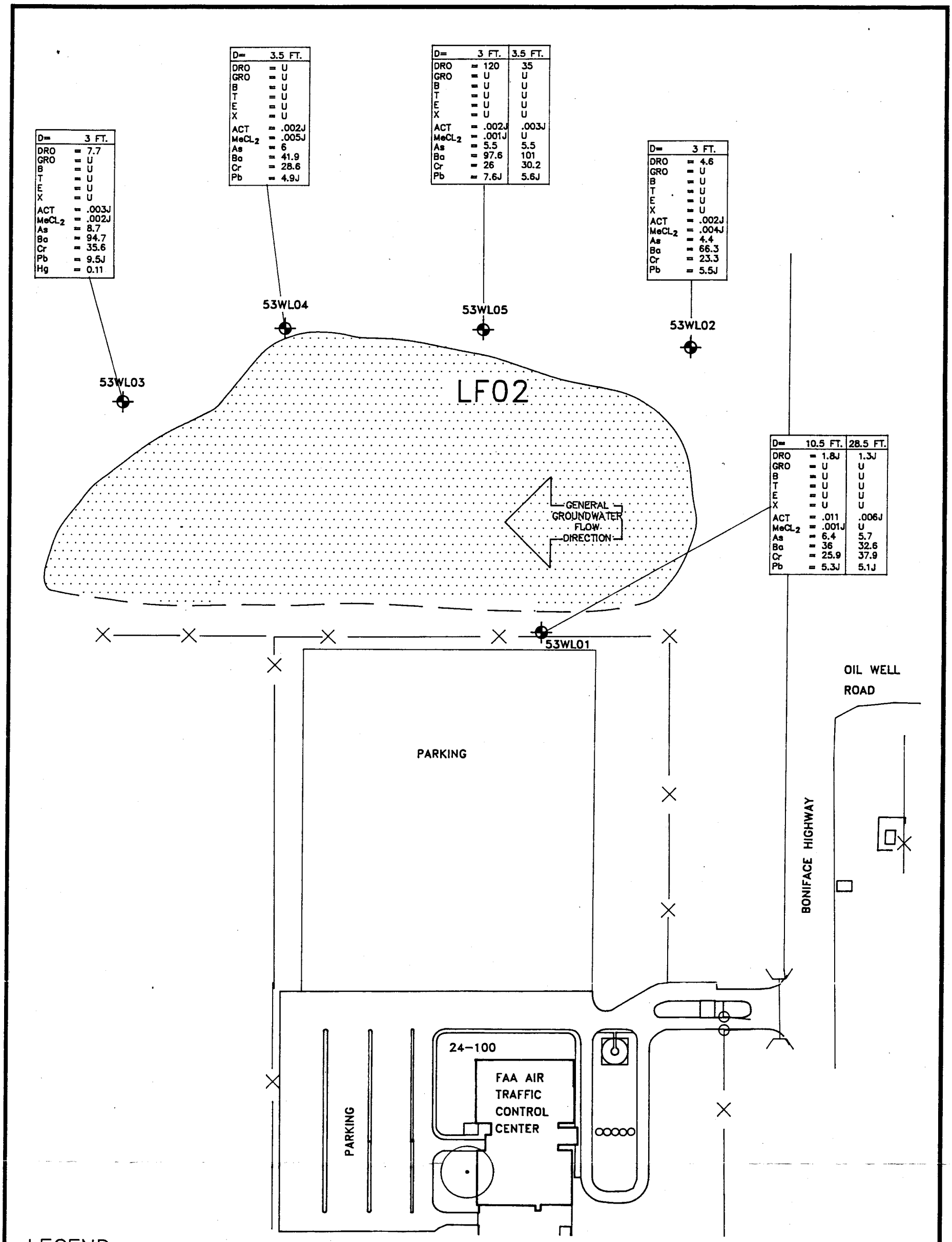
3.12.2 Objectives

The objectives of LF02 landfill/disposal site assessment were to:

- Evaluate the former landfill as a potential source of contamination,
- Develop a leaching model for the landfill using SESOIL to include the potential for migration of contaminants to the deep aquifer,
- Assess whether more information is needed to allow the site to be considered "no further action necessary," and
- Obtain information needed to prepare a landfill closure work plan.



DRAWING: F3605 DRAWN: ABB/SR C/SC: 1:5500 DISK: NET9/93 DATE: 09/22/93 CHECK: D.G.	FIGURE 3.12 LOCATION MAP SITE LF02	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-008-800



LEGEND

- MONITORING WELL
- LANDFILL/DISPOSAL SITE

D = SAMPLE DEPTH
DRO = DIESEL RANGE ORGANICS
GRO = GASOLINE RANGE ORGANICS
B = BENZENE
T = TOLUENE
E = ETHYLBENZENE
X = TOTAL XYLENES
ACT = ACETONE
$MeCL_2$ = METHYLENE CHLORIDE
As = ARSENIC
Ba = BARIUM
Cr = CHROMIUM
Hg = MERCURY
Pb = LEAD
J = ESTIMATED
U = UNDETECTED

NOTE: ANALYTICAL RESULTS REPORTED AS mg/kg

N

0 75 150
SCALE IN FEET

SOURCE: ENSR 6583-118/LF02.DWG/TNH/5179_3A/9010-003/LF02MW/11/10/93

3RD SPTG/CEVR
ELMENDORF AFB, ALASKA

FIGURE 3.12-1
SOIL BORING LOCATIONS & ANALYTICAL RESULTS FOR SERA PHASE 1B SITE LF02

DATE: 01/12/94	DRAWN BY: SR/ABB	SCALE: AS SHOWN	DRAWING: LF02MW3
C/SC: 1:150 DISK: 837/93	ENGINEER: C. HUMPHREY	CHECKED: J. WILLIAMS	PROJECT: 9010-008-800

3.12.3 Field Investigation

3.12.3.1 Groundwater Monitoring Well Installation and Sample Collection

A total of five groundwater monitoring wells were installed at LF02 (Figure 3.12-1). Soil samples were collected during drilling of the well locations. Well 53WL01 was drilled to a depth of 34.5 feet bgs. The other four wells, north of the former landfill, were installed at depths of 12.5 to 13 feet bgs. Monitoring well construction diagrams are provided on the boring logs presented in Appendix A.

The groundwater monitoring wells were developed and sampled as described in Section 2.2.4. The soil and groundwater samples were analyzed for GRO, DRO, VOCs, and RCRA metals.

3.12.4 Results/Findings

3.12.4.1 Field Observations

Prior to the commencement of drilling activities, the site was inspected for the presence of unmarked utilities, apparent surface staining, and present usage of the grounds surrounding the former landfill. The following observations were noted:

- The northern edge of the landfill drops about 25 feet to the elevation of the four northern wells.
- The surface of the landfill has been vegetated by brush and trees.
- Several rusted 55-gallon drums were observed at the surface.
- Upon removal of the overlying vegetation, weathered beverage containers and paint cans were found near the surface.

The subsurface exploration program revealed a thin layer of peat near the surface in some locations overlying poorly to moderately graded gravels. Some locations encountered sand interbedded with the gravel. Groundwater was encountered within 3 feet of the surface at the northern edge of the former landfill. Subsurface exploration of the soils beneath well 53WL01 encountered gravel to the full depth of the well (34.5 feet bgs).

Field screening results on soil samples were not helpful in selecting the samples for laboratory analysis. Field screening results are included on the boring logs presented in Appendix A. None of the soil samples showed elevated PID readings.

3.12.4.2 Analytical Results

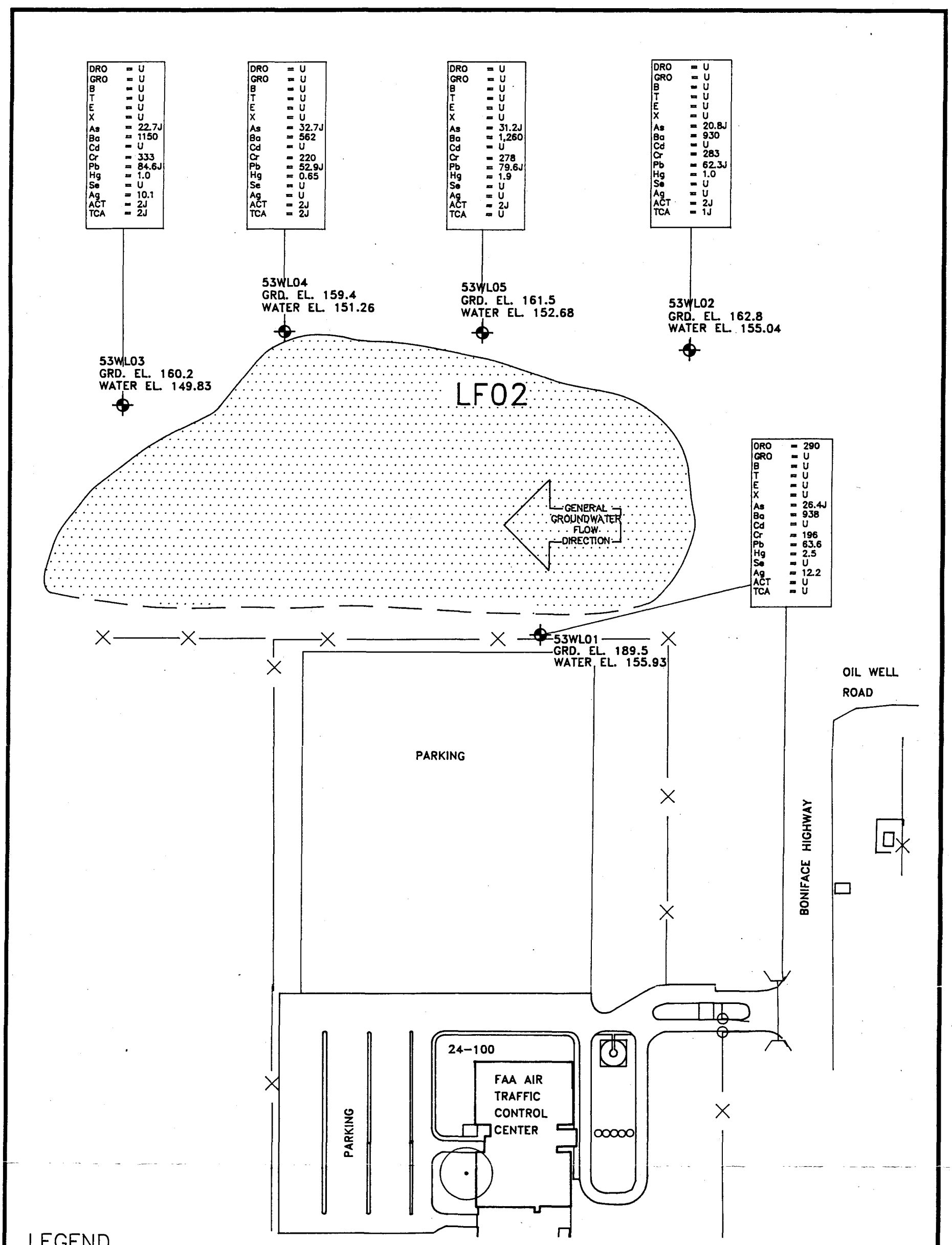
The laboratory results are presented in Appendix B and summarized on Figures 3.12-1 and 3.12-1A, and in Table 3.12-1. The only VOCs detected in the soil samples were acetone and methylene chloride. Both of the compounds were detected at trace concentrations and may be considered laboratory contamination. GRO compounds were not detected in the soil samples; however, DRO was detected in trace concentrations from soil samples collected from well locations 53WL02, 53WL03, and 53WL05. The sample collected from 3.0 feet bgs from well 53WL05 had an elevated concentration of 120 mg/kg DRO. Metals concentrations in the soil samples were not above normal ranges for surface soils in Alaska.

The results of the metals analysis of the groundwater samples indicated that chromium was present in concentrations exceeding State and Federal MCLs in samples collected from all five of the well locations. Mercury was detected with a concentration of 2.5 µg/l in the groundwater sample collected from 53WL01. GRO was not detected in concentrations above method reporting limits. DRO was detected in the groundwater sample collected from 53WL01. VOC analysis revealed the presence of acetone in very low concentrations from the groundwater samples, with the exception of 53WL02. The presence of acetone at these low concentrations may be attributed to laboratory contamination. 1,1,2,2-tetrachloroethane was detected at trace concentrations (approximated) from groundwater samples collected from 53WL02, 53WL03, and 53WL04.

3.12.4.3 Conceptual/SESOIL Modeling

Monitoring wells were placed upgradient and downgradient of LF02 to quantify the current chemical contribution of the former landfill to the aquifer. This assessment is based on the assumption that any difference in constituent concentrations between upgradient and downgradient wells would be likely due to porewater leaching through the landfill and into the aquifer.

Based on a comparison of upgradient and downgradient groundwater quality, the groundwater sampling results indicate that there is no significant contaminant contribution resulting from site LF02. No VOCs were detected in wells either upgradient or downgradient of LF02. DRO was detected at upgradient well 53WL01. Since this detection is upgradient of the landfill, it appears highly unlikely that LF02 is the source of the DRO detected. Comparisons between upgradient



LEGEND

- MONITORING WELL
- LANDFILL/DISPOSAL SITE

DRO = DIESEL RANGE ORGANICS
GRO = GASOLINE RANGE ORGANICS
B = BENZENE
T = TOLUENE
E = ETHYLBENZENE
X = TOTAL XYLENES
As = ARSENIC
Ba = BARIUM
Cd = CADMIUM
Cr = CHROMIUM
Pb = LEAD
Hg = MERCURY
Se = CHROMIUM
Ag = SILVER
ACT = ACETONE
TCA = TETRACHLOROETHANE
J = ESTIMATED
U = UNDETECTED
NOTE: ANALYTICAL RESULTS REPORTED AS µg/kg

N

0 75 150
SCALE IN FEET

SOURCE: ENSR 6583-118/LF02.DWG/TNH/5179_3A/9010-003/LF02MW/11/10/93

3RD SPTG/CEVR
ELMENDORF AFB, ALASKA

FIGURE 3.12-1A
MONITORING WELL LOCATIONS & ANALYTICAL RESULTS FOR SERA PHASE 1B SITE LF02

DATE:	DRAWN BY:	SCALE:	DRAWING:
01/12/94	SR/ABB	AS SHOWN	LF02MW2
C/SC: 1:150 DISK: 848/93	ENGINEER: C. HUMPHREY	CHECKED: J. WILLIAMS	PROJECT: 9010-008-800

033500

Table 3.12-1. Summary Table, LF02.

Boring/ Well No.	Depth (feet)	Sample Number	DRO (mg/kg)	GRO (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)	Other Compounds (mg/kg)
Soil Analyses									
53WL01	10.5	53WL01SO10.5N	1.8J	U	U	U	U	U	ACT - .011 $MeCl_2$ - .001J
53WL01	28.5	53WL01SO28.5N	1.3J	U	U	U	U	U	ACT - .006J
53WL02	3.0	53WL02SO3.0N	4.6	U	U	U	U	U	ACT - .002J $MeCl_2$ - .004J
53WL03	3.0	53WL03SO3.0N	7.7	U	U	U	U	U	ACT - .003J $MeCl_2$ - .002J
53WL03	3.5	53WL03SO0FD	3.6J	U	U	U	U	U	ACT - .003J $MeCl_2$ - .002J
53WL04	3.5	53WL04SO3.5N	U	U	U	U	U	U	ACT - .002J $MeCl_2$ - .005J
53WL05	3.0	53WL05SO3.0N	120	U	U	U	U	U	ACT - .002J $MeCl_2$ - .001J
53WL05	3.5	53WL05SO3.5N	35	U	U	U	U	U	ACT - .003J

Boring/ Well No.	Depth (feet)	Sample Number	DRO (µg/l)	GRO (µg/l)	B (µg/l)	T (µg/l)	E (µg/l)	X (µg/l)	Other Compounds (µg/l)
Water Analyses									
53WL01	–	53WL01WGN	290	U	U	U	U	U	U
53WL02	–	53WL02WGN	U	U	U	U	U	U	ACT - 2J 1,1,2,2-TCA 1J

Table 3.12-1. Summary Table, LF02 (Cont'd).

Boring/ Well No.	Depth (feet)	Sample Number	DRO (µg/l)	GRO (µg/l)	B (µg/l)	T (µg/l)	E (µg/l)	X (µg/l)	Other Compounds (µg/l)
Water Analyses (Cont'd)									
53WL03	--	53WL03WGN	U	U	U	U	U	U	ACT - 2J 1,1,2,2-TCA 2J
53WL04	--	53WL04WGN	U	U	U	U	U	U	ACT - 2J 1,1,2,2-TCA 2J
53WL05	--	53WL05WGN	U	U	U	U	U	U	ACT - 2J

Well No.	Depth (feet)	Sample Number	As (mg/kg)	Ba (mg/kg)	Cd (mg/kg)	Cr (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	Se (mg/kg)	Ag (mg/kg)
Soil Analyses - Metals										
53WL01	10.5	53WL01SO10.5N	6.4	36	U	25.9	5.3J	U	R	U
53WL01	28.5	53WL01SO28.5N	5.7	32.6	U	37.9	5.1J	U	R	U
53WL02	3.0	53WL02SO3.0N	4.4	66.3	U	23.3	5.5J	U	R	U
53WL03	3.0	53WL03SO3.0N	8.7	94.7	U	35.6	9.5J	0.11	R	U
53WL03	3.5	53WL03SO0FD	4.7	56.6	U	32.9	4.7J	U	R	U
53WL04	3.5	53WL04SO3.5N	6	41.9	U	28.6	4.9J	U	R	U
53WL05	3.0	53WL05SO3.0N	5.5	97.6	U	26	7.6J	U	R	U
53WL05	3.5	53WL05SO3.5N	5.5	101	U	30.2	5.6J	U	R	U

Table 3.12-1. Summary Table, LF02 (Cont'd).

Well No.	Depth (feet)	Sample Number	As (µg/l)	Ba (µg/l)	Cd (µg/l)	Cr (µg/l)	Pb (µg/l)	Hg (µg/l)	Se (µg/l)	Ag (µg/l)
Water Analyses - Metals										
53WL01	–	53WL01WGN	26.4J	938	U	196	63.6J	2.5	U	12.2
53WL02	–	53WL02WGN	20.8J	930	U	283	62.3J	1	U	U
53WL03	–	53WL03WGN	22.7J	1,150	U	333	84.6J	1	U	10.1
53WL03	–	53WL03WGFD	27.2J	1,230	U	281	68.3J	1.5	U	10.4
53WL04	–	53WL04WGN	32.7J	562	U	220	52.9J	0.65	U	U
53WL05	–	53WL05WGN	31.2J	1,260	U	278	79.6J	1.9	U	U

Key:
- Ag = Silver.
- As = Arsenic.
- ACT = Acetone.
- B = Benzene.
- Ba = Barium.
- Cd = Cadmium.
- Cr = Chromium.
- DRO = Diesel range organics.
- E = Ethylbenzene.
- GRO = Gasoline range organics.
- Hg = Mercury.
- J = Estimated.
- NA = Not analyzed.
- Pb = Lead.
- R = Data is rejected and considered unuseable due to unacceptable associated quality control results.
- Se = Selenium.
- T = Toluene.
- 1,1,2,2-TCA = 1,1,2,2-Tetrachlorethane.
- U = Not detected at the method reporting limit.
- X = Total xylenes.

Note: See Appendix B for the method reporting limit for each analysis.

and downgradient sampling well results at LF02 are summarized below.At LF02, comparison of metals concentrations in groundwater between wells 53WL01 and 53WL02 (upgradient) and well 53WL03 (downgradient) shows a decrease in most metals. The variation from upgradient to downgradient groundwater quality is very small and is unlikely to reflect landfill influence.

Comparison between upgradient and downgradient wells indicates very minor differences in groundwater quality. Where changes are evident, the magnitude is small and downgradient concentrations are commonly lower than upgradient. No significant source of either organic or inorganic contaminants is apparent in the groundwater sampled at LF02.

Numerical Modeling

The soil parameters were entered for three layers. The layers were selected based on soil types described in site boring logs and parameter values from the SESOIL data base. Physical parameters, such as depth to groundwater and thickness of landfill layer, were taken from site investigation data. The surface area of LF02 was estimated to be 22 acres. Monthly climate data for temperature and precipitation were taken from *Climate of the States* (NOAA 1985) for the Anchorage International Airport.

The modeling results indicate that landfill porewater is expected to reach groundwater in several months at the landfill site. This is largely due to the short distance from the bottom of the landfill to the groundwater table (approximately 3 feet). Therefore, if significant concentrations of contaminants were present in the landfill, they would likely have reached the aquifer many years ago.

Groundwater flow calculations were made to estimate travel time of groundwater beneath the landfill to the monitoring wells. These calculations are based on Darcy's law and require hydraulic gradient information obtained from the monitoring wells (depth to groundwater and x-y location) and hydraulic conductivities estimated from soil type information obtained in the boring logs. At LF02, the average groundwater velocity is estimated to be 300 ft/yr, and the distance from the edge of the landfill to a downgradient monitoring well is approximately 50 feet. Estimated travel time of groundwater from beneath LF02 to a downgradient monitoring well is estimated to be 2 months.

Considering the SESOIL porewater travel time estimates and the Darcy groundwater flow travel time estimates, the total travel time for porewater from LF02 to downgradient wells is expected to be approximately 14 months. This estimate further supports the conclusion that if significant concentrations of contaminants were present in the landfill, they would likely have entered the aquifer.

Dilution of porewater from LF02 into the aquifer is of interest in estimating potential contaminant concentrations in groundwater. A dilution factor estimate provides an upper limit on how much of a contaminant could enter the groundwater without detection of significant concentrations. A groundwater dilution factor for the landfill was calculated based on unsaturated zone water flux estimates from SESOIL and groundwater volumetric flow rate estimates from Darcy's law calculations. A dilution factor of 3 was obtained for LF02. These factors indicate that concentrations of contaminants in porewater from the landfill would be effectively divided by 3 after entering the aquifer, assuming complete mixing in groundwater.

The landfill was created approximately 50 years ago. If significant concentrations of contaminants have entered the aquifer, it seems very likely, based on the SESOIL modeling results, that they would have done so long ago. Since no significant contributions were detected in groundwater sampling, it seems likely that the material currently remaining in the landfill is not soluble and will not likely impact groundwater quality in the future.

3.12.4.4 Evaluation of Adequacy/Completeness

The condition of the soils surrounding the landfill have been adequately characterized. A site-specific groundwater flow direction was determined and the condition of the groundwater upgradient and downgradient of the landfill has been satisfactorily assessed. The above information used in conjunction with SESOIL leachability modeling have adequately characterized the site. The required information to evaluate whether additional data is needed for closure of the landfill has been assembled. The objectives of the site investigation have been met.

3.12.5 Conclusions/Recommendations

3.12.5.1 Soil

The results of the soil analyses indicate that none of the targeted hydrocarbons are present in concentrations requiring remediation. Concentrations of DRO were detected in several soil samples; however, none of the samples had concentrations exceeding cleanup standards for Level B soils. The RCRA metals analysis on the soil samples showed normal concentrations of the metals for surface soils in Alaska. The landfill has not adversely affected the surrounding soils.

3.12.5.2 Groundwater

Three-point analysis of the water table elevations measured from wells 53WL01, 53WL02, and 53WL03 indicated that groundwater was flowing west. The average gradient was calculated to be 0.0072 ft/ft.

Results of the SESOIL modeling indicate that the potential for leachate to reach the water table is high; however, the results of the groundwater sampling do not indicate that the landfill is contributing to groundwater contamination. Concentrations of chromium exceeding the State and Federal MCLs were detected in all of the groundwater samples. The source of the groundwater contamination may therefore be attributed to upgradient sources or is a natural occurrence.

3.12.5.3 Follow-up Actions

Annual groundwater sampling should continue to assess the presence of the detected contaminants. This site was placed into the CERCLA program by USAF based on elevated concentrations of chromium, lead, and mercury in groundwater.

3.13 ST64, JP-4 Leak (IRPIMS Site 52)

3.13.1 Introduction

Site ST64 is located on Burns Road, approximately 2,000 feet from Building 42-425 (Hangar 11; Figure 3.13). The site is bordered to the south by Taxiway 6, to the north by a 25,000-gallon deicer tank, and to the east by Hangar 11 (Figure 3.13-1). The ground surface of the site is grass and gravel surrounded by an asphalt-covered circular drive. The site is located within CERCLA operable unit OU4.

ST64 became a source of concern when a soil vapor survey detected a leak from one of the four USTs. Site ST64 is comprised of four USTs: Tank 425D, a 500-gallon diesel UST; Tank 425C, a 3,000-gallon diesel UST; Tank 425B, a 3,000-gallon JP-4 UST; and Tank 425A, a 2,500-gallon mogas UST.

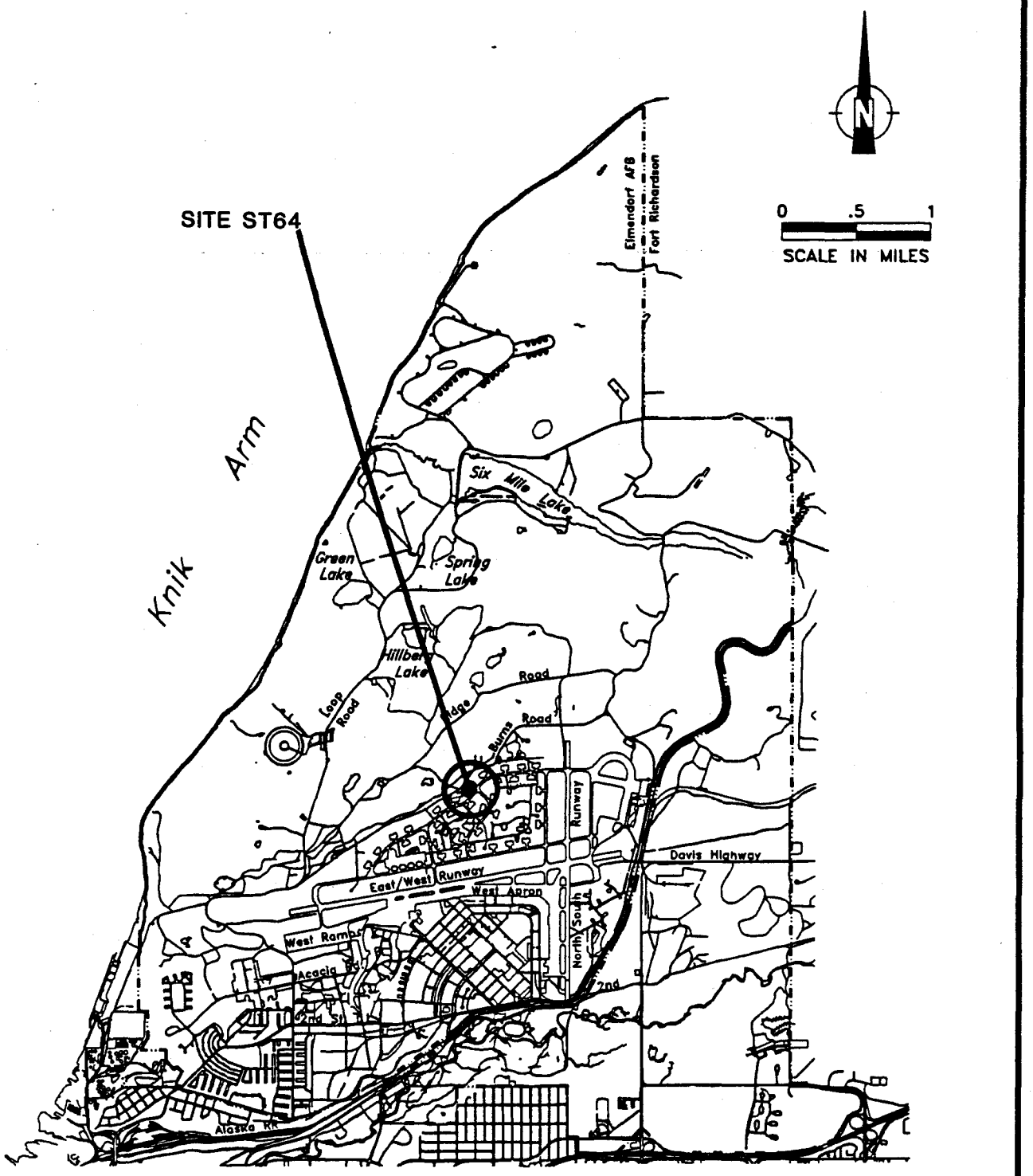
A soil vapor survey was conducted by tightness-testing tanks No. 425B and 425A (Tracer Nos. 68 and 26) on 6 March 1991 for possible leaks (Tracer 1991a). Soil vapor samples were collected on 18 April 1991. Test results indicated that Tank 425B failed the leak test. There are no records indicating that Tanks 425D and 425C have been tightness-tested; it was assumed that they have not been tested and are potential leak sources.

The Elmendorf Storage Tank Management Plan (STMP) tank information database cannot confirm that the tanks have been emptied; the status is listed as unknown and assumed to be inactive.

3.13.2 Objectives

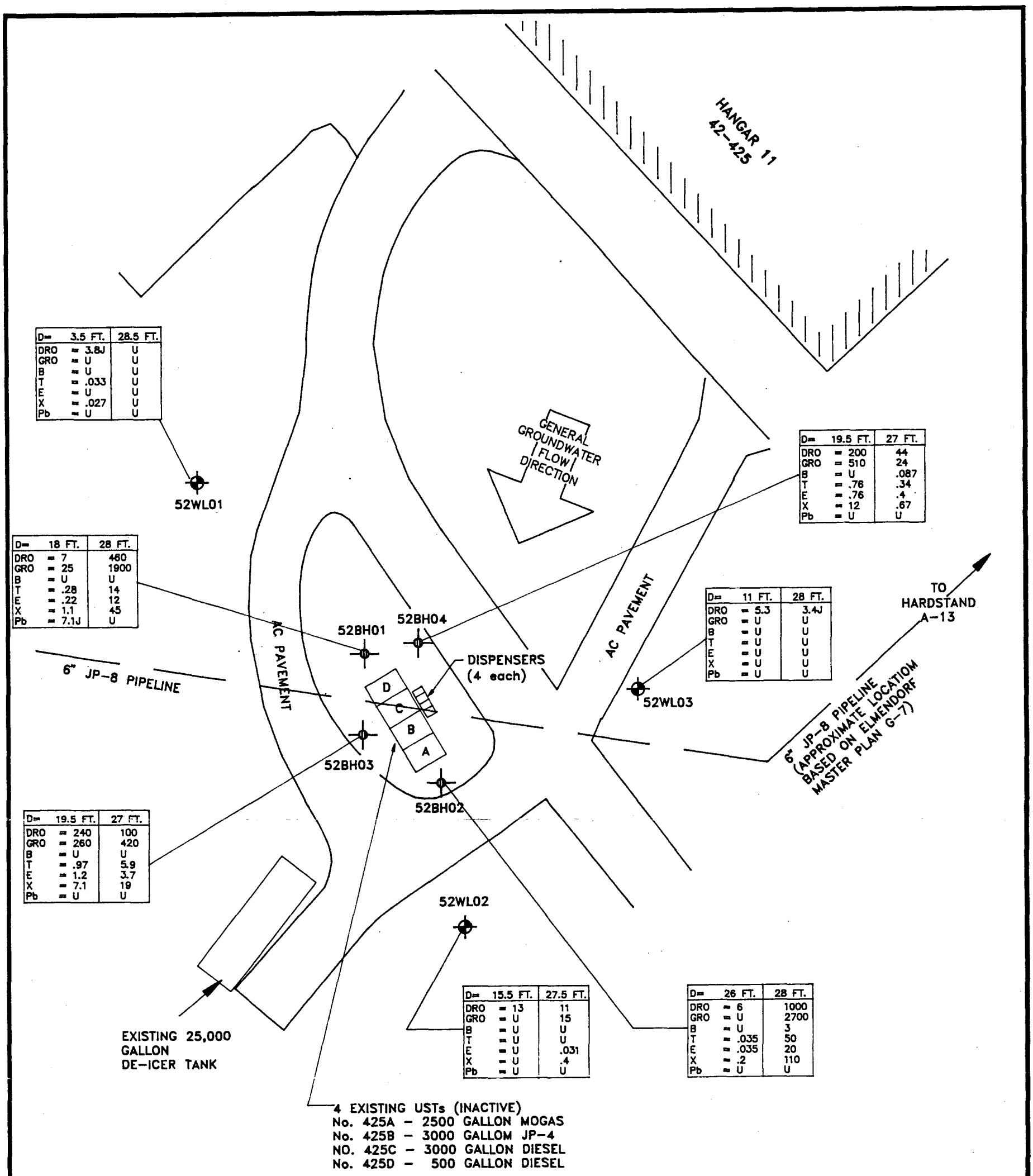
The objectives for the ST64 site assessment were to:

- Assess the horizontal and vertical extent of hydrocarbon-impacted soils, and
- Assess whether hydrocarbon-impacted soils at this site are contributing to the groundwater contamination.



DRAWING: F3605 DRAWN: ABB/SR C/SC: 1:5500 DISK: NET9/93 DATE: 09/22/93 CHECK: D.G.	FIGURE 3.13 LOCATION MAP SITE ST64	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-008-800

033509



LEGEND

- MONITORING WELL
- SOIL BORING

DRO = DIESEL RANGE ORGANICS
DRO = DIESEL RANGE ORGANICS
GRO = GASOLINE RANGE ORGANICS
B = BENZENE
T = TOLUENE
E = ETHYLBENZENE
X = TOTAL XYLENES
Pb = LEAD
J = ESTIMATED
U = UNDETECTED
NOTE: ANALYTICAL RESULTS REPORTED AS mg/kg
BASE MAP IS APPROXIMATE

N

0 15 30
SCALE IN FEET

SOURCE: ENSR 6583-118/ST64.DWG/TNH/5179_3D/9010-003/ST64MW/11/10/93

3RD SPTG/CEVR
ELMENDORF AFB, ALASKA

FIGURE 3.13-1
SOIL BORING LOCATIONS & ANALYTICAL RESULTS FOR SERA PHASE 1B SITE ST64

DATE: 01/12/94	DRAWN BY: SR/ABB	SCALE: AS SHOWN	DRAWING: ST64MW2
C/SC: 1:30 DISK: 837/93	ENGINEER: C. HUMPHREY	CHECKED: J. WILLIAMS	PROJECT: 9010-008-800

033511

3.13.3 Field Investigation

3.13.3.1 Soil Borings

Four soil borings were drilled and sampled around the location of the four tanks at site ST64 (Figure 3.13-1). The borings were advanced to approximately 30 feet bgs where groundwater was encountered. Boring logs are presented in Appendix A. Soil samples were analyzed for DRO, GRO, BTEX, and lead.

3.13.3.2 Groundwater Monitoring Well Installation and Sample Collection

Three monitoring wells were installed at site ST64 to assess the site-specific groundwater flow direction and groundwater quality upgradient and downgradient of the site (Figure 3.13-1A). Well 52WL01 was installed north of the UST locations (toward the Elmendorf Moraine) to a depth of 35 feet bgs. Well 52WL02 was installed south of the UST locations at a depth of 32.5 feet bgs. Well 52WL03 was installed east of the UST locations to a depth of 34.5 feet bgs. Groundwater monitoring well construction diagrams are included on the boring logs presented in Appendix A.

Three groundwater monitoring wells were developed and sampled as described in Section 2.2.4. The groundwater samples were analyzed for DRO, GRO, BTEX and lead.

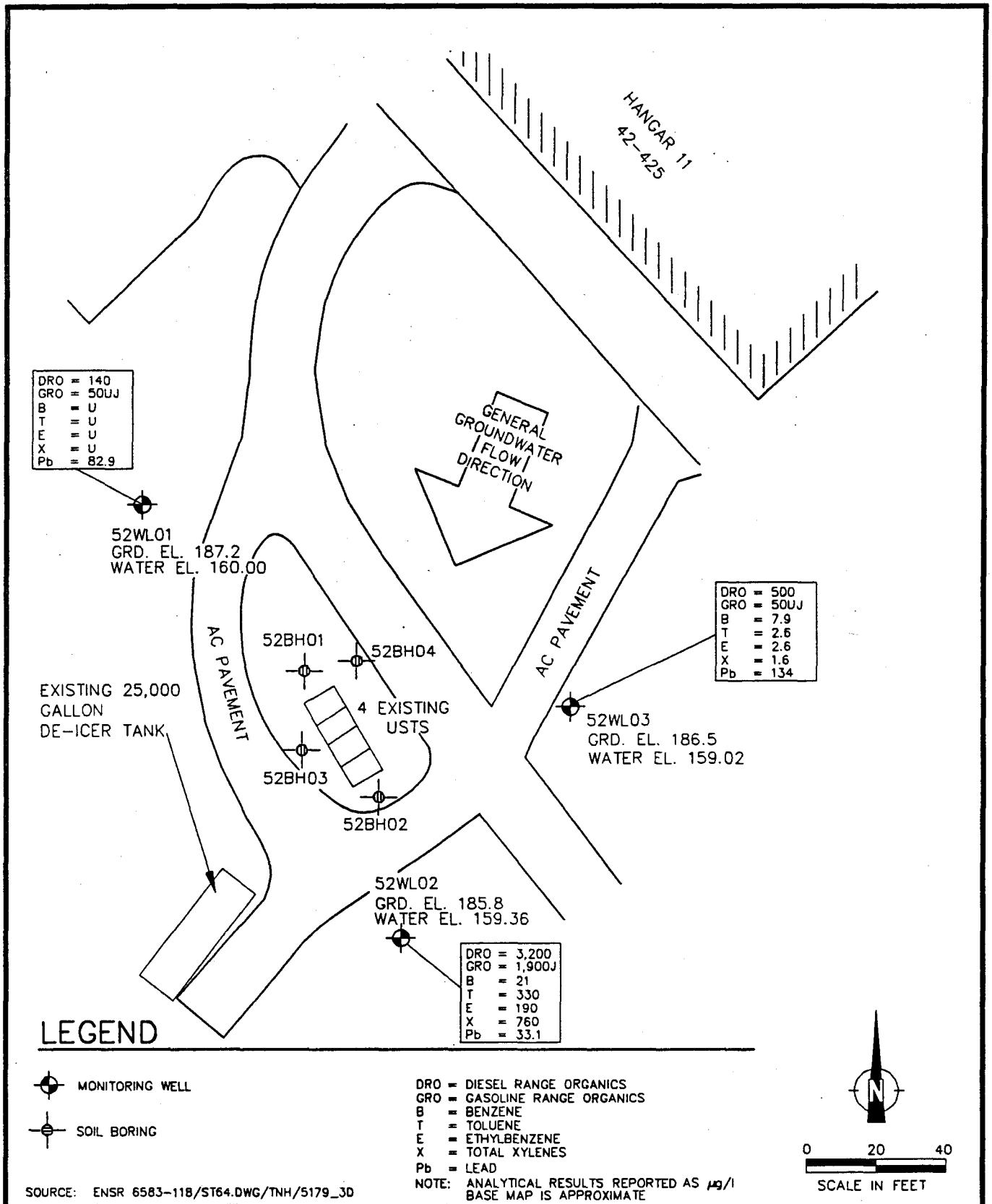
3.13.4 Results/Findings

3.13.4.1 Field Observations

Prior to the commencement of drilling activities, the site was inspected for the presence of unmarked utilities, apparent surface staining, and present usage of the grounds surrounding the location of the USTs. The following observations were noted:

- The utilities were not located as indicated on the site map.
- The fuel dispensers appeared to be out of operation.

The subsurface exploration program encountered interbedded layers of well-graded to poorly graded gravels, and poorly graded, fine to medium sands. Silty, grain-supported gravel was noted extending from the surface to a depth ranging between 5 and 10 feet bgs in borings 52BH01 and 52BH02, respectively.



DRAWING: •ST64MW DRAWN: ABB/SR C/SC: 1:40 DISK: 752/93 DATE: 01/11/94 CHECK: D.G.	FIGURE 3.13-1A MONITORING WELL LOCATIONS AND ANALYTICAL RESULTS FOR SERA PHASE 1B SITE ST64	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-008-800

Field PID readings on soil samples were used to select the samples for laboratory analysis. Field screening results are included on the boring logs presented in Appendix A. Soil samples collected from all of the borings and well 52WL03 showed elevated PID readings. PID readings generally increased at depths near the water table.

3.13.4.2 Analytical Results

The results of the laboratory analysis are presented in Appendix B and summarized on Figures 3.13-1 and 3.13-1A, and in Table 3.13-1. BTEX, GRO, and DRO were detected in both soil samples submitted from boring 52BH01; however, the sample collected from 28.0 feet bgs (just above the water table) had much higher concentrations of the analytes with total BTEX, GRO, and DRO concentrations of 71, 1900, and 460 mg/kg, respectively. High concentrations of hydrocarbons were also detected in the samples collected from the other borings. Soil samples collected from well 52WL01 detected trace concentrations of toluene, total xylenes, and DRO from the 3.5 feet bgs sample, and no hydrocarbons were detected in the sample collected from 28.5 feet bgs. Low concentrations of GRO and DRO were detected in the 27.5-foot-bgs sample from 52WL02, and only DRO was detected from the 15.5-foot-bgs sample. Both soil samples analyzed from 52WL03 showed trace concentrations of DRO. Nondetectable or low (7.1 mg/kg) levels of lead were indicated in the soil samples.

The groundwater samples analyzed from wells 52WL01, 52WL02, and 52WL03 had lead concentrations of 82.9, 33.1, and 134 µg/l. The groundwater samples collected from wells 52WL02 and 52WL03 had detectable concentrations of BTEX, DRO, and GRO. Groundwater from well 52WL01 also detected DRO with a concentration of 140 µg/l.

3.13.4.3 Conceptual Modeling

The conceptual model for this site is presented in Figure 3.13-2. The extent of the impacted soils related to the release are generally confined to the area immediately around the UST locations and extending toward well 52WL02.

JP-4 is likely emanating from Tank 425B and possible plumes are shown from the two diesel tanks. The diesel tanks are possible sources of soil/groundwater contamination.

3.13.4.4 Evaluation of Adequacy/Completeness

The site assessment of ST64 has adequately characterized the vertical and horizontal extent of the contaminated soils in the vicinity of the UST locations.

Table 3.13-1. Summary Table, ST64.

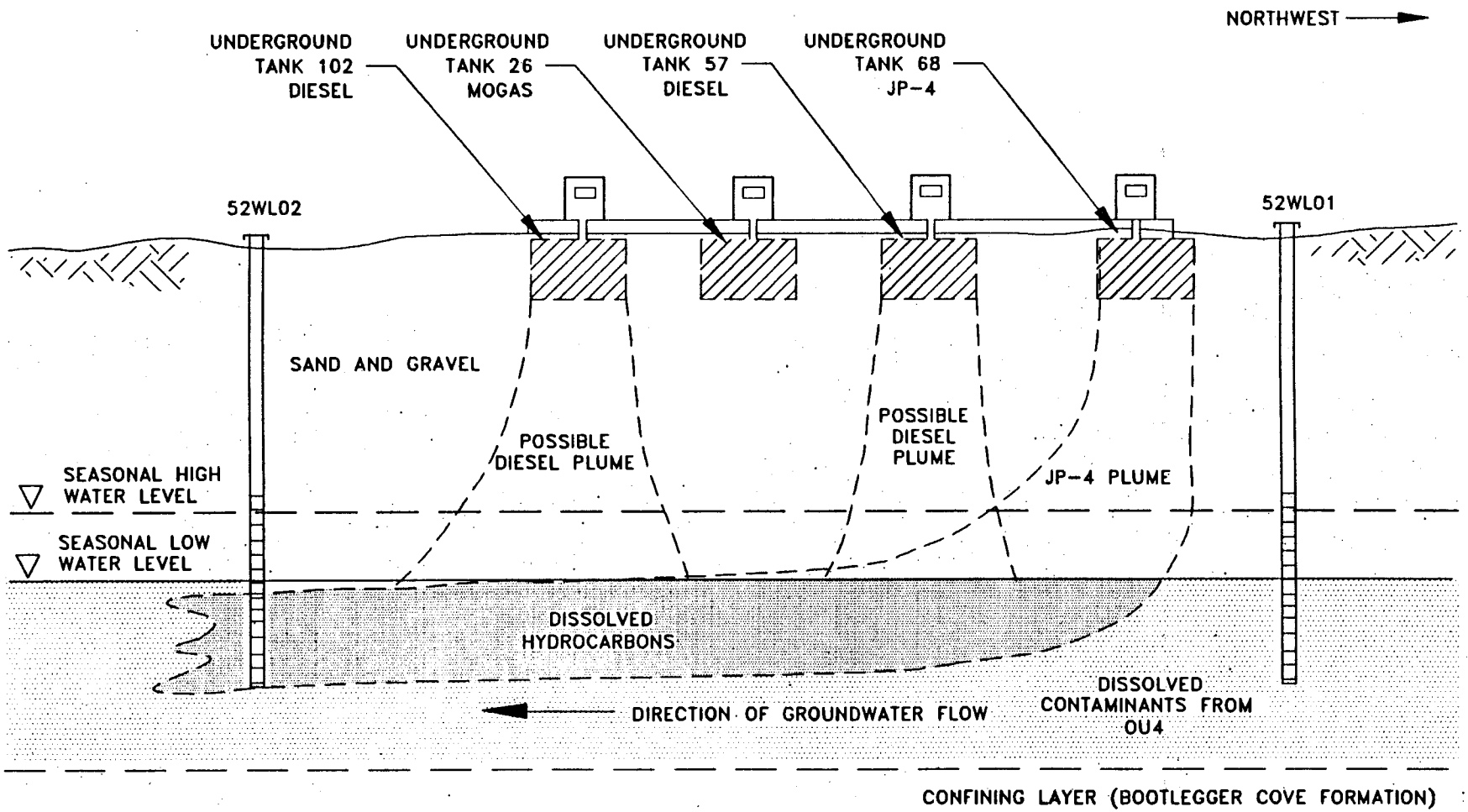
Boring Well No.	Depth (feet)	Sample Number	DRO (mg/kg)	GRO (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)	Other Compounds (mg/kg)
Soil Analyses									
52WL01	3.5	52WL01SO3.5N	3.8J	U	U	.033	U	.027	Lead - U
52WL01	28.5	52WL01SO28.5N	U	U	U	U	U	U	Lead - U
52WL02	15.5	52WL02SO15.5N	13	U	U	U	U	U	Lead - U
52WL02	16.0	52WL02SO16.0MS	U	U	U	U	U	U	Lead - U
52WL02	27.5	52WL02SO27.5N	11	15	U	U	.031	.4	Lead - U
52WL03	11.0	52WL03SO11N	5.3	U	U	U	U	U	Lead - U
52WL03	28.0	52WL03SO28N	3.4J	U	U	U	U	U	Lead - U
52BH01	18.0	52BH01SO18.0N	7	25	U	.28	.22	1.1	Lead - 7.1J
52BH01	18.5	52BH01SO0FD	180	680	U	8.7	6.2	27	Lead - U
52BH01	28.0	52BH01SO28.0N	460	1900	U	14	12	45	Lead - U
52BH02	26.0	52BH02SO26.0N	6	U	U	.035	.035	.2	Lead - U
52BH02	28.0	52BH02SO28.0N	1000	2700	3	50	20	110	Lead - U
52BH03	19.5	52BH03SO19.5N	240	260	U	.97	1.2	7.1	Lead - U
52BH03	19.0	52BH03SO0FD	390	570	U	4.4	3.6	25	Lead - U
52BH03	27.0	52BH01SO27.0N	100	420	U	5.9	3.7	19	Lead - U
52BH04	19.5	52BH04SO19.5N	200	510	U	.76	.76	12	Lead - U
52BH04	27.0	52BH04SO27.0N	44	24	.087	.34	.4	.67	Lead - U

Table 3.13-1. Summary Table, ST64 (Cont'd).

Well Number	Sample Number	DRO (µg/l)	GRO (µg/l)	B (µg/l)	T (µg/l)	E (µg/l)	X (µg/l)	Other Compunds (µg/l)
Water Analyses								
52WL01	52WL01WGN	140	50UJ	U	U	U	U	Lead - 82.9
52WL02	52WL02WGN	3,200	1900J	21	330	190	760	Lead - 33.1
52WL03	52WL03WGN	500	50UJ	7.9	2.6	2.6	1.6	Lead - 134

Key:
B = Benzene.
DRO = Diesel range organics.
E = Ethylbenzene.
GRO = Gasoline range organics.
J = Estimated.
T = Toluene.
U = Not detected at the method reporting limit.
UJ = Not detected above the method reporting limit; reported method reporting limit is an approximate value.
X = Total xylenes.

Note: See Appendix B for the method reporting limit for each analysis.



NOT TO SCALE

DRAWING: ST64CSM C/SC: 1:1 DATE: 11/12/93	DRAWN: ABB/SR DISK: 760/93 CHECK: CH	FIGURE 3.13-2 CONCEPTUAL SITE MODEL FOR SERA PHASE 1B SITE ST64	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-008-800

The site-specific groundwater flow direction and gradient were determined for site ST64. The condition of the groundwater both upgradient and downgradient of the UST locations has been satisfactorily characterized to determine if the suspected release(s) from the UST(s) have impacted the groundwater.

The objectives of the site characterization have been met.

3.13.5 Conclusions/Recommendations

3.13.5.1 Soil

Pursuant to 18 AAC 78 for UST sites, a matrix score of 41 was computed for site ST64. The matrix score sheet is presented in Table 3.13-2.

A matrix score of 41 requires Level A cleanup standards. The soil samples collected from the four borings have total BTEX, GRO, and DRO concentrations exceeding Level A cleanup standards. The soil samples collected from the well locations do not exceed the cleanup standards.

Gas chromatography traces obtained from the DRO analysis were interpreted to help identify and differentiate between refined petroleum product types (gasoline, diesel fuel, JP-4, JP-8, motor oil, etc.), biogenic hydrocarbons (waxy plant paraffins), or laboratory contamination origin.

High concentrations of hydrocarbons were reported in the GRO and DRO ranges from locations 52BH01 and 52BH02 at depths of 28 feet. Observation of the DRO chromatographic traces from these samples revealed matching characteristics of individual resolved peaks over a UCM in the approximated hydrocarbon range of n-C_6 through n-C_{16}. A specific homologous series of peaks representative of normal alkanes are observed between the approximated hydrocarbon range of n-C_9 through n-C_{16}. Chromatograms were interpreted by comparison to fuel standard chromatograms (gasoline, diesel fuel, JP-4, JP-8, motor oil) analyzed at the laboratory. Interpretation of these chromatograms indicates that the product exhibits the characteristics of a JP-4 fuel.

The high concentrations of hydrocarbon compounds in the soils around the tanks indicate that a release or releases have occurred. Both GRO and DRO were detected at high concentrations. The high concentrations may be attributed to a release from the JP-4 Tank (Tank 425B). The presence of elevated concentrations of DRO in the subsurface soils can also be related to a JP-4 release.

Table 3.13-2. Matrix Score Sheet for Site ST64.

1. Depth to Subsurface Water		
< 5 feet	(10)	10
5 - 15 feet	(8)	
15 - 25 feet	(6)	
25 - 50 feet	(4)	
> 50 feet	(1)	
2. Mean Annual Precipitation		
> 40 inches	(10)	
25 - 40 inches	(5)	
15 - 25 inches	(3)	3
< 15 inches	(1)	
3. Soil Type (Unified Soil Classification)		
Clean, coarse-grained soils	(10)	10
Coarse-grained soils with fines	(8)	
Fine-grained soils (low OC)	(3)	
Fine-grained soils (high OC)	(1)	
4. Potential Receptors		
Base Well 29, 2,000 feet upgradient		
Public well within 1,000 feet, or		
Private well(s) within 500 feet	(15)	
Municipal/private well within 1/2 mile	(12)	
Municipal/private well within 1 mile	(8)	8
No Known well within 1/2 mile	(6)	
No Known well within 1 mile	(4)	
Non-potable groundwater	(1)	
5. Volume of Contaminated Soil		
> 500 cubic yards	(10)	10
100 - 500 cubic yards	(8)	
25 - 100 cubic yards	(5)	
> De Minimus - 25 cubic yards	(2)	
De Minimus	(0)	
	Total	41

Matrix Score		Cleanup level in mg/kg			
		Diesel	Gasoline/Unknown		
		Diesel Range Petroleum Hydrocarbons	Gasoline Range Petroleum Hydrocarbons	Benzene	BTEX
Level A	>40	100	50	0.1	10
Level B	27-40	200	100	0.5	15
Level C	21-26	1,000	500	0.5	50
Level D	<20	2,000	1,000	0.5	100

3.13.5.2 Groundwater

The groundwater flow direction for site ST64 was determined using water table elevations from the basewide data. Groundwater is flowing to the southwest.

The concentration of lead in the groundwater samples collected from the three wells exceeds both State and Federal MCLs (0.015 µg/l). Benzene was detected in concentrations exceeding the State and Federal MCLs from wells 52WL02 and 52WL03. GRO was detected in the downgradient wells (52WL02 and 52WL01) indicating that the groundwater has been contaminated by a source between well 52WL01 and the downgradient wells. This source may be interpreted to be the JP-4 tank (Tank 425B). DRO was detected in groundwater samples collected from all three wells with the highest concentration (3,200 µg/l) detected in well 52WL02. Well 52WL01 had a DRO concentration of 140 µg/l, and well 52WL03 had a concentration of 500 µg/l. Upgradient or cross-gradient sources may be contributing to the concentration of DRO in the groundwater; however, the elevated concentrations detected from downgradient wells 52WL02 and 52WL03 suggests a release may have occurred from either diesel tank. Other sources of groundwater hydrocarbon contamination exist near ST64. OU4 is located east of the site and may be contributing to the high concentrations of lead and benzene in the groundwater.

3.13.6 Follow-up Actions

The USTs are out of service and should be closed/removed, and remedial systems should be considered if associated contamination cannot be removed at that time.

If soil contamination is encountered during removal of the USTs, it should be handled in accordance with ADEC regulations and guidance.

The groundwater requires remediation. The results of the OU-4 investigation should be reviewed prior to consideration of groundwater remediation at site ST64.

3.14 ST65, Diesel Leak (IRPIMS Site 51)

3.14.1 Introduction

ST65 is located on the south side of Oil Well Road and nearby Fire Station No. 3 (Building 24-857). The site is located in the vicinity of a fuel dispenser and one out-of-service, 500-gallon diesel UST (Tank No. 850). Figure 3.14 shows the site location and Figure 3.14-1 shows the area included in this investigation.

The UST at this site was identified as possibly leaking due to a positive result from a soil vapor survey leak test (Tracer 1991b).

Geotechnical borings drilled in 1984 by COE show that the subsurface material in the area is predominantly sand and gravel to a depth of over 40 feet.

3.14.2 Objectives

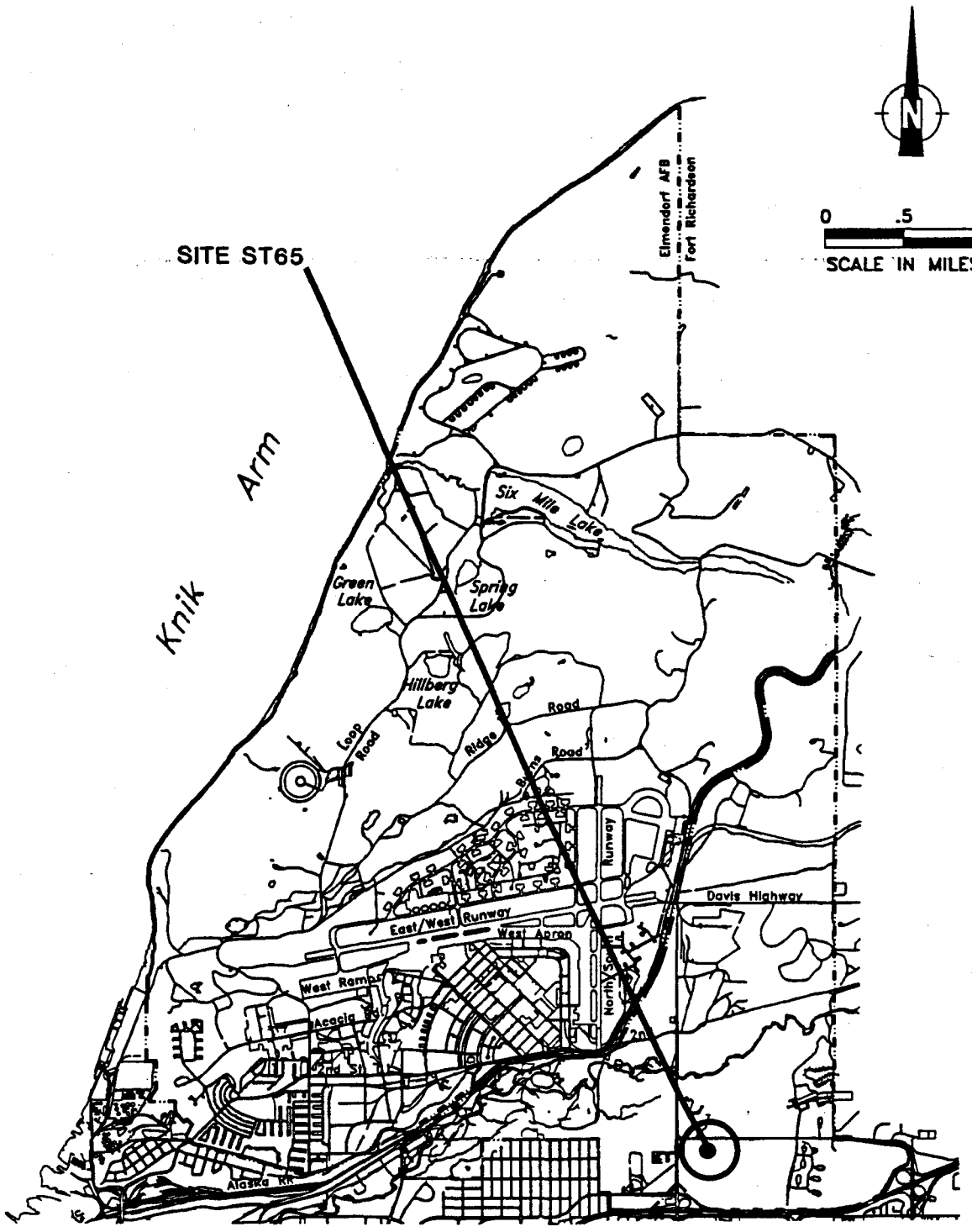
The objectives of the investigation at this site were to:

- Assess the horizontal and vertical extent of suspected diesel fuel contamination in the soil, and
- Evaluate if a leak in this UST has occurred and contributed to groundwater contamination.

3.14.3 Field Investigation

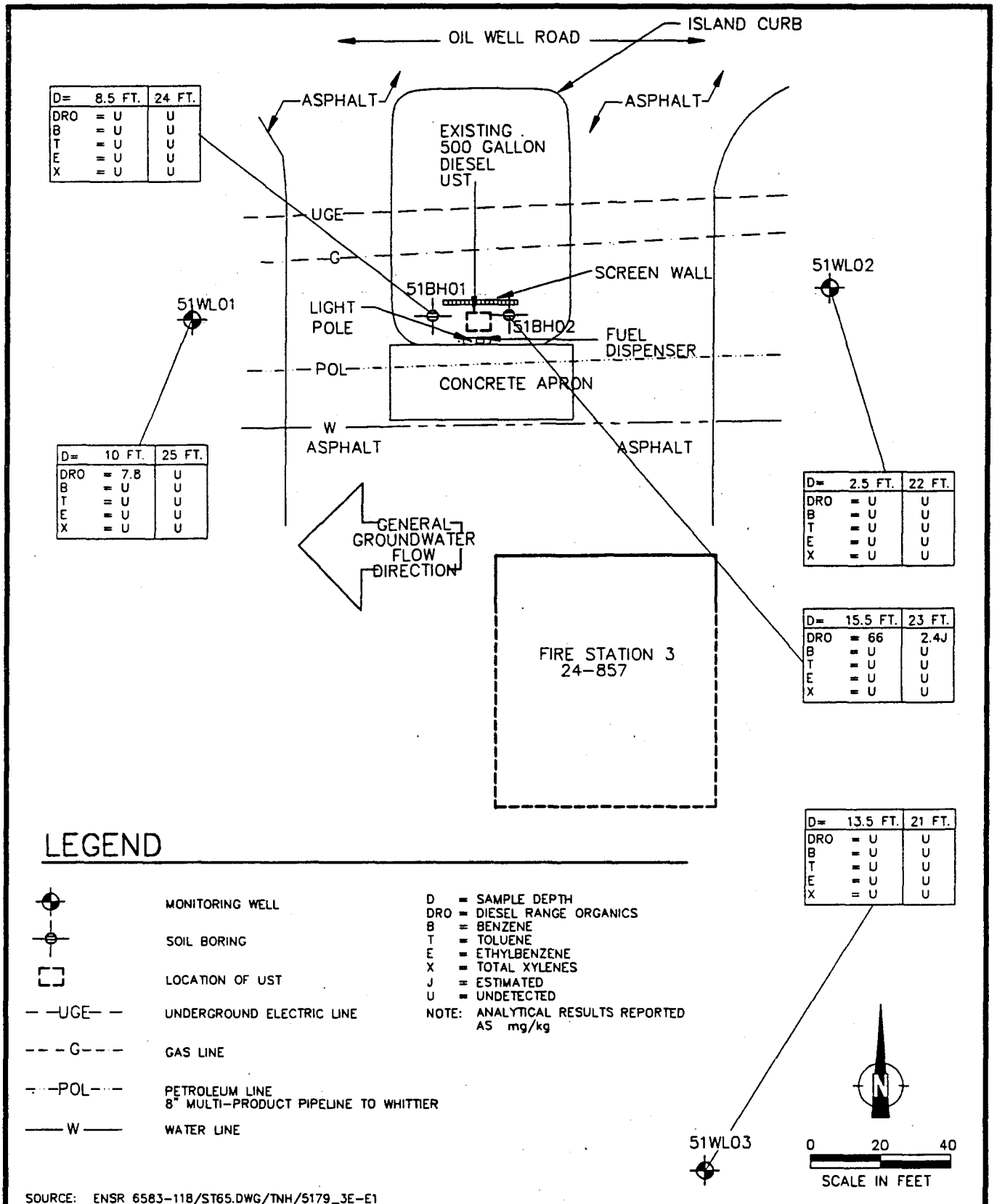
3.14.3.1 Soil Borings

A total of two soil borings were drilled and sampled at site ST65 (Figure 3.14-1). A third boring was planned to be drilled north of the tank; however, the presence of a wall, underground utility, and overhead electrical lines prevented access to this location. Borings were advanced to a depth of approximately 26.5 feet bgs where groundwater was encountered. Boring logs are presented in Appendix A. Soil samples were analyzed for DRO and BTEX.



Municipality of Anchorage

DRAWING: F3605 DRAWN: ABB/SR C/SC: 1:5500 DISK: NET9/93 DATE: 09/22/93 CHECK: D.G.	FIGURE 3.14 LOCATION MAP SITE ST65	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-008-800



SOURCE: ENSR 6583-118/ST65.DWG/TNH/5179_3E-E1

DRAWING: ST65MW	DRAWN: ABB/SR	FIGURE 3.14-1 SOIL BORING LOCATIONS AND ANALYTICAL RESULTS FOR SERA PHASE 1B SITE ST65
C/SC: 1:40	DISK: 752/93	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-008-800
DATE: 01/10/93	CHECK: C.H.	

3.14.3.2 Groundwater Monitoring Well Installation and Sample Collection

Three groundwater monitoring wells were installed at site ST65. Well 51WL01 was installed west of the tank location to a depth of 30 feet bgs. Well 51WL02 was installed east of the tank location to a depth of 30 feet bgs. Monitoring well 51WL03 was moved from the original location north of the tank to a location south of the fire station. The presence of overhead and underground utilities prevented access to the planned location. The well was drilled and sampled to a depth of 29.6 feet bgs. Groundwater monitoring well construction diagrams are included on the boring logs presented in Appendix A.

Groundwater monitoring wells were developed and sampled as described in Section 2.2.4. The samples were analyzed for DRO and BTEX. Results are shown on Figure 3.14-1A.

3.14.4 Results/Findings

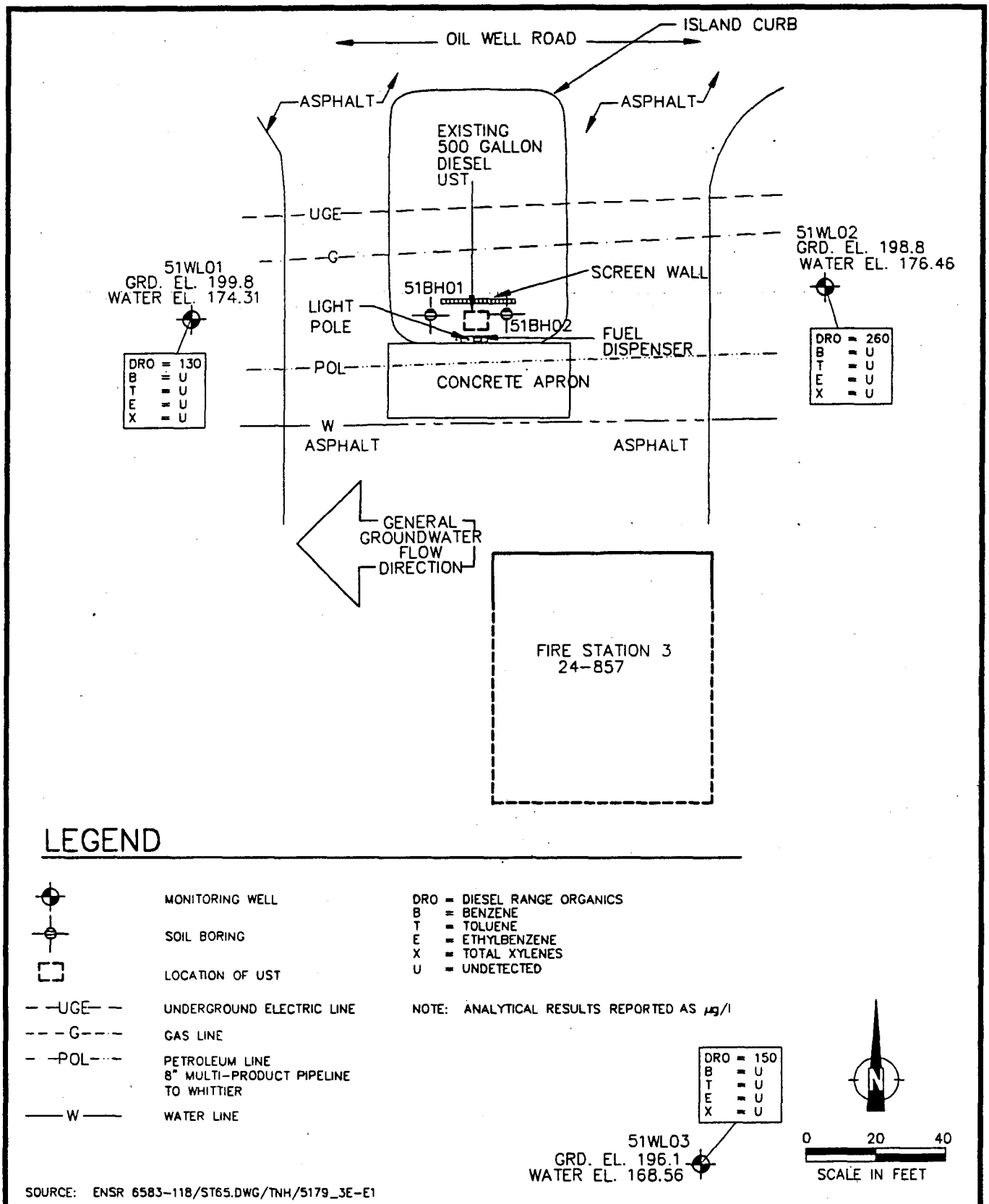
3.14.4.1 Field Observations

Prior to the commencement of drilling activities, the site was inspected for the presence of unmarked utilities, apparent surface staining, and present usage of the grounds surrounding the UST location. The following observations were noted:

- The UST is surrounded on the south, west, and east side by an asphalt driveway.
- Overhead utilities prohibited drill rig access to borings/wells north of the wall.
- An unmarked POL pipeline was located south of the UST location. Elmendorf Master Plan drawings indicate the POL pipeline to be an 8-inch, multi-product line that delivers fuels to Whittier. The pipeline is operated by Defense Fuels, which regularly reports line monitoring and testing results to ADEC.

The subsurface exploration encountered a tan silt with coal fragments extending from the surface to a depth of approximately 5 feet bgs. Mainly well-graded and poorly graded gravels were found below the silt layer.

Field PID readings on soil samples were used to help select the samples submitted for laboratory analysis. Field screening results are included on the boring logs presented in Appendix A. None of the soil samples had elevated PID readings.



SOURCE: ENSR 6583-118/ST65.DWG/TNH/5179_3E-E1

DRAWING: ST65MW2 DRAWN: ABB/SR C/SC: 1:40 DISK: 848/93 DATE: 01/11/93 CHECK: C.H.	FIGURE 3.14-1A MONITORING WELL LOCATIONS AND ANALYTICAL RESULTS FOR SERA PHASE 1B SITE ST65	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-008-800

033526

3.14.4.2 Analytical Results

The results of the laboratory analysis are presented in Appendix B and summarized on Figures 3.14-1 and 3.14-1A, and in Table 3.14-1. A concentration of 66 mg/kg of DRO was detected in the soil sample collected from 15.5 feet bgs from boring 51BH02, and a concentration of 2.4 mg/kg was detected in the 23-foot bgs sample. The soil sample collected from 10 feet bgs during drilling of well 51WL01 had a concentration of DRO of 7.8 mg/kg. None of the other samples had hydrocarbon concentrations exceeding method reporting limits.

BTEX compounds were not detected in the groundwater samples collected from the three monitoring wells on site. DRO was detected at trace concentrations in all of the groundwater samples.

3.14.4.3 Evaluation of Adequacy/Completeness

The soil borings were installed in close proximity to the UST location, and the extent of the impacted soils has been defined. The investigation sampled representative groundwater from locations both downgradient and cross-gradient from the tank location. The objectives of the site investigation have been met.

3.14.5 Conclusions/Recommendations

3.14.5.1 Soil

Pursuant to 18 AAC 78 requirements, a matrix score of 34 was computed for the subject site. The matrix score sheet for site ST65 is presented in Table 3.14.2.

A matrix score of 34 requires Level B cleanup standards. None of the soil samples had concentrations of the analytes exceeding cleanup levels.

3.14.5.2 Groundwater

The groundwater flow direction for site ST65 was determined using basewide data, which indicate flow to the west.

The groundwater samples collected from the three on-site wells had similar DRO concentrations (ranging from 130 to 260 µg/l).

Table 3.14-1. Summary Table, ST65

Boring/ Well No.	Depth (feet)	Sample Number	DRO (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)
Soil Analyses							
51WL01	10.0	51WL01SO10.0N	7.8	U	U	U	U
51WL01	25.0	51WL01SO25.0N	U	U	U	U	U
51WL02	2.5	51WL02SO2.5N	U	U	U	U	U
51WL02	22.0	51WL02SO22.0N	U	U	U	U	U
51WL03	13.5	51WL03SO13.5N	U	U	U	U	U
51WL03	21.0	51WL03SO21.0N	U	U	U	U	U
51BH01	8.5	51BH01SO8.5N	U	U	U	U	U
51BH01	24.0	51BH01SO24.0N	U	U	U	U	U
51BH02	15.5	51BH02SO15.5N	66	U	U	U	U
51BH02	23.0	51BH02SO23.0N	2.4J	U	U	U	U

Well Number	Sample Number	DRO (µg/l)	B (µg/l)	T (µg/l)	E (µg/l)	X (µg/l)
Water Analyses						
51WL01	51WL01WGN	130	U	U	U	U
51WL02	51WL02WGN	260	U	U	U	U
51WL03	51WL03WGN	150	U	U	U	U
51WL03	51WL0WGFD	130	NA	NA	NA	NA

Key: B = Benzene.
DRO = Diesel range organics.
E = Ethylbenzene.
J = Estimated.
NA = Not analyzed.
T = Toluene.
U = Not detected at the method reporting limit.
X = Total xylenes.

Note: See Appendix B for the method reporting limit for each analysis.

Table 3.14-2. Matrix Score Sheet for Site ST65.

1. Depth to Subsurface Water		
< 5 feet	(10)	
5 - 15 feet	(8)	
15 - 25 feet	(6)	
25 - 50 feet	(4)	4
> 50 feet	(1)	
2. Mean Annual Precipitation		
> 40 inches	(10)	
25 - 40 inches	(5)	
15 - 25 inches	(3)	3
< 15 inches	(1)	
3. Soil Type (Unified Soil Classification)		
Clean, coarse-grained soils	(10)	10
Coarse-grained soils with fines	(8)	
Fine-grained soils (low OC)	(3)	
Fine-grained soils (high OC)	(1)	
4. Potential Receptors		
Base Well 50, 1,000 feet downgradient		
Public well within 1,000 feet, or		
Private well(s) within 500 feet	(15)	15
Municipal/private well within 1/2 mile	(12)	
Municipal/private well within 1 mile	(8)	
No Known well within 1/2 mile	(6)	
No Known well within 1 mile	(4)	
Non-potable groundwater	(1)	
5. Volume of Contaminated Soil		
> 500 cubic yards	(10)	
100 - 500 cubic yards	(8)	
25 - 100 cubic yards	(5)	
> De Minimus - 25 cubic yards	(2)	2
De Minimus	(0)	
	Total	34

Matrix Score		Cleanup level in mg/kg			
		Diesel	Gasoline/Unknown		
		Diesel Range Petroleum Hydrocarbons	Gasoline Range Petroleum Hydrocarbons	Benzene	BTEX
Level A	>40	100	50	0.1	10
Level B	27-40	200	100	0.5	15
Level C	21-26	1,000	500	0.5	50
Level D	<20	2,000	1,000	0.5	100

3.14.6 Follow-up Actions

The results of this investigation indicate that subsurface soils in the vicinity of the UST do not contain concentrations exceeding ADEC cleanup levels and groundwater has not been affected. No further action is required.

The out-of-service UST should be closed out in accordance with 18 AAC 78. Groundwater data could be compared with other data from the area to improve the characterization of the general groundwater quality.

3.15 Site ST72, Leaking Tanks (IRPIMS Site 57)

3.15.1 Introduction

Site ST72 is the location of reported contaminated soils believed to have been caused by a leaking UST pipe (Pollution Incident Report, 18 April 1990). The site is on a hilltop north of Building 42-500 and south of Ridge Road (Figure 3.15). Two diesel USTs were removed from behind Building 42-500 in April 1990. The USTs are identified as No. 460 (USAF No. 5) and No. 507 in the Elmendorf STMP.

Building 42-500 has been occupied by the Civil Air Patrol (CAP) since in the mid-1970s, at which time both USTs were in use (D&M 1988). An unconfirmed 1982 USAF report indicated that the tanks were filled with gravel and abandoned in place.

In March 1990 while excavating for a new antenna tower, a contractor struck an underground pipe that connected the two USTs. Rusted pipelines were observed, and it was assumed that the piping had leaked prior to 1982. After a visual inspection, soil contamination was observed in the tank excavation, and construction was halted. The Elmendorf AFB Environmental Office and ADEC were notified of the leak.

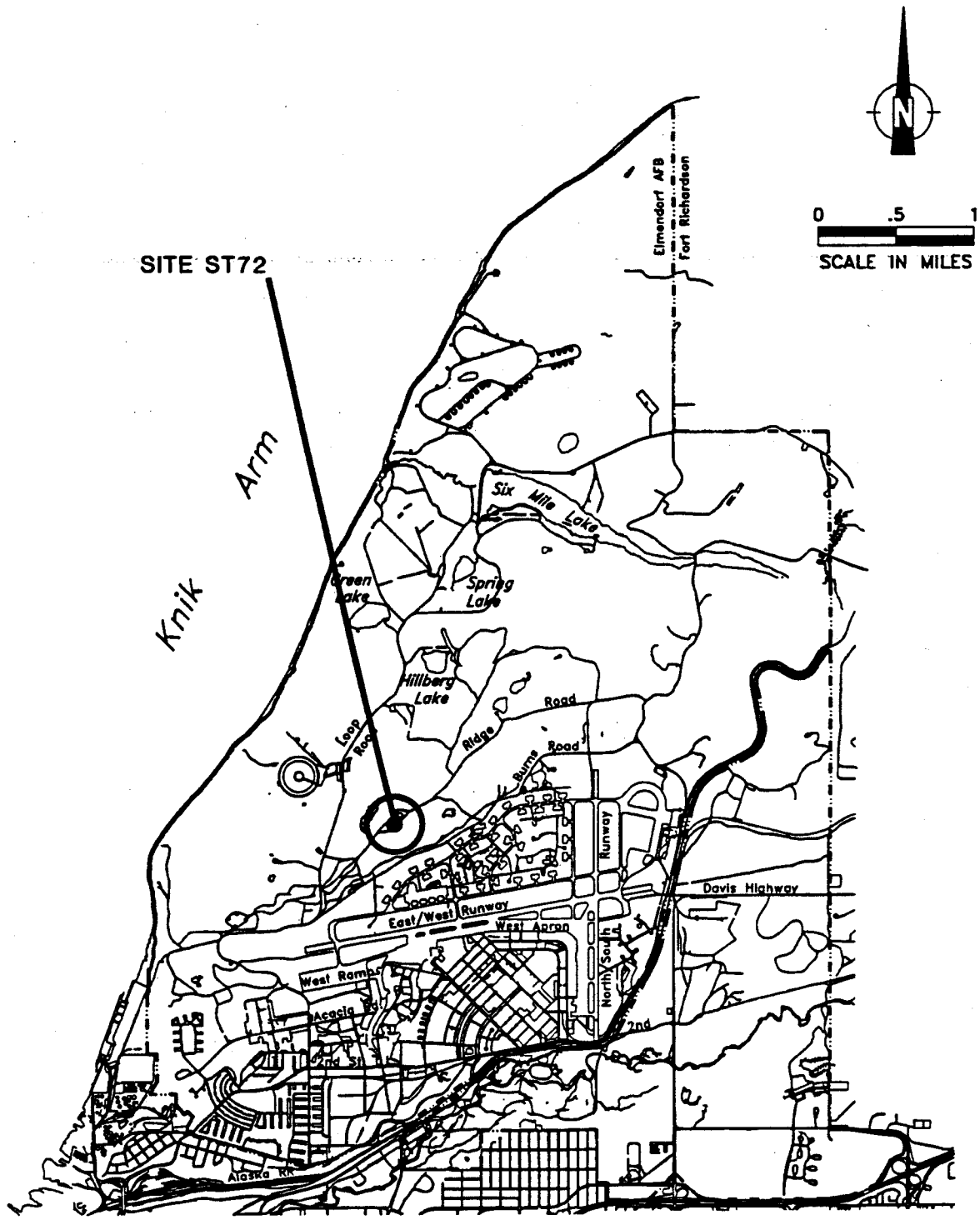
Leak tests were conducted on both USTs in March 1990, and the tanks were found to be leak-free (Pollution Incident Report, 18 April 1990). The UST underground piping was believed to be corroded. Further excavation and soil sampling revealed soil contamination extending below and lateral to the USTs.

Both USTs and approximately 300 cubic yards of contaminated soil (to a depth of over 14 feet bgs) were removed (Pollution Incident Report, 18 April 1990). ADEC approved the soil and tank removal, and backfilling of the excavation.

3.15.2 Objectives

The objectives of the ST72 site assessment were to:

- Incorporate existing data into a conceptual site model to assess potential cross-contamination from other contamination sources, and
- Assess the horizontal and vertical extent of contamination from the diesel tank leak.



DRAWING: F3605 DRAWN: ABB/SR C/SC: 1:5500 DISK: NET9/93 DATE: 09/22/93 CHECK: D.G.	FIGURE 3.15 LOCATION MAP SITE ST72	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-008-800

3.15.3 Field Investigation

The Alascom Communications tower has been built over the former UST locations, limiting the drill rig access. Six soil borings were advanced at the site. Three of the borings were converted to monitoring wells. Three soil borings were positioned in the closest accessible locations around the former tanks. Three monitoring wells were installed to assess water quality and evaluate if soil contamination contributes to groundwater degradation. The site plan with soil borings and monitoring well locations is presented in Figure 3.15-1.

3.15.3.1 Soil Borings

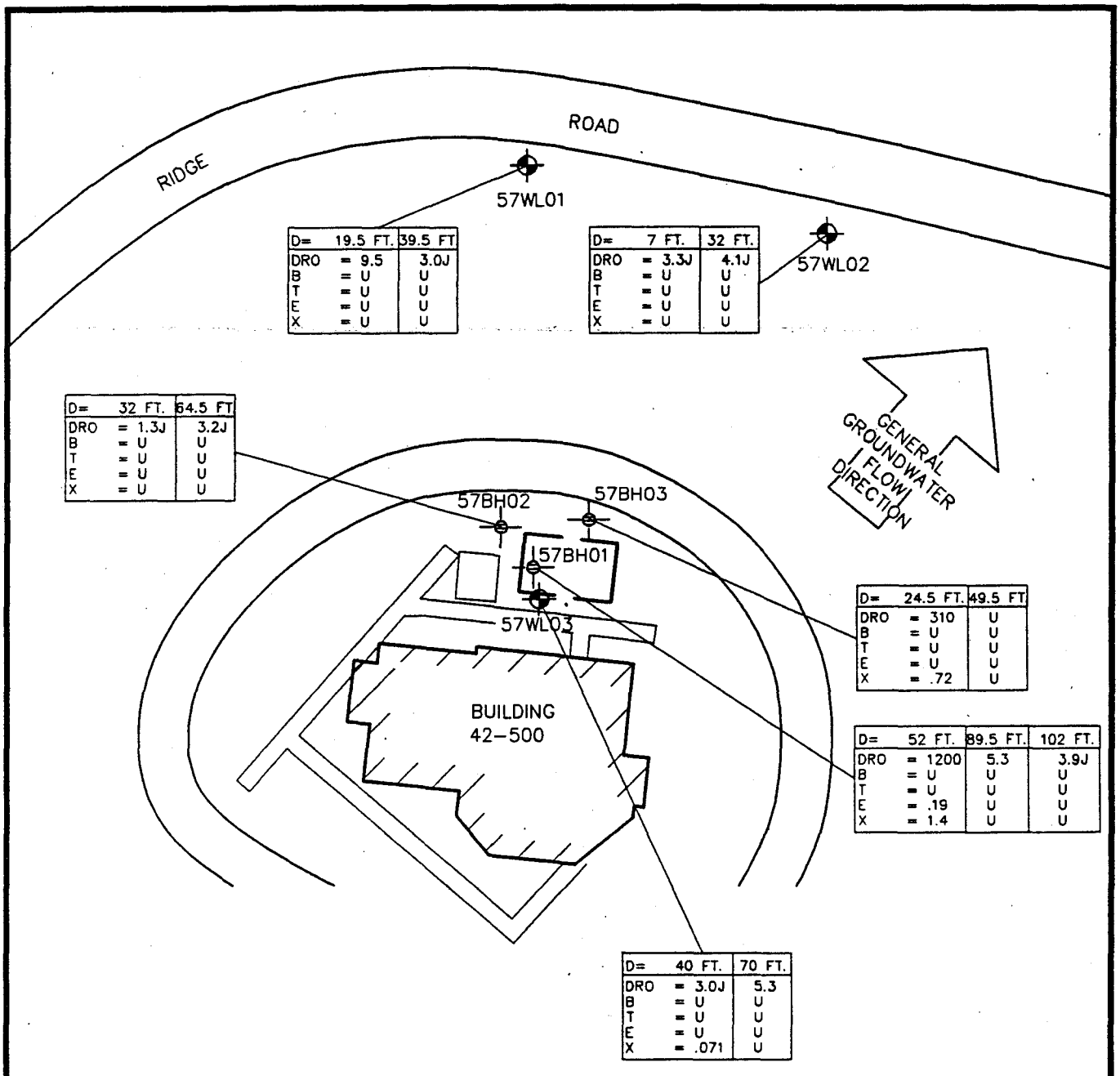
Three borings, advanced between 26 July and 2 August 1993, were positioned around a depressed area appearing to be the location of the former USTs. One boring, 57BH01, was placed in the center of the depressed area, and 57BH02 and 57BH03 were advanced on the northwest and northeast end of the former USTs. Borehole 57BH01 was advanced to 104.5 feet bgs before encountering saturated soils. Boring 57BH02 was located 15 feet northwest of 57BH01 and was terminated at 64.5 feet bgs at the saturated zone. A clayey, silty, sand layer observed during advancement in boring 57BH01 is a potential explanation for the water level discrepancy. Boring 57BH03 was advanced 10 feet beyond the bottom of potential contamination, above the saturated zone, based on visual inspection and PID recordings.

The soil samples were analyzed for DRO and BTEX. Two samples were analyzed from each boring, with the exception of 57BH01 where three samples were analyzed. The boring logs are presented in Appendix A.

3.15.3.2 Groundwater Monitoring Well Installation and Sample Collection

Three of the six soil borings advanced at site ST72 were converted to monitoring wells. Two samples from each boring were collected and analyzed for DRO and BTEX. Monitoring well 57WL03 was installed 30 July 1993, directly south of the former USTs in the expected upgradient direction. Monitoring wells 57WL01 and 57WL02 were installed 27 and 28 July 1993 in the projected downgradient area, north of the former tanks along Ridge Road (Figure 3.15-1). The boring logs and monitoring well construction diagrams are included in Appendix A.

The monitoring wells were developed and sampled as described in Section 2.2.4. The groundwater samples were analyzed for DRO and BTEX. Results are shown on Figure 3.15-1A.



LEGEND

MONITORING WELL

SOIL BORING

LOCATION OF FORMER UST

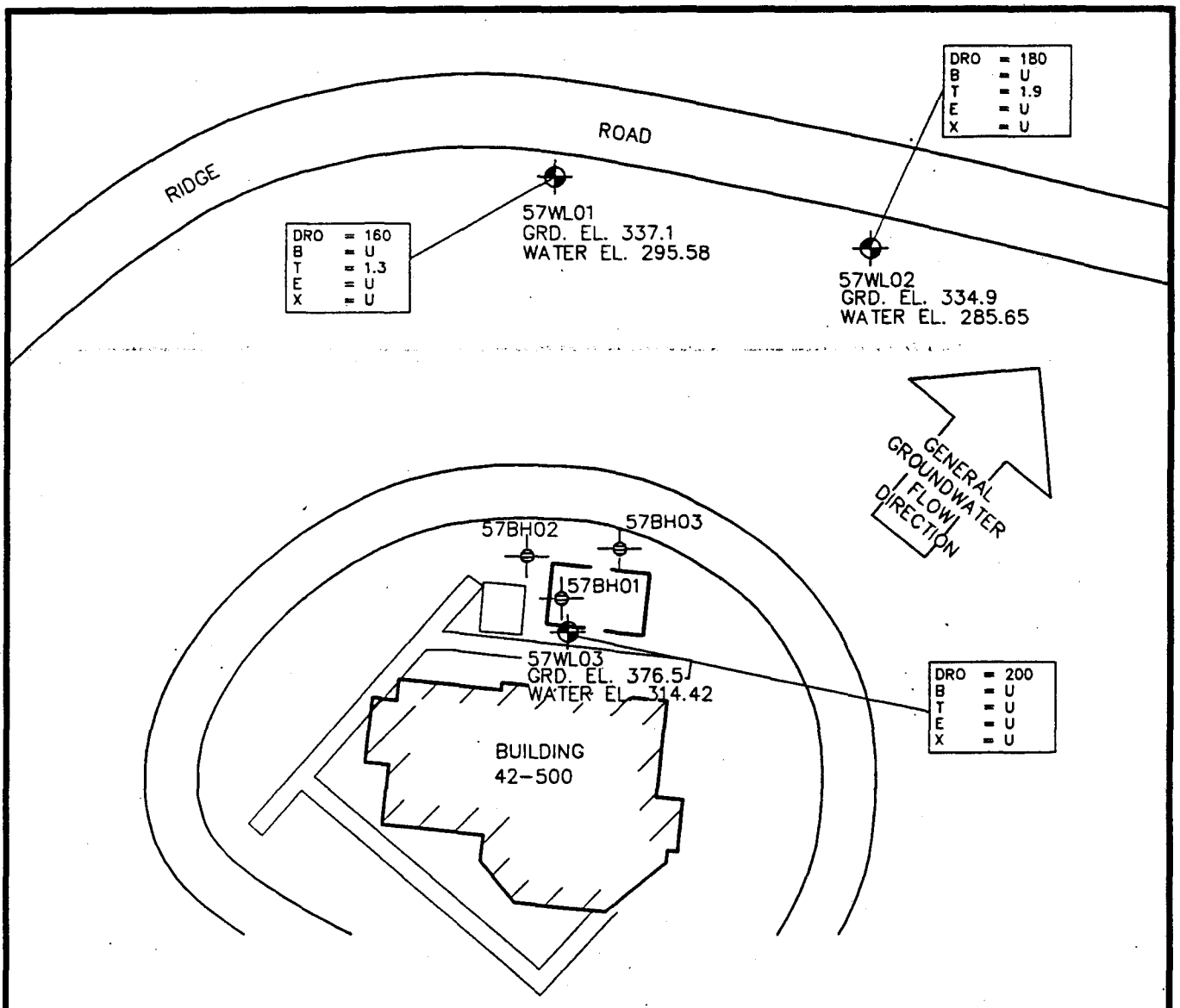
D = SAMPLE DEPTH
DRO = DIESEL RANGE ORGANICS
B = BENZENE
T = TOLUENE
E = ETHYLBENZENE
X = TOTAL XYLENES
J = ESTIMATED
U = UNDETECTED
NOTE: ANALYTICAL RESULTS REPORTED AS mg/kg

N

0 25 50
SCALE IN FEET

SOURCE: ENSR 6583-118/ST72.DWG/TNH/5179_3G

DRAWING: ST72MW	DRAWN: ABB/SR	FIGURE 3.15-1 SOIL BORING LOCATIONS AND ANALYTICAL RESULTS FOR SERA PHASE 1B SITE ST72
C/SC: 1:50	DISK: 752/93	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-008-800
DATE: 01/12/94	CHECK: C.H.	



LEGEND

- MONITORING WELL
- SOIL BORING
- LOCATION OF FORMER UST

DRO = DIESEL RANGE ORGANICS
GRO = GASOLINE RANGE ORGANICS
B = BENZENE
T = TOLUENE
E = ETHYLBENZENE
X = TOTAL XYLENES
U = UNDETECTED

NOTE: ANALYTICAL RESULTS REPORTED AS µg/l

N

0 25 50
SCALE IN FEET

SOURCE: ENSR 6583-118/ST72.DWG/TNH/5179_3G

DRAWING: ST72MW2 DRAWN: ABB/SR C/SC: 1:50 DISK: 837/94 DATE: 01/17/94 CHECK: C.H.	FIGURE 3.15-1A MONITORING WELL LOCATIONS AND ANALYTICAL RESULTS FOR SERA PHASE 1B SITE ST72	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-008-800

3.15.4 Results and Findings

3.15.4.1 Field Observations

Prior to the commencement of drilling activities, the site was inspected for the presence of unmarked utilities, apparent surface staining, and present usage of the surrounding area. The following observations were noted:

- Monitoring well 57WL03 and the three soil borings are located on a hilltop south of Ridge Road behind the CAP building. Several stored vehicles were parked in the area, and a slight stain was observed beneath the vehicles. No odor was detected.

- The two downgradient monitoring wells, 57WL01 and 57WL02, were installed along Ridge Road, topographically 35 to 40 feet below the soil borings and monitoring well 57WL03 locations. After clearing the brush along the roadside, a moderate hydrocarbon odor was detected. Visual inspection indicated that oil had possibly been sprayed along the road either during road construction or as dust abatement.

The lithology is predominantly silty sands to gravelly sands. Noted exceptions were observed in 57WLO2 and 57BH01, where clayey sands and clayey silty sands were encountered. A clayey or silty sand was noted directly above the saturated zone in 57WL02 and at 7 to 15 feet bgs in 57BH01. A clayey silty sand comparable to the lithology in 57WL02 was also encountered at 82 feet bgs in boring 57BH01. The clayey lithology was continuous in boring 57BH01 to the saturated zone at 104.5 feet bgs.

3.15.4.2 Analytical Results

The results of the laboratory analyses are summarized in Table 3.15-1 and presented in Appendix B.

Field records indicate elevated PID recordings for all soil samples obtained in boring 57BH01 to 70 feet bgs. Laboratory analysis of the sample collected at 52 feet bgs confirmed high concentrations of BTEX and DRO. Subsequent samples at 89.5 and 102 feet bgs did not detect BTEX above the method reporting limit, and DRO was detected at low concentrations at 89.5 feet bgs and at an amount not quantifiable at 102 feet bgs. BTEX compounds were not detected in boring 57BH02, and DRO was detected but not at an amount that can be quantified. Field PID recordings in boring 57BH03 detected hydrocarbons to 40 feet bgs. Laboratory analysis

Table 3.15-1. Summary Table, ST72.

Boring/ Well No.	Depth (feet)	Sample Number	DRO (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)
Soil Analyses							
57BH01	52.0	57BH01SO52.0N	1200	U	U	.19	1.4
57BH01	89.5	57BH01SO89.5N	5.3	U	U	U	U
57BH01	102.0	57BH01SO102.0N	3.9J	U	U	U	U
57BH02	32.0	57BH02SO32.0N	1.3J	U	U	U	U
57BH02	31.5	57BH02SO0FD	3.1J	U	U	U	U
57BH02	64.5	57BH02SO64.5N	3.2J	U	U	U	U
57BH03	24.5	57BH03SO24.5N	310	U	U	U	.72
57BH03	49.5	57BH03SO49.5N	U	U	U	U	U
57WL01	19.5	57WL01SO19.5N	9.5	U	U	U	U
57WL01	39.5	57WL01SO39.5N	3.0J	U	U	U	U
57WL02	7.0	57WL02SO7.0N	3.3J	U	U	U	U
57WL02	6.5	57WL02SO0FD	NA	U	U	U	U
57WL02	32.0	57WL02SO32.0N	4.1J	U	U	U	U
57WL03	40.0	57WL03SO40.0N	3.0J	U	U	U	.071
57WL03	70.0	57WL03SO70.0N	5.3	U	U	U	U

Well Number	Sample Number	DRO (µg/l)	B (µg/l)	T (µg/l)	E (µg/l)	X (µg/l)
Water Analyses						
57WL01	57WL01WGN	NA	U	1.4	U	U
57WL01	57WL01WGFD	160	U	1.3	U	U
57WL02	57WL02WGN	180	U	1.9	U	U
57WL03	57WL03WGN	200	U	U	U	U

Key: B = Benzene.
DRO = Diesel range organics.
E = Ethylbenzene.
J = Estimated.
NA = Not analyzed.
T = Toluene.
U = Not detected at the method reporting limit.
X = Total xylenes.

Note: See Appendix B for the method reporting limit for each analysis.

detected elevated levels of total xylenes and DRO at 24.5 feet bgs but did not detect these analytes at the specified method reporting limit at 49.5 feet bgs.

Field records also detected hydrocarbons in surface soils along Ridge Road in 57WLO1 and 57WL02. Laboratory analysis did not detect levels of BTEX above the method reporting limit in soil samples at both 57WLO1 and 57WLO2. Low concentrations of DRO were detected in 57WL01 and at an amount not quantifiable at 57WL02.

Both groundwater samples in the two downgradient wells contained low concentrations of toluene. DRO was detected in 57WL02 at 180 µg/l but not in the groundwater sample at 57WL01. Soil samples obtained during the advancement of 57WL03 at 40 and 70 feet bgs detected low concentrations of DRO and 71 µg/l BTEX at 40 feet bgs. Groundwater samples from 57WL03 had elevated concentrations of DRO, but BTEX was not detected at the method reporting limit.

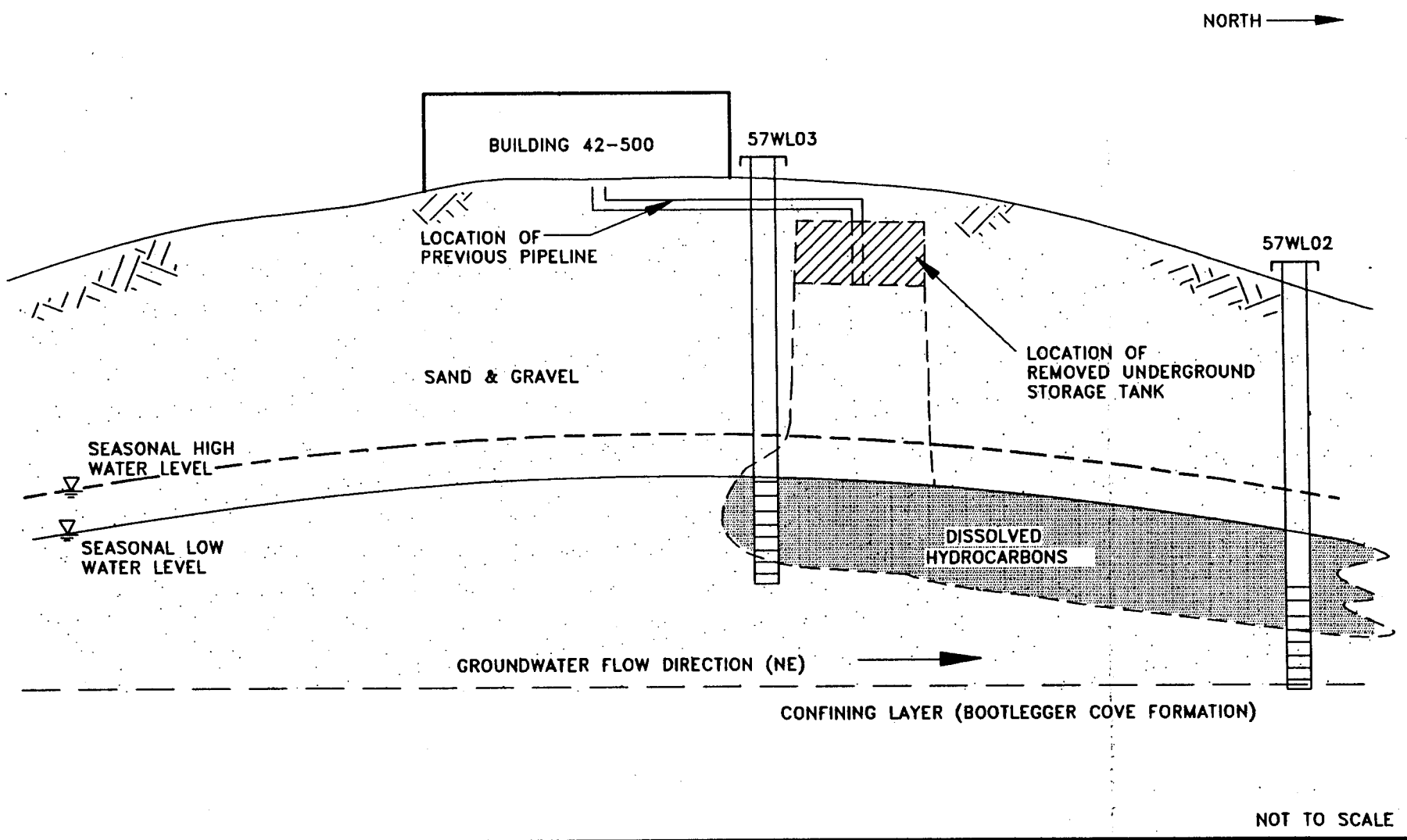
3.15.4.3 Conceptual Model

The conceptual model for ST72 is presented as Figure 3.15-2. Local groundwater flow direction was determined by three-point analysis using water table elevations recorded from the three installed monitoring wells. The groundwater flow direction is to the northeast. Diesel components were detected in soil samples and groundwater samples obtained in the vicinity of the former USTs. Diesel components and BTEX were also detected in groundwater from monitoring well 57WL02 in the downgradient flow direction and low concentrations of BTEX in well 57WL01.

3.15.4.4 Evaluation of Adequacy/Completeness

The soil samples obtained from the advancement of soil borings and installation of monitoring wells confirmed contamination of subsurface soils in the former UST area. The reported soil contamination surrounding the former diesel USTs is implicated as a source of groundwater contamination by the occurrence of DRO in the downgradient groundwater flow direction.

The maximum depth of contamination was indicated by field observations and PID recordings but was not verified by laboratory analysis. The lateral extent of contamination has not been defined to the south or east. The northwestern extent has been limited by analysis of soil samples below cleanup levels in boring 57BH02.



DRAWING: ST72CSM	DRAWN: ABB/SR	FIGURE 3.15-2 CONCEPTUAL SITE MODEL FOR SERA PHASE 1B SITE ST72
C/SC: 1:1	DISK: 756/93	3RD SPTG/CEVR ELMENDORF AFB, ALASKA PROJECT 9010-008-800
DATE: 11/10/93	CHECK: C.H.	

3.15.5 Conclusions and Recommendations

3.15.5.1 Soil

Pursuant to the requirements set forth in 18 AAC 75 for petroleum POL sites, a matrix score of 41 was computed for the site. The matrix score sheet for site ST72 is presented in Table 3.15-2.

A matrix score of 44 requires Level A cleanup standards. Soil samples from both monitoring wells along Ridge Road were below the Level A cleanup standards. The maximum confirmed depth of soil contamination in borings 57BH01 and 57BH03 is 52 and 24.5 feet bgs respectively, although elevated field recordings with the PID continued for 15 feet below the sample depth in both borings. Soil samples analyzed from boring 57BH02 were below the Level A cleanup standards.

3.15.5.2 Groundwater

Three-point analysis of the groundwater elevations indicated a local groundwater flow direction to the northeast. The local flow direction was determined using groundwater elevations recorded from wells 57WL01, 57WL02, and 57WL03.

The highest concentration of DRO was 200 µg/l in well 57WL03 near the former USTs. Monitoring well 57WL02 in the downgradient direction had a comparable groundwater concentration of DRO with 180 µg/l. Detectable levels of toluene were recorded from the groundwater samples collected from wells 57WL01 and 57WL02, but were below the listed MCL for toluene.

3.15.5.3 Follow-up Actions

Hydrocarbon contamination of soil and groundwater has been detected at site ST72. The former diesel USTs are implicated as the source. The areal extent of affected soil appears to be localized near the source. The relatively low and localized concentrations of DRO found in soil near the location of the former USTs may be suited to the application of a small-scale bioventing system for remediation of the soil.

Table 3.15-2. Matrix Score Sheet for Site ST72.

1. Depth to Subsurface Water		
< 5 feet	(10)	8
5 - 15 feet	(8)	
15 - 25 feet	(6)	
25 - 50 feet	(4)	
> 50 feet	(1)	
2. Mean Annual Precipitation		
> 40 inches	(10)	3
25 - 40 inches	(5)	
15 - 25 inches	(3)	
< 15 inches	(1)	
3. Soil Type (Unified Soil Classification)		
Clean, coarse-grained soils	(10)	8
Coarse-grained soils with fines	(8)	
Fine-grained soils (low OC)	(3)	
Fine-grained soils (high OC)	(1)	
4. Potential Receptors		
Base Well 29, 400 feet downgradient		15
Public well within 1,000 feet, or		
Private well(s) within 500 feet	(15)	
Municipal/private well within 1/2 mile	(12)	
Municipal/private well within 1 mile	(8)	
No Known well within 1/2 mile	(6)	
No Known well within 1 mile	(4)	
Non-potable groundwater	(1)	
5. Volume of Contaminated Soil		
> 500 cubic yards	(10)	10
100 - 500 cubic yards	(8)	
25 - 100 cubic yards	(5)	
> De Minimus - 25 cubic yards	(2)	
De Minimus	(0)	
	Total	44

Matrix Score		Cleanup level in mg/kg			
		Diesel	Gasoline/Unknown		
		Diesel Range Petroleum Hydrocarbons	Gasoline Range Petroleum Hydrocarbons	Benzene	BTEX
Level A	>40	100	50	0.1	10
Level B	27-40	200	100	0.5	15
Level C	21-26	1,000	500	0.5	50
Level D	<20	2,000	1,000	0.5	100

Soil type at the site appears to vary over short distances. The close proximity of sand and silty sand deposits at similar elevations has resulted in groundwater first being encountered at different elevations. The change in permeability between these soil types may also cause local variation in groundwater flow, although none was documented in this investigation. Groundwater contamination has been detected below the site and in the downgradient direction. Groundwater monitoring should continue to monitor changes in DRO and toluene concentration. Additional soil borings to the east, south, and northeast may better define the limits of soil contamination. An active sewer line and transformer shed limits the access to the west, and the communications tower limits access to the east.

4.0 ANALYTICAL PROGRAM

The overall project objective was to confirm the existence, nature, and extent of petroleum, oil, and lubricants (POL) contamination at the individual sites. To meet this project objective, the analytical program was developed to satisfy ADEC requirements for UST, non-UST, and solid waste site assessments and guidance (ADEC 1992). The analytical program was tailored for the analysis and characterizations of petroleum hydrocarbons, VOCs, PCBs, and metals.

Subcontract laboratories were selected based upon laboratory capabilities, adherence to a rigorous quality assurance/quality control (QA/QC) program, and participation in the ADEC petroleum hydrocarbon sample performance audit program. Each laboratory has additionally undergone a systems audit by ENSR Consulting and Engineering (ENSR) quality assurance staff and provided standard operating procedures (SOPs) for analysis.

Samples collected for the SERA 1A data collection activities were submitted to Analytical Technologies, Inc., (ATI) located in Renton, Washington.

Samples collected for the SERA 1B data collection activities were submitted to ETC Northwest Laboratory (ETC-NW) located in Redmond, Washington.

A Data Assessment Report is included as Appendix C to this report.

The Data Assessment Report summarizes and documents the data verification and validation procedures used for this project. The report includes discussion of specific project data that were qualified following the procedures and presents a compilation of all quality control sample results obtained for these investigations.

4.1 Analytical Methodology

The analytical methods for petroleum hydrocarbons were developed by a joint American Petroleum Institute (API) and U.S. Environmental Protection Agency (EPA) Hydrocarbon Work Group. These petroleum hydrocarbon characterization methods are based in part on EPA *Test Methods for Evaluating Solid Waste* (SW-846: 3rd Edition) methods 8000, 8015, and 8100. In March 1992, ADEC distributed these API/EPA consensus methods (1992) for use.

Gasoline Range Organics

The API/EPA *Method for the Determination of Gasoline Range Organics* (GRO: 5030/8015 modified) was used for an assessment of light-range hydrocarbons. The GRO method targets extractable organics between the defined hydrocarbon range of C_6 to C_{10} with a boiling point range between approximately 60° and 170°C.

This GRO method also permitted the assessment of the volatile aromatic compounds (GRO/BTEX: 5030/8020/8015 modified) of potential concern: benzene, toluene, ethylbenzene and xylenes (BTEX) by utilizing an in-series PID.

Diesel Range Organics

The API/EPA *Method for the Determination of Diesel Range Organics* (DRO: 3550/8100 modified) was used for an assessment of middle-range hydrocarbons. The DRO method targets extractable organics between the defined hydrocarbon range of C_{10} to C_{28} with a boiling point range between approximately 170° and 430°C.

Chromatography traces are obtained from the DRO analysis that can be interpreted to help identify product types (gasoline, diesel fuel, crude oil, etc.) throughout the petroleum hydrocarbon ranges as defined by State guidance (ADEC 1991a). The subjective interpretation of product, also referred to as its "fingerprint," may provide information as to the source from petrogenic crude oil or refined petroleum and biogenic origin. Also interpretation of products undergoing the natural processes of weathering and field/laboratory introduced contamination is possible.

The conventional hydrocarbon method, "Petroleum Hydrocarbons Total, Recoverable" (TPH: 418.1), utilizing infrared spectroscopy was additionally analyzed on selected samples.

Volatile Organic Compounds

Analysis of 35 target compound listed (TCL) VOCs was assessed by EPA SW-846 method 8240 or Contract Laboratory Program (CLP) protocols defined in *Statement of Work for Organic Analysis* OLM01.8 methodology (EPA 1990a). Both methods employ the gas chromatography mass spectroscopy (GC/MS) technique that can provide maximum confidence in the identification of compounds of potential concern and minimize the risk of error in qualitative identification.

Particular compounds of concern were the volatile aromatic compounds (BTEX) and halogenated volatile compounds (i.e., chlorinated solvents).

Low-level detection of VOCs in water was achieved by modifying the CLP protocols by increasing the volume of water sample to be analyzed by purge and trap extraction. This effectively lowered the quantitation or reporting limits to a value below the concentration of concern but above the analytical method detection limit (MDL).

Volatile aromatic compounds (BTEX) were also assessed by EPA SW-846 method 8020 in instances when the analysis would not be combined with the GRO analysis.

Metals

The eight regulated RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) were analyzed in selected samples by EPA SW-846 methodology (EPA 1987). Total metals were assessed by method 6010, an inductively coupled plasma spectroscopy (ICP) technique, and method 7000, a graphite furnace atomic absorption (GFAA) technique.

Polychlorinated Biphenyls

The presence of PCB in selected samples was assessed by EPA SW-846 method 8080, a gas chromatography technique.

4.2 Analytical Data Quality Assessment

The analytical laboratories (ATI and ETC-NW) were requested to submit detailed SOPs for the methods of analysis prior to receipt of project samples.

Included within these SOPs were the laboratory control limits for the data quality assessment samples of laboratory control samples, matrix spike samples, and system monitoring compounds (surrogate spikes). Laboratory results for data quality assessment samples were compared to these control limits during data validation procedures.

4.2.1 Detection Limits

The analytical laboratories were requested to submit MDL data prior to receipt of project samples to ensure that each laboratory's method reporting limits (MRL) met quantitation limit guidance as developed by State guidelines (ADEC 1992).

The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero (EPA 1984). A minimum of seven water samples are prepared, spiked with the targeted compounds of interest, and processed through the entire analytical method for the determination of MDL.

Soil detection limits are matrix dependent. Estimates of MDLs in soils were based on the corresponding MDL in aqueous matrices adjusted for the mass of sample (dry weight) and the volume of extract solvent used in each analysis.

The MRLs that are established between two to five times the MDLs meet quantitation limit guidance as developed by State guidelines (ADEC 1992).

4.2.2 Laboratory Quality Control Samples

Results for laboratory quality control samples are used within the laboratory to monitor sample preparation and analytical instrument control. Out-of-control instances may initiate corrective action such as the reanalysis of affected samples within an analytical batch.

Method (Reagent) Blanks

The method (reagent) blank is used to monitor laboratory contamination. A sample of laboratory-grade Ottawa sand representative of soil matrix and laboratory reagent water for water matrix were treated with all the reagents and in the same manner as the samples (i.e., digested, extracted, distilled). The method blank must contain less than the MRL for the compounds of interest or all sample processing will be halted until corrective measures are taken and documented. A minimum of one method blank was prepared and analyzed every day for each batch of 20 samples processed.

Matrix Spike Samples

Project bias or accuracy was assessed by preparing and analyzing matrix spikes samples. Matrix spikes samples were prepared by fortifying a project sample with known quantities of the targeted compounds at concentrations within the range of concentrations expected in the sample. This fortified sample was analyzed along with an unfortified sample, and percent recovery of the compounds within the representative project sample matrix was assessed.

Matrix spikes samples prepared in the laboratory were analyzed for one out of every 20 project samples submitted or a minimum frequency of 5 percent.

System Monitoring Compounds

System monitoring compounds, also referred to as surrogate spikes, were used to fortify all samples (duplicates and matrix spike samples), method blanks, and laboratory control samples prior to sample preparation and analysis for GRO, BTEX, DRO, VOC, and PCB analysis. The surrogate recovery, expressed as a percent recovery, was calculated and compared to method or laboratory-generated established control limits.

Recovery values of surrogate spikes were not determined when project samples required dilution. The dilutions are necessary for correct sample quantitation within the established standard calibration range of the instrument. As a consequence, the surrogates are diluted as well, and the resulting surrogate concentrations are too low for accurate determination of recoveries. No further corrective action at the laboratory is warranted.

Laboratory Control Samples

Laboratory control samples were an internal quality control check applied by the laboratory for the petroleum hydrocarbon, GRO, DRO, and BTEX analyses. Project bias or accuracy was assessed by preparing and analyzing duplicate laboratory control samples (LCS). LCS were prepared by fortifying a method blank in the laboratory with known quantities of the targeted compounds of interest at concentrations within the range of concentrations expected in the sample. This fortified aliquot is then analyzed, and the percent recovery was calculated. Duplicate laboratory control samples were prepared and analyzed for 2 out of every batch of 20 samples submitted or a minimum frequency of 10 percent.

4.2.3 Field Quality Control Samples

Field Duplicates

Field duplicates were included in the analytical scheme for an indication of overall measurement variability. This includes variability due to sample matrix differences, sampling, and the analytical measurement system. Field duplicate samples were two samples collected from the same location, stored in separate containers, and analyzed independently.

Field duplicates were collected at a frequency of 10 percent for samples collected for this project. These samples were intentionally submitted blind to the laboratory to mask their identity as field duplicates. Field duplicate results are identified and designated with "FD" as the last two characters in the field-sample tracking number.

Blanks

Trip blanks consisting of laboratory-distilled water were included into the analytical scheme for the VOC and BTEX water analyses. The trip blanks, which accompanied the empty sample containers from their origin through sampling activities, are incorporated to indicate any contaminants present in the air as well as any introduced through sample container handling. Trip blanks are handled, packaged, shipped, and analyzed in the same manner as all other samples. Trip blank results are identified and designated with "TB" as the last two characters in the field-sample tracking number. No trip blanks were included for soil data collection activities.

Trace levels of methylene chloride were detected in trip blanks and associated laboratory method blanks. Considered a common laboratory contaminant due to its use as an extraction solvent and presence in the laboratory atmosphere, a multiplication factor of 10 (EPA 1991) is applied to results before a real presence is suspected. Methylene chloride reported at less than 10 µg/l is considered contribution from laboratory contamination.

Field blanks (equipment rinsate blanks) were included in the analytical scheme for VOC analysis to assess the efficiency of decontamination procedures used in the field for the water sampling program. Since disposable bailers were incorporated for the water sampling, no actual decontamination procedures on sample bailers between wells were employed. Distilled water that was taken to the site was poured into a disposable bailer and then decanted into sample containers for VOC analysis. A trace level of toluene was reported at 1 µg/l. Field blank results are identified and designated with "FB" as the last two characters in the field-sample tracking number.

4.3 Data Verification Procedures

Data verification procedures were performed to ensure the competency of the reported results. A complete cross-checking of laboratory identification numbers with ENSR identification numbers was performed to ensure that analysis had been performed as specified by the chain-of-custody documentation. Missing information regarding samples or any quality control procedures were noted. The identified discrepancies from data verification procedures were corrected through requested correspondence with the laboratory.

Each laboratory additionally supplied the analytical results on electronic media to permit a transfer to working spreadsheets and generation of report tables. Data verification procedures were performed on the spreadsheets by comparing the values to the hardcopy analytical results supplied.

4.4 Data Validation Procedures

Data validation procedures were performed for a systematic and independent verification to determine method compliance and assess data quality.

Validation was performed from the laboratory sample result sheets, summary quality control sheets, available raw data, and electronic data diskette deliverables. Quality control sample results of method blanks, surrogate spike recovery, laboratory control sample, matrix spike, and matrix spike duplicate analyses were reviewed. An evaluation of samples meeting method-recommended holding times were calculated.

Electronic data diskette deliverables in an EPA standard "format A" were produced for the VOC and metals analyses. The format of the electronic deliverables is specified by EPA CLP Statement of Work Methods for Organics (EPA 1990a) and Inorganics (EPA 1990b) analysis. Electronic data were processed with ENSR's Automated Data Validation (ADV) System software for generation of quality control summary reports and trend analysis. Particular reports are designed to show samples/results affected by specific technical data review criteria specified in the EPA CLP National Functional Guidelines for Data Review (EPA 1988, 1991). Data in reports are optimized for assignment of data review qualifiers.

Data validation for the petroleum hydrocarbon analysis followed procedures in a Department of Energy Hazardous Waste Remedial Action Program document (DOE 1990).

Qualifier flags were inserted on data tables (Appendix B) for data affected by quality control sample results or exceeded holding times as identified during the review and validation process.

All qualifier codes used in this report are defined as;

U The analyte was analyzed for, but was not detected above the reported MRL.

Note: The associated numerical value indicates the approximate concentration necessary to detect the analyte in this sample.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

Note 1: Data qualified as "J" (estimated) are acceptable and usable for many purposes, but a greater degree of uncertainty is associated with these values than unqualified data.

Note 2: DRO data results qualified with "J" indicate an estimated value reported at less than the MRL and above the laboratory MDL.

Note 3: May indicate holding times were exceeded.

UJ The analyte was not detected above the reported sample MRL. However, the reported MRL is approximate and the associated numerical value may not accurately or precisely represent the concentration necessary to detect the analyte in this sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

D Compounds identified in analysis at a secondary dilution factor.

B Analyte found in associated blank as well as sample.

5.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC). 1988. RCRA Facility Assessment Report. August 1988, p. 25.

_____. 1991a. *Interim Guidance for Non-UST Contaminated Soil Cleanup Levels.* Guidance Number 001; Revision Number 1. ADEC, Juneau, Alaska

_____. 1991b. *Guidance for Storage, Remediation, and Disposal of Non-UST Petroleum-Contaminated Soils*. July 29, 1991.

_____. 1991c . *Guidance Manual for Underground Storage Tank Regulations 18 AAC 78.*

_____. 1992. Standard Quality Assurance Program Plan for Underground Storage Tank Systems Regulated by 18 AAC 78. Draft 2. March 26.

Alaska Department of Environmental Conservation and the United States Air Force. 1992. *State-Elmendorf Environmental Restoration Agreement.* U.S. Department of Defense, Elmendorf AFB, Anchorage, Alaska. October 1, 1992.

American Petroleum Institute/U.S. Environmental Protection Agency (API/EPA). 1992. Hydrocarbon Workgroup Consensus Methods. *"Method for the Determination of Diesel Range Organics," Revision 2, dated 2/5/92,* ENSECO/Rocky Mountain Analytical Laboratory, Denver, Colorado.

Battelle. 1991. *Elmendorf Air Force Base, Alaska, Installation Restoration Program, Site Summary, Volume 2 of 2.* Prepared for United States Air Force under Contract DE-AC06-76RLO 1830. October 1991.

Black and Veatch (B&V). 1990. *Installation Restoration Program, Stage 3, Remedial Investigation/Feasibility Study, Elmendorf AFB, Alaska, Vols. 1 through 6.* Prepared for Headquarters Alaskan Air Command, Elmendorf AFB, Alaska.

Bonazountas, M. and J. Wagner. 1984. *SESOIL: A Seasonal Soil Compartment Model.* Designed for the U.S. Environmental Protection Agency, Office of Toxic Substances, Washington, D.C. EPA Contract No. 68-01-6271. Arthur D. Little, Inc., Cambridge, MA.

CH_2M Hill. 1991. *Elmendorf Restoration Program, Site Summary.* Prepared for U.S. Air Force, 21 CSG/DEEV, Elmendorf AFB, Alaska.

_____. 1993. *Elmendorf AFB, Environmental Restoration Program, Basewide Background Sampling Report.* Prepared for 3rd STDG/DEVR, Elmendorf AFB, Alaska.

Dames and Moore (D&M). 1986. *Installation Restoration Program, Phase II, Confirmation/ Quantification, Stage 1, Elmendorf AFB, Alaska.* Prepared for Alaskan Air Command, Elmendorf AFB, Alaska

_____. 1988. *Installation Restoration Program, Phase II, Confirmation/Quantification, Stage 2, Elmendorf AFB, Alaska.* Final Report prepared for Alaskan Air Command, Elmendorf AFB, Alaska, and Battelle EMO, Richland, Washington.

DOWL Engineers Inc (DOWL). 1991. *Site Assessment Report, Underground Storage Tank Closure Program for Elmendorf AFB Service Station, Elmendorf AFB, Alaska.* Prepared for Army and Air Force Exchange Service, Dallas, Texas.

Eagleson, P.S. 1978. "Climate, soil, and vegetation, 1, introduction to water balance dynamics." *Water Resour. Res.* 14(5): 705-712. Paper 8W0184.

Engineering-Science (ES). 1983. *Installation Restoration Program, Phase I Records Search, Elmendorf AFB, Alaska.* Prepared for U.S. Air Force, AFESC/DEV, Tyndall AFB, Florida; and Alaskan Air Command, Elmendorf AFB, Alaska.

Harding Lawson Associates (HLA). 1988. *Installation Restoration Program, Integrated Remedial Investigation/Feasibility Study, Work Plan for Elmendorf AFB, Alaska.* Prepared for Alaskan Air Command, Elmendorf AFB, Alaska.

Jacobs Engineering Inc. 1992. *Operable Unit 1 Management Plan.* Elmendorf AFB, Alaska. Prepared for 3rd Wing/Environmental Management, Elmendorf AFB, Alaska, in association with Harding Lawson Associates.

James Montgomery Consulting Engineer, Inc. (JMCE) and Harza Environmental Services Inc. (HES). 1988. *Elmendorf AFB Restoration Project, Remedial Investigation: Field Activities and Data Analysis. Vols. I and II.*

National Oceanic and Atmospheric Administration (NOAA). 1985. *Climate of the States*. Vol. 1. Alabama - New Mexico. Detroit: Gale Research Co.

Radian Corporation. 1993. *Technical Memorandum-16 February 1993, Well Sampling at OU4.* Prepared for AFCEE/ESR Brooks AFB, Texas.

Tracer Research Corporation. 1991a. Tracer Tight™ Test of Four Underground Storage Tanks at Elmendorf AFB, Alaska, April 25, 1991. Prepared for VRCA Environmental Services, Fairbanks, Alaska.

_____. 1991b. Tracer Tight™ Test of One Underground Storage Tanks at Facility 24857, Elmendorf AFB, Alaska, January 30, 1991. Prepared for VRCA Environmental Services, Fairbanks, Alaska.

_____. 1991c. Tracer Tight™ Test of One Underground Storage Tanks at Facility 62255, Elmendorf AFB, Alaska, January 28, 1991. Prepared for VRCA Environmental Services, Fairbanks, Alaska.

U.S. Army Corps of Engineers (COE). 1991a. "Summary of Fieldwork and Chemical Data Report, Classic Owl, Elmendorf AFB, Alaska" Memorandum for COE North Pacific Division, Alaska Region, Engineering Office, Management Branch, Air Force Section, to COE North Pacific Division, Alaska Region, Engineering Office, Geotechnical Branch, Material Section. May 15, 1991.

_____. 1991b. "Summary of Fieldwork and Chemical Data Report from September 1991 Sampling Effort, Classic Owl, Elmendorf AFB, Alaska." Memorandum from COE North Pacific Division, Alaska Region, Engineering Office, Management Branch, Air Force Section, to COE North Pacific Division, Alaska Region, Engineering Office, Geotechnical Branch, Materials Section. November 12, 1992.

U.S. Air Force (USAF). 1992a. *Elmendorf AFB, Alaska, Environmental Restoration Program, Final Operable Unit 4 Limited Field Investigation.* November 1992, Elmendorf AFB, Alaska.

_____. 1992b. *Environmental Restoration Project, Management Action Plan, Final, Revision 0, December 1992*. Elmendorf AFB, Alaska.

_____. 1992c. *Environmental Restoration Program, Basewide Background Sampling Report.* December 1992. Elmendorf AFB, Alaska.

_____. 1993a. *Basewide Background Sampling Report.* January 1993, Elmendorf AFB, Alaska

_____. 1993b. *Environmental Restoration Program, Management Plan Operable Unit 4.* February 1993, Elmendorf AFB, Alaska.

_____. 1993c. *Basewide Monthly Water Level Data Package, January 1993.* February 1993, Elmendorf AFB, Alaska.

_____. 1993d. *Basewide Environmental Staging Facility Operation and Maintenance Plan, Final.* March 1993, Elmendorf AFB, Alaska.

_____. 1993e. *SERA Phase 1A Site Assessment Work Plans, DRAFT.* Environmental Compliance Program. U.S. Air Force, Elmendorf AFB, Alaska. Prepared by ENSR Consulting and Engineering (ENSR). March 22, 1993.

_____. 1993f. *SERA Phase 1B Site Assessment Work Plans, FINAL.* Environmental Compliance Program. U.S. Air Force, Elmendorf AFB, Alaska. Prepared by ENSR Consulting and Engineering (ENSR). July 16, 1993.

_____. 1993. SERA Phase 1B Site Assessment.

U.S. Department of Energy (DOE). 1990. Requirements for Quality Control of Analytical Data, Document No. DOW/HWP-65/R1, Rev. No. 1,

U.S. Environmental Protection Agency (EPA). 1987. SW-846 Test Methods for Evaluating Solid Waste, 3rd Edition, Revision 1.

_____. 1984. 40 CFR Part 136, Federal Register, Appendix B--"Determination and Procedure for the Determination of the Method Detection Limit--Revision 1.11.

_____. 1988. "Laboratory Data Validation: Functional Guidelines for Evaluating Inorganics Analysis. Office of Emergency and Remedial Response.

_____. 1990a. "Contract Laboratory Program Statement of Work for Organic Analysis: Multi-Media, Multi-Concentration. Document No. OLM01.0. Office of Emergency and Remedial Response.

_____. 1990b. "Contract Laboratory Program Statement of Work for Inorganic Analysis: Multi-Media, Multi-Concentration. Document No. ILM01.0. Office of Emergency and Remedial Response.

_____. 1991. "National Functional Guidelines for Organic Data Review. Office of Emergency and Remedial Response.

U.S. Geological Survey (USGS). 1993. Groundwater Site Inventory (GWSI) database system. Water Resources Division, Anchorage Field Office.