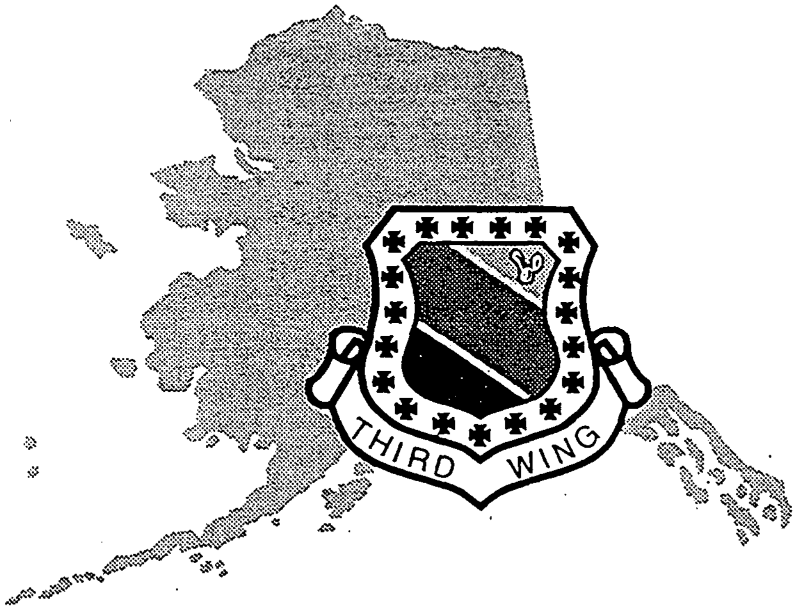
PB95-964603
EPA/ROD/R10-95/108
March 1995

EPA Superfund Record of Decision:

Elmendorf Air Force Base (O.U. 5), Greater Anchorage Borough, AK 12/28/1994



UNITED STATES AIR FORCE
ELMENDORF AIR FORCE BASE, ALASKA

ENVIRONMENTAL RESTORATION PROGRAM

RECORD OF DECISION
OPERABLE UNIT 5

FEBRUARY 1995

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF TABLES

ACRONYM LIST

AAC	=	Alaska Administrative Code
ACM	=	Alaska Cleanup Matrix for non-Underground Storage Tank soil
ADEC	=	Alaska Department of Environmental Conservation
AFB	=	Air Force Base
ARARs	=	Applicable or Relevant and Appropriate Requirements
ASWQ	=	Alaska Surface Water Quality standards
BESG	=	Elmendorf Bioenvironmental Engineering Services Group
BTEX	=	Benzene, Toluene, Ethylbenzene, and Xylene
CERCLA	=	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	=	Code of Federal Regulations
COC	=	Contaminant of Concern
COE	=	Corps of Engineers
CPF	=	Cancer Potency Factor
CSF	=	Cancer Slope Factor
ELCR	=	Excess Lifetime Cancer Risks
ERA	=	Environmental Risk Assessment
FFA	=	Federal Facilities Agreement
FS	=	Feasibility Study
GMR	=	Groundwater Modeling Report
HI	=	Hazard Index
HRA	=	Health Risk Assessment
IRIS	=	Integrated Risk Information System
IRP	=	Installation Restoration Program
MCC	=	Maximum Contaminant Concentration
MCL	=	Maximum Contaminant Level
MCLG	=	Maximum Contaminant Level Goal
mg/kg	=	Milligrams of Contaminant/Kilogram of Medium (soil)
NCP	=	National Oil and Hazardous Substances Pollution Contingency Plan
ND	=	Not Detected
NFA	=	No Further Action
NPDES	=	National Pollution Discharge Elimination System
O&M	=	Operation and Maintenance
OU	=	Operable Unit
PAH	=	Polycyclic Aromatic Hydrocarbons
PCB	=	Polychlorinated biphenyl
PCE	=	Tetrachloroethene
RfD	=	Reference Dose
RI	=	Remedial Investigation
RME	=	Reasonable Maximum Exposure
ROD	=	Record of Decision
SARA	=	Superfund Amendments and Reauthorization Act

ACRONYMS (Continued)

SERA	=	State/Elmendorf Restoration Agreement
SQC	=	Sediment Quality Criteria
SVOC	=	Semivolatile Organic Compound
TBC	=	To be considered; guidance or criteria not promulgated (and therefore not an ARAR) that is nonetheless "to be considered" in developing remediation goals
TCE	=	Trichloroethylene
TFH	=	Total Fuel Hydrocarbon
TOC	=	Total Organic Carbon
TPH	=	Total Petroleum Hydrocarbon
μg/kg	=	Micrograms of Contaminant/Kilogram of Medium (soil)
μg/L	=	Micrograms of Contaminant/Liter of Solution (water)
USAF	=	United States Air Force
U.S. EPA	=	U.S. Environmental Protection Agency
VOC	=	Volatile Organic Compound

PART I. DECLARATION

SITE NAME AND LOCATION

Elmendorf Air Force Base (AFB)
Operable Unit (OU) 5
Elmendorf Air Force Base, Alaska

STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the selected remedial action for OU 5 at Elmendorf AFB. It was developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C. §9601 et seq., and, to the extent practicable, in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR §300 et seq. The attached administrative record index (Appendix A) identifies the documents upon which the selection of the remedial action is based.

The selected remedy includes passive extraction of seep water, natural attenuation for upper aquifer and surface water, institutional controls for upper aquifer water, and sampling of water and sediment. The U.S. Air Force, the U.S. Environmental Protection Agency (U.S. EPA), and the State of Alaska, through the Department of Environmental Conservation (ADEC), concur with the selected remedy.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances (fuels and fuel constituents) from this OU, if not addressed by implementing the response action selected in this ROD, may present an imminent or substantial endangerment to public health, welfare, or the environment. Specific hazardous substances include jet fuel, gasoline range organics, benzene, and trichloroethylene (TCE) (from upgradient sources).

DESCRIPTION OF THE SELECTED REMEDY

The selected remedy was chosen from many alternatives as the best method of treating contaminated soil, sediment, groundwater, and surface water in OU 5. It will address the risks to health and the environment caused by the hypothetical exposure of a future resident to contaminated groundwater and the possible exposure of animals and transient humans to contaminated water from surface seeps. The selected remedy will address this risk by reducing contamination to below cleanup levels established for OU 5. Contamination in other OUs will be addressed in additional RODs.

The major components of the selected remedy include:

- Contaminated seep water in the western and middle portions of the OU will be passively drained using horizontally inserted extraction wells in the bluff. The water will flow to a constructed wetland, currently planned to be built in the snowmelt pond. A layer of material such as gravel will be placed over the sediments which contain PCBs in order to isolate the contamination.

- Approximately 3,000 cubic yards of soil contaminated with fuel products will be excavated and treated at an on-base treatment facility to reduce contaminant concentrations below cleanup goals. The treated soil will be reused on base either to fill the excavation or for general fill.

- Natural attenuation will be relied upon to attain cleanup levels in the contaminated upper aquifer and surface water other than seep water, including the beaver pond wetland area.

- Institutional controls that prohibit use of the upper aquifer will ensure that people will not be exposed to contaminated groundwater until cleanup goals are achieved.

- Groundwater, seep water, and surface water will initially be sampled on a quarterly basis. Sediment will be sampled annually. Results of the monitoring program will be assessed annually for at least the first 5 years to determine if cleanup levels have been achieved. If cleanup levels have not been reached, aggressive actions such as air sparging with soil vapor extraction or active extraction with air stripping may be necessary. Bioventing of soil is an additional option that could treat soil contamination. If there are any significant differences between the actions being taken as part of this ROD, an explanation of significant differences or a ROD amendment will be issued.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element. Pursuant to Executive Order 11990 and the authority delegated by SAFO 780-1, and taking into account the information contained in the ROD the Air Force finds that there is no practicable alternative to construction in the wetland area set forth in the selected remedy and that the selected remedy includes all measures to minimize harm to the wetlands.

Because the remedy will result in hazardous substances remaining on-site above health-based levels, a review will be conducted within five years after commencement of remedial action. The review will ensure that the remedy continues to provide adequate protection of human health and the environment.

LEAD AND SUPPORT AGENCY ACCEPTANCE
OF THE RECORD OF DECISION,
ELMENDORF AIR FORCE BASE, OPERABLE UNIT 5

This signature sheet documents agreement between the U. S. Air Force and the United States Environmental Protection Agency on the Record of Decision for Operable Unit 5 at Elmendorf Air Force Base. The Alaska Department of Environmental Conservation concurs with the Record of Decision.

JOHN S. FAIRFIELD, Lt Gen, USAF
Chairman, HQ PACAF
Environmental Protection Committee

1 Feb 95
Date

LEAD AND SUPPORT AGENCY ACCEPTANCE
OF THE RECORD OF DECISION,
ELMENDORF AIR FORCE BASE, OPERABLE UNIT 5

This signature sheet documents agreement between the U. S. Air Force and the United States Environmental Protection Agency on the Record of Decision for Operable Unit 5 at Elmendorf Air Force Base. The Alaska Department of Environmental Conservation concurs with the Record of Decision.

for CHUCK CLARKE
Regional Administrator
Region X
U.S. Environmental Protection Agency

12·28·94
Date

LEAD AND SUPPORT AGENCY ACCEPTANCE
OF THE RECORD OF DECISION,
ELMENDORF AIR FORCE BASE, OPERABLE UNIT 5

This signature sheet documents agreement between the U. S. Air Force and the United States Environmental Protection Agency on the Record of Decision for Operable Unit 5 at Elmendorf Air Force Base. The Alaska Department of Environmental Conservation concurs with the Record of Decision.

Janice Adair 1. 5. 95

JANICE ADAIR Date
Regional Administrator
Southcentral Regional Office
Alaska Department of Environmental Conservation

PART II. DECISION SUMMARY

This Decision Summary provides an overview of the problems posed by the contaminants at Elmendorf Air Force Base (AFB) Operable Unit (OU) 5. It identifies the areas considered for remedial response, describes the remedial alternatives considered, and analyzes those alternatives compared to the criteria set forth in the National Contingency Plan (NCP). This Decision Summary explains the rationale for selecting the remedy and how the remedy satisfies statutory requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

1.0 SITE DESCRIPTION

1.1 Physical Description

Elmendorf AFB is located approximately two miles north of downtown Anchorage. The base provides defense for the United States through surveillance, logistics, and communications support. OU 5 is located along the southern boundary of Elmendorf AFB (see Figure 1-1), and covers an area over 7,000 feet long and over 1,200 feet wide.

OU 5 is geographically diverse. In the western part of the OU, a steep bluff gives way to a broad flat area that ends in Ship Creek. In the eastern area, a more gently sloping bluff leads to a wetland called the beaver pond area (see Figure 1-2). The beaver pond area is a wetland in the eastern part of OU 5 where there are several shallow connected water bodies and marsh areas. The central part of the OU is a transitional area with a bluff and some surface water features, including the snowmelt pond and a fish hatchery. The snowmelt pond is an elongate shallow water body measuring approximately 50 x 300 feet and is located in the center of the OU. It was formed by beavers backing up natural drainages. It is called the snowmelt pond because snow is often piled on top of the bluff, in the area near the pond.

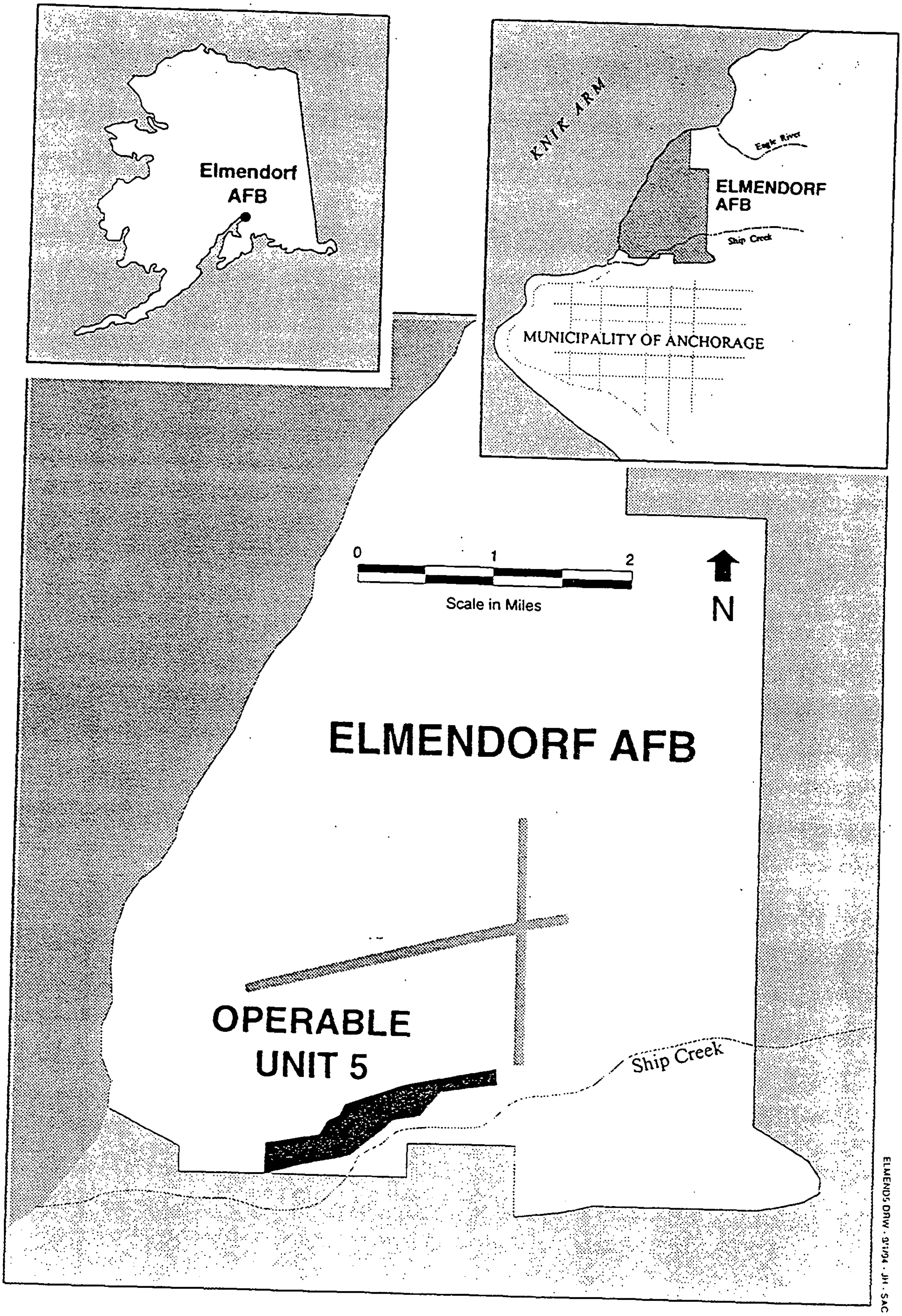


Figure 1-1. Location Map of Elmendorf AFB, Alaska

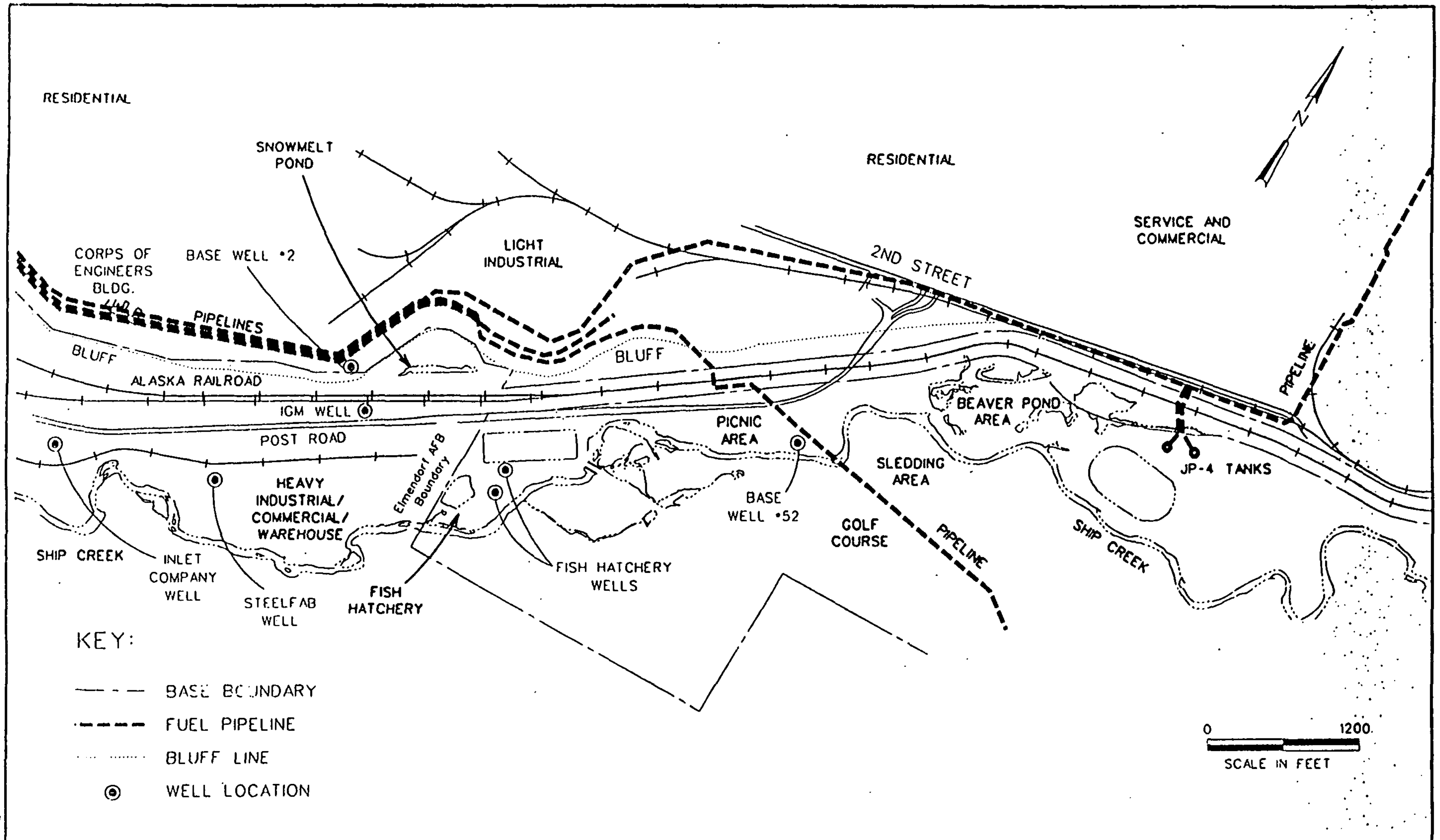


Figure 1-2. Land Uses and Well Locations

Runoff generally flows from north to south through the OU towards Ship Creek. Drainage ditches facilitate runoff in the western area. The snowmelt pond is an old drainage ditch which has backed up and formed a broad, shallow pond.

Portions of the land at the base of the bluff are in the flood plain of Ship Creek. Areas of the golf course can be temporarily flooded in periods of high flow of Ship Creek.

1.2 Land Use

Land uses vary across OU 5. The primary land use throughout most of the OU is light industrial. Diesel fuel, jet fuel, multiproduct fuel lines, and distribution lines are located in OU 5 on top of the bluff (see Figure 1-2). An Army Corps of Engineers (COE) building is located near the western side of the OU, above the bluff. Some military residential units are located back from the bluff on the eastern and western sides of the OU. Ship Creek flows from east to west along the southern edge of the base.

Land uses between the base of the bluff and Ship Creek include designated open areas, a railroad right of way, Post Road, a picnic area and golf course, and a fish hatchery. Though there is a diversity of wildlife in OU 5, there are no reported rare or endangered species in OU 5. During the winter, the golf course is used as a cross-country ski area, and a hill on the eastern side of the OU is a popular sledding area. A snowmelt pond is located on Alaska Railroad Company land between the base and the railroad tracks near the middle of the OU. A commercial/industrial area that is part of the Municipality of Anchorage is located just south of OU 5. There are no known historic buildings or archaeologic sites in OU 5.

1.3 Hydrogeology and Groundwater Use

OU 5 is located in a glacial outwash plain composed predominantly of sand and gravel. There are two aquifers--an unconfined upper aquifer and a confined lower aquifer--hydrologically separated by an impermeable layer called the Bootlegger Cove Formation (See Figure 1-3). The water table (upper aquifer) is approximately 30 feet below the ground surface above the bluff and is composed of sand and gravel and is highly permeable. The thickness of the sand and gravel varies, depending on the topography. On top of the bluff the sand and gravel is approximately 50- to 80-feet thick. The saturated thickness is approximately 20 to 50 feet. Near Ship Creek, where the groundwater is shallow, the formation is as little as 10 feet thick with a 5-foot saturated thickness. Groundwater flows from north to south, discharging out of the bluff as groundwater seeps in several locations. The water table aquifer is not used for any purpose on base. Its future use, even if there were no impact, is limited because of the higher yield of the lower aquifer. The aquifer quality is locally degraded by contaminant sources. More detail on impacts is provided in Section 3.0.

Groundwater in the upper aquifer flows toward Ship Creek. Results from two stream gaging stations indicate that Ship Creek gains water along its course most of the year. Some groundwater flowing toward Ship Creek contributes to creek flow. Groundwater that does not discharge as seeps or to the creek becomes underflow. Sampling during the remedial investigation indicated no contamination in Ship Creek

As indicated above, the Bootlegger Cove Formation is a layer of clay, silt, and silty clay that separates the upper and lower aquifer. This formation acts as a hydraulic aquitard and is from 5- to over 200-feet thick in OU 5.

The lower aquifer is confined by the Bootlegger Cove Formation and is up to 550 feet thick. The top of the aquifer is found approximately 150 feet below the surface. This aquifer is used as a source of water but sampling has not indicated any contamination.

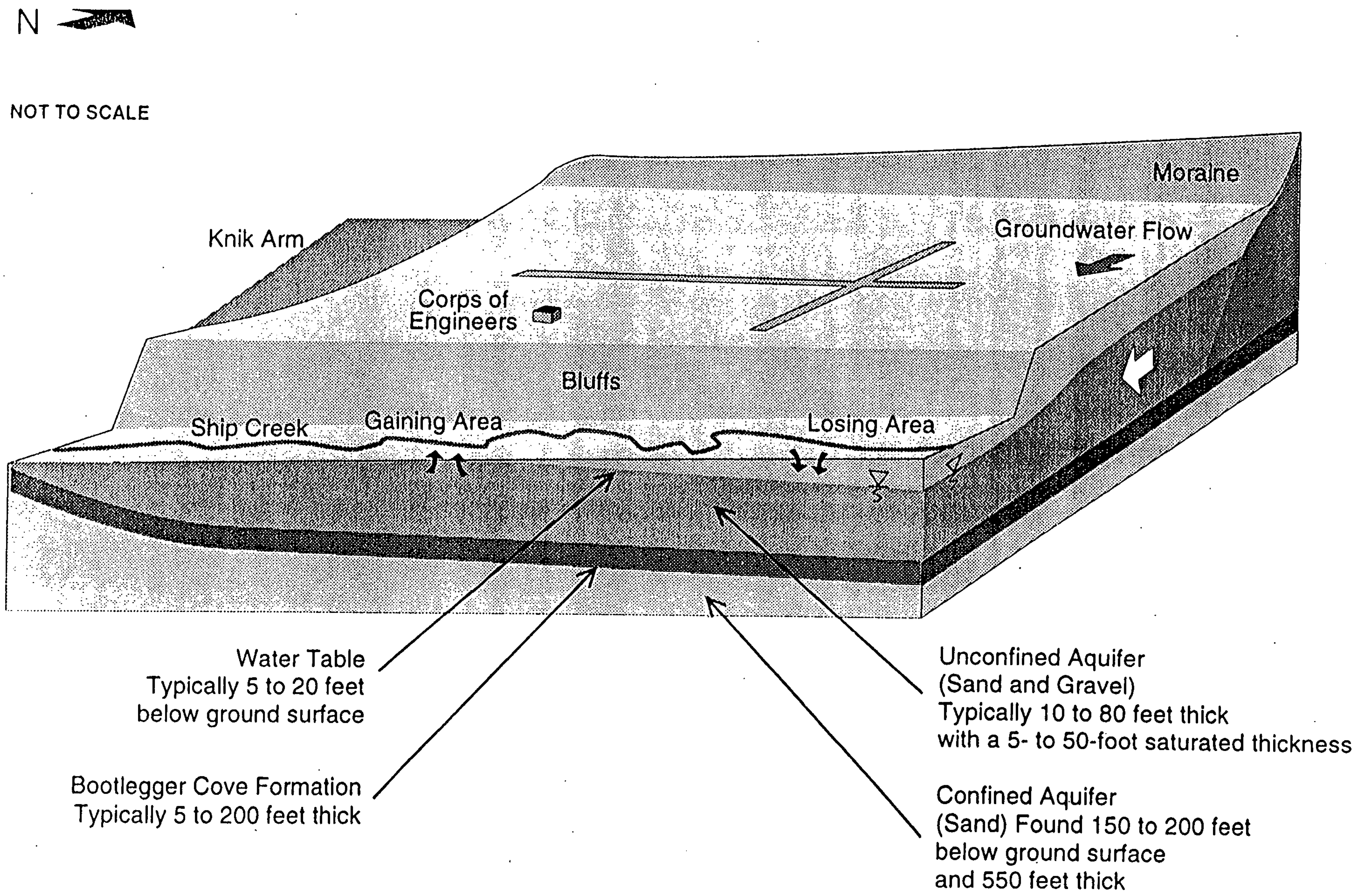


Figure 1-3. Hydrogeologic Conceptual Model

ELMEND6.DRW · 12/7/94 · JH · SAC

The locations of water wells in OU 5 are shown on Figure 1-2. Four base wells, two of which are located in OU 5, pump water from the confined lower aquifer, approximately 150 feet below ground surface. Two wells are located south of the fish hatchery, another above the bluff line between the snowmelt pond and the COE building, and the fourth below the bluff, near where a pipeline crosses *Ship Creek* (see Figure 1-2). Water from the base wells is used for drinking water. Hatchery wells are used to regulate fish hatchery water temperature and quality. Three additional wells screened in the lower aquifer were identified in the heavy industrial area southwest of OU 5. This industrial area is a part of the city of Anchorage and is not located on Elmendorf AFB.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 Identification of Activities Leading to Current Contamination at OU 5

As part of the ongoing mission at Elmendorf Air Force Base, aircraft are regularly refueled and many of the fuel lines are located in OU 5. These fuel lines have, at times, leaked fuel into the soil and groundwater surrounding the pipelines. Before the leaks could be detected, fuel product and fuel constituents such as benzene migrated from the leak to the water table. This migration from source areas is the primary cause of contamination at OU 5. A schematic of the principal transport mechanisms are shown on Figure 2-1 and are discussed below. Understanding transport is important because the contaminants and risks are not always associated with the source area, but with the area where an exposure is possible. The risk assessment considered the current and future transport of contaminants to potential receptors.

Dissolved aqueous transport. The principal transport mechanism of solvents and fuels contamination is by aqueous solution in groundwater and surface water. Contaminants can dissolve into solution when water passes over contaminated soil. As contaminated water migrates, it can deposit contaminants on the soil through which it passes. This appears to be the case with the diesel contamination found in soil and sediment in the middle of the OU.

Volatilization. Contaminants, such as volatile organic compounds (VOCs) and lighter fuel constituents, can become gases, either volatilizing into the soil or directly to the atmosphere. Concentrations of VOCs in soil gas were detected at relatively low concentrations (1 to 10 μg/L) indicating that volatilization is not a significant migration pathway.

Colloid/Particle Transport. Contaminants adhered to particles in water can be transported by entrainment if runoff washes away soil or if surface water is churned up.

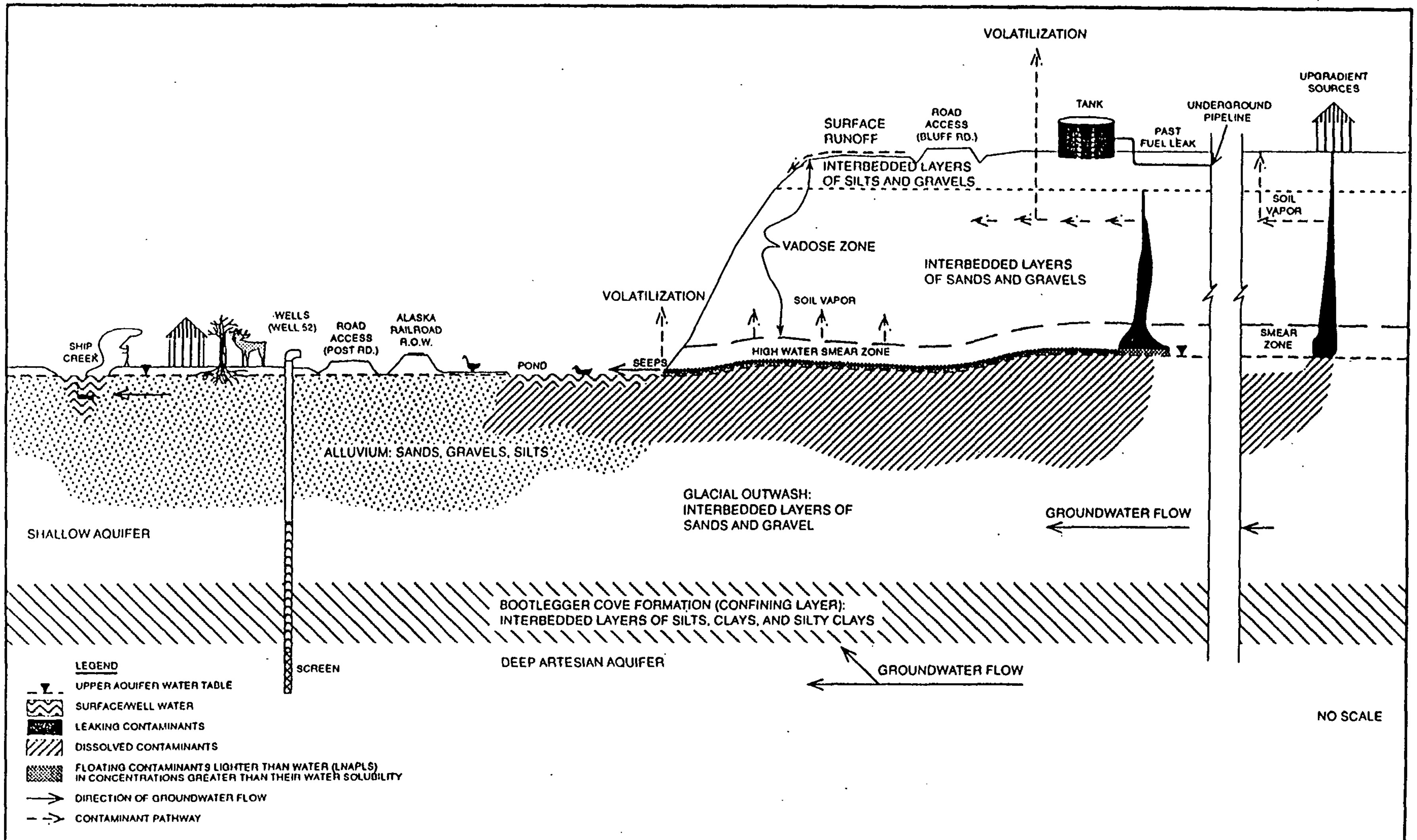


Figure 2-1. A Schematic of Principal Transport Mechanisms in OU 5

Particle transport is a potential transport mechanism for PCBs in the snowmelt pond if the sediments are disturbed.

In OU 5, the discovery of hydrocarbon seeps in the early 1980s was the first indication of the leaks. From the leak, fuel migrated in a southerly direction seeping from the bluff face located along the southern end of OU 5. When leaks were identified they were repaired and residual hydrocarbon was recovered to the extent possible. Hydrocarbon was recovered at the bluff face using absorbents and skimming any floating product found on surface water drainages. The remaining hydrocarbon and hydrocarbon constituents are the primary cause of environmental impact at OU 5.

Environmental investigations have been conducted at OU 5 since the mid-1980s. Several small-scale studies discovered evidence of contamination in various parts of OU 5. The first investigation to examine contamination throughout the whole area was done by Black and Veatch in 1988.

The Black and Veatch study was followed in 1992 by the remedial investigation (RI) completed by CH2M Hill. The RI determined the nature and extent of contamination, and the potential risks to public health and the environment. The results were compiled and analyzed in the RI report.

Radian Corporation conducted two investigations while completing the Feasibility Study (FS). In one study, the extent of PCB contaminants in the snowmelt pond water and sediment was identified. In the other study, the capacity of the beaver pond wetland area to naturally attenuate contamination was assessed. In addition, the Elmendorf Bioenvironmental Engineering Services Group (BESG) have been collecting groundwater and surface water samples from throughout Elmendorf AFB since 1987.

Six CERCLA sites in the OU were identified based on the location of hydrocarbon seeps and known leaks. The location of the sites is shown on Figure 2-2.

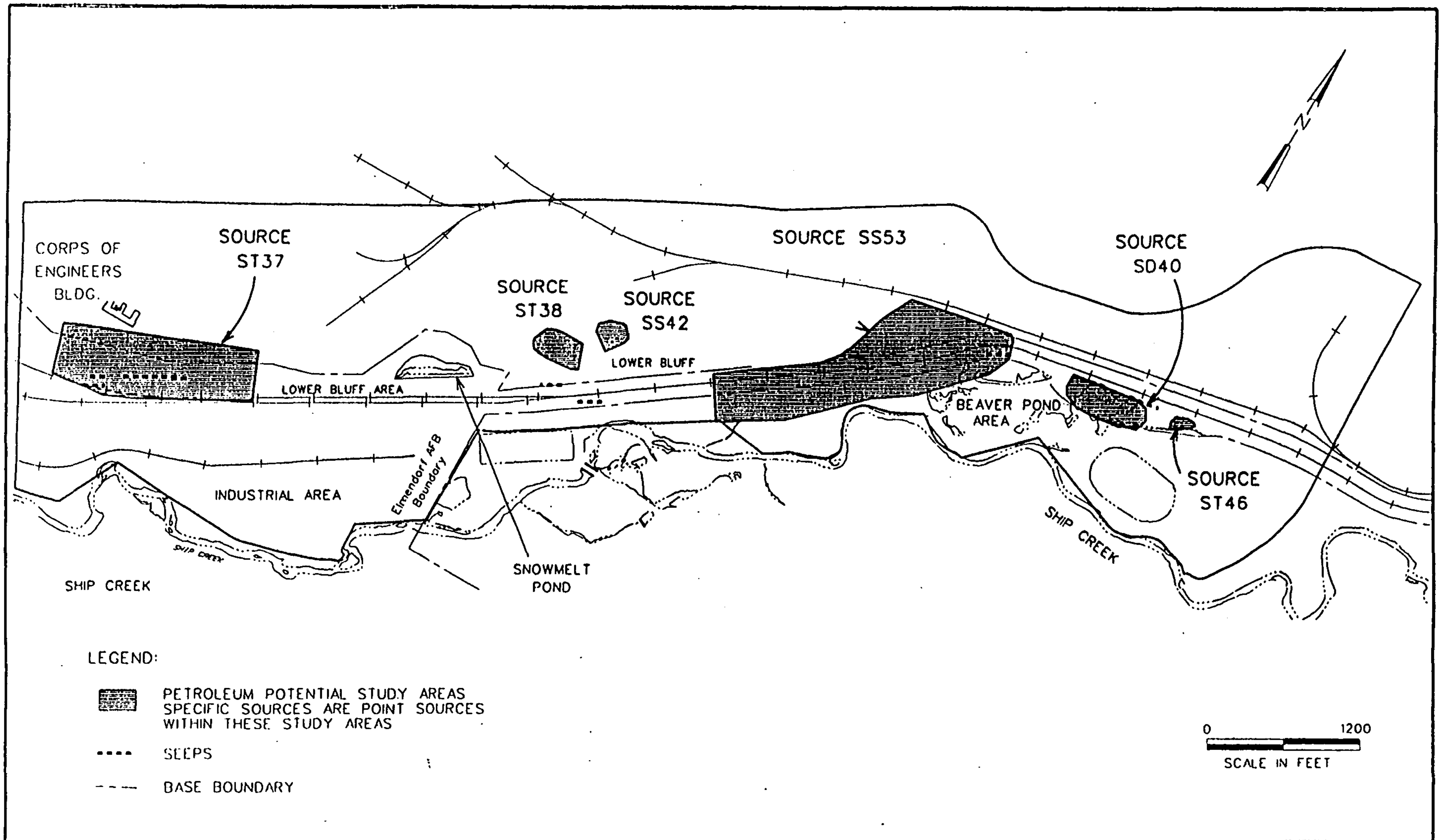


Figure 2-2. Potential Source Areas in OU 5

Three of the source areas were identified based on leaks in buried tanks and pipelines. In the late 1950s at Source ST37, several thousand gallons of diesel fuel leaked from a fuel line south of the U.S. Army Corps of Engineers (COE) building. Over the years, thousands of gallons of fuel have been recovered from hydrocarbon seeps using absorbents at the face of the bluff, immediately south of this site. The ST38 leak occurred in the mid-1960s in a JP-4 jet fuel pipeline. As with ST37, migration led to seepage of fuel sheens from the bluff, east of the snowmelt pond; no fuel was recovered. ST46 had a pipeline leak occur in 1978 when JP-4 jet fuel seeped into the wetlands at the base of the bluff and Ship Creek. After the leaking pipe was repaired, fuel continued to seep from the bank into the beaver pond. All leaks have been repaired and the pipelines and tanks are given annual checks and triannual detailed evaluations to locate leaks.

At a fourth site (SS42), an estimated 8,000-gallon, one-time spill of diesel fuel occurred in March 1976. Most of the fuel was recovered off the frozen ground. The final two source areas are identified as SD40, and SS53 and are directly upgradient of where fuel seeped from the bluff. At SD40, oil was reported seeping out of the bank near the railroad tracks and flowing through a marsh into Ship Creek during the late-1960s. (However, the Remedial Investigation did not find any residual contamination in Ship Creek.) The source of this oil could not be determined. SS53, another fuel seep of unknown origin, was observed during the spring thaw for an unspecified number of years. The seep flowed into a drainage ditch parallel to Post Road. The potential source area, as shown in Figure 2-2, is in the middle of the OU along the railroad right of way.

Solvent constituents, primarily TCE, are detected in the upper aquifer groundwater in OU 5. The solvent sources are located upgradient of the OU, in areas where solvent spills or disposal occurred in the past. Source areas include shop drains (OU 3) and sanitary landfills (OU 1, OU 2 [ST-20]). The general locations of source areas are shown on Figure 2-3. Solvents from these upgradient source areas have migrated toward OU 5 in the groundwater. Plumes from these source areas are well-defined geographically, and OU 5 is

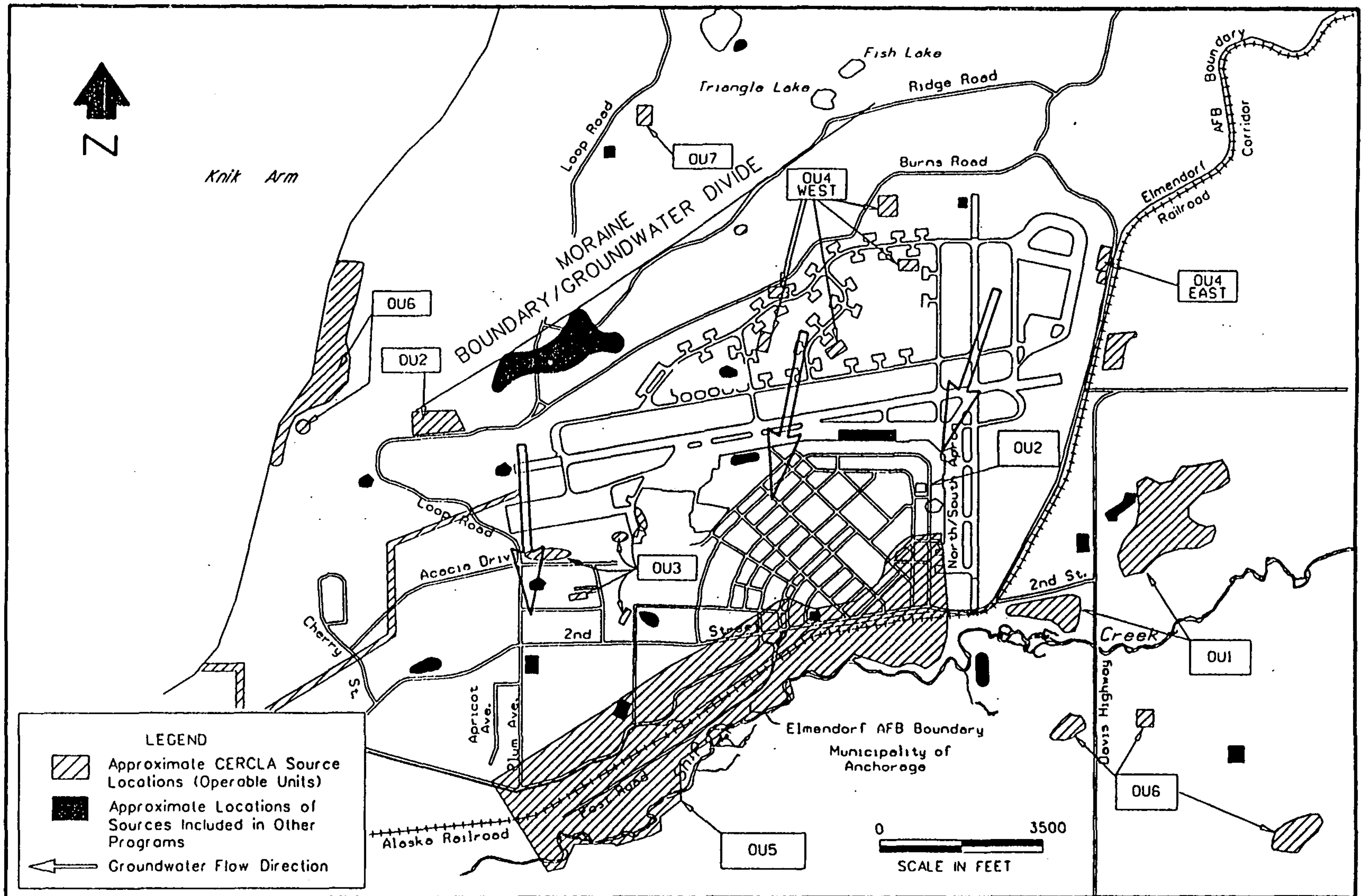


Figure 2-3. General Locations of Source Areas

known to capture approximately 90% of the groundwater flowing from Elmendorf AFB, including all of the areas shown on Figure 2-3.

Upgradient source areas are being studied as part of the remedial investigations of each individual OU and as part of State/Elmendorf Restoration Agreement (SERA) site studies. However, the impacts of the upgradient sources on OU 5 were evaluated in a groundwater model. The results of the model (discussed later) were used to predict future groundwater quality at OU 5 and to select a remedial action to treat future conditions at OU 5.

2.2 Regulatory and Enforcement History

Based on the results of environmental investigations, Elmendorf AFB was listed on the National Priorities List by the U.S. Environmental Protection Agency (U.S. EPA) in August 1990. This listing designated the facility as a federal site subject to the remedial response requirements of CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986. On 22 November 1991, the USAF, U.S. EPA, and the Alaska Department of Environmental Conservation (ADEC) signed the Federal Facilities Agreement (FFA) for Elmendorf AFB. The contaminated areas of Elmendorf AFB were divided into seven OUs, each to be managed as a separate region and investigated according to varying schedules. There are six RCRA source areas along the upgradient edge of the western and central portions of OU 5. All six of these source areas are currently going through RCRA clean closure. However, if contamination has reached the groundwater, it will be addressed under CERCLA and handled as part of the action at OU 5.

In accordance with the FFA, a Remedial Investigation (RI) of OU 5 was conducted in the summer of 1992. The RI determined the nature and extent of the contamination, and the potential risks to public health and the environment. The results were compiled and analyzed in the RI report. The RI concluded that fuel, fuel constituents, and low levels of solvents were found in soil and groundwater in OU 5. Fuel constituents were also detected at relatively low concentrations in surface water ditches and in the beaver pond wetland area. The impacts to soil were found in the areas where impacted groundwater seeped from the bluff. Impacts in the soil at the source areas (location of the leaks) were low and did not pose a threat to human health or the environment.

Based on the RI results, No Further Action (NFA) Decision Documents were prepared, signed, and approved in August 1994 for the soil in the potential source areas in OU 5 except ST37, the western area diesel leak. The NFA sites are ST-38, SS-42, SS-53, SD-40, and ST-46.

Two investigations were conducted while completing the FS. One study investigated the extent of PCB contamination in the snowmelt pond water and sediment. The other study assessed the capacity of the beaver pond wetland area to naturally attenuate contamination. The Final RI/FS was submitted in March, 1994. A Proposed Plan was distributed to the public on 6 June 1994, and a public meeting to discuss the plan was held on 23 June 1994. A Draft OU 5 Groundwater Modeling Report (GMR) was issued on 4 August 1994.

2.3 Role of Response Action

The CERCLA process described above is intended to identify solutions to contamination issues where they exist. The remedial action described in this ROD addresses threats to human health and the environment posed by contamination at OU 5. The RI/FS and the Groundwater Modeling Reports define these threats as primarily groundwater contaminants. The OU 5 GMR was used to further document the appropriateness of the decisions made in this ROD. At this time, groundwater will be monitored. Further response actions, coordinated with regulatory agencies, could be considered if monitoring finds concentrations of contaminants greater than predicted by the GMR.

2.4 Community Participation

Public participation has been an important component of the CERCLA process at Elmendorf AFB. Activities aimed at informing and soliciting public input regarding base environmental programs include:

- **Environmental Update.** Environmental Update is a newsletter distributed to the community and interested parties. It discusses the progress that has been made on OUs and advises the public about opportunities to provide input concerning decisions to address contaminated areas of the base. Aspects of the OU 5 CERCLA progress have been published in this update.

- **Community Relations Plan.** The base environmental personnel maintain and regularly update a Community Relations Plan. It describes how the base will both inform the public of base environmental issues and solicit public comment on base environmental programs.

- **The Technical Review Committee.** Base personnel meet quarterly with representatives of the community to discuss base environmental programs and solicit their comments.

- **Public Workshops.** On 5 February 1992, approximately 75 people attended a public workshop where base personnel discussed base environmental programs and encouraged public participation.

- **Videotape.** Base personnel made a videotape describing base environmental activities. The tape is used with both internal (to the base) and external audiences.

- **Community Council Briefs.** The Air Force regularly provides briefs to the community council on the progress of the Installation Restoration Program (IRP). Specific presentations were made regarding the progress at OU 5 and on the planned remediation.

- **Speakers Bureau.** The 3rd Wing Public Affairs Office maintains a speakers bureau capable of providing speakers versed in a variety of environmental subjects to military and civic groups.

- **Newspaper Releases.** News releases were published on significant events during the IRP. News releases were made announcing all public meetings that were held to discuss proposed remedial actions.

- **Information Repositories.** Public access to technical documents was provided through information repositories located at the Bureau of Land Management's Alaska Resources Library and the University of Alaska at Anchorage's Consortium Library. The information in the repositories was also maintained in the administrative record. The remedial action was selected based on the information held in the administrative record.

- **Display Board.** During public functions, a display board, showing key elements and progress of the Elmendorf IRP, was used to communicate technical issues to the public. It was used during both on-base and off-base events.

- **Proposed Plan.** The proposed plan was distributed to the public on 6 June 1994, a public meeting was held 23 June 1994, and the public review period was from 6 June to 6 July 1994. The plan was approved on 7 July 1994.

- **Public Notice.** Public notices have been issued prior to all significant decision points in the IRP. For OU 5, public notice was issued for the proposed plan in the *Anchorage Daily News* (6/1/94) and the *Sourdough Sentinel* (6/3/94).

- **Mailing List.** A mailing list of parties interested in the restoration program is maintained by the base. Notices and publications (news releases including the OU 5 proposed plan meeting) was released via the mailing list.

- **Responsiveness Summary.** Public comments were received on the proposed plan. The Air Force maintained a record of all comments and has published responses to the comments in this Record of Decision.

All decisions made for OU 5 were based on information contained in the Administrative Record.

3.0 SITE CONTAMINATION, RISKS, AND AREAS REQUIRING RESPONSE ACTIONS

This section identifies the areas which may require remedial action. These areas were chosen based on the risk that contaminants pose to human health and the environment. The basis of this analysis is the data collected during the Remedial Investigation (RI) which identified the nature and extent of contamination in OU 5.

3.1 Nature and Extent of Contamination

During the RI, samples of soil, soil gas, groundwater, sediment, and surface water were collected and analyzed for organic and inorganic constituents. Significant levels of organic contaminants were detected in the soil, sediment, seeps, and groundwater. The contaminants include: fuel products (benzene), volatile organic compounds (VOCs), inorganic compounds, and semivolatile organic compounds (SVOCs). Tables 3-1, 3-2, and 3-3 show the contaminants detected and the frequency of detections. Figures are referenced below that show the location of detected constituents.

In the upper aquifer and in some seeps, fuels were the most frequently detected contaminants in OU 5. Concentrations of diesel (ranging from not detected [ND] to 290 μg/L), gasoline (ND to 700 μg/L) and jet fuel (ND to 760 μg/L) were found. VOCs were also found in groundwater samples at the eastern and western portions of the OU. Trichloroethylene (TCE) was the most commonly detected VOC (ranging from ND to 52 μg/L). Figures 3-1 and 3-2 show the distribution of organic compounds in groundwater. Inorganics were detected in a few groundwater samples above background. Barium and manganese were the metals most often detected above background concentrations. However, only one manganese detection was significantly above background (one order of magnitude). The source identification efforts, operational history of the base, and the RI revealed no source of manganese contamination in OU 5. Therefore, the results are thought to be

Table 3-1

Potential Contaminants of Concern — Water

Contaminant	Maximum Concentration	MCLs	Frequency (Detections/# Samples)
Groundwater (Maximum Concentration and MCLs - μg/L)			
1,1,1-Trichloroethane	9.4	200	1/7
1,1,2,2-Tetrachloroethane	8	—	1/7
Benzene	8.5	5	4/16
Ethylbenzene	16	700	2/10
JP-4	760	—	4/23
TFH Diesel	290	—	7/28
TFH Gas	700	—	3/17
Toluene	1.4	1,000	2/8
Trichloroethylene (TCE)	52	5	6/14
Xylenes, total	39	10,000	2/10
bis(2-ethylhexyl) phthalate	20[a]	6	5/26
tert-butyl methyl ether	0.56	—	1/7
Di-n-butyl phthalate	1	—	3/13
Diethyl phthalate	1	—	3/25
N-nitrosodiphenylamine	5	—	2/15
1,1-Dichloroethane	1.3	—	1/3
2-Methylnaphthalene	9	—	1/3
Aluminum[b]	68	50 - 200	2/3
Barium	103	2,000	4/6
Calcium[b]	94,700	—	1/5
Chloroethane	1.3	—	1/3
Iron[b]	12,600	300	3/4
Manganese[b]	4,280	50	3/6
Naphthalene	13	—	1/3
Potassium[b]	2,070	—	1/5
Selenium[b]	2.5	50	2/5
Vanadium[b]	5	—	2/5

Table 3-1

(Continued)

Contaminant	Maximum Concentration	MCLs	Frequency (Detections/# Samples)
Surface Water (Maximum Concentration and MCLs - μg/L)			
1,1,1-Trichloroethane	1.9	200	2/5
1,1-Dichloroethane	2.3	—	1/5
1,2-Dichloroethane	2.6	5	1/5
4-Methylphenol (p-cresol)	7	—	1/4
Benzene	1.5	5	2/10
Bromomethane	13	—	1/5
Ethylbenzene	12	700	1/5
JP-4	770	—	1/5
Naphthalene	1	—	1/3
TFH Gas	400	—	1/3
Toluene	27	1,000	3/9
Trichloroethylene (TCE)	6.6	5	4/10
Xylenes, total	19	10,000	1/5
trans-1,2-Dichloroethene	1.9	100	1/3
1,1,2,2-Tetrachloroethane	4.3	—	2/5

[a] Resampling of groundwater showed no Bis(2-ethylhexyl) phthalate at well OU 5 MW-11, the site of the 20 μg/L detection.

[b] Only those metals detected above background listed.

Table 3-2

Potential Contaminants of Concern — Sediment

Contaminant	Maximum Concentration	Frequency (Detections/# Samples)
Sediment (Maximum Concentration - µg/kg)		
2-Methylnaphthalene	100	2/10
4-Methylphenol (p-cresol)	89	1/5
Anthracene	230	1/5
Benzo(a)anthracene	59	1/5
Benzo(a)pyrene	91	1/5
Benzo(b)fluoranthene	58	1/5
Benzo(k)fluoranthene	63	1/5
Chrysene	120	2/5
Ethylbenzene	930	3/10
Fluoranthene	130	1/5
PCB-1260 (Arochlor 1260)	1,600	4/6
Phenanthrene	270	3/10
Pyrene	150	1/5
TFH Diesel	7,400,000	2/5
TFH Gas	700,000	2/3
Toluene	26	1/5
Xylenes, total	6,200	2/5
bis(2-ethylhexyl) phthalate	240	1/5
JP-4	100,000	1/5
Naphthalene	69	1/5

Table 3-3

Potential Contaminants of Concern — Soil

Contaminant	Maximum Concentration	Maximum Background Concentration[a]	Frequency (Detections/ # Samples)
Soil (Maximum Concentration - μg/kg, regardless of depth)			
4-Nitrophenol	100	—	1/5
Diethyl phthalate	49	—	2/6
Pyrene	280	—	3/8
Di-n-butyl phthalate	39	—	1/1
Ethylbenzene	202	—	3/12
JP-4	14,000	—	2/11
TFH Gas	310,000	—	5/18
Toluene	64	—	3/18
Xylenes, total	3,940	—	4/12
bis(2-Ethylhexyl) phthalate	180	—	3/3
Benzo(k)fluoranthene	180	—	2/2
Fluoranthene	300	—	2/2
Phenanthrene	240	—	2/2
TFH Diesel	1,160,000	—	11/26
Benzene	14.9	—	2/6
2-Methylnaphthalene	48	—	1/1
Anthracene	63	—	1/1
Benzo(a)anthracene	200	—	1/1
Benzo(a)pyrene	330	—	1/1
Benzo(b)fluoranthene	160	—	1/1
Benzo(g,h,i)perylene	100	—	1/1
Chrysene	240	—	1/1
Indeno(1,2,3-c,d)pyrene	98	—	1/1
4-Methylphenol (p-cresol)	51	—	1/1

Table 3-3

(Continued)

Contaminant	Maximum Concentration	Maximum Background Concentration[a]	Frequency (Detections/# Samples)
Soil (Maximum Concentration - mg/kg) (Continued)			
Aluminum	19,100 mg/kg	19,211	1/38
Arsenic	28.2 mg/kg	9.0	1/38
Barium	3,650 mg/kg	131.4	10/38
Beryllium	1.3 mg/kg	0.47	3/38
Calcium	35,300 mg/kg	4,021	10/38
Copper	38 mg/kg	183	4/38
Cadmium	3.1 mg/kg	1.46	1/38
Chromium (Total)	64 mg/kg	25.5	1/38
Lead	206 mg/kg	18.3	21/38
Manganese	199,000 mg/kg	459.4	8/38
Mercury	0.31 mg/kg	0.11	2/38
Potassium	1,440 mg/kg	508.5	1/38
Sodium	1,430 mg/kg	364.9	14/38
Selenium	3.1 mg/kg	0.37	3/38
Silver	22 mg/kg	0.91	1/38
Thallium	0.59 mg/kg	NE	5/26
Zinc	159 mg/kg	49.9	3/38

[a] Background value was 99% confidence limit for the mean for surface soil.

NE = Not established.

— = Background concentrations provided for inorganic analytes.

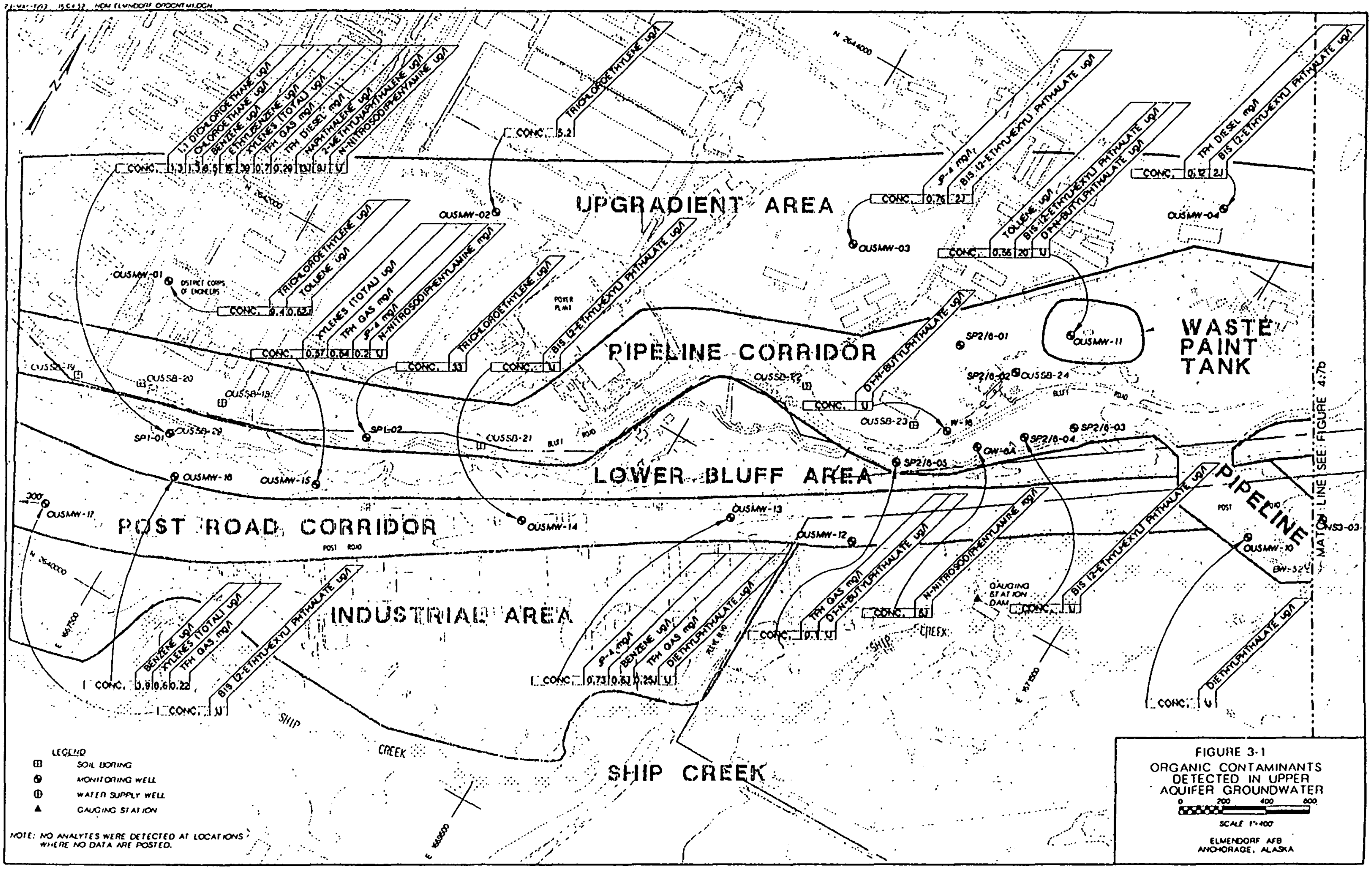


FIGURE 3-1
ORGANIC CONTAMINANTS DETECTED IN UPPER AQUIFER GROUNDWATER

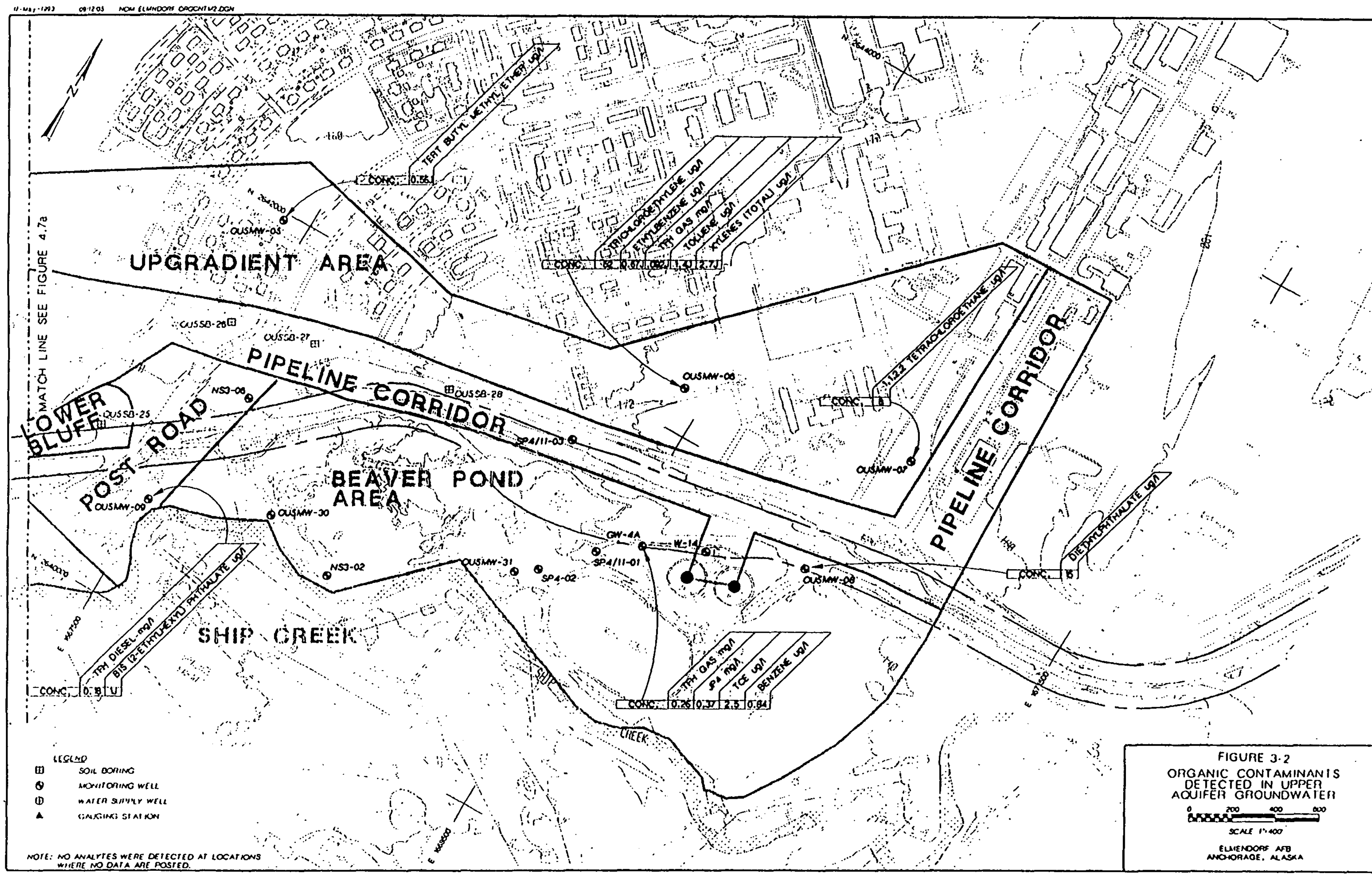


FIGURE 3-2
ORGANIC CONTAMINANTS DETECTED IN UPPER AQUIFER GROUNDWATER

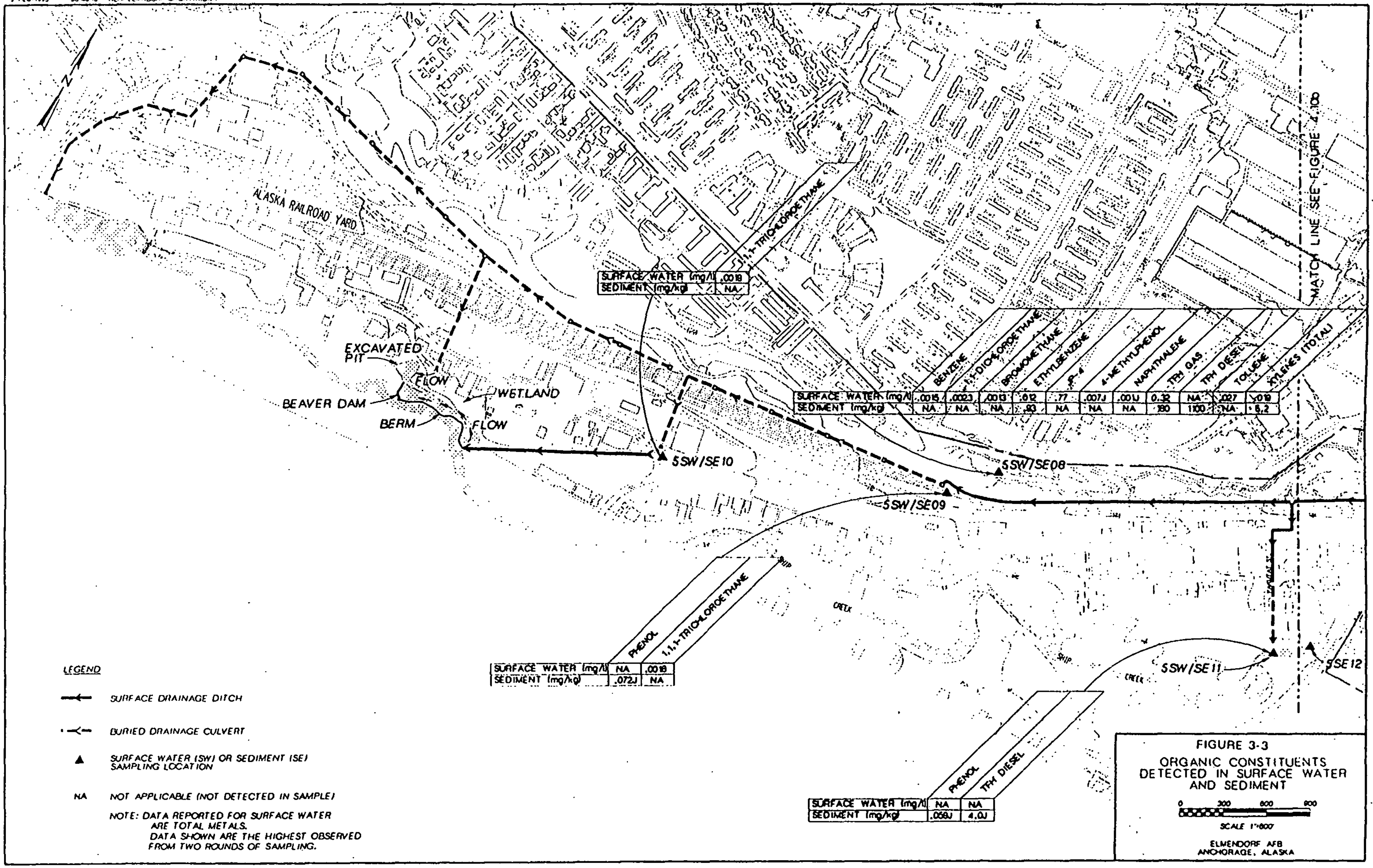
naturally occurring and are the result of geological variability typical of glacial outwash plains.

Surface water (ditch water, the snowmelt pond, and the beaver pond wetlands) has been impacted by volatile organics. Seeps are not considered surface water but discharges from groundwater. However, most concentrations are low (see Table 3-1) and the compounds were generally detected in 20% of the samples. The exception is TCE which was detected in 4 of 10 samples. A single detection of JP-4 (770 μg/L) was found on a puddle formed by seep water. The puddle is technically surface water, but is not a body of water like the beaver pond wetland area or the snowmelt pond. Figures 3-3 and 3-4 show the distribution of organics in surface water.

Sediment has been impacted in the beaver pond and snowmelt pond. Semivolatile compounds are found in 20% of the samples tested with anthracene having the highest concentration (230 μg/kg) (see Table 3-2). PCBs were detected in 4 of 6 sediment samples taken at the snowmelt pond with a maximum concentration of 1,600 μg/kg. Volatile organics and fuel hydrocarbons were also detected with xylene being the most prevalent VOC and TFH-diesel being the most prevalent fuel hydrocarbon. The distribution of organics found in sediment are shown on Figures 3-3 and 3-4.

Soil at different depths has been impacted by VOCs, semivolatiles, fuel hydrocarbons, and metals (Table 3-3). The VOCs, toluene, xylene, and ethylbenzene were detected in approximately 20% to 25% of the samples. Most of the semivolatile compounds are found in a single sample set. Otherwise semivolatile organics are found sporadically. The distribution and depth of organic compounds in soil are shown on Figures 3-5 and 3-6.

Metals were found above background in soil (see Table 3-3). Manganese had the highest concentration at one location. Most of the metals that exceeded background are naturally found at high concentrations. Very few concentrations of contaminants detected at OU 5 were above background. Lead and sodium exceeded background the greatest number



5SW/SE10:

	1,1,1-TRICHLOROETHANE
SURFACE WATER (mg/l)	.0018
SEDIMENT (mg/kg)	NA

5SW/SE08:

	BENZENE	1,1-DICHLOROETHANE	BROMOMETHANE	ETHYLBENZENE	JP-4	4-METHYLPHENOL	NAPHTHALENE	TPH GAS	TPH DIESEL	TOLUENE	XYLENES (TOTAL)
SURFACE WATER (mg/l)	.0015	.0023	.0013	.012	.77	.007J	.001J	0.32	NA	.027	.019
SEDIMENT (mg/kg)	NA	NA	NA	.93	NA	NA	NA	180	1100	NA	6.2

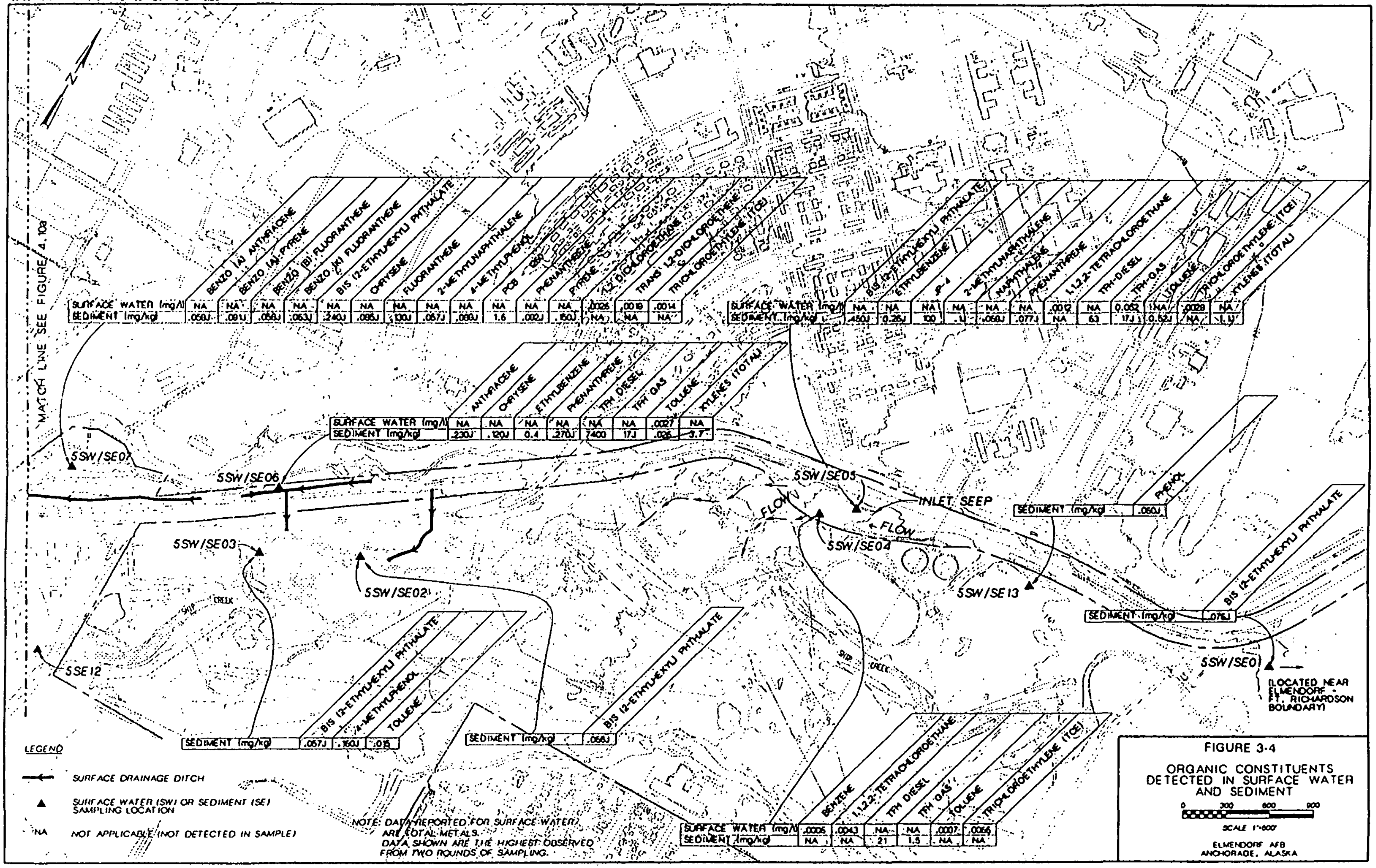
5SW/SE09:

	PHENOL	1,1,1-TRICHLOROETHANE
SURFACE WATER (mg/l)	NA	.0018
SEDIMENT (mg/kg)	.072J	NA

5SW/SE11:

	PHENOL	TPH DIESEL
SURFACE WATER (mg/l)	NA	NA
SEDIMENT (mg/kg)	.058J	4.0J

FIGURE 3-3
ORGANIC CONSTITUENTS DETECTED IN SURFACE WATER AND SEDIMENT



	BENZO (A) ANTHRACENE	BENZO (A) PYRENE	BENZO (B) FLUORANTHENE	BENZO (K) FLUORANTHENE	BIS (2-ETHYLHEXYL) PHTHALATE	CHRYSENE	FLUORANTHENE	2-METHYLNAPHTHALENE	4-METHYLPHENOL	PCB - 1260	PHENANTHRENE	PYRENE	1,2 DICHLOROETHANE	TRANS 1,2-DICHLOROETHENE	TRICHLOROETHYLENE (TCE)
SURFACE WATER (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	.0026	.0019	.0014
SEDIMENT (mg/kg)	.050J	.091J	.058J	.063J	.240J	.086J	.130J	.067J	.080J	1.6	.002J	.150J	NA	NA	NA

	BIS (2-ETHYLHEXYL) PHTHALATE	ETHYLBENZENE	JP-4	2-METHYLNAPHTHALENE	NAPHTHALENE	PHENANTHRENE	1,1,2,2-TETRACHLOROETHANE	TPH-DIESEL	TPH-GAS	TOLUENE	TRICHLOROETHYLENE (TCE)	XYLENES (TOTAL)
SURFACE WATER (mg/l)	NA	NA	NA	NA	NA	NA	.0012	NA	0.062	NA	.0029	NA
SEDIMENT (mg/kg)	.450J	0.26J	100	.1J	.068J	.077J	NA	63	17J	0.52J	NA	1.1J

	ANTHRACENE	CHRYSENE	ETHYLBENZENE	PHENANTHRENE	TPH DIESEL	TPH GAS	TOLUENE	XYLENES (TOTAL)
SURFACE WATER (mg/l)	NA	NA	NA	NA	NA	NA	.0027	NA
SEDIMENT (mg/kg)	.230J	.120J	0.4	.270J	7400	17J	.026	3.7

	PHENOL
SEDIMENT (mg/kg)	.060J

	BIS (2-ETHYLHEXYL) PHTHALATE
SEDIMENT (mg/kg)	.076J

	BIS (2-ETHYLHEXYL) PHTHALATE	4-METHYLPHENOL	TOLUENE
SEDIMENT (mg/kg)	.057J	.160J	.015

	BIS (2-ETHYLHEXYL) PHTHALATE
SEDIMENT (mg/kg)	.066J

	BENZENE	1,1,2,2-TETRACHLOROETHANE	TPH DIESEL	TPH GAS	TOLUENE	TRICHLOROETHYLENE (TCE)
SURFACE WATER (mg/l)	.0006	.0043	NA	NA	.0007	.0066
SEDIMENT (mg/kg)	NA	NA	21	1.5	NA	NA

FIGURE 3-4

ORGANIC CONSTITUENTS DETECTED IN SURFACE WATER AND SEDIMENT

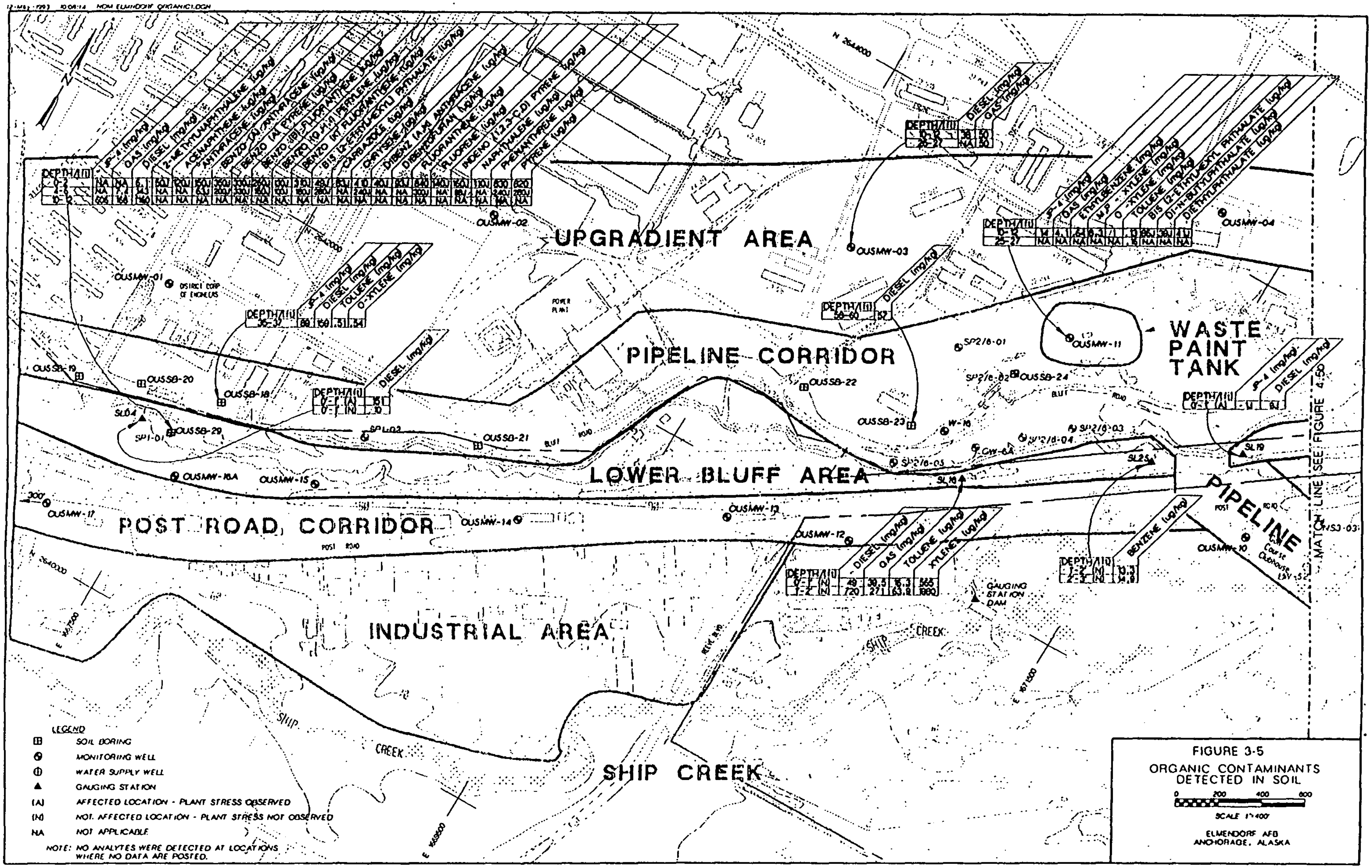


FIGURE 3-5
ORGANIC CONTAMINANTS DETECTED IN SOIL

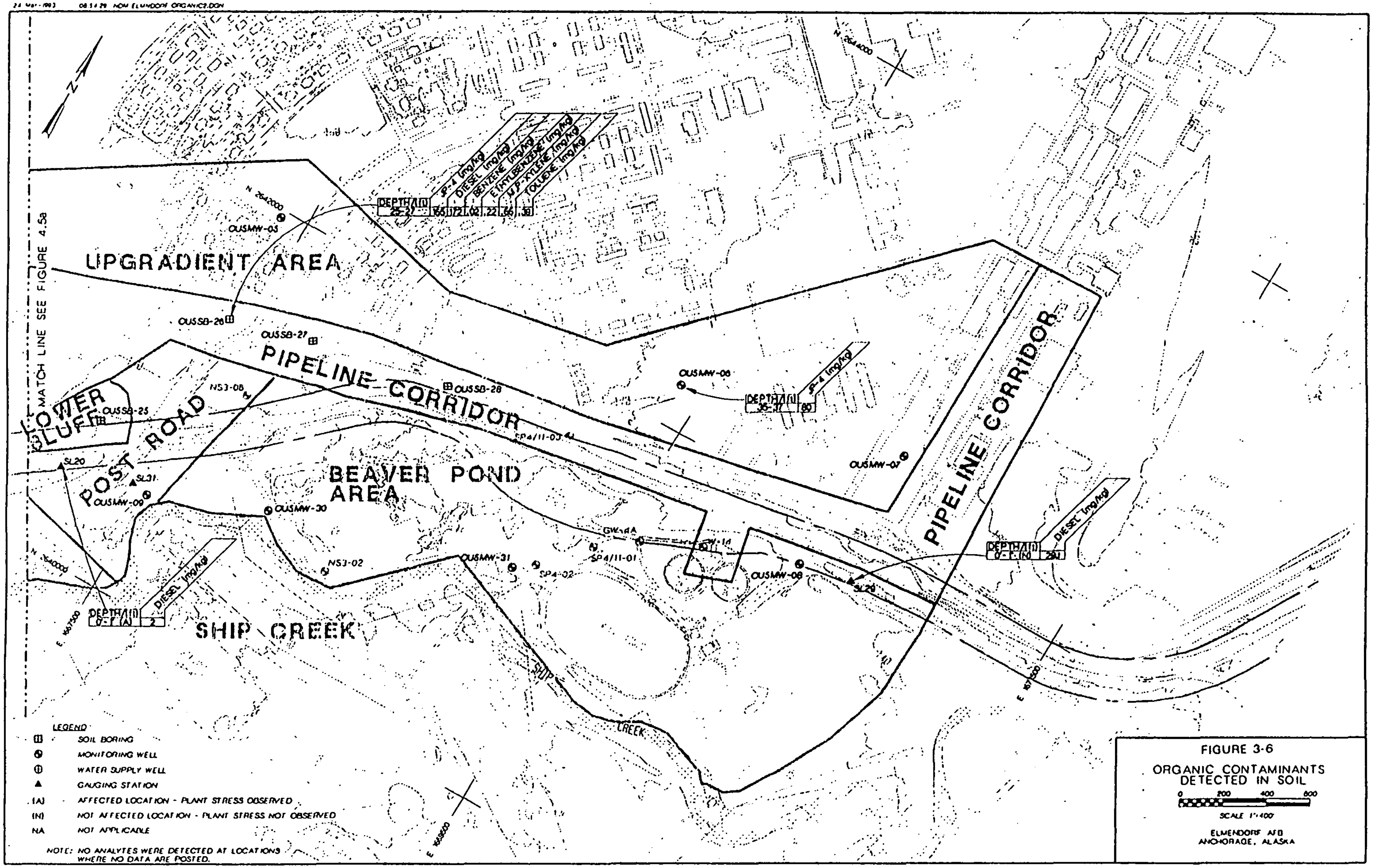


FIGURE 3-6
ORGANIC CONTAMINANTS DETECTED IN SOIL

of times. Figures 3-7 and 3-8 show the distribution of inorganics in soil. Generally, higher concentrations of the metals were found in organic rich soil. Organic soils can adsorb and concentrate metals so it is reasonable to conclude that the elevated concentrations are due to natural accumulation through adsorption and not through impacts from base operations. This conclusion is further supported by there being no historical evidence of sources that would discharge metals.

Detailed studies were performed at the beaver pond wetland and snowmelt pond to determine if the impacts identified during the RI were, or could, affect the environment. Samples were taken of the sediment and water in the beaver pond and were tested for microbial potential, adsorption, and chemistry. The retention time and flow rate in the wetland also was determined. This study concluded that the beaver pond was currently treating the contaminant load entering the wetland via groundwater discharge and has treated water contamination for many years without a significant degradation of the wetland. The study estimated that the pond is 18 times larger than necessary to treat the current contaminant load by natural processes.

The snowmelt pond was studied to determine the extent of PCB contamination in the pond's water and sediment. PCBs were not detected in any water samples. Total organic carbon (TOC) was also measured at sediment sampling locations because PCB sediment standards vary according to accompanying TOC concentrations. TOC binds the PCBs to sediment material, reducing its ability to migrate. PCB concentrations are below standards at three locations but above standards at two locations where TOC is high. There was no geographical pattern to the locations where TOC is not sufficient to bind the PCBs (reflected in lower standards at these locations).

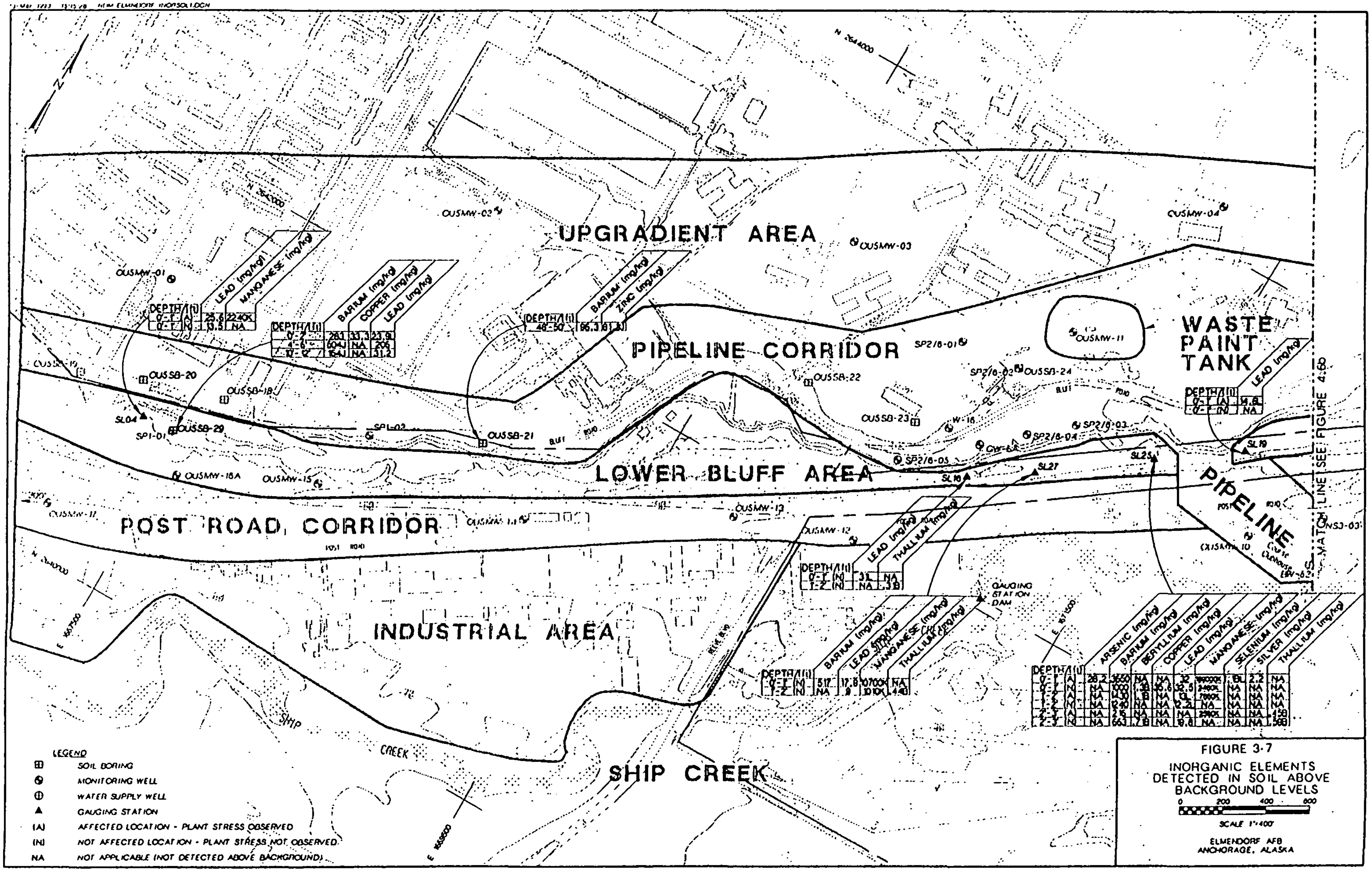


FIGURE 3-7
INORGANIC ELEMENTS DETECTED IN SOIL ABOVE BACKGROUND LEVELS

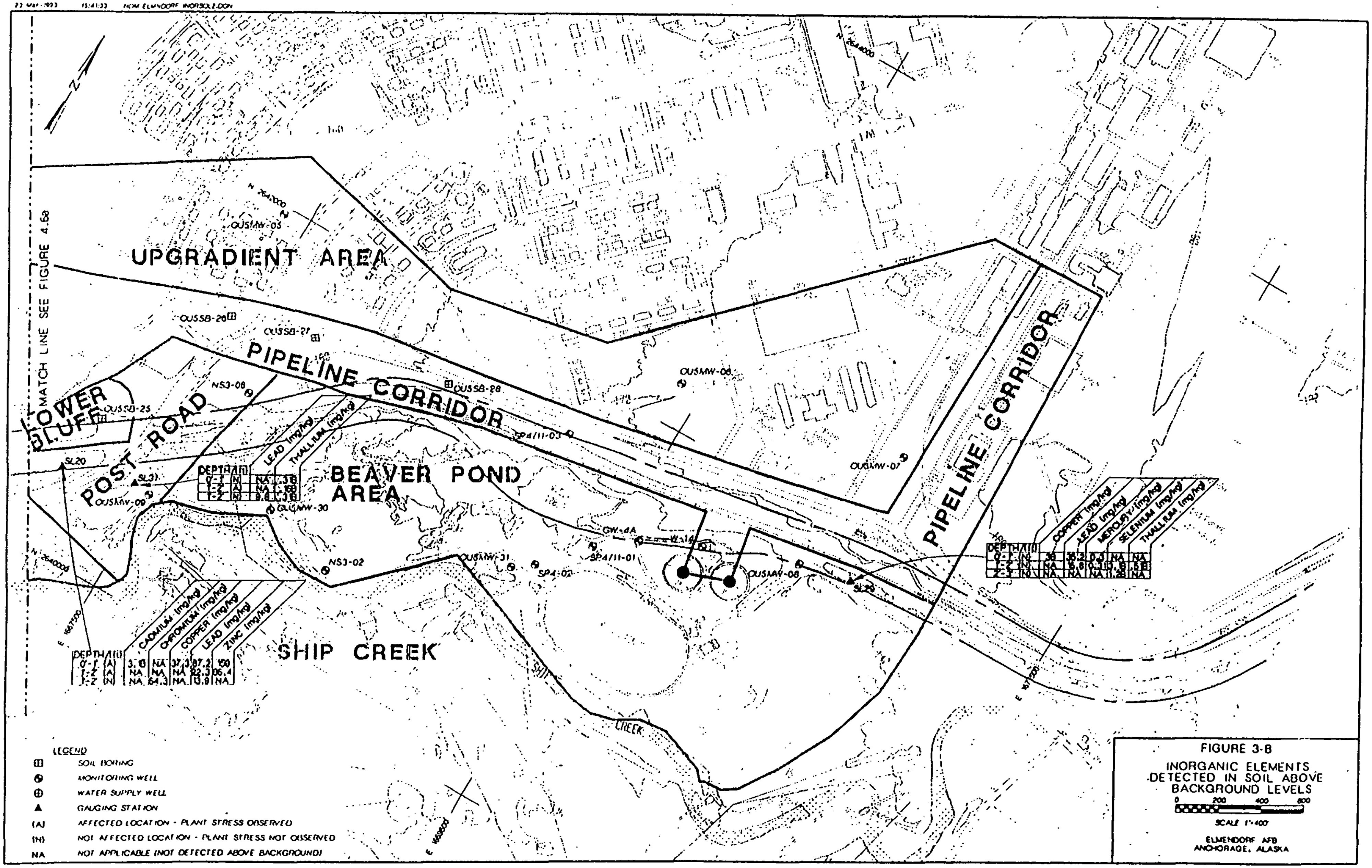


FIGURE 3-8
INORGANIC ELEMENTS DETECTED IN SOIL ABOVE BACKGROUND LEVELS

3.2 Risk Evaluation

Based on the concentrations of contaminants detected during the RI, human health and environmental risk assessments were performed to determine if areas should be considered for remedial action. All concentrations of contaminants, including all potential contaminants of concern, whether exceeding Applicable or Relevant and Appropriate Requirements (ARARs) (discussed later) or not, were included in the risk assessments.

Human Health Risk Assessment (HRA)

By determining under what land use conditions people are potentially exposed to what chemicals, for how long, and by what pathways of exposure, the cancer and noncancer risks were determined in the RI/FS.

Exposed Populations and Exposure Pathways—Listed below are four possible exposure pathways to contamination. Details on the parameters used in the Health Risk Assessment are shown on Table 3-4.

- **Residential (Current and Future Potential).** The HRA evaluated exposure of residents to contaminated surface soil through direct contact (incidental ingestion and dermal absorption) and inhalation of dusts. Their exposure to lower and upper aquifer groundwater through inhalation (showering), ingestion, and dermal contact (showering) was also evaluated.

- **Current and Future Short-Term Workers.** The HRA evaluated exposure of workers to contaminated subsurface soil through direct contact (dermal absorption and incidental ingestion) and inhalation of vapors from the soil.

- **Exposure of Current and Future Recreationalists (Children).** Exposure of children was evaluated with respect to contaminated sediment (ingestion and dermal absorption) and contaminated surface water (ingestion, dermal absorption, and inhalation of volatiles from surface water).

Table 3-4

Parameters Used in the Risk Assessment

Exposure Parameters	Pathway					
	Subsurface Soil	Surface Soil		Groundwater		Surface Water
	RME	RME	Average	RME	Average	RME
Exposed Individual	Trench Worker	Resident		Resident		Recreational User
Body Weight (kg)	70	15 (0-6 yr) 70 (>6 yr)	70	70	70	35
Soil Ingestion Rate (mg/day)	480	200 (0-6 yr) 100 (>6 yr)	100	NA	NA	NA
Exposed Skin Surface Area (cm^2)	5,000	5,800	5,000	23,000	20,000	3,900 Sediment 10,000 Water
Adherence to Skin Factor (mg/cm^2)	1.0	1.0	0.2	NA	NA	1.0
Days/year exposed (Inhalation and Ingestion)	24	350	275	NA	NA	NA
Years exposed	5	30	9	30	9	5
Days/year exposed	NA	350	40	350	275	26
Dust inhalation rate (m^3/day)	NA	20	20	15	15	NA
Particulate concentration (μg/m^3)	NA	50, 30	50, 30	NA	NA	NA
Water Ingestion Rate (L/day)	NA	NA	NA	2	1.4	0.05
Time in Water (min/day)	NA	NA	NA	15	10	60
Sediment Ingestion Rate (mg/day)	NA	NA	NA	NA	NA	100

- **Exposure of Recreationalists.** The HRA evaluated recreationalists' exposure to contaminants through the consumption of fish caught in Ship Creek.

Exposure Assumptions—Risk can be calculated both for the average exposure and the reasonable maximum exposure (RME) of the population. All chemicals detected during sampling were evaluated as potential sources of cancer and noncancer health risks. In the case of metals, risks were only calculated if the metals concentrations exceeded background concentrations. Average exposure risks were assessed using the arithmetic average concentration at the site. RME risks were assessed using the 95% upper confidence limit of the arithmetic mean concentration in soil, sediment, surface water, or groundwater in subareas such as the beaver pond wetland area.

Conservative assumptions were used to avoid underestimating risk. For example, the HRA assumed that future residents would live where the contaminants are located and they would drink and shower with the contaminated, upper aquifer groundwater. This is a highly conservative assumption since the topography of the bluff and wetlands at the base of the bluff would not allow for construction of residences along the bluff where contamination is greatest. In addition, the upper aquifer is unlikely to be used as a water supply because of its poor yield relative to the lower, confined aquifer.

Using exposure levels and standard values for the toxicity of contaminants, excess lifetime cancer risks (ELCRs) and hazard indices (HIs) were calculated to describe cancer and noncancer risks, respectively. The ELCR is the additional chance that an individual exposed to site contamination will develop cancer during his/her lifetime. It is expressed as a probability such as 1×10^{-6} (one in a million).

The HI estimates the likelihood that exposure to the contamination will cause some negative health effect. An HI score above one indicates that some people exposed to the contamination may experience at least one negative health effect.

ELCRs and HIs were calculated using Reference Doses (RfDs) and Cancer Slope Factors (CSFs) which represent the relative potential of compounds to cause adverse noncancer and cancer effects, respectively.

Two sources of RfDs and CSFs were used for this assessment. The primary source was Integrated Risk Information System (IRIS) database, the U.S. EPA repository of agency-wide verified toxicity values. If a toxicity value was not available through IRIS, then the latest available quarterly update of the Health Effects Assessment Summary Tables (HEAST) issued by the U.S. EPA's Office of Research and Development was used as a secondary source. For some chemicals detected at OU 5, no toxicity value from IRIS or HEAST was available, and toxicity values were provided by the U.S. EPA Region X as provisional RfDs and cancer slope factors.

Table 3-5 summarizes the highest human health risks discovered in the HRA. The risks are based on exposure to soil and groundwater. Locations where the risk exceeds 10^{-6} (i.e., 10^{-4}, 10^{-5}) are shown on Figure 3-9. At two locations in the central part of the OU groundwater quality exceeds standards, but risk was less than 10^{-5}. The only scenario that generates a noncancer HI value exceeding one, or total excess lifetime cancer risks greater than 1×10^{-4}, is when future residents ingest the upper aquifer groundwater in the western area of OU 5 for 70 years. For ingestion of upper aquifer groundwater extracted along the base of the bluff, the estimated risks are largely due to arsenic and manganese which are thought to naturally occur at elevated concentrations.

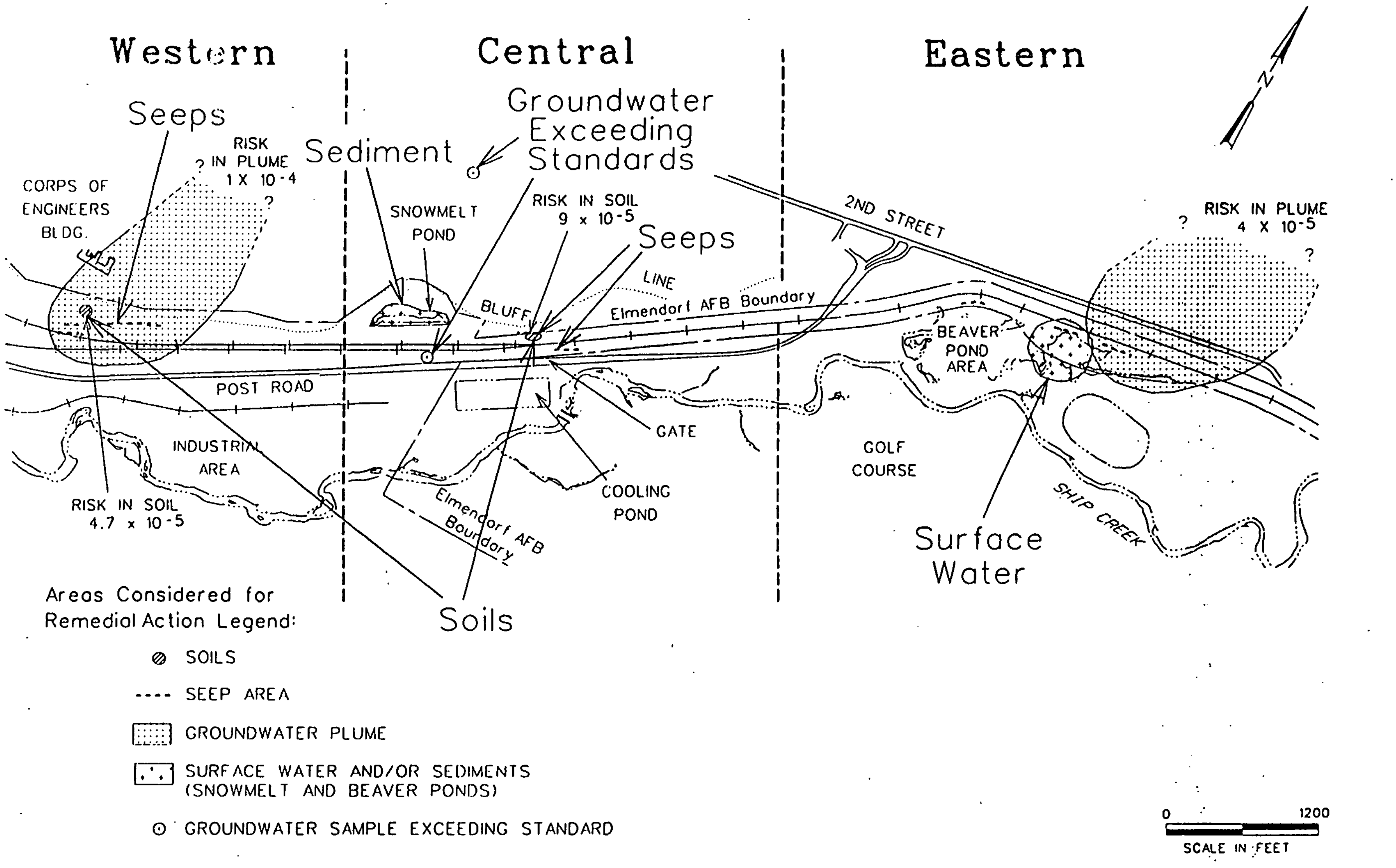


Figure 3-9. Human Health Risk in OU 5

Table 3-5. Human Health Risks

Media	Location	Cumulative Risk	Chemical(s) Driving the Risk
Soil	Western Area	4.7×10^{-5} ELCR[a], HI <1	Arsenic, PAHs
	Central Area	9×10^{-5} ELCR[a], HI <1	Arsenic
Groundwater	Western Plume	1×10^{-4} ELCR[a], HI = 3	Arsenic, gasoline, manganese, diesel fuel, and benzene
	Eastern Plume	4×10^{-5} ELCR[b], HI < 1	Gasoline, TCE

[a] Excess lifetime cancer risk, assumed future resident, 70 years of exposure by ingestion.
[b] Assumed future resident, 70 years if inhaling vapors while showering.

The risk was calculated using assumptions regarding exposure pathways and the time receptors, including humans and animals, were exposed to the contaminants. Constant exposure was assumed over a lifetime. This is a conservative approach that may overestimate the actual risk. Risk management decisions were made considering the uncertainty in the assumptions used in the risk assessment. At OU 5 the shallow groundwater is not used and is not expected to be used in the future, so existing risks and potential risks are significantly less than the worst-case risk.

Environmental Risk Assessment (ERA)

The ERA did not link particular contaminants to specific ecological impacts. However, it identified potential risks to the environment and environmental receptors which may have been affected by contaminants. The risk is calculated using an equivalency factor and specific risk numbers are not calculated. Detected concentrations are compared to critical concentrations published in the literature.

The ecological risk at the snowmelt pond was determined by comparing PCB concentrations and associated TOC data with sediment quality criteria for the protection of aquatic life. The PCB standard is variable, depending on the TOC. The higher the TOC, the more the PCBs are bound to the sediment, and are not available for uptake by receptors.

The most specific correlation between environmental risk and particular contamination is at the snowmelt pond. Waterfowl such as dabblers are the only potential receptors. Sediment contaminated with PCBs at 1.16 mg/kg (the highest concentration found) could pose a risk to ducks if they dig with their beaks in the pond sediments. Fish are not found in the snowmelt pond.

In general, animals could be exposed to contaminants through the soil gas they breathe while burrowing, the plants they eat, and the dermal contact they have with media contaminated by fuels. Plants could potentially be affected by contamination. The RI/FS determined that plant stress exists in OU 5, but was probably not caused by identified contaminants in the OU. The stress is probably due to natural conditions. The ERA did not discover any impacted endangered species or endangered species habitat.

Uncertainties Associated with the Risk Assessment

Risk assessments involve calculations based on a number of factors, some of which are uncertain. The effects of the assumptions and the uncertainty factors may not be known. Usually, the effect is difficult to quantify numerically, so the effect is discussed qualitatively. Some of the major assumptions and uncertainty factors associated with the risk assessment are the following:

- The assessment used EPA Region 10 default exposure parameters for most calculations. Some of these parameters are not realistic for a subarctic climate (May overestimate risk).
- Existing concentrations are assumed to be the concentrations in the future. No reduction through natural degradation and attenuation over time is taken into account (May overestimate risk).
- No increase through additional contamination is assumed (May underestimate risk).
- Potential degradation products of existing organic contaminants are not considered (May overestimate or underestimate risk).

3.3 Established Final Contaminants of Concern (COCs) and Cleanup Levels

Final COCs were developed from the results of the risk assessment and by considering regulatory standards. The final COCs are shown on Table 3-6 along with the maximum detected result. The basis for identifying the COC (risk or regulatory standard) is identified. The cleanup levels that will be achieved by the remedial action at OU 5 are also shown on Table 3-6.

3.4 Summary

Actual or threatened releases of hazardous substances from OU 5, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

Table 3-6

Final Contaminants of Concern and Cleanup Levels

Contaminant	Maximum Concentration	Basis for COC	Clean Up Level	Basis for Clean Up Level
Groundwater				
TCE	52 μg/L	Contributes to a risk > 10^{-5}	5 μg/L	MCL[a]
Benzene	8.5 μg/L	Contributes to a risk > 10^{-5}	5 μg/L	MCL[a]
TFH Diesel	290 μg/L	Contributes to a risk > 10^{-5}	10 μg/L	Alaska Water Quality Standards[b]
TFH-Gas	700 μg/L	Contributes to a risk > 10^{-5}	10 μg/L	Alaska Water Quality Standards[b]
Surface Water				
Sheen	Sheens exists	Water Quality Standard	No sheen	Alaska Water Quality Standards[b]
TFH-Gas	400 μg/L	Water Quality Standard	10 μg/L	Alaska Water Quality Standards[b]
JP-4	770 μg/L	Water Quality Standard	10 μg/L	Alaska Water Quality Standards[b]
Soil				
TFH-Diesel	1,160 mg/kg	Threat to groundwater	1,000 mg/kg	Alaska Cleanup Matrix Level C[c]

[a] 40 CFR Part 131, and 18 ACC Chapter 70.010a and d, 70.015 through 70.110, 18 AAC 80.070.

[b] 18 AAC 70.020. Based on ecological risk (protective of aquatic resources).

[c] 18 AAC 78.315.

4.0 REMEDIAL ACTION OBJECTIVES, ALTERNATIVES, AND COMPARATIVE ANALYSIS

4.1 Remedial Action Objectives

Specific remediation alternatives were developed and evaluated for the areas with potential risk and that exceeded the cleanup levels identified in Section 3.3. Specific remedial action objectives are:

- Protect human health and the environment by preventing ingestion and contact with contaminated groundwater by people and preventing animal contact with contaminated seep water;
- Use treatment techniques whenever practicable;
- Implement a solution that is capable of managing impacts from upgradient sources as the contaminants reach OU 5; and
- Implement a cost effective solution that can achieve the cleanup levels for the final COCs.

4.2 Alternatives

Beaver Pond Wetland Area and Snowmelt Pond Remedial Alternatives

The sediment and surface water in the beaver pond wetland area have few treatment options available that would be practical and feasible.

Natural attenuation and institutional controls would be the only response actions that would be both effective and implementable for the beaver pond wetland area. Any attempt to either contain, extract and treat ex situ, or treat surface water in situ would negatively affect the wetlands area. For example, physically removing visible sheens, dredging sediments, or processing wetland water through a treatment facility would all upset ecological balances, disturb the water flow, and/or violate potential ARARs that specify minimal disturbance of wetlands. It has been demonstrated in previous studies that the beaver pond wetland area is a viable natural wetland that can remediate contaminants entering into it.

The constructed wetland will be made by partially filling the snowmelt pond so that its average depth is 6 to 12 inches. This partial filling will isolate the PCBs in the sediments. The constructed (enhanced) wetland will expand the dimensions of the existing snowmelt pond to treat low volumes of impacted water collected from groundwater seeps at OU 5. Impacts to the existing snowmelt pond area will be minimized by the use of sediment nets. Mitigation will be accomplished by increasing the area of the snowmelt pond and by the planting of additional wetland vegetation.

The remedial alternative for the beaver pond wetlands is appropriate if the following is true:

1. The beaver pond wetland continues to actively remediate groundwater that discharges into the pond.

2. Concentrations of the COCs found at OU 5 today will not increase in the future due to upgradient impacts.

The second assumption deals with the migration of contaminants from upgradient sources.

Impacts at OU 5 from upgradient sources were evaluated in a three dimensional flow and transport model. The purpose of the model was to predict the future concentrations of benzene and TCE in OU 5. These two compounds are the primary risk drivers at OU 5 and each has sources upgradient of OU 5. Figures 4-1 and 4-2 show benzene concentrations across Elmendorf AFB currently and in 10 years. Figures 4-3 and 4-4 show TCE concentrations currently and in 10 years over the same geographical area. These figures show that the concentrations of benzene and TCE in the groundwater that come from upgradient sources are predicted to decrease in OU 5 over time.

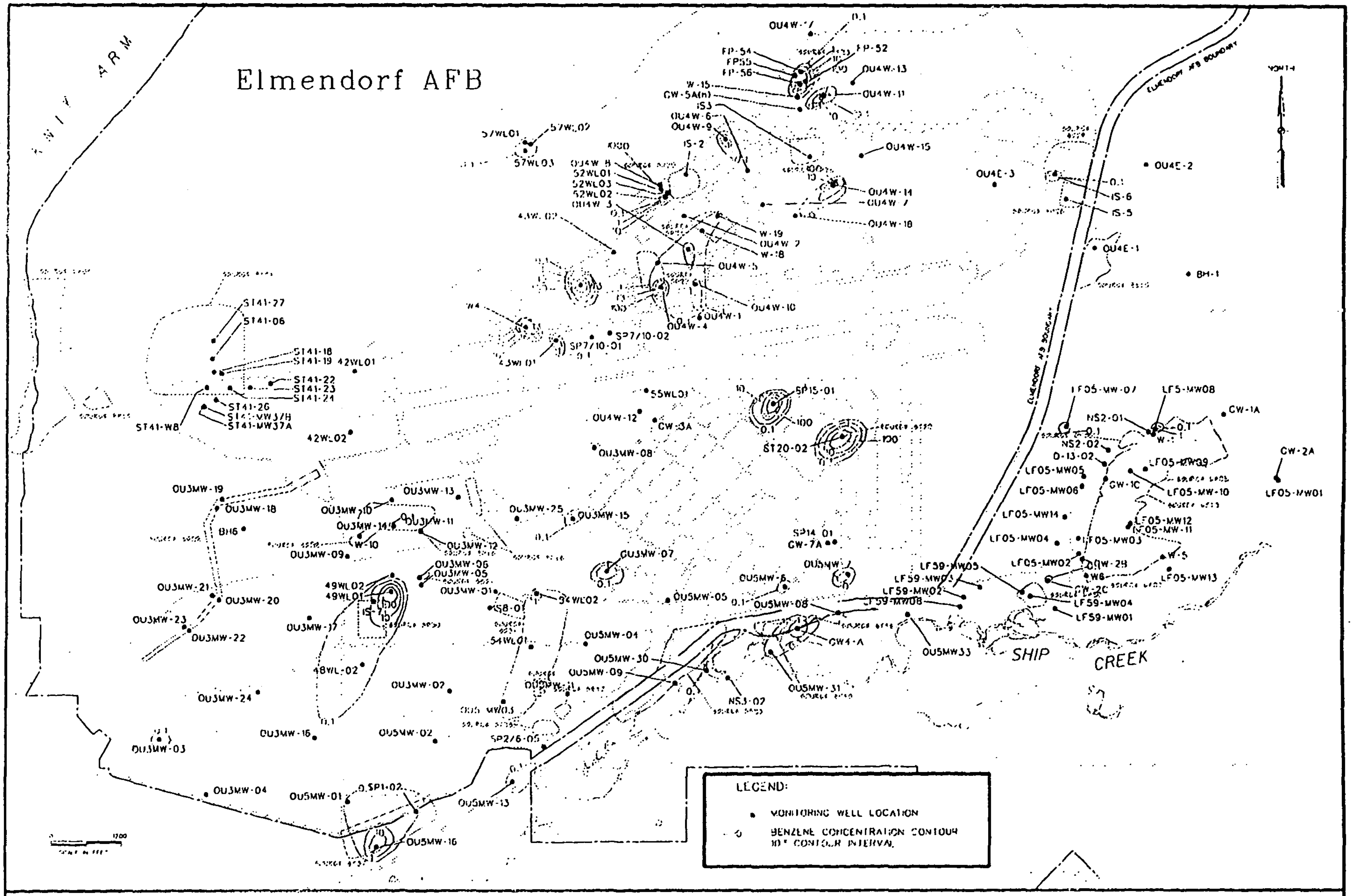


Figure 4-1. Elmendorf AFB Benzene Concentrations at the Water Table (Present)

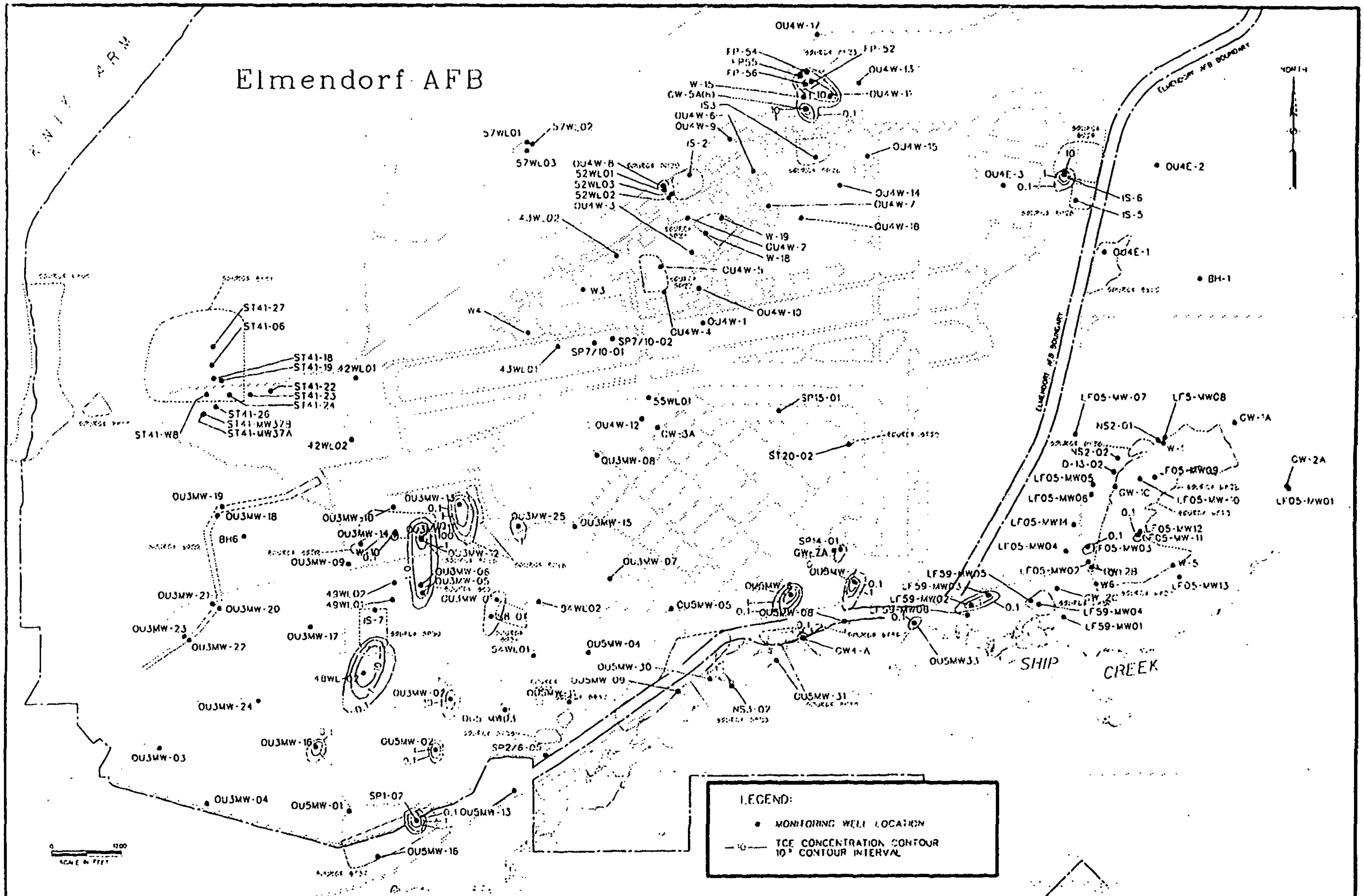


Figure 4-2. Elmendorf AFB TCE Concentrations at the Water Table (Present)

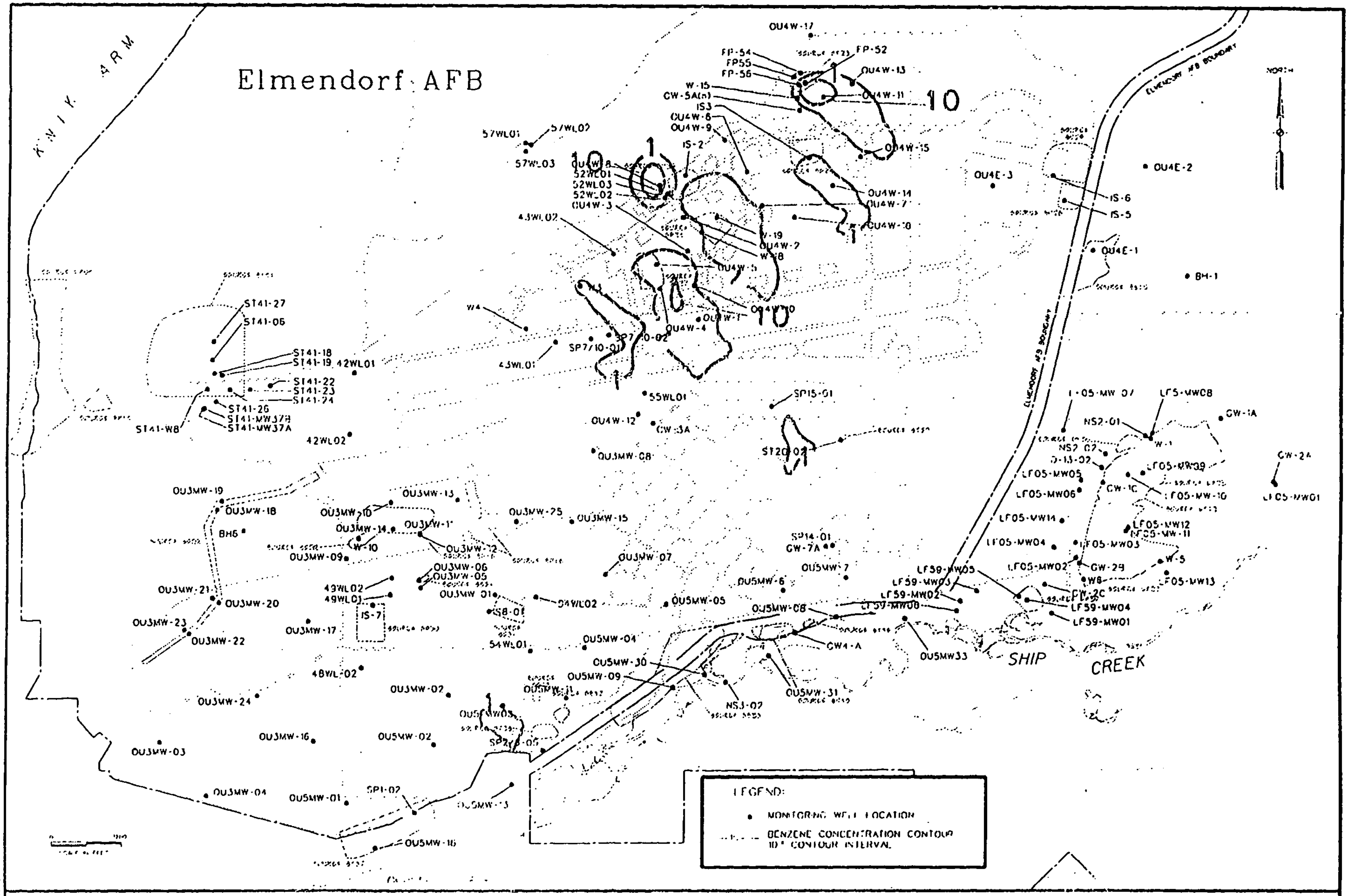


Figure 4-3. Elmendorf AFB Benzene Concentrations at the Water Table (10 Years)

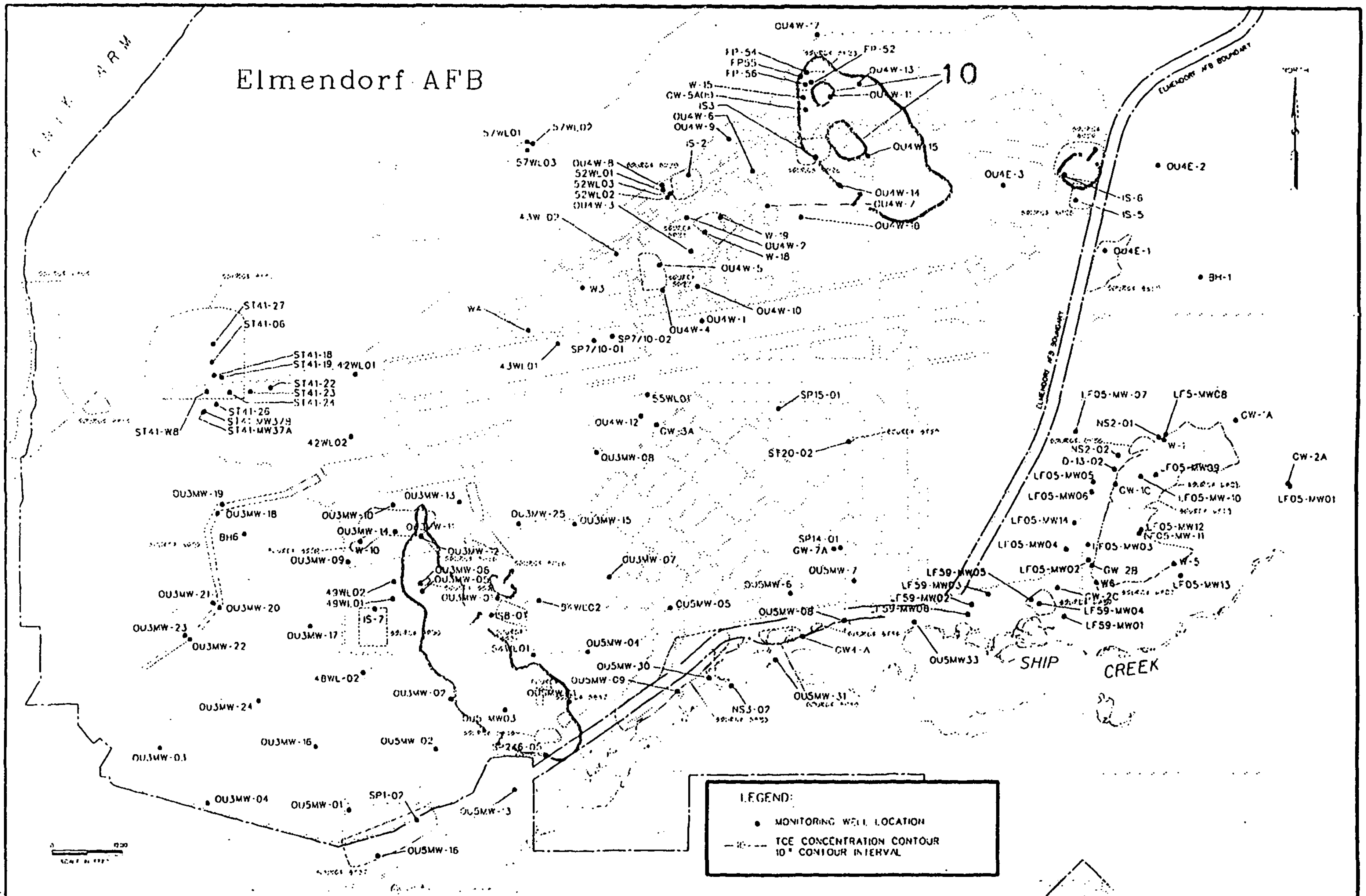


Figure 4-4. Elmendorf AFB TCE Concentrations at the Water Table (10 Years)

The concentration contours on the year 10 figures show lower concentrations than in figures for earlier years; however, the areas affected appear larger than the plumes shown on the current year figures. Some of the increase in affected area is due to migration, but the apparent increase in plume size is also due to the method used to develop the plume contours. The current year plume contours were drawn by hand, interpreting the extent of contamination based on the distribution of concentrations. The year 10 contours are computer generated using the model output. Data are plotted on a much tighter grid using the model output. Also the model interpolates data and projects migration from a source to a model grid node. These two factors associated with the model make a plume look larger than if drawn using professional experience and judgment.

A sensitivity analysis was run on the model to determine if changes in the model assumptions could result in a different conclusion. For example, if no natural degradation of TCE occurs, could conditions possibly degrade at OU 5? The model was run with no TCE degradation and the results show that, in the 5- to 10-year horizon, the concentration of TCE increases and impacts OU 5. Thereafter, TCE concentrations will decline. This finding is not realistic because the TCE was released 10 to 20 years ago. If there were no natural attenuation the concentrations of the COCs would be higher at OU 5 than revealed by the RI. Another sensitivity analysis run on the model was to determine the effect on OU 5 if the source areas contribute contaminants for 30 years. With this change in assumptions, the model predicted that conditions at OU 5 would not degrade in the future. Concentrations of TCE would slowly attenuate over 15 to 20 years, a longer period than if sources ceased contributing contaminants in 5 years.

The model results show that the assumption that impacts will not increase at OU 5 is reasonable.

Identification of Remedial Action Alternatives

To identify a remedial action alternative that could best achieve the objectives, ten media specific options were identified. These options included no action, excavation, pumping, passive extraction, treatment (e.g., granular activated carbon), bioventing, biological treatment, institutional controls, air sparging, and wetland treatment. These options were combined in the FS into 32 multimedia alternatives. Each alternative was evaluated against the first seven CERCLA evaluation criteria. Though there are 32 alternatives, many are only slightly different from each other. To simplify the comparative analysis, the 32 alternatives were grouped into four alternatives that represent the primary actions that could be taken.

Except for the no action and natural attenuation alternatives, the cost of each alternative includes 30 years of monitoring groundwater and surface water, including Ship Creek, the beaver pond wetland area, and influent and effluent of treatment systems, for the contaminants of concern. This monitoring assumption is worst case and includes the cost for a hypothetical monitoring program. The actual monitoring program will be developed as part of the design of the selected alternatives. The actual number of locations that will be monitored could be less than the worst case hypothetical assumption and actual costs would probably be lower than those presented in this ROD. However, any changes in costs would affect all alternatives and would not affect the alternative selection process. A 7% discount rate was assumed in calculating present worth cost. Any expense of using or acquiring land not owned by the Air Force is not included in the cost estimates. The four alternatives are as follows:

1. No Action

No Cost

Evaluation of this alternative is required by CERCLA as a baseline reflecting current conditions without any clean up. This alternative is used for comparison with each of the alternatives. While natural processes should degrade and reduce the concentrations of the chemicals of concern to acceptable levels, this alternative does not include any long-term monitoring. There are no costs associated with this alternative. Time frame until cleanup goals are achieved cannot be determined.

2. Natural Attenuation with Institutional Controls for Groundwater and Beaver Pond Wetlands Area/Passive Extraction with a Constructed Wetland for Groundwater Seeps/Isolation of Snowmelt Pond Sediments/Excavation, Biopiling, and Backfilling for Soil

Estimated Capital Costs:	$0.8 million
Annual Cost:	$0.08 million
Present Worth Cost:	$1.6 million
Time to Complete Clean Up:	20 years
Discount Rate:	7%
Cost Accuracy:	-30 to +50%

Groundwater would be remediated by natural processes that break down and dilute contaminants. In addition, institutional controls in the form of deed restrictions would prevent future use of the contaminated water. The Air Force would continue to monitor groundwater quality and would regularly update off-base land owners of the monitoring results. If there is any indication that contamination is getting worse, the remedial actions would be reevaluated and additional action would be taken if necessary.

Seep water would be passively extracted by natural flow with passive extraction wells and collection systems from the upper aquifer before it reaches the groundwater seeps. Thus, the groundwater seeps would be eliminated. The contaminated water would be channeled to the snowmelt pond where engineered wetlands would be constructed. Biological processes would remove most of the contaminants from the water. The treated water would flow from the constructed wetlands into a drainage ditch. Tests to determine treatment effectiveness would be necessary. The engineered wetland would also isolate the snowmelt pond sediments. This alternative would treat all the contaminated seep water except the seep water flowing into beaver pond wetland area. Treatment of those groundwater seeps must rely on natural attenuation to avoid damaging the wetland habitat.

About 1,500 cubic yards of soil would be excavated from both of the areas with surface soil contamination (see Figure 3-9). Much of this soil would have to be removed to install the passive extraction wells. The holes would be backfilled with treated soil or clean soil. The contaminated soil would be transported to the eastern end of the base to the existing biopiling system.

Biopiling involves supplying air and required nutrients to a soil pile to maximize natural degradation. Degradation of contaminants would be monitored to document the breakdown rate and confirm that cleanup levels are being met. The treated soil would be used on base for fill after cleanup levels are achieved. It would take approximately 4 months to remove the contaminants from the excavated soil by biopiling.

3. **Active Extraction** for Groundwater and Groundwater Seeps/Natural Attenuation for Beaver Pond Wetlands Area/Natural Degradation with Institutional Controls for Soil/Isolation for Snowmelt Pond Sediments

Capital Costs:	$2.5 million
Annual Cost:	$2.1 million
Present Worth Cost:	$28.4 millon

Time to Complete Clean Up: 30 years
Discount Rate: 7%
Cost Accuracy: -30 to +50%

Water would be pumped from the aquifer and near the groundwater seeps through wells that would be installed. The water would flow into an air stripper (system to volatilize contaminants) where the contaminants would be transferred to the air. The air carrying the contaminants would then be filtered by an activated carbon system. Activated carbon would be disposed at an U.S. EPA-approved RCRA facility. Finally, the water would be discharged into the aquifer at the base of the bluff. Separate systems could be used in different areas. This system would remove more water than passive extraction, which allows it to treat both the groundwater seeps and the groundwater.

Natural degradation would remediate the soil contamination and institutional controls would restrict access by humans.

4. Air Sparging with Soil Vapor Extraction for Groundwater and Groundwater Seeps/Natural Attenuation for Beaver Pond Wetland Area/Bioventing for Soil/Isolation for Snowmelt Pond Sediments

Capital Costs: $2.9 million
Annual Cost: $1.8 million
Present Worth Cost: $24.8 million
Time to Complete Clean Up: 30 years
Discount Rate: 7%
Cost Accuracy: -30 to +50%

This system would volatilize the groundwater contaminants while they are in the ground. Compressed air would be pumped into the areas with contaminated groundwater through wells that would be installed. The bubbling air would separate contaminants from the groundwater by volatilizing them into the soil vapor. A soil vapor extraction system would then remove the contaminant-carrying vapors from the soil, so that the contaminants can be adsorbed by activated carbon. Finally, the activated carbon is disposed at an U.S. EPA-approved RCRA facility. Breakthroughs (leaks of contaminant-carrying air) are possible in the lower bluff area and near the bluff face. Tests to determine treatment effectiveness would be needed. The Air Force might need to get permission from landowners to install this system on privately owned land below the bluffs.

Soil would be treated by bioventing. This process would add oxygen into the soil to enhance the growth of natural microbial populations that feed on the organic contaminants. A blower would force air into contaminated soil via wells. Nitrogen and phosphorous could be added to stimulate bacterial growth and contaminant destruction. Soil sampling would be needed to ensure that cleanup levels were being achieved. It is uncertain how long it would take to clean up the contamination. Bioventing may require pumping out groundwater to lower the water table near the contaminants if the water table is too close to the contaminated soil.

4.3 Summary of Comparative Analysis of Alternatives

The comparative analysis describes how each of the four alternatives meet the CERCLA evaluation criteria relative to each other. Because the beaver pond wetland area and snowmelt pond remedial alternatives will be included in any selected alternative, the comparative analysis focuses on areas which are not addressed by these remedies.

4.3.1 Threshold Criteria

Overall Protection of Human Health and the Environment. Alternative 4 would provide the greatest protection of human health and the environment because groundwater, groundwater seeps, and soil would all be actively treated to acceptable cleanup levels. Alternative 3 is slightly less protective since soil is not actively treated.

Environmental receptors would continue to be exposed to surface soil contamination until it is remediated by natural degradation.

Alternative 2 would provide nearly as much protection as Alternatives 3 and 4 by actively treating groundwater seeps and soil, the contamination most likely to impact human health and the environment. Currently, there are no environmental or human receptors of upper aquifer groundwater. Institutional controls for groundwater in Alternative 2 would ensure that people will not be exposed to upper aquifer groundwater in the future.

Alternative 1 would not be as protective because people and environmental receptors would continue to be exposed to contaminated soils and groundwater seeps until contaminants in these media degrade to acceptable levels.

Natural processes would take longer to remediate the soil and, without monitoring, the progress of the natural attenuation and accompanying reduction in risk could not be assessed. In addition, Alternative 1 leaves open the possibility that future base personnel and residents might use contaminated upper aquifer groundwater.

Compliance with ARARs. Compliance with ARARs would be achieved for Alternatives 3 and 4 which actively treat contaminants in all impacted media. The time to achieve cleanup levels is uncertain but is predicted to be less than 15 years. Alternatives 1 and 2 would comply with applicable cleanup regulations for groundwater and would likely achieve cleanup levels within 15 to 20 years, based on the groundwater model.

Alternative 1, the no action alternative, would not comply with ARARs for soil. In addition, without monitoring, there would be no way to determine when, or if, cleanup levels had been achieved in either soil or groundwater.

4.3.2 Primary Balancing Criteria

Long-Term Effectiveness and Permanence. All alternatives could be effective in the long term. The model predicts that natural attenuation would be effective and will remediate to the cleanup levels. Once cleanup levels are met, remediation will be permanent. None of the alternatives would be expected to produce toxic by-products.

Reduction in Toxicity, Mobility, and Volume through Treatment. Treatment for this criteria is assumed to mean processes other than those which would naturally occur. Alternative 4 would reduce the volume of contaminants through treatment to a greater degree than other alternatives because it would actively treat contaminated soil, groundwater, and groundwater seeps. Alternatives 2 and 3, both of which employ active treatment on two media, would provide slightly less reduction through treatment. Alternative 1, which would not actively treat any media, would not meet this criteria.

Short-Term Effectiveness. Short-term effectiveness is primarily affected by whether alternatives would reduce risk in the short term and the degree to which alternatives can be implemented immediately without causing negative side effects on the environment. Alternatives which actively treat water or restrict its use reduce risk faster than alternatives which solely rely on natural attenuation.

Alternatives that negatively impact the environment during implementation are not effective in the short term. This is the case with remedial alternatives that affect the beaver pond wetlands. Pumping water from the pond or interception of groundwater that feeds the wetland would ruin the existing natural habitat. For this reason, natural attenuation is the selected remedy for the wetlands. Natural attenuation is relatively effective in the short term since implementing natural attenuation is the only alternative which causes no impact to the wetland while providing monitoring necessary to be sure cleanup levels are being met. The study of the beaver pond wetlands showed that it is a healthy functioning system, and is currently managing contaminants entering the wetland through groundwater flow, by natural physical, chemical, and biological processes.

Alternative 2 would be the most effective in the short term. Groundwater use restrictions and soil and seep treatment would immediately reduce risk to humans and the environment. Soil treatment could be completed within a year.

Alternative 4 would be fairly effective in the short term. Once implemented, soil treatment could be completed within a year and its active extraction of groundwater could expedite contaminant removal compared to natural attenuation. A treatability study for bioventing would be necessary. More important, to implement bioventing in shallow soil below the bluff some of the shallow aquifer might have to be dewatered. This would cause short-term damage to wetland environment in the area.

Similarly, the short-term effectiveness of Alternative 3 would be reduced because active extraction of groundwater would negatively affect the wetland environments. In addition, this alternative would rely on natural attenuation of soil which would not reduce the impact of soil contaminants on environmental receptors.

Alternative 1 would be the least effective alternative in the short term because it would not take immediate steps to reduce risks and would require the longest time to achieve cleanup levels.

Implementability. As discussed above, Alternatives 2, 3, and 4 would require treatability studies before they could be implemented. Alternative 2 also requires access to non-Air Force property to construct a wetland in the snowmelt pond. Alternative 3 would be the most difficult to implement because treated water could not be easily discharged into the shallow groundwater in the area below the bluff. Alternative 4's implementability would also be limited by the need to dispose of or regenerate activated carbon. Alternative 2 would be simpler to implement than Alternative 3 and 4; since the technology is not complex, the treatment options do not involve discharges of large volumes of water, disposal of captured contaminants, or other technical obstacles to implementation. Alternative 1 would be the easiest alternative to implement since no actions are involved.

Cost. Estimated capital costs, and annual operational and maintenance (O&M) cost, are shown in the description of alternatives. The present worth is the capital and O&M cost over a 30-year period using a discount rate of 7 percent. The costs are accurate to within -30% to +50% of the actual costs. Alternative 1 has no cost while active alternatives (Alternatives 3 and 4) have the highest costs. Alternative 2 has a relatively moderate cost.

4.3.3 Modifying Criteria

State Acceptance. The State of Alaska concurs with the Air Force and U.S. EPA in the selection of Alternative 2.

Community Acceptance. Based on the comments received during the public comment period, the public has no preference of alternatives. One letter raised concern about implementing alternatives on land not owned by the Air Force. Locating the wetland in the snowmelt pond is the current engineering concept because of its location and existing water balance conditions. There is also the beneficial result of isolating the PCBs in the sediment of the pond if the wetland is built at this location. Another comment described using electromagnetic/radio frequency technology to treat soil. The technology described would be a viable solution comparable to the alternatives with active treatment (Alternatives 3 and 4). These alternatives have high cost to benefit ratios (high cost for the incremental benefit). The third comment supported Alternative 2.

5.0 SELECTED REMEDY

The selected remedy is Alternative 2 because it best meets the nine CERCLA criteria. It protects human health and the environment and complies with ARARs. It is effective at reducing contamination both in the short term and long term, and is implementable, cost-effective, and acceptable to the public and the State of Alaska. Alternative 2 provides an appropriate level of treatment to reduce risks and comply with ARARs. Other alternatives do not meet the CERCLA criteria as well as Alternative 2. Alternatives 3 and 4 provide little additional environmental benefit, especially relative to risk reduction in Alternative 2, which is the most cost effective of the four alternatives.

Alternative 2 was selected because it best provides the following specific benefits at OU 5:

- Existing habitat in the beaver pond wetlands area is preserved. The monitoring will ensure that the current health state of the wetlands is being maintained and improved as contaminant concentration levels are decreasing.

- The habitat in the snowmelt pond will be improved from an open pond to a vegetated wetlands system. This alternative is consistent with the city of Anchorage's land-use plan that calls for the snowmelt pond to be a greenbelt preservation area.

- The pathway for PCBs found in the snowmelt pond sediment is broken by constructing the wetland in this off-base location.

- The impacts from seep water are isolated, thus protecting wildlife and plants. Collecting the water protects surface water bodies. This action prevents the spread of contaminants on the land surface.

- Shallow contaminated soil source areas potentially contributing contaminants to groundwater are removed.

- Institutional controls will eliminate risk to human health by ensuring that contaminated upper aquifer groundwater will not be consumed by people until cleanup levels (MCLs for benzene and TCE, see Section 3.3) are met.

- The remedy is appropriate because fuel pipes are regularly maintained. The pipelines and tanks are hydrostatically tested annually and pressure tested under higher pressures triannually.

Specific components of the selected remedy are illustrated in Figure 5-1 and consist of the following:

Groundwater

(1) Institutional controls on land use and water use restrictions will restrict access to the contaminated groundwater throughout OU 5 until cleanup levels listed in Table 3-6 have been achieved.

(2) Groundwater will be monitored to estimate the rate of natural attenuation, to provide an early warning of potential off-site contaminant migration, and to ensure protection of human health and the environment.

Seeps

(1) Seep water will be passively extracted from areas of contamination along the western and central bluffs. The water will be drained to the constructed wetland where enhanced natural chemical, physical and biological processes will reduce contamination to below cleanup levels. The location of the constructed wetland will be determined in the Remedial Design phase. If it is located at the snowmelt pond, the recommended site, a layer of permeable material will be placed over pond sediment. Baffles would be installed to control the flow of water and maintain retention time and native vegetation will be put in place to help degrade contaminants.

(2) Water will be monitored near the exit of the constructed wetland to ensure that the wetland is reducing concentrations to below the Alaska water quality standards specified in Table 3-6.

(3) Natural attenuation will be relied upon to treat seep and surface water in the beaver pond wetland area.

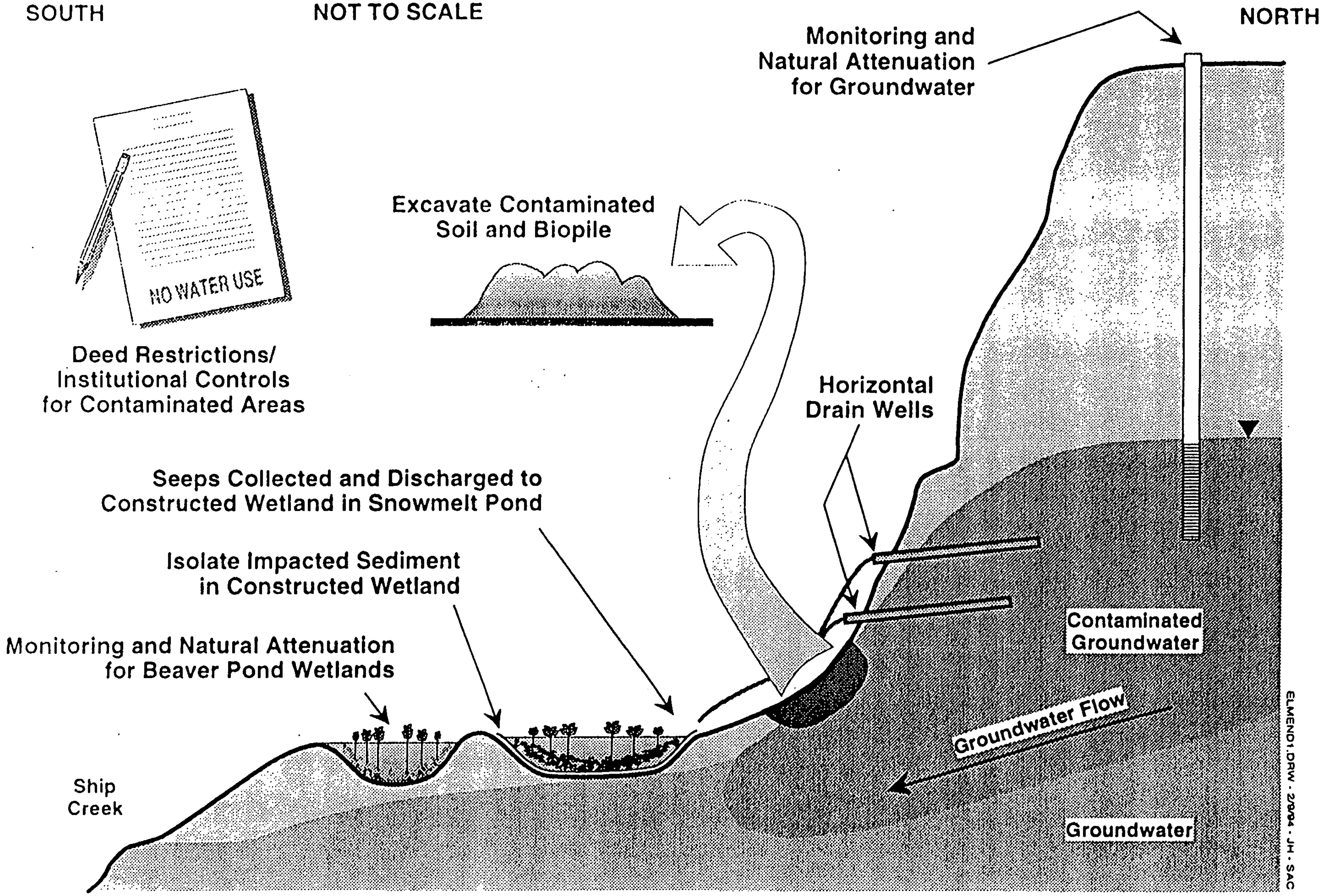


Figure 5-1. Selected Remedy

(4) Water from the seeps and beaver pond wetland areas will be monitored to estimate the rate of natural attenuation and make sure that contamination does not reach Ship Creek.

Soil

(1) Approximately 3,000 cubic yards of contamination soil near the ground surface will be excavated in the western and central areas and transported to an on-base treatment facility. The treatment facility will be selected in the Remedial Design phase; biopiling is currently being considered.

(2) Soil removed from the areas of contamination will be replaced by treated soil or clean fill from on base.

(3) Soil in the treatment facility will be monitored for contaminant concentration reduction. When the concentrations are below cleanup levels, the soil will be removed and used as fill around the base.

The remedy will be implemented after the Remedial Design has been completed. The Remedial Design is currently in progress. It is expected that the remedy will be implemented for 30 years, or until cleanup levels have been achieved. The actual time frame for remediation is not known but the groundwater model predicts cleanup levels will be achieved in 10 to 15 years. A 30-year planning horizon specified in U.S. EPA guidance documents is being used. Monitoring data will be regularly reviewed to assess the progress made by the selected remedy toward the cleanup levels. If problems are identified, further remedial action will be considered. The public, the State of Alaska, and the U.S. EPA will be consulted before further remedial actions are chosen.

Because the remedy will result in hazardous substances remaining on-site above health based levels, a review will be conducted within five years after commencement of remedial action. The review will ensure that the remedy continues to provide adequate protection of human health and the environment.

5.1 Statutory Determinations

The selected remedy satisfies the requirements under Section 121 of CERCLA to:

- Protect human health and the environment;
- Comply with ARARs;
- Be cost effective; and
- Utilize permanent solutions and alternative treatment technologies to the maximum extent practicable.

5.1.1 Protective of Human Health and the Environment

The selected remedy is protective of human health and the environment. The current points of exposure include surface soil, seeps, surface water, and sediment. Treatment will eliminate contamination in surface soil and seeps. An additional benefit of constructing the wetland in the snowmelt pond is that doing so would protect environmental receptors by isolating PCBs in the sediments. Natural attenuation will treat the beaver pond wetland area surface water. The Beaver Pond study showed natural attenuation would be effective and any other treatment method would pose a significant threat of doing more harm than good to the wetland environment.

There are no direct current receptors of groundwater in OU 5. Institutional controls will eliminate the risk to human health by ensuring that contaminated upper aquifer groundwater will not be consumed by people until cleanup levels (MCLs for benzene and TCE) are met. The time required to achieve MCLs is not known, but could be as short as 10 to 15 years based on the groundwater model. The three dimensional model of contaminant flow at Elmendorf AFB showed that conditions are not expected to degrade at OU 5 from sources within the OU and from sources upgradient. Over time, conditions will improve and the model predicts that cleanup objectives can be met by natural attenuation processes. Therefore, the model further substantiates that the selected alternative is protective of human health and the environment. A remediation period of 10 to 15 years is reasonable given current land use at the site.

5.1.2 Applicable or Relevant and Appropriate Requirements (ARARs)

Chemical-Specific ARAR—Chemical-specific cleanup levels for OU 5 are identified in Table 5-1. The Maximum Contaminant Levels (MCLs) established for drinking water under State and Federal laws are relevant and appropriate to groundwater contaminants of concern at OU 5 as a chemical-specific regulation. For petroleum contaminated soil that will be removed and remediated, it is relevant and appropriate to apply soil cleanup level C from Table D of 18 Alaska Administrative Code (AAC) 78.315.

Location-Specific ARARs—Requirements which must be met due to the location of the contamination and remedial actions are identified in Table 5-2. For OU 5 there are location-specific requirements for the wetland areas between the bluffs and Ship Creek. Current studies indicate that portions of OU 5 between the bluffs and Ship Creek meet the legal criteria for waters of the United States under 33 CFR Part 328.3. Although formal permits are not required, the substantive requirements under the Clean Water Act Section 404 are applicable.

Action-Specific ARARs—The selected remedy will comply with those ARARs applicable to construction of the wetlands and extraction system and to the excavation of the contaminated soil. Complying with the substantive requirements of National Pollution Discharge Elimination System (NPDES) and Alaska wastewater provisions will be necessary to allow water treated by the constructed wetlands to discharge into a drainage ditch. Action-specific ARARs are shown in Tables 5-3 and 5-4. Treated water discharged from wetlands into Alaska surface waters will be controlled to ensure that the quality of the receiving waters meets the organic standards for fresh water set forth under 18 AAC 70.020. Groundwater and groundwater seeps located at OU 5 contain naturally occurring high

Table 5-1

Chemical-Specific Applicable or Relevant and Appropriate Requirements

Contaminant	Maximum Concentration	Cleanup Level Established by ARAR	Source of Requirement
Groundwater			
TCE	52 μg/L	5 μg/L	MCL[a]
Benzene	8.5 μg/L	5 μg/L	MCL[a]
TFH Diesel	290 μg/L	10 μg/L	Alaska Water Quality Standards[b]
TFH-Gas	700 μg/L	10 μg/L	Alaska Water Quality Standards[b]
Surface Water			
Sheen	Sheens exists	No sheen	Alaska Water Quality Standards[b]
TFH-Gas	400 μg/L	10 μg/L	Alaska Water Quality Standards[b]
JP-4	770 μg/L	10 μg/L	Alaska Water Quality Standards[b]
Soil			
TFH-Diesel	1,160 mg/kg	1,000 mg/kg	Alaska Cleanup Matrix Level C[c]

[a] 40 CFR Part 131, and 18 ACC Chapter 70.010a and d, 70.015 through 70.110, 18 AAC 80.070.

[b] 18 AAC 70.020.

[c] 18 AAC 78.315.

Table 5-2

Location-Specific ARARs

Statutory, Regulatory Basis	Citation	Description
Resource Conservation and Recovery Act	40 CFR Sec. 264.18 18 AAC Sec. 63.040	Prohibits or restricts siting of hazardous waste management units in certain sensitive areas (100-year floodplain, active seismic area, wetlands).
Clean Water Act, Section 404	33 USC 1251 et seq. Sec. 404 40 CFR Part 230 33 CFR Parts 320-330	Prohibits discharge of dredged or fill material into wetlands without a permit.

Table 5-3

Action-Specific Federal ARARs
Operable Unit 5
Elmendorf Air Force Base, Alaska

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comments/ Applicability
Clean Water Act	33 USC Sec. 1251-1376		
• EPA-Administered Permit Programs: The National Pollutant Discharge Elimination System	40 CFR Part 122	Requirements for the discharge of pollutants from any point source into waters of the U.S. (surface waters)	Applicable if remedial action requires outfall discharge
• Criteria and Standards for the National Pollutant Discharge Elimination System	40 CFR Part 125	Provides discharge criteria, chemical standards, and permit forms for existing industrial operations.	Applicable to remedial actions which cause discharge to waters of the U.S.
Occupational Safety and Health Act of 1970	29 USC Sec. 657 and 667		
• Occupational Safety and Health Standards	29 CFR Part 1910	Sets standards for safety in the work environment.	Applicable to all remedial actions
• Safety and Health Regulations for Construction	29 CFR Part 1926	Sets standards for safety in the construction work environment.	
• Safety and Health Standards for Federal Service Contracts	29 CFR Part 1925	States that safety and health standards are applicable to work performed under Federal Service Contracts.	
Clean Air Act			
• National Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50	Establishes standards for ambient air quality to protect public health and welfare.	

Table 5-4

Action-Specific State ARARs and TBCs
Operable Unit 5
Elmendorf Air Force Base, Alaska

Standard, Requirement, Criteria, or Limitation	Citation	Description
Alaska Air Quality Control Regulations	18 AAC Ch. 50	Establishes emission standards for classes of air pollution sources.
Alaska Wastewater Disposal Regulations	18 AAC 72.500 - 72.600	Provides for disposal of nondomestic wastewater into or onto the land, surface water, or groundwater.
Alaska Water Quality Use Classes and Criteria	18 AAC 70.020	Provides water quality standards for freshwater uses.

background levels of inorganic substances. In determining compliance with NPDES and Alaska Wastewater provisions, additional treatment will not be required to reduce concentration in the effluent below the background concentrations set forth in Table 5-5.

5.1.3 Cost Effectiveness

The remedy is the most cost effective of the alternatives because it affords overall effectiveness proportional to its costs. The additional protection that can be achieved by actively treating groundwater in Alternatives 3 and 4 provides only marginal increases in protection of human health and the environment with a cost several times higher than the selected remedy.

5.1.4 Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The U.S. Air Force, the State of Alaska, and EPA have determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a cost-effective manner at OU 5. Of those alternatives that are protective of human health and the environment and comply with ARARs, the U.S. Air Force, the State of Alaska, and EPA have determined that the selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence, reduction in toxicity, mobility, or volume achieved through treatment, short-term effectiveness, implementability, cost (as discussed in the preceding section), and the statutory preference for treatment as a principal element and considering State and community acceptance.

All alternatives would use readily available technologies and would be feasible to construct. Alternatives 1 and 2 would be readily implementable; they require no additional remedial action beyond construction of an engineered wetland. The technologies involved in Alternatives 3 are effective and use treatment technologies, but are less implementable due to environment impacts caused by the alternatives.

Table 5-5

Maximum Allowable Effluent Discharge Based on Background Concentrations of Metals in Groundwater

Constituent	Concentration (mg/L)
Antimony	0.05
Arsenic	0.1
Beryllium	0.01
Cadmium	0.005
Chromium	0.05
Copper	0.2
Lead	0.5
Manganese	30
Mercury	0.005
Nickel	0.2
Selenium	0.1
Silver	0.01
Thallium	0.2
Zinc	0.5

The most decisive factors in the selection decision were long-term effectiveness and implementability. Alternative 2 provides the best option for cost effective and practical remediation of OU 5, because the benzene and TCE concentrations will return to background conditions in time. Alternatives 3 and 4 would reduce the concentrations of these compounds in the aquifer; however, given the fragile nature of the geochemical environment, Alternatives 3 and 4 present considerable risk of damaging the natural wetlands in OU 5. Active extraction and air sparging will affect the water chemistry and water balance of the wetlands, most likely negatively impacting the habitat in the wetlands.

5.1.5 Preference for Treatment as a Principal Element

The selected remedy satisfies this statutory preference by using a constructed wetland to remediate seeps and by on-base treatment of contaminated soils. Because of the substantial additional cost of actively treating groundwater, its potential negative effects on OU 5 hydrology, and the fact that there are no current receptors of groundwater, institutional controls and monitoring are a better way of addressing groundwater contamination than active treatment. Natural attenuation and isolation are used in areas where active treatment is impractical.

5.2 Documentation of Significant Changes

The selected remedy was the preferred alternative presented in the proposed plan. No significant changes have been made.

PART III. RESPONSIVENESS SUMMARY

Public Input in the OU 5 Selected Remedy

The primary avenues of public input have been through the Proposed Plan and public comment period. The Proposed Plan for OU 5 was issued to the public on 6 June 1994. This began a public comment period that ended on 6 July 1994. To encourage public comment, the USAF inserted a pre-addressed, written comment form in distributed copies of the Proposed Plan. The comment forms were also distributed at the 23 June 1994 public meeting, held at the Federal Building in Anchorage.

The public meeting to receive comments on the Proposed Plan was attended by 26 people including nine community members. Oral comments were received from two people: one representative from Physicians for Social Responsibility, and one citizen representing himself. Following the public meeting, and prior to the conclusion of the public comment period, written comments were submitted by four individuals.

All comments received are documented in the administrative record file for the site. A transcript of the public meeting is available for public review at the site information repositories. The repositories are located at the Bureau of Land Management's Alaska Resources Library and the University of Alaska at Anchorage's Consortium Library. Public comments, relevant to OU 5 and/or the environmental restoration program at Elmendorf, are presented below and have been paraphrased for greater clarity. This ROD is based on the documents in the Administrative Record and comments received from the public.

Response to Public Comments

Public Comment 1: There was a concern that biopile technology and intrinsic remediation may not work in this climate.

USAF Response: A study by Cold Regions Research Labs indicates that biopile technology will work in this climate. ADEC has observed a number of bioremediation projects in the Anchorage area which have been effective at remediating petroleum-contaminated sites. Some bioremediation projects in the Anchorage area have achieved ADEC Alaska Cleanup Matrix Level A cleanup standards for petroleum-contaminated soils. Level A cleanup standards require restoring the formerly contaminated soil to a point where the soil can be reused without any restrictions, limitations, or potential harmful effects to human health and the environment.

The Air Force Center for Environmental Excellence and the EPA's Kerr Laboratory are cooperatively conducting a treatability study to validate intrinsic remediation at OU 5. If the ongoing treatability study does not validate the feasibility of intrinsic remediation, then a more active remedial action will be implemented.

Also, a detailed intrinsic remediation study on the beaver pond wetland area was done in 1993 to determine if natural physical, chemical, and biological processes destroy the contaminants and clean up the environment. The study at the beaver pond did show that intrinsic remediation is working. There are high levels of contaminants at the back of the pond near where groundwater discharges into the pond. No contaminants were detected in the water leaving the pond. The study concludes that microorganisms play a critical role in contamination breakdown and reduction.

To determine if a plume contaminated primarily with fuel products and, in particular, benzene would naturally degrade in this climate, a mathematical model was used to estimate migration and breakdown of contaminants. The climate was considered in choosing appropriate model parameters, and the model results showed effective reduction of contamination through intrinsic remediation. The proposed alternatives also include monitoring. If the monitoring shows that our assumptions were not correct, the proposed alternative will be reevaluated and, if necessary, a more aggressive approach to clean up will be taken.

Public Comment 2: Is the Base suggesting alternatives before they are proven to work?

USAF Response: The proposed plan addresses the primary components of the remedial action; specific techniques will be developed in the remedial design. The components of the Proposed Plan (monitoring, wetland treatment, soil treatment, and restrictions on the use of groundwater) will meet the remedial action objectives. If a specific design feature such as natural attenuation does not operate as predicted, the other remedial actions discussed in the proposed plan are contingent alternatives that can be reevaluated in the future.

Public Comment 3: A concern was raised that since the releases occurred up to 50 years ago and contamination is still found, that intrinsic remediation occurs slowly.

USAF Response: The tanks and leaks were not drained of fuel product and repaired until a few years ago. There could have been a continuous fuel leak for some time and data show the plumes have not migrated far in 50 years. The limited migration suggests relatively quick and effective natural attenuation.

Public Comment 4: Is the rate of plume migration currently being monitored?

USAF Response: Yes. The rate of migration is tracked and is well documented in a remedial investigation report. Data and the groundwater model show that detectable contamination does not migrate far from the source.

Public Comment 5: The USAF was asked to clarify whether intrinsic remediation means groundwater quality is only being monitored.

USAF Response: Yes. There will be up to 19 monitoring wells in OU 5. The monitoring will be used to document that intrinsic remediation is remediating groundwater and that there is no threat to human health and the environment. If the monitoring data show that cleanup levels are not being achieved, additional remedial action may be needed and would be coordinated through the U.S. EPA and ADEC.

Public Comment 6: When will the plumes with contamination reach Ship Creek?

USAF Response: On a site-wide basis, it does not appear that contaminants will reach and impact Ship Creek. The model of groundwater flow and contaminant transport showed that in the future contaminant concentrations in groundwater will decline and that Ship Creek will not be affected.

Public Comment 7: A concern was raised about how remedial action will be affected if Elmendorf AFB were to close.

USAF Response: Before any property is conveyed outside the base, there are procedures to make sure it's not contaminated. Before property can be legally conveyed, all remedies necessary to protect human health and the environment must be in place. In the event property is conveyed, by law the United States must specifically retain the right to enter the property for remediation purposes should additional remediation activities be necessary. When a base reaches the Base Realignment and Closure Committee, and they have decided to close that installation, one of the first major decisions is how to clean that property up as fast as possible to convey that property to the private sector. At that time, more expensive alternatives that would expedite remediation could be selected. Therefore, if the base were to close, remedial action would continue.

Public Comment 8: Does the Proposed Plan consider the cumulative effects from the combination of contaminants?

USAF Response: Yes. In the residential-use risk assessment scenario, the Air Force looked at cumulative risk and made decisions on that basis, despite the fact that the risk assessment is very conservative. The greatest potential risk is from using the shallow aquifer. That aquifer is not being used at the Base, so the likelihood of drinking water being drawn from that aquifer is very unlikely.

Public Comment 9: The Proposed Plan for Remedial Action for Operable Unit 5 (OU 5) includes a wetland planned on property owned by the Alaska Railroad Corporation. The action could render the land permanently unusable.

USAF Response: Elmendorf AFB will be working with the Alaska Railroad Corporation to gain access to the snowmelt pond area beneath the OU 5 bluff area where pipes and lift stations will be located. The access agreement will provide for monitoring for the duration of the remediation effort; possibly up to 30 years.

Public Comment 10: The comment was made that the remedial action should be implemented cost effectively.

USAF Response: Elmendorf AFB will implement the remedial response cost effectively, remaining in compliance with all regulatory and engineering requirements.

Public Comment 11: In situ soil remediation using electromagnetic/radio frequency technology has been thoroughly tested and evaluated. Could this technique be used at OU 5?

USAF Response: The preferred remedial action was selected after a review of technologies shown to be effective at the time the Feasibility Study was conducted. Contaminated soil is limited to small areas with relatively low concentrations of the contaminants of concern. Given these conditions, and since the impacted soil is easily removed, in situ methods of remediation did not have favorable scores in the evaluation of alternatives.

Public Comment 12: The concern was raised that it has taken a long time for action at OU 5.

USAF Response: The evaluation of impacts and developing remedial alternatives for OU 5 was conducted following approved U.S. EPA guidance on conducting Remedial Investigations and Feasibility Studies. All work and decision making was done according to the schedule and requirements in the Federal Facilities Agreement.

Public Comment 13: Is the lower aquifer contaminated?

USAF Response: No, wells have been installed into the lower aquifer and analytical data have shown that the aquifer is not impacted.

Public Comment 14: Are contaminants migrating into Ship Creek and the Knik Arm?

USAF Response: Ship Creek has been sampled and data have shown that it has not been impacted. Monitoring of Ship Creek indicates that no measurable amounts of contaminants are migrating from OU 5 into Ship Creek and the Knik Arm. Monitoring will continue to be conducted in the future as part of the selected alternative. If monitoring indicates that Ship Creek could be impacted in the future, corrective action will be taken in cooperation with the regulatory agencies.

Public Comment 15: Will covering snowmelt pond sediment with a layer of gravel isolate PCBs?

USAF Response: PCBs adhere strongly to sediment and have a very low solubility. The primary transport mechanism is through sediment transport. By covering the sediment with a layer of gravel, the transport mechanism will no longer exist. Because of the very low solubility of PCBs, no detectable concentrations of PCBs are expected in the water overlying the gravel. The pond water will be monitored.

Public Comment 16: Will intrinsic remediation effectively work at OU 5?

USAF Response: Intrinsic remediation has been an effective process at the base to date. The Beaver Pond Study (RI/FS, Appendix R) showed that the beaver pond wetland area could effectively attenuate contaminants that enter it. The contaminant plumes are relatively small and have not shown signs of widespread migration. The intrinsic remediation alternative for groundwater is preferred because it is presently working, is shown to be effective, and is the most cost effective alternative. The alternative was selected after evaluating all alternatives against the nine U.S. EPA evaluation criteria, and the alternative was found to comply with applicable, relevant, and appropriate requirements. Groundwater and surface water will be monitored. If the monitoring data indicate that intrinsic remediation is not functioning as predicted, Elmendorf AFB will work with the regulatory agencies to take corrective action.

APPENDIX A

OU 5 ADMINISTRATIVE RECORD INDEX

Appendix A

Index to OU 5 Documents in Administrative Record

Date Submitted	Document Number	Title/Subject	Author
7/01/94	017830-018519	Management Plan, Operable Unit 5, Elmendorf Air Force Base, Alaska	EMO/Battelle/CH2M Hill
3/04/94	031679-033304	Operable Unit 5 Remedial Investigation/Feasibility Study	USAF-Elmendorf AFB
11/17/93	025778-025778	Letter from USAF to U.S. EPA requesting comments on OU 5 Draft RI/FS and identification of ARARs	Sharon Stone, USAF-3 SPTG/CEVR
11/17/93	025779-025779	Letter from USAF to U.S. EPA requesting comments on OU 5 Draft RI/FS and identification of ARARs	Sharon Stone, USAF-3 SPTG/CEVR
11/17/93	025780-025780	Letter from USAF to Alaska Department of Environmental Conservation requesting comments on OU 5 Draft RI/FS and identification of ARARs	Sharon Stone, USAF-3 STTG/CEVR
12/08/93	025788-025788	Letter from Alaska Department of Environmental Conservation requesting 20 day extension for comments on the Draft RI/FS	Jennifer Roberts, Alaska Department of Environmental Conservation
6/01/94	040264	News release in the Anchorage Daily News announcing public comment period and public meeting for the OU 5 Proposed Plan	USAF-Elmendorf AFB
6/03/94	040265	News release in the Sourdough Sentinel announcing public comment period and public meeting for the OU 5 Proposed Plan	USAF-Elmendorf AFB
5/01/94	040268-040283	Elmendorf Air Force Base, OU 5, The Proposed Plan for Remedial Action	USAF-Elmendorf AFB
5/01/94	040284-040321 (confidential)	Mailing list: May 1994 OU 5 Proposed Plan Fact Sheet	USAF-Elmendorf AFB

Appendix A

Index to OU 5 Documents in Administrative Record (Continued)

Date Submitted	Document Number	Title/Subject	Author
12/94	Unassigned	Transcript of Public Meeting Written Public Comments	USAF-Elmendorf AFB
11/18/94	Unassigned	State Comments OU 5 ROD	ADEC
11/17/94	Unassigned	U.S. EPA Comments OU 5 ROD	U.S. EPA
12/94	Unassigned	Groundwater Modeling Report	Radian Corporation