FINAL
21 March 2012

Decision Document

Area 303

Former Adak Naval Complex

Adak, Alaska

Department of the Navy
Naval Facilities Engineering Command Northwest
1101 Tautog Circle
Silverdale, WA 98315

FINAL DECISION DOCUMENT
AREA 303
FORMER ADAK NAVAL COMPLEX
ADAK ISLAND, ALASKA

COVER SHEET AND SIGNATURE PAGE

SITE NAME: Area 303

ADEC DATABASE RECORD KEY: 200325X113401

ADEC REGULATORY AUTHORITY: Oil and Other Hazardous Substances Pollution Control (18 Alaska Administrative Code [AAC] 75, Article 3)

RESPONSIBLE PARTY: Department of the Navy
BRAC Program Management Office, West
1455 Frazee Road, Suite 900
San Diego, CA 92108-4310

CHEMICALS OF POTENTIAL CONCERN/MEDIA IMPACTED:

Soil: Petroleum hydrocarbons and volatile organic compounds (VOCs)
Groundwater: Petroleum hydrocarbons, semivolatile organic compounds (SVOCs), VOCs, and lead
Soil Vapor: Petroleum hydrocarbons and VOCs

ON-SITE CONTAMINANT CONCENTRATIONS:

Chemicals present in groundwater, soil, and soil vapor at Area 303 pose no unacceptable risk to human health above target health goals, provided that institutional controls prohibiting the use of groundwater as a drinking water source remain in effect. Some discontinuous free product has been observed in recent monitoring well investigations. Exposures to free product may represent an unacceptable health risk. However, the presence of free product has been detected in monitoring wells where groundwater is approximately 22 to 25 feet below ground surface (bgs), which is likely too deep for human exposure. The deep vapor sample located in the vicinity of free product close to the water table (greater than 15 feet bgs) also indicated the presence of a potential inhalation hazard for workers if future construction activities were to result in soil disturbance at levels deeper than 15 feet bgs. Because construction activities are not likely to occur deeper than 15 feet bgs, direct exposure to free product is

unlikely. However, exposures to vapors might be a concern in the 10- to 15-foot-depth interval in a deep excavation in this area.

Various petroleum-related chemicals were detected in groundwater at concentrations greater than the tabulated groundwater cleanup levels (18 AAC 75.345[b][1], Table C). Because concentrations in groundwater could pose an unacceptable risk if groundwater was used for drinking, the maximum and minimum detected concentrations for these chemicals in groundwater at Area 303 are provided in Table 1. Institutional controls are in place to prevent the use of groundwater as a drinking water source.

The ecological risk assessment concluded that no ecological threat exists to terrestrial receptors from chemicals detected in surface soil. The groundwater plume from Area 303 has not reached the off-site surface water body (East Canal). Impacts to surface water in East Canal have been addressed under Solid Waste Management Unit (SWMU) 62 evaluations. Ecological exposure to surface water in East Canal was considered to be a minor or insignificant exposure pathway.

Table 1
Concentrations of Chemicals Exceeding the Tabulated Groundwater Cleanup Levels

Chemical	Groundwater		
	Minimum Concentration (µg/L)	**Maximum Concentration (µg/L)**	**Cleanup Criteria (ADEC Table C) (µg/L)**
Semivolatile Organic Compounds			
Dibenz(a,h)anthracene	0.106	0.441	0.12
Volatile Organic Compounds			
Benzene	0.435 J	220	5
Ethylbenzene	1.27	1,800	700
Toluene	0.27	1,980	1,000
Total Inorganics			
Lead	1.85	440	15
Total Petroleum Hydrocarbons			
Diesel-range organics	76 J	21,400 J	1,500
Gasoline-range organics	31 J	78,000	2,200

Notes:
ADEC - Alaska Department of Environmental Conservation
J - estimated value
µg/L - microgram per liter

CLEANUP LEVELS:

Soil: The risk assessment for this site established that the existing concentrations in soil do not pose a risk to humans or the environment above target health goals.

Therefore, the soil concentrations identified during the site investigation and used in the risk assessment are protective of human health and the environment.

Soil Vapor: Vapor intrusion target levels for soil vapor (or soil gas) have been developed by Alaska Department of Environmental Conservation (ADEC) and are conservative, risk-based screening levels. The screening values used in the risk assessment for soil vapor were one-tenth of the target levels for deep soil gas from Appendix F of the 2009 ADEC *Draft Vapor Intrusion Guidance for Contaminated Sites*. These screening criteria were used in the supplemental risk assessment for this site to select which chemicals might present a human health risk through the vapor intrusion pathway. The risk evaluation demonstrated that the existing concentrations in soil vapor do not pose a risk to humans above target health goals, unless unprotected construction workers are digging deeper than 15 bgs—a very unlikely scenario. Soil vapor locations were selected to provide worst-case vapor data. Therefore, the existing concentrations at the site are protective of human health.

Groundwater: Cleanup levels are based on the groundwater cleanup levels established for groundwater used for drinking water in 18 AAC 75.345[b][1], Table C. The groundwater cleanup levels for Area 303 are as follows:

- Dibenz(a,h)anthracene: 0.12 µg/L (0.00012 mg/L)
- Benzene: 5 µg/L (0.005 mg/L)
- Ethylbenzene: 700 µg/L (0.7 mg/L)
- Toluene: 1,000 µg/L (1 mg/L)
- Lead: 15 µg/L (0.015 mg/L)
- Diesel-range organics (DRO): 1,500 µg/L (1.5 mg/L)
- Gasoline-range organics (GRO): 2,200 µg/L (2.2 mg/L)

Surface Water and Sediment: Although petroleum hydrocarbons released in Area 303 have not impacted East Canal, migration of petroleum hydrocarbons or VOCs in groundwater may result in a future exceedance of Alaska surface water quality standards. As specified in 18 AAC 75.345(f), groundwater that is closely connected hydrologically to nearby surface water may not cause an exceedance of the surface water quality standards in the nearby surface water body. Water quality standards for surface water bodies of the state established by 18 AAC Chapter 70 are based on water use classes and subclasses. Unless a surface water body has been reclassified in accordance with 18 AAC 70.230, the water body is protected for all water use classes and subclasses. Because the canals of the airport ditch system, including East Canal, have not been reclassified, all subclasses of the freshwater class apply to these water bodies. Therefore, the water quality standards potentially applicable to the airport ditch system, including East Canal, are:

- Total aqueous hydrocarbons (TAqH) in the water column may not exceed 15 µg/L
- Total aromatic hydrocarbons (TAH) in the water column may not exceed 10 µg/L

- Petroleum hydrocarbons in shoreline or bottom sediments may not cause deleterious effects to aquatic life

- Surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration (18 AAC 70.020[b][17][A][i], 18 AAC 70.020[b][17][B][ii], and 18 AAC 70.020[b][17][C])

Alaska State regulations do not establish cleanup levels for sediment. Therefore, sediment cleanup levels are established based on the results of the ecological risk assessment conducted for the site. The results of the screening-level risk assessment indicated that no ecological threat exists for any ecological receptor from any petroleum-release product at Area 303. Therefore, cleanup levels are not necessary for sediment.

CLEANUP REMEDY:

The selected cleanup remedy for Area 303 is monitored natural attenuation, institutional controls, and free-phase product recovery. Monitored natural attenuation will help to demonstrate whether contaminant concentrations decrease to below the ADEC cleanup levels, and institutional controls will be used to protect human health and the environment as long as groundwater concentrations are greater than the groundwater cleanup levels. Institutional controls, including excavation notifications and a groundwater use restriction, will remain in effect to protect human health and the environment until groundwater cleanup levels in 18 AAC 75.345, Table C, have been achieved. Passive free-product recovery will be used to reduce the risk of exposure to free product and of free product migrating to East Canal.

REVIEW OF CLEANUP ACTION AFTER SITE CLOSURE:

Under 18 AAC 75.380(d)(1), ADEC may require the Navy to perform additional cleanup if information is discovered that leads ADEC to make a determination that the cleanup described in this decision document is not protective of human health, safety, and welfare or the environment, or if information becomes available that indicates the presence of previously undiscovered contamination or exposure routes related to Navy activities.

ACCEPTANCE BY PARTIES:

The U.S. Navy has proposed the remedy decision outlined in this document. The State of Alaska agrees that, when properly implemented, the remedies selected comply with state law.

Cindy L. O'Hare, P.E.
Adak BRAC Environmental Coordinator
U.S. Navy, Naval Facilities Engineering
Command Northwest

6 Apr 2012
Date

John Halverson
Federal Facilities Environmental
Restoration Program Manager
Alaska Department of Environmental Conservation

3/30/2012
Date

CONTENTS

ABBREVIATIONS AND ACRONYMS v

1.0 INTRODUCTION 1-1

2.0 BACKGROUND 2-1
2.1 PHYSICAL CHARACTERISTICS OF THE SITE 2-1
2.2 SITE HISTORY 2-3
2.2.1 Site Regulatory History 2-5
2.2.2 Site Release History 2-7
2.3 DESCRIPTION OF AREA 303 CONTAMINANTS AND MEDIA IMPACTED 2-8
2.4 CLEANUP ACTIVITIES PERFORMED TO DATE 2-8
2.4.1 GCI Compound, UST GCI-1 2-9
2.4.2 Telephone Exchange Building, UST 10324-A 2-10
2.4.3 SA 79, Main Road Pipeline 2-10
2.4.4 SWMU 62, New Housing Fuel Leak 2-10
2.5 LAND USE 2-11
2.6 GROUNDWATER USE 2-11

3.0 IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN 3-1
3.1 SOIL 3-1
3.2 GROUNDWATER 3-2
3.3 SOIL VAPOR 3-3

4.0 CONTAMINANT CONCENTRATIONS AND ESTIMATED EXTENT OF CONTAMINATION 4-1
4.1 EXTENT OF FREE PRODUCT 4-1
4.2 ESTIMATED EXTENT OF CONTAMINATION IN SOIL, GROUNDWATER, AND SOIL VAPOR 4-2
4.2.1 Soil 4-3
4.2.2 Groundwater 4-3
4.2.3 Soil Vapor 4-4

5.0 SUMMARY OF RISK ASSESSMENT 5-1
5.1 HUMAN HEALTH RISK ASSESSMENT 5-1
5.1.1 Data Evaluation 5-2
5.1.2 Exposure Assessment 5-4

CONTENTS (Continued)

5.1.3 Toxicity Assessment 5-6
5.1.4 Risk Characterization 5-6
5.2 ECOLOGICAL RISK ASSESSMENT 5-8
5.2.1 Ecological Risk Assessment Procedures 5-8
5.2.2 Problem Formulation 5-9
5.2.3 Screening-Level Ecological Risk Assessment 5-9

6.0 REMEDIAL ACTION OBJECTIVES AND CLEANUP LEVELS 6-1
6.1 REMEDIAL ACTION OBJECTIVES 6-1
6.2 CLEANUP LEVELS 6-1
6.3 EXTENT OF CONTAMINATION 6-2

7.0 REMEDIAL ACTION ALTERNATIVES 7-1

8.0 COMPARATIVE ANALYSIS OF ALTERNATIVES 8-1

9.0 DESCRIPTION OF SELECTED CLEANUP ACTION 9-1

10.0 PUBLIC INVOLVEMENT 10-1
10.1 PUBLIC INVOLVEMENT ACTIVITIES 10-1
10.2 FUTURE CONTACTS 10-1

11.0 RESPONSIVENESS SUMMARY 11-1

12.0 REFERENCES 12-1

APPENDICES

A Property Owner Concurrence
B Analytical Results

CONTENTS (Continued)

FIGURES

1-1 Location Map, Adak Island, Alaska 1-2
1-2 Site Location and Vicinity, Area 303 1-3
2-1 Groundwater Flow Map of Area 303 2-13
2-2 Lower Permeability Layers That May Affect Downward Percolation of Groundwater, Area 303 2-15
2-3 Location of Airport Ditch System, Area 303 2-17
2-4 Potential Petroleum Sources at Area 303 2-19
2-5 Land Use in the Vicinity of Area 303 2-20
4-1 Estimated Extent of Free Product and Groundwater Contamination, Area 303 4-5
4-2 Estimated Extent of Soil Contamination, Area 303 4-7
5-1 Human Health Conceptual Site Model, Area 303 5-10
5-2 Ecological Conceptual Site Model, Area 303 5-11
8-1 Evaluation of Alternatives for Area 303 8-3
9-1 Selected Cleanup Remedy – Free-Product Recovery and Proposed Locations of New Free-Product Recovery and Groundwater Monitoring Wells, Area 303 9-7

CONTENTS (Continued)

TABLES

2-1 Summary of Environmental Field Investigations at Area 303 2-21
3-1 Chemicals of Potential Concern in Soil, Groundwater, and Soil Vapor at Area 303 3-5
4-1 Groundwater Elevations at Area 303 on July 18, 2006 4-9
4-2 Free-Product Thickness Measurement Summary for Area 303 4-11
4-3 Summary of Analytical Results for Chemicals of Potential Concern at Area 303 4-12
5-1 Construction Worker Exposures to Groundwater—Exposure Assumptions and Intake Equations 5-12
5-2 Construction Worker Exposures to Soil—Exposure Assumptions and Intake Equations 5-13
5-3 On-Site Worker Exposures to Indoor Air—Exposure Assumptions and Intake Equations 5-14
5-4 Carcinogenic Toxicity Criteria Used in the 2007 Risk Assessment 5-15
5-5 Noncarcinogenic Toxicity Criteria Used in the 2007 Risk Assessment 5-16
5-6 Carcinogenic Toxicity Criteria Used in the 2011 Supplemental Risk Assessment 5-18
5-7 Noncarcinogenic Toxicity Criteria Used in the 2011 Supplemental Risk Assessment 5-19
5-8 Summary of Exposure-Point Concentrations at Area 303 5-20
5-9 Summary of Total Risks and Hazards for the Construction Worker From Groundwater and Soil at Area 303 5-22
5-10 Summary of Risks and Hazards for Future On-Site Worker Exposures to Soil Vapor from Indoor Air at Area 303 5-23
5-11 Results of Screening-Level Ecological Risk Assessment for Receptors Exposed to Surface Soil at Area 303 5-24
6-1 Groundwater Cleanup Levels and Maximum Groundwater Concentrations, Area 303 6-4
8-1 EPA Criteria 8-4
8-2 Categories of Petroleum Sites on Adak Island 8-5
8-3 Evaluation of Suitability of Cleanup Alternative 8-6
9-1 Area 303 Cost Estimate for Monitored Natural Attenuation and Institutional Controls 9-9
9-2 Area 303 Cost Estimate for Free-Phase Product Recovery 9-11

ABBREVIATIONS AND ACRONYMS

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ARC	Adak Reuse Corporation
ARAR	applicable or relevant and appropriate requirements
avgas	aviation gasoline
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CMP	comprehensive monitoring plan
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CSM	conceptual site model
DD	decision document
DRO	diesel-range organics
EPA	U.S. Environmental Protection Agency
FFA	Federal Facilities Agreement
FFS	focused feasibility study
GCI	General Communications, Inc.
GRO	gasoline-range organics
ICMP	institutional control management plan
JP-5	jet petroleum No. 5
µg/L	microgram per liter
mg/kg	milligram per kilogram
mg/L	milligram per liter
MNA	monitored natural attenuation
msl	mean sea level
Navy	U.S. Navy
NMCB	Naval Mobile Construction Battalion
O&M	operation and maintenance
OU	operable unit
PCE	tetrachloroethene
RAB	Restoration Advisory Board
RAO	remedial action objective
ROD	Record of Decision
RRO	residual-range organics
SA	source area
SAERA	State-Adak Environmental Restoration Agreement

ABBREVIATIONS AND ACRONYMS (Continued)

SVOC	semivolatile organic compound
SWMU	solid waste management unit
TAC	The Aleut Corporation
TAH	total aromatic hydrocarbons
TAqH	total aqueous hydrocarbons
TPH	total petroleum hydrocarbons
USGS	U.S. Geological Survey
UST	underground storage tank
VOC	volatile organic compound

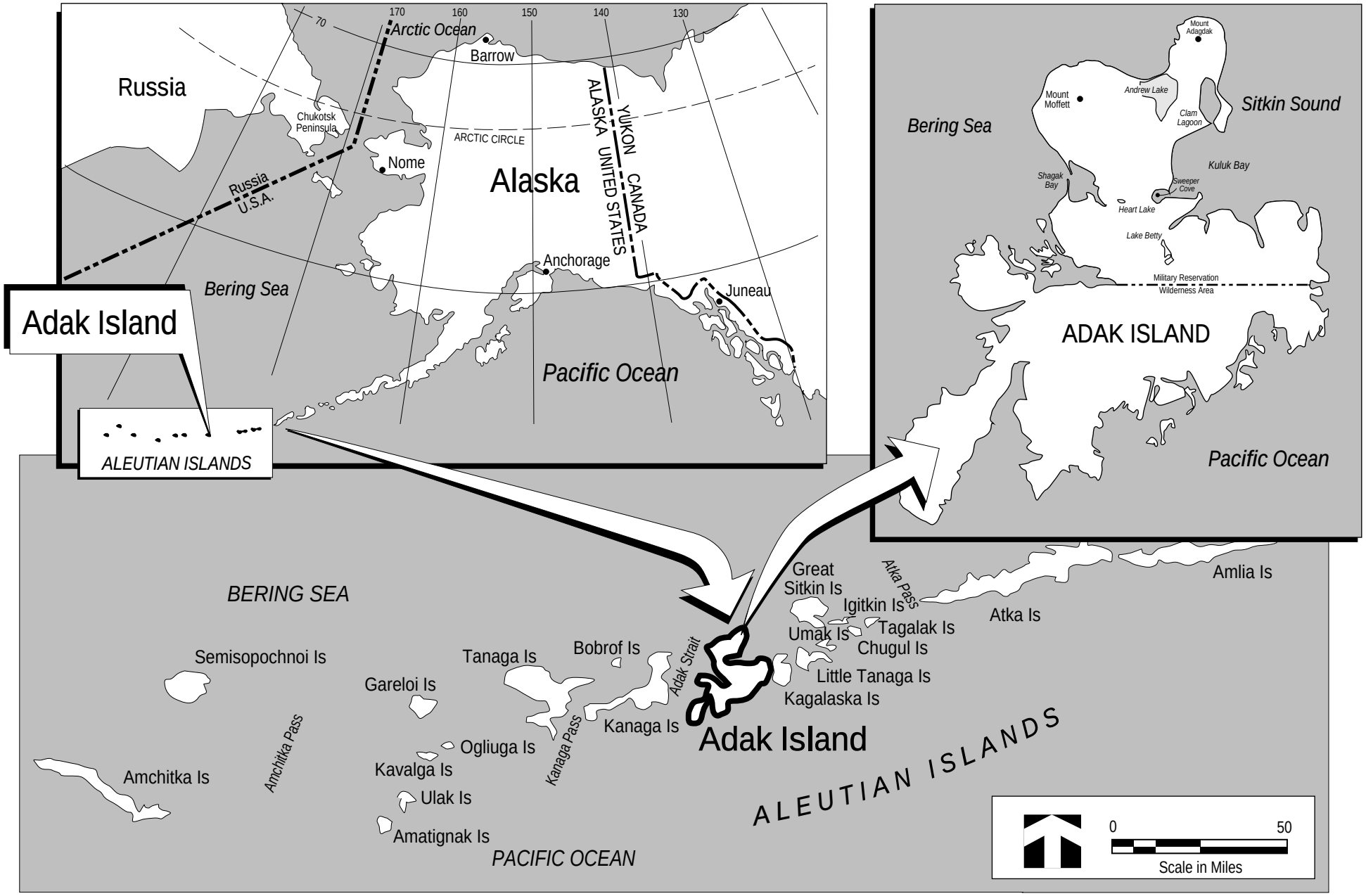
DECLARATION

1.0 INTRODUCTION

The U.S. Navy (Navy) has proposed the remedy decision outlined in this document for Area 303 at the former Adak Naval Complex. The State of Alaska agrees that, when properly implemented, the remedies selected comply with state law. The Adak Naval Complex is located on Adak Island, Alaska, approximately 1,200 air miles southwest of Anchorage, Alaska, in the Aleutian Island chain (Figure 1-1). Figure 1-2 shows the general location of Area 303.

This DD was developed in accordance with the Alaska Department of Environmental Conservation (ADEC) Oil and Other Hazardous Substances Pollution Control regulations (18 Alaska Administrative Code [AAC] Chapter 75). The decisions documented in this DD are based on supporting documents in the Administrative Record, which is located at the offices of Naval Facilities Engineering Command Northwest in Silverdale, Washington.

The State of Alaska and the Navy have agreed to the decisions outlined in this document. In addition, The Aleut Corporation (TAC), the current property owner, has concurred with the selected cleanup remedy (Appendix A). Monitored natural attenuation (MNA), institutional controls, and free-phase product recovery have been selected as the remedy for Area 303. Section 9 discusses the selected cleanup remedy for Area 303 in more detail. The Navy is responsible for implementing the cleanup remedy presented in this DD.



U.S.NAVY

Figure 1-1
Location Map, Adak Island, Alaska

Adak Island, AK
DECISION DOCIMENT

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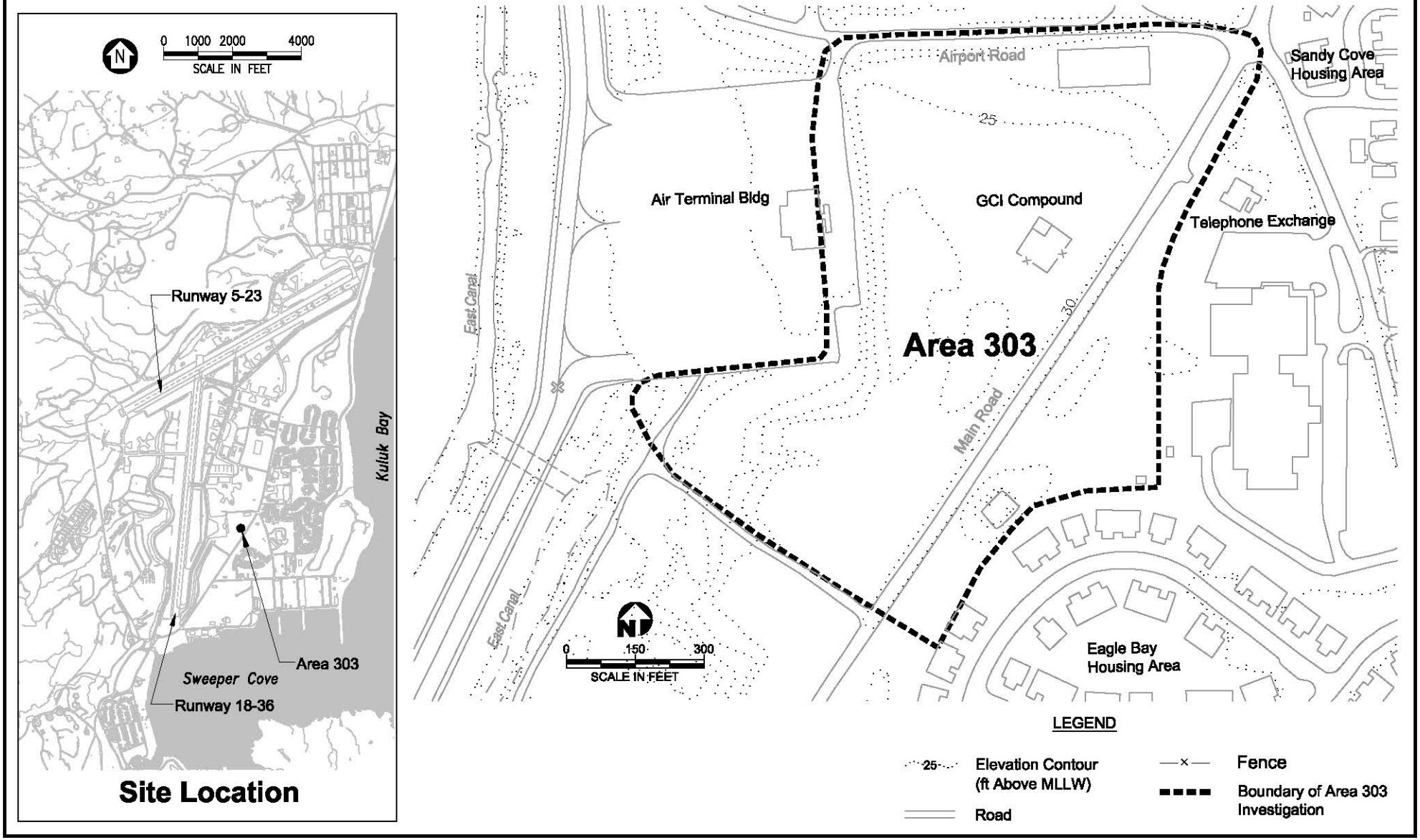

U.S. NAVY	SCALE: AS SHOWN	**Figure 1-2** **Site Location and Vicinity** **Area 303**	Adak Island, AK DECISION DOCUMENT

T:\ADAK\IDIQ\Sub-Tasks\DO 31\Decision Document\FIG 1-2 SITE LOC.dwg
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2.0 BACKGROUND

This section provides general background information for Area 303. The focused feasibility study (FFS) report, Revision 1 (U.S. Navy 2011b) provides additional information on Area 303.

2.1 PHYSICAL CHARACTERISTICS OF THE SITE

Adak Island experiences a polar maritime climate characterized by persistently overcast skies, high winds, frequent and often violent storms, and a narrow range of temperature fluctuation throughout the year. The average total annual precipitation for Adak Island is about 60 inches, most of which falls as rain in the lower elevations. Average monthly precipitation varies from a low of about 3 inches during June and July to a high of 7 to 8 inches during November and December. Snowfall averages over 100 inches a year at sea level.

The general topography of the site is relatively flat with surface drainage directed to the west. The ground surface at Area 303 consists of the asphalt-paved Main Road, multiple small gravel-covered lots in highly disturbed areas near existing structures, and an extensive level area covered with native grasses composing the less disturbed areas. Elevations of the ground surface in this area are generally 26 to 30 feet above mean lower low water.

Prior to military use of Adak Island during World War II, the western portion of the downtown area was occupied by a back beach lagoon. The lagoon was separated from Kuluk Bay by a series of sand dunes. Military forces filled the lagoon with sand and rock to construct the airfield. The sand dunes were leveled to create the relatively flat area occupied by downtown Adak today. Area 303 is believed to be situated near the eastern shoreline of the former lagoon, outside of the fill area.

The geology and hydrogeology at the site are characterized by sandy soils derived from stream, wind, and wave action. The subsurface soils have variable permeability and generally consist of sands and gravels with occasional layers of organic silt and clay. The saturated sands typical in the downtown portion of Adak Island have a high water-bearing capacity. The organic silts and clays have low water-bearing capacity and typically cause shallow water in the subsurface to pond above the primary aquifer as small perched groundwater zones.

In 1994, the Navy conducted an extensive study of groundwater conditions on Adak Island. The groundwater study concluded that groundwater in the primary aquifer beneath the downtown area of Adak, situated west of Main Road, flows generally west toward the East Canal of the airport ditch system. The groundwater study also concluded that, although some seasonal variation in regional groundwater levels are observed in the downtown area, the general direction

of groundwater flow does not vary seasonally. In addition, the shallow groundwater flow pattern in the vicinity of the airfield is controlled by the water levels in the airport ditch, which fluctuate within a small range as a result of ditch pumping (U.S. Navy 1995a).

Water levels were measured on July 18, 2006, in all 35 wells that were included in 2006 Area 303 site characterization activities (U.S. Navy 2011b). All 35 wells are screened in the primary aquifer and, therefore, measure the water level in the primary aquifer. Groundwater in the primary aquifer was found beneath the site at depths ranging from 5 feet below ground surface (bgs) to as much as 28 feet bgs, depending on the location, during the 2006 characterization activities. The depth to groundwater was generally greater than 17 feet bgs in all locations, with the exception of the wells located in the extreme western portion of the site (03-012, MW-303-34, MW-303-35, MW-303-36, and MW-303-37) and a single well adjacent to Main Road (MW-303-25). The 2006 groundwater elevations were used to contour the groundwater surface of the primary aquifer as shown on Figure 2-1. Groundwater in the primary aquifer flows west across the site. This is consistent with the findings of the 1994 groundwater study. The hydraulic gradient appears to be fairly consistent across the site at 0.0027 foot/foot.

Layers of lower permeability material, such as organic silt and clay, were encountered within the sandy soils at several locations. These layers are believed to represent the position of either the former lagoon bottom, or small lakes that occurred within low-lying areas between the sand dunes that were present in the downtown area prior to military arrival on Adak. These lower permeability layers retard the downward percolation of groundwater, which may result in localized zones of perched groundwater. Perched groundwater will generally migrate through the less permeable layers, as well as flow across these surfaces, from topographic highs toward topographic lows following preferential pathways until it cascades off the edges of these fine-grained layers into the primary aquifer below. Figure 2-2 shows an interpretation of the lateral extent of these lower permeability layers based on the boring log review. Three lower permeability layers were identified within Area 303. The largest of these layers exists in the central and northern portions of Area 303 and underlies more than half of the site. Two smaller layers were identified in the southeastern portion of Area 303 near Eagle Bay Housing.

The elevations of the surface of these layers are shown on Figure 2-2. Elevations of the surface of the largest of these layers range from approximately 23 feet mean sea level (msl) in well 04-202 to 8 feet msl in well 04-187. The surface of this layer slopes away from the two highest elevations on the layer's surface at 04-202 and MRP-MW2, as shown on Figure 2-2. The two smaller layers appear to be slightly sloped. The smallest and shallowest layer appears to slope to the south, with a surface elevation of approximately 25 to 24.5 feet msl. The layer that lies below the smallest layer has a surface elevation of 21 to 22.5 feet msl and appears to slope to the southeast. However, the preferential flow pathways for the perched groundwater cannot be identified with any certainty because of the natural variability exhibited by the upper surface of these less permeable layers.

No perched groundwater was encountered during drilling at Area 303 in 2006. Perched groundwater is present in well MRP-MW3, which was installed in 1992 and is directly adjacent to MRP-MW2 in the northeast portion of Area 303. Perched groundwater was also detected in former well 03-708, located approximately 125 feet west-northwest of MRP-MW3 (Figure 2-2). Therefore, the extent of the perched groundwater in Area 303 is limited. The depth to the perched water ranged from approximately 2 to 5 feet bgs.

The closest surface water body in the vicinity of Area 303 is the East Canal of the airport ditch system. A portion of the East Canal is located near the southwestern boundary of Area 303 (Figure 2-3). The airport ditch system, including the East Canal, was constructed to prevent runway flooding during high-water periods. The East Canal is an engineered diversionary structure designed to collect surface runoff from the airfield and surrounding area and convey it from the airport runway area. It parallels the north-south runway (Runway 18-36) and consists of a series of interconnected ditches. The canal contains fresh water year round. It generally has steeply sloped banks lined with tundra grass.

Water in the East Canal flows through the Crossover Canal (which is contained in underground culverts) into the West Canal, where it is transferred through turbine pumps into South Sweeper Creek. This renders the airport ditch system (including the East Canal) an isolated, intrastate, and non-navigable waterway. Because the engineered drainage canals of the airport ditch system are isolated from South Sweeper Creek and are not considered navigable waters of the United States, they do not fall under the jurisdiction of the Clean Water Act. However, these surface water bodies are considered waters of the State of Alaska and are subject to the Alaska Water Quality Standards (18 AAC 70). South Sweeper Creek, located approximately 4,000 feet along this transport pathway from Area 303, is the closest downgradient water body that is considered navigable waters of the United States. As such, it falls under the jurisdiction of the Clean Water Act. South Sweeper Creek receives surface water and groundwater from approximately 30 percent of the Sweeper Cove drainage basin, including stormwater runoff collected by the airport drainage ditch system. The outlet of South Sweeper Creek forms a sandy estuary where it empties into Sweeper Cove.

The stormwater conveyances in Area 303 consist primarily of ditches, culverts, catch basin inlets, manholes, and outlets. In general, stormwater west of Main Road flows via ditches or, after percolating into soil, with groundwater toward the East Canal of the airport ditch system and ultimately to South Sweeper Creek (U.S. Navy 1995c).

2.2 SITE HISTORY

Military presence on Adak began in 1942 with its occupation as a staging area to mount a counter-offensive to dislodge Japanese troops from Attu and Kiska Islands. The Navy presence

at Adak was officially recognized by Public Land Order 1949, dated August 19, 1959, which withdrew the northern portion of Adak Island, comprising approximately 76,800 acres, for use by the Navy for military purposes. The Navy also used the base to conduct a variety of Cold War-era military activities. Naval Air Facility Adak was on the list of Department of Defense installations recommended for closure in 1995, and that recommendation became final when Congress did not disapprove the list. The active Navy mission ceased, and the base operationally closed on March 31, 1997.

From April 1997 through September 2000, the Navy operated critical facilities such as the power plant, airfield, and environmental cleanup systems through a caretaker contractor. In June 1998, the Navy entered into a lease with the Adak Reuse Corporation (ARC), the designated local redevelopment authority. This lease authorized ARC to use or sublease property in the developed core of the military reservation for commercial reuse. In October 2000, ARC began operating community facilities such as the airfield and utility systems in support of reuse activities under the authority of this lease.

In September 2000, the Navy and U.S. Department of the Interior entered into a land transfer agreement titled *Agreement Concerning the Conveyance of Property at the Adak Naval Complex, Adak, Alaska* with TAC, an Alaska Native corporation. This agreement set forth the terms and conditions for the conveyance of approximately 47,000 acres of the former Adak Naval Complex property to TAC. The transfer of property occurred on March 17, 2004. The land transfer includes all of the downtown area, housing units, and industrial facilities. Excluded from this transfer were any offshore islands, islets, rocks, reefs, and spires; fixtures and equipment owned by the United States and associated with the airfield; improvements owned by the United States and managed by the Federal Aviation Administration; and improvements owned by the United States and managed by the Fish and Wildlife Service. TAC currently owns Area 303.

The property was transferred to TAC by an Interim Conveyance that included institutional controls. Institutional controls specified for the downtown area of Adak Island reduce the potential human exposure to the petroleum-related and hazardous chemicals left in place and are applicable to Area 303. These institutional controls are implemented through the final institutional control management plan (ICMP) (U.S. Navy 2010a) and include:

- Land use restrictions, primarily limited to areas designated for commercial or industrial use
- Notification to the Navy of intrusive soil excavation activities deeper than 2 feet
- Groundwater restrictions that prohibit use of the downtown aquifer as a drinking water resource

Land Use Restrictions

Commercial and industrial land uses and continuing residential land uses (where housing exists in the downtown area) are permitted in accordance with the Interim Conveyance document. Residential housing is allowed in existing housing units located at Amulet Housing, Arctic Acres Housing, and Solid Waste Management Unit (SWMU) 62. Future residential housing construction will be evaluated for impacts to ongoing petroleum cleanup activities.

Excavation Notification

Excavation notification is required for each proposed excavation below 2 feet at each institutional control site. The primary purpose of the excavation notification institutional control is to apprise the Navy of changes to land use. It also provides an opportunity for the Navy to provide site-specific information to the excavating party. The Navy will evaluate notifications to determine whether a proposed project at an institutional control site is consistent with the land use assumptions. The notifications are an additional tool for the Navy to receive timely information (in the absence of local zoning requirements) to monitor land use restrictions.

Groundwater Use Restriction

Domestic use of groundwater in the downtown area is restricted because of the potential presence of petroleum compounds and other chemicals in the groundwater. Domestic groundwater use is defined as that used by households or transients for human and animal consumption, cooking, bathing, showering, gardening, irrigation, washing consumable food products, watering animals, or any other domestic use. The excavation notification program at individual sites provides one barrier to drilling, and enforcement of the prohibition will occur through periodic visual inspections. The visual inspections focus on unauthorized wells in the restricted area.

2.2.1 Site Regulatory History

Adak was initially proposed for placement on the National Priorities List in 1992 and was officially listed in 1994. In 1993, the Navy, as lead agency, entered into a three-party Federal Facilities Agreement (FFA) with the U.S. Environmental Protection Agency (EPA) and ADEC, which incorporated the EPA's cleanup process under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986. The CERCLA exclusion of petroleum as a hazardous substance required that cleanup of petroleum-related chemicals would follow State of Alaska regulations. Therefore, the FFA stated that petroleum-contaminated sites, such as those containing underground storage tanks (USTs) and leaking underground fuel lines, would be evaluated under a separate two-party agreement between the Navy and the State of Alaska. The

Navy and ADEC signed this agreement, the two-party State-Adak Environmental Restoration Agreement (SAERA), in April 1994.

The former Adak Naval Complex was divided into two operable units (OUs), A and B, for investigation and cleanup activities. OU A includes CERCLA and petroleum sites, and OU B includes ordnance explosive sites. A total of 180 sites, not including Area 303 (petroleum contamination in Area 303 was discovered at a later date), were evaluated within OU A. Of the 180 sites, 128 sites were petroleum sites investigated under SAERA. In May 1997, the Navy and ADEC agreed to integrate the cleanup decision process for petroleum sites with the cleanup decision process being conducted for hazardous substance release sites under CERCLA. As a result, the Record of Decision (ROD) for OU A was prepared for both the petroleum-contaminated sites and the hazardous-substance-release sites. The Navy, EPA, and ADEC signed the ROD in 2000 (U.S. Navy, USEPA, and ADEC 2000).

The OU A ROD selected final or interim remedies for each of the 128 petroleum-contaminated sites identified on Adak Island. The interim remedy, free-product recovery, was selected for 14 sites that contained measurable quantities of free-phase petroleum product. In addition, the OU A ROD specified that these 14 sites would require future remedy selection pursuant to the two-party SAERA. To clarify regulatory authority, the OU A ROD was amended in 2003 to remove these 14 petroleum sites, and 48 others with further action, from CERCLA authority (U.S. Navy, USEPA, and ADEC 2003). Therefore, final remedies for these 14 petroleum-contaminated sites were selected in accordance with 18 AAC 75.325 through AAC 75.390, which provides the regulatory procedures and requirements for petroleum cleanup decisions.

On May 20, 2005 ADEC signed the DD for 10 of these 14 sites, where the remaining petroleum-related chemicals pose no risk to human health or the environment above target health goals, provided that institutional controls remain in effect (U.S. Navy and ADEC 2005). DDs for the four remaining sites also have been finalized. At three of the four sites, petroleum-related chemicals pose a potential risk to human health or the environment above target health goals. These DDs were signed as follows:

- The Naval Mobile Construction Battalion (NMCB) Building T-1416 Expanded Area DD was signed by ADEC on March 16, 2006 (U.S. Navy and ADEC 2006a)
- The South of Runway 18-36 Area DD was signed by ADEC on September 20, 2006 (U.S. Navy and ADEC 2006b)
- The SWMU 62, New Housing Fuel Leak site DD was signed by ADEC on August 16, 2006 (U.S. Navy and ADEC 2006c)

ADEC signed the DD for the fourth site, SWMU 17, Power Plant No. 3 Area, on December 19, 2006 (U.S. Navy and ADEC 2006d). Area 303 was defined after the OU A ROD was signed, during the 2003 U.S. Geological Society (USGS) investigation performed to monitor natural attenuation of petroleum in groundwater in the downtown area (see Section 2.2.2).

2.2.2 Site Release History

During 2002, the USGS evaluated the Navy's groundwater monitoring program for OU A at the former Adak Naval Complex to determine how well the program was meeting the objectives specified in the ROD. The Navy then asked the USGS to conduct a field investigation on Adak to obtain information that would be the basis to modify the existing monitoring program such that it would better monitor the effectiveness of natural attenuation processes. The resulting field investigation was conducted during May and June 2003 (USGS 2005).

As part of this investigation, the USGS collected groundwater samples using a Geoprobe sample collection method from 10 locations between the General Communications, Inc. (GCI) Compound, a known petroleum-release site included in the OU A ROD, and East Canal. The chemical analyses conducted on these samples identified the presence of gasoline-range organics (GRO) at concentrations that greatly exceeded those obtained from the GCI source area. Based on the distribution of GRO concentrations in the primary aquifer in the vicinity of the GCI Compound, the USGS concluded that a second overlapping GRO plume existed in this area, which had not previously been identified. The USGS further stated that the second GRO plume was emanating from an unidentified source somewhere south or southwest of the GCI source area along Main Road (USGS 2005). The area of contamination was defined as a result of the USGS investigation and called Area 303. The Navy subsequently investigated the newly identified GRO plume in Area 303 to characterize the release and prepared a FFS (U.S. Navy 2011b).

Figure 2-4 identifies the potential sources of the petroleum hydrocarbons present at Area 303. These potential sources include portions of major fuel distribution pipelines located within Area 303:

- An aviation gasoline (avgas) pipeline distribution system formerly used to provide fuel to truck fuel stands along the airfield and to transfer fuel from the former Fuel Dock No. 7 to Tank Farm B
- A diesel pipeline formerly used to transfer fuel from the former Fuel Dock No. 7 to Tank Farm C
- The jet petroleum No. 5 (JP-5) pipelines, including the Main Road Pipeline, formerly used to transfer fuel from the Fuels Facility to Steam Plant No. 4, and

various aboveground storage tanks that stored fuel for distribution to individual housing units at SWMU 62

None of these pipelines is currently active, and all pipelines within the vicinity of Area 303 have been decommissioned (U.S. Navy 2010b). Based on the results of the 2006 remedial investigation and the 2009 pipeline integrity testing performed as part of pipeline decommissioning, the source of GRO was likely the avgas pipeline distribution system. The diesel and JP-5 pipelines are not considered potential sources of the GRO compounds, because these pipelines were used to transport heavier petroleum hydrocarbon chemicals within the grouping commonly referred to as diesel-range organics (DRO).

2.3 DESCRIPTION OF AREA 303 CONTAMINANTS AND MEDIA IMPACTED

Decisions documented in this DD are based on information gathered from various environmental field investigations the Navy performed in the vicinity of Area 303 between 1988 and 2010, as indicated in Table 2-1. Area 303 was investigated by the Navy in 2006 and 2010. In addition, several investigations of the petroleum-release sites located within the Area 303 boundaries or immediately adjacent to Area 303 occurred. Figures 1-2 and 2-1 show the locations of these nearby sites in relation to Area 303. These sites are the following:

- GCI Compound, UST GCI-1
- Telephone Exchange Building, UST 10324-A
- Source Area (SA) 79, Main Road Pipeline
- SWMU 62, New Housing Fuel Leak including the Sandy Cove Housing and Eagle Bay Housing areas

These investigations indicated that petroleum-related chemicals, primarily GRO, semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs), and lead, were present in samples of subsurface soil, soil vapor, and groundwater collected from various locations near Area 303. In addition, the concentrations of petroleum-related chemicals in soil, groundwater, and soil vapor exceeded the applicable ADEC cleanup criteria or vapor intrusion target levels.

2.4 CLEANUP ACTIVITIES PERFORMED TO DATE

No cleanup activity has been implemented at Area 303. However, the Navy has decommissioned pipelines in the downtown area, including the avgas and JP-5 pipelines

discussed in Section 2.2.2. The Navy has also verified that the diesel pipeline in the vicinity of Area 303 was previously decommissioned. Decommissioning work included integrity testing using a vacuum test; draining, cleaning, and filling the pipelines with grout; removing all aboveground sections of pipeline, valve sheds, valves, and controls; and removing all underground low-point drains, high-point vents, and valve pits/vaults. Pipeline integrity testing results indicated that sections of the 8-inch diameter avgas pipeline and its 6-inch-diameter branch were compromised and were likely to have leaked. Both of these sections are located in the northern part of Area 303. This decommissioning work was completed in September 2009.

Cleanup activities have been performed at other sites within the Area 303 boundaries or adjacent to Area 303. These are:

- The GCI Compound UST site, located near the center of Area 303
- The Telephone Exchange Building UST site, located at the northeast boundary of Area 303
- The Main Road petroleum transfer pipeline site, which traverses Area 303 adjacent to and west of Main Road
- The SWMU 62, New Housing Fuel Leak site, including Sandy Cove Housing and Eagle Bay Housing areas, which are located at the extreme northeast and southeast boundaries of Area 303, respectively

2.4.1 GCI Compound, UST GCI-1

The Navy removed a UST and the associated piping and dispenser from the GCI Compound site during 1995. Free-phase petroleum product was observed in the excavation at the time of tank removal. Free-product recovery was selected as an interim remedy for the GCI Compound site in the ROD for OU A (U.S. Navy, USEPA, and ADEC 2000). Passive-style product skimmers were used at this site to recover product when detected in measurable quantities. Free product was recovered at the GCI Compound site to the maximum extent practicable, following the requirements of the ROD for OU A and 18 AAC 75.325(f)(1)(B) (U.S. Navy and ADEC 2005). Following completion of the interim remedy, the Navy evaluated additional alternative remedial options for the site. MNA with institutional controls was selected as the preferred final remedy for the GCI Compound site during 2005 (U.S. Navy and ADEC 2005). This remedy was implemented at the GCI Compound site during 2006. As a result, groundwater monitoring is conducted annually at this site.

Although free-product recovery is not a component of the final remedy for this site (U.S. Navy and ADEC 2005), monthly monitoring and free-product recovery were performed at one well

(04-202) based on a request by ADEC during comment resolution on the 2006 annual groundwater monitoring report (U.S. Navy 2007b). This well was gauged monthly from May 2007 through May 2010, concurrently with free-product recovery activities at South of Runway 18-36 Area, NMCB Building Area, and SWMU 62, New Housing Fuel Leak. No free-product recovery occurred in well 04-202 during monthly free-product recovery activities, because thicknesses greater than 0.5 foot were not measured in this 2-inch well. Monthly free-product recovery activities at well 04-202 were discontinued in June 2010, because free product had not been measured in that well since September of 2007.

2.4.2 Telephone Exchange Building, UST 10324-A

The Navy removed a UST and its associated piping from the Telephone Exchange Building site during 1995. Free-phase petroleum product was not encountered at this site during tank removal and subsequent site characterization activities. This site was designated for no further action in the ROD for OU A (U.S. Navy, USEPA, and ADEC 2000).

2.4.3 SA 79, Main Road Pipeline

During repair and replacement activities along the Main Road Pipeline, several areas were detected with petroleum hydrocarbons in pipeline trenching. A 1994 release investigation identified two areas along the pipeline containing petroleum-related chemicals in subsurface soils (U.S. Navy 1994). Free-phase petroleum product was not encountered at this site during the 1994 characterization activities. The ROD for OU A selected limited groundwater monitoring for this site (U.S. Navy, USEPA, and ADEC 2000). Limited groundwater monitoring activities along the northern end of the pipeline (north of Airport Road) were discontinued in 2005 because concentrations of chemicals of concern met endpoint criteria. Monitoring activities along the southern end of the pipeline (south of South Sweeper Creek) are continuing (U.S. Navy 2011a).

2.4.4 SWMU 62, New Housing Fuel Leak

During 1988 and 1989, the Navy identified and repaired 21 fuel piping leaks at SWMU 62, New Housing Fuel Leak site. Free-phase petroleum product was observed on the groundwater surface at several locations beneath this site. Free-product recovery was selected as an interim remedy for the SWMU 62, New Housing Fuel Leak site in the ROD for OU A (U.S. Navy, USEPA, and ADEC 2000). A free-product recovery system was installed at this site that pumped groundwater to draw product into the recovery wells. This system operated between October 1989 and May 2000, when it was determined to have met the negotiated product-recovery endpoints and was shut down. This system recovered an estimated 154,000 gallons of free product from multiple plumes during its 11-year operational life (U.S. Navy 1999b). Following completion of the interim remedy, the Navy evaluated additional alternative remedial options for

the site. Institutional controls, free-product containment and passive recovery, surface soil excavation, and MNA for groundwater were selected as the preferred final remedy for the New Housing Fuel Leak site during 2006 (U.S. Navy and ADEC 2006c). This remedy was implemented at the site during 2006 (U.S. Navy 2007). Ongoing activities include periodic passive free-product recovery in a product recovery trench and existing site wells, and annual groundwater monitoring. These ongoing activities include product recovery and groundwater monitoring at locations in the extreme southern and northern portions of Area 303, which are part of the DRO plume associated with the Eagle Bay Housing and Sandy Cove Housing areas of SWMU 62.

2.5 LAND USE

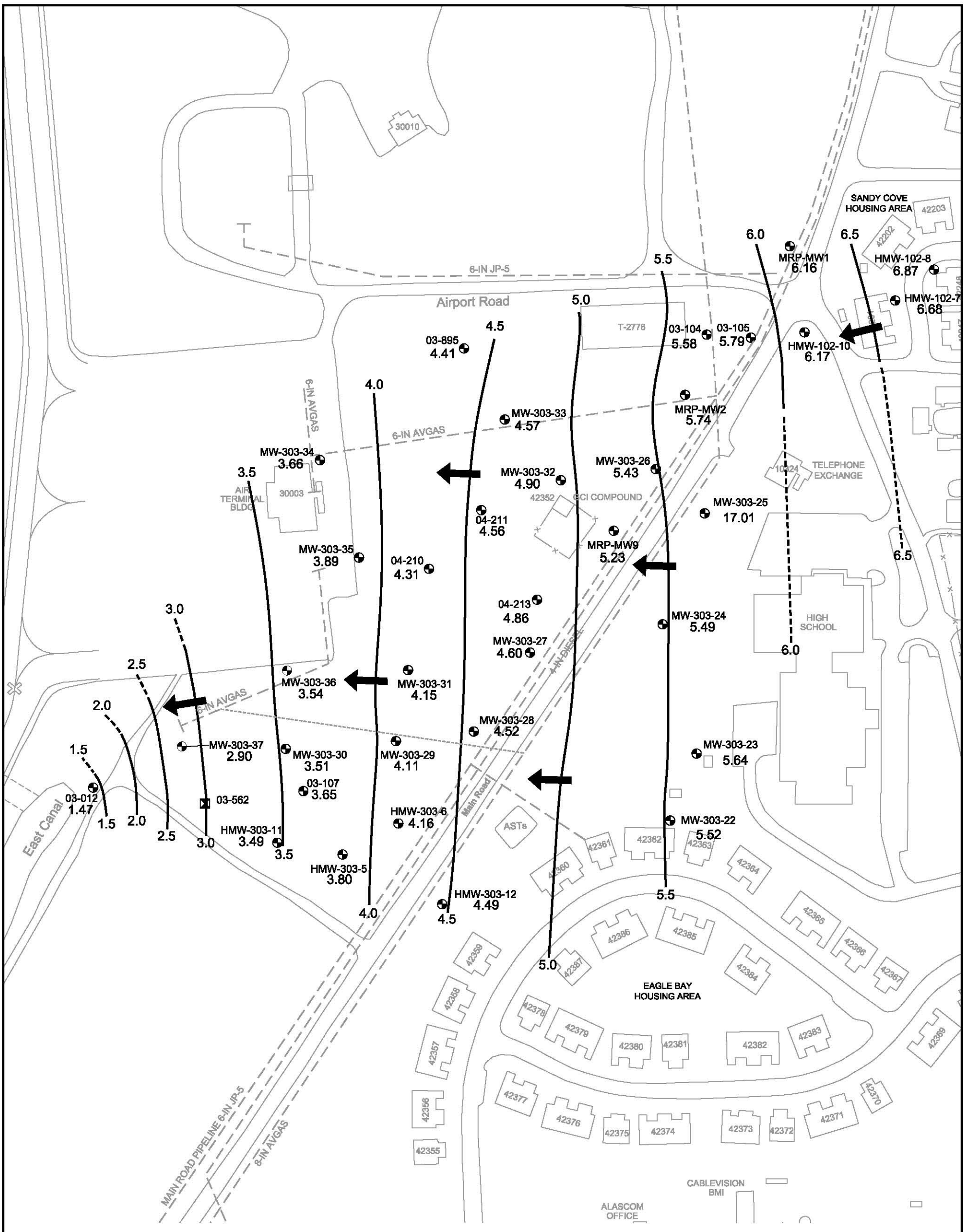
Navy records indicate that land use within Area 303 was restricted to aviation or industrial purposes. Maps of military facilities on Adak from 1946 identified the presence of an underground avgas distribution pipeline traversing the site. A gasoline station (Building 2788) and motor pool structure were formerly located at this site in the vicinity of the GCI Compound (USACE 1946). No evidence remains of these earlier buildings (U.S. Navy 1995b). The date of installation for the GCI Compound is estimated to be between 1977 and 1987, based on a review of available aerial photographs.

ARC classifies future land use at the Area 303 site west of Main Road as commercial (Figure 2-5). The Navy anticipates that the western portion of the site will continue to be used for commercial or industrial purposes. Commercial activities must be planned, organized, and sited to mitigate impact on and buffer any adjacent noncommercial/industrial lands (ARC 2000). The eastern portion of the site between Main Road and the former high school building is designated for public facilities reuse, and the portion of the site between Main Road and the Eagle Bay Housing area is designated for residential reuse. Land use west of the site is designated for aviation reuse. The intent of this category is to provide for aviation or aviation-related commercial/industrial activities. The adjacent property to the northeast and southeast, consisting of the Sandy Cove and Eagle Bay Housing areas, is classified for residential or future residential reuse. The intent of these categories is to serve the residential needs of the community (ARC 2000).

2.6 GROUNDWATER USE

According to 18 AAC 75.350, groundwater is considered to be a drinking water source, unless it can be demonstrated that the groundwater is not currently being used as a drinking water source and groundwater is not a reasonably expected future source of drinking water. Although groundwater is not being used as a drinking water source on Adak and institutional controls are

in place preventing the use of the downtown aquifer, groundwater is still considered to be a potential future source of drinking water at Area 303 because potable water could be obtained, should a well be installed at the site.



LEGEND

- Fence
- Monitoring Well
- Pipeline Location as Traced
- Pipeline Termination
- Former Pipeline Location Not Found
- —5.0— Groundwater Elevation Contour (ft Above MLLW) (Dashed Where Inferred)
- Groundwater Flow Direction

Note: Water levels shown for each well are in feet above MLLW and were recorded on July 18, 2006

U.S. NAVY	0 90 180 SCALE IN FEET	**Figure 2-1 Groundwater Flow Map of Area 303**	Adak Island, AK DECISION DOCUMENT

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LEGEND

- 12 — Contours in Feet Above Mean Sea Level
- Fence
- Monitoring Well Sampled
- Monitoring Well Not Sampled
- Recovery Well Not Sampled
- Abandoned Monitoring Well
- Extent of Clayey Sand and Silt Layers
- Geoprobe Well Sampled
- Geoprobe Well Not Sampled
- USGS Geoprobe Sample
- URS Geoprobe Sampling Location
- Pipeline Location as Traced
- Pipeline Termination
- Former Pipeline Location Not Found

Notes:

1. Approximate elevations of top of clayey sand and silt layers are provided near well locations when available.
2. The two smaller overlapping layers in the southeastern portion of the site are located at different elevations. The smallest layer with a north to south orientation is above the slightly larger layer which is oriented northwest to southeast.

U.S. NAVY

0 90 180
SCALE IN FEET

Figure 2-2
Lower Permeability Layers That May Affect Downward Percolation of Groundwater
Area 303

Adak Island, AK
DECISION DOCUMENT

T:\ADAK\IDIQ\Sub-Tasks\DO 31\Decision Document\FIG 2-2 SURF CONTOURS.dwg
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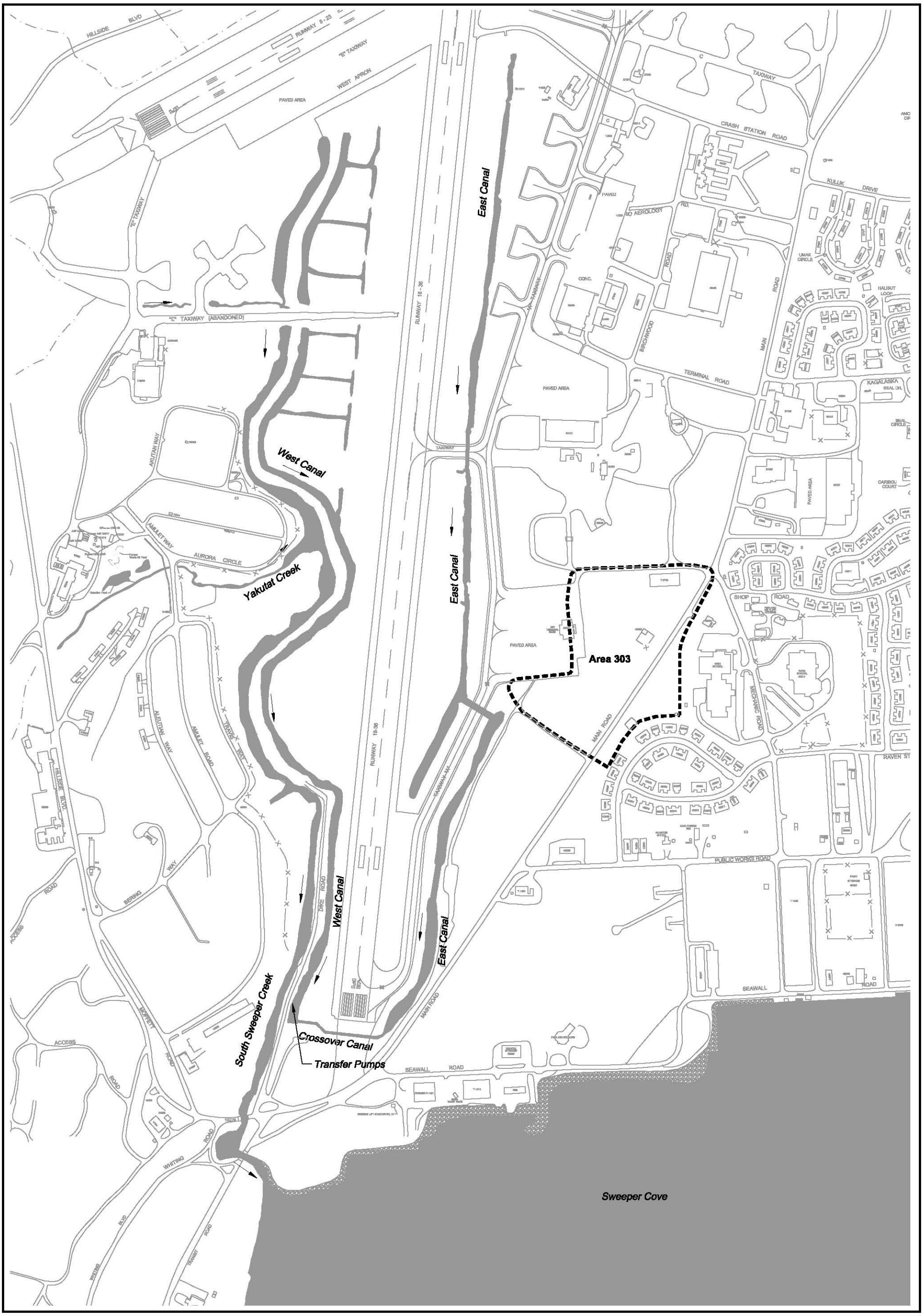

U.S. NAVY	0 300 600 SCALE IN FEET	**Figure 2-3** **Location of the Airport Ditch System** **Area 303**	Adak Island, AK DECISION DOCUMENT

T:\ADAK\IDIQ\Sub-Tasks\DO 31\Decision Document\Fig 2-3 AIRPORT DITCHES.dwg
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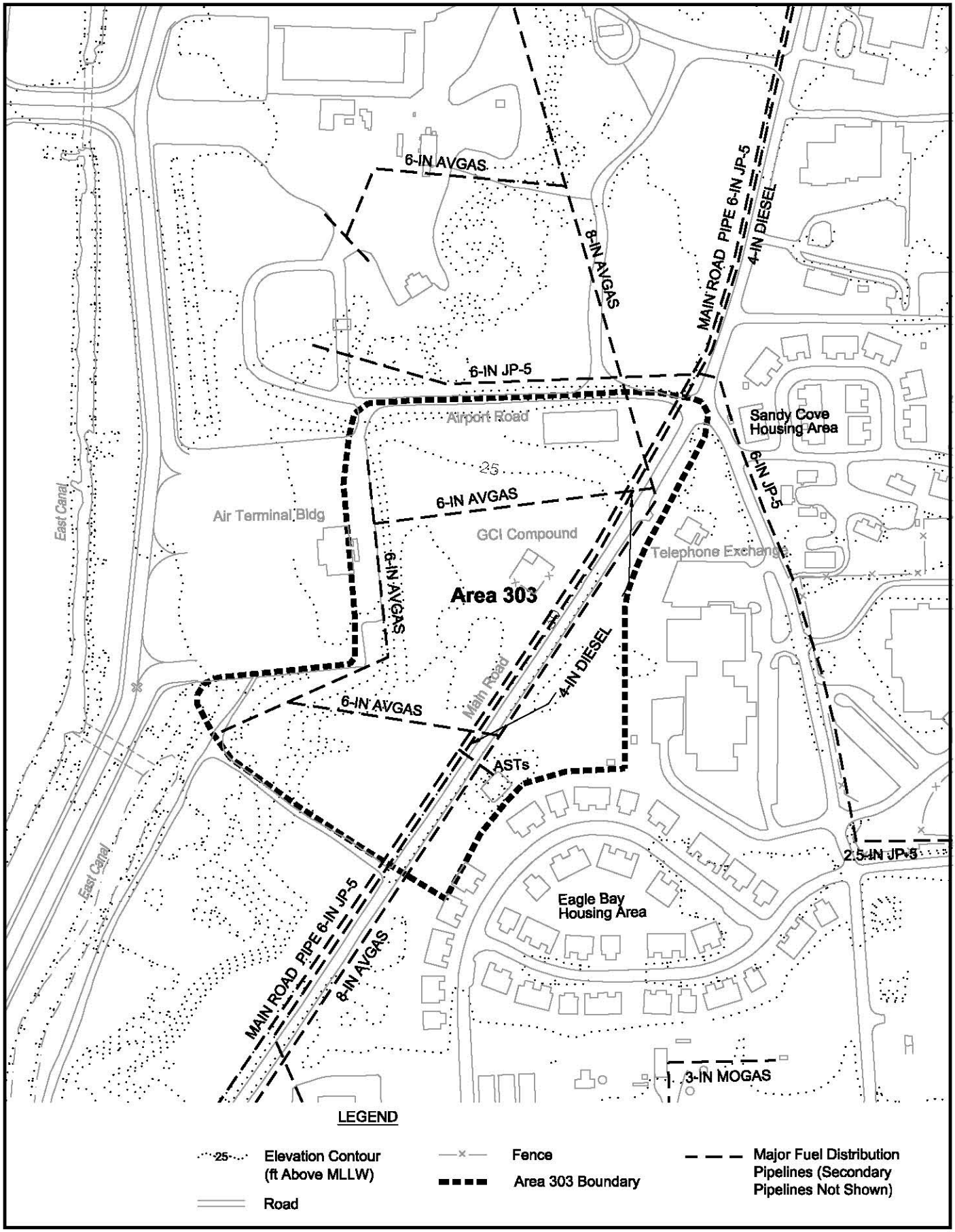

U.S. NAVY	N 0 175 350 SCALE IN FEET	**Figure 2-4** **Potential Petroleum Sources at Area 303**	Adak Island, AK DECISION DOCUMENT

T:\ADAK\IDIQ\Sub-Tasks\DO 31\Decision Document\FIG 2-4 PETRO SOURCES.dwg
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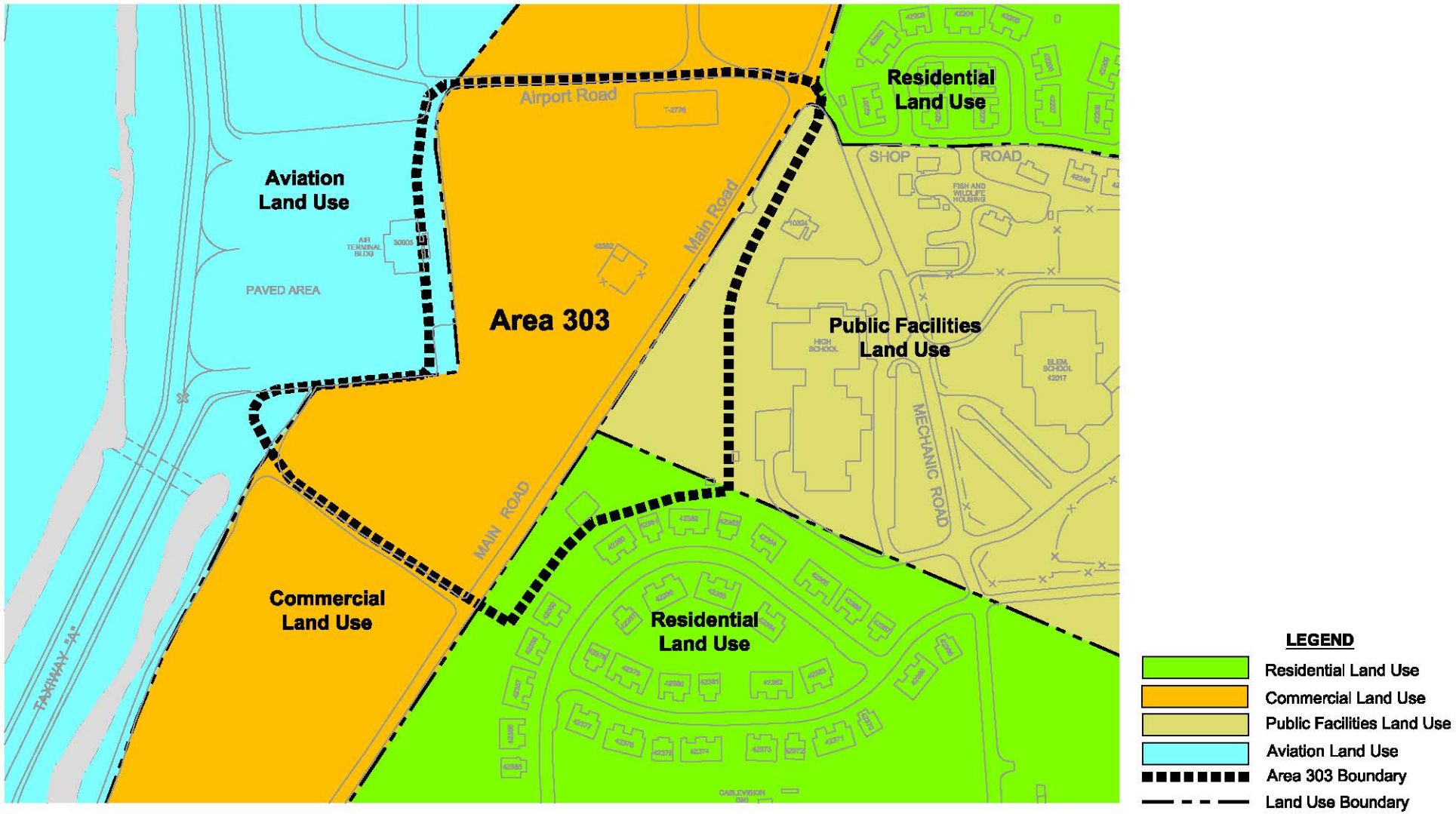

Note:
Residential land use is prohibited unless specifically authorized in writing by the Department of the Navy according to the Interim Conveyance dated March 7, 2004.

U.S. NAVY	N 0 175 350 SCALE IN FEET	**Figure 2-5** **Land Use in the Vicinity of Area 303**	Adak Island, AK DECISION DOCUMENT

T:\ADAK\IDIQ\Sub-Tasks\DO 31\Decision Document\FIG 2-5 Land Use.dwg
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Table 2-1
Summary of Environmental Field Investigations at Area 303

Date	Investigation Area	Investigation Activity
1988-1989	SWMU 62, New Housing Fuel Leak	Release investigation was conducted to identify and repair petroleum leaks in the fuel distribution system at the site, evaluate the extent of petroleum fuel released, and initiate product recovery.
1994	SA 79, Main Road Pipeline	Release investigation was conducted to evaluate the extent of fuels released in the vicinity of the Main Road Pipeline.
1995	GCI Compound, UST GCI-1	UST, piping, and dispenser were removed. Free-phase petroleum product was observed during tank removal.
1995	Telephone Exchange Building, UST 10324-A	UST and piping were removed. Free-phase petroleum product was not encountered during excavation.
1999	SWMU 62, New Housing Fuel Leak	Free-product recovery closure report was prepared to demonstrate that the existing free-product recovery system had recovered product to its practicable endpoint.
2001-ongoing	SA 79, Main Road Pipeline	Limited groundwater monitoring activities were performed. Monitoring activities north of Airport Road were discontinued in 2005 because concentrations of chemicals of concern met endpoint criteria. Monitoring activities south of South Sweeper Creek are continuing.
2002-2003	GCI Compound	While investigating the groundwater near the GCI Compound, GRO contaminants from another source were discovered. The detection of this GRO plume was when Area 303 was first discovered.
2006	Area 303	Remedial investigation was performed to delineate the lateral extent of dissolved-phase, petroleum-related chemicals in the groundwater, including a survey of pipelines within Area 303, and to evaluate conditions for human health and ecological risk assessment.
2010	Area 303	Soil vapor investigation was conducted to provide data for a supplemental human health risk assessment that included evaluation of the possible vapor intrusion pathway for all categories of land use, including residential.

Notes:
GCI - General Communications, Inc.
GRO - gasoline-range organics
SA - Source Area
SWMU - solid waste management unit
UST - underground storage tank

3.0 IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

Petroleum hydrocarbons and VOCs have been detected in soil, groundwater, and soil vapor at Area 303. In addition, SVOCs and lead have been detected in groundwater. The concentrations of chemicals in these media at this site were compared to ADEC cleanup criteria and/or human health and ecological risk-based screening criteria to identify the chemicals of potential concern (COPCs). The COPCs in soil, groundwater, and soil vapor are shown in Table 3-1 and discussed below.

3.1 SOIL

A chemical was identified as a COPC if its concentration exceeded the ADEC Method Two cleanup levels established to prevent migration of contaminants from soil to groundwater in the "over 40 inches of rainfall" zone (18 AAC 75.341, Tables B1 and B2), or if it was identified as a COPC in the human health risk assessment. The ecological risk assessment concluded that no ecological threat exists to terrestrial receptors from chemicals detected in surface soil. For ecological risk assessment, surface soil is 0 to 6 feet bgs. The following COPCs were identified in soil at Area 303:

- 1,2,4-Trimethylbenzene
- 1,3,5-Trimethylbenzene
- Benzene
- C6-C10 aliphatics
- C8-C10 aromatics
- C10-C21 aromatics
- DRO
- Ethylbenzene
- GRO
- Residual-range organics (RRO)
- Toluene
- Xylenes

Concentrations of all of the above COPCs except for RRO in soil at the site exceeded the most stringent ADEC Method Two soil criteria in one or more samples. Therefore, they were included as COPCs for the site. These COPCs were not identical to the COPCs selected for the human health risk assessment, because the risk assessment selected COPCs using different criteria, as described in Section 5. Specifically, benzene was not included as a human health COPC, because the detected concentrations were less than the human health risk assessment

screening criterion. C6-C10 aliphatics, C8-C10 aromatics, and C10-C21 aromatics were not included as separate human health COPCs, because these are fractions of DRO and GRO, and these fractions were evaluated as part of the DRO and GRO evaluations in the human health risk assessment. RRO was identified as a human health COPC even though its concentrations did not exceed the most stringent ADEC Method Two soil criteria. RRO was included because its concentration exceeded the human health risk assessment screening criteria. The remaining COPCs exceeding ADEC Method Two soil criteria (1,2,4- trimethylbenzene, 1,3,5-trimethylbenzene, DRO, ethylbenzene, GRO, toluene, and xylenes) also were selected as human health COPCs.

3.2 GROUNDWATER

A chemical was identified as a COPC if its concentration exceeded the ADEC groundwater cleanup levels (18 AAC 75.345[b][2]) or if it was identified as a COPC in the human health risk assessment. The following COPCs were identified at Area 303:

- 1,2,4-Trimethylbenzene
- 1,3,5-Trimethylbenzene
- Benzene
- Bis(2-ethylhexyl)phthalate
- Dibenz(a,h)anthracene
- DRO
- Ethylbenzene
- GRO
- Lead
- Naphthalene
- RRO
- Toluene
- m,p-Xylene
- o-Xylene
- Xylenes

Concentrations of benzene, dibenz(a,h)anthracene, DRO, ethylbenzene, GRO, lead, and toluene in groundwater at the site exceeded ADEC groundwater cleanup levels. Therefore, they were included as COPCs for the site. These COPCs were not identical to the COPCs selected for the human health risk assessment, because the risk assessment selected COPCs using different criteria, as described in Section 5. Specifically, lead was not included as a COPC in groundwater in the human health risk assessment, because the only complete exposure pathways to groundwater are inhalation and dermal contact during subterranean construction activities, and

lead is not considered volatile nor is it readily absorbed through the skin. 1,2,4-Trimethylbenzene, 1,3,5-trimethylbenzene, bis(2-ethylhexyl)phthalate, naphthalene, RRO, m,p-xylene, o-xylene, and xylenes were identified as COPCs in the human health risk assessment, even though their concentrations did not exceed the ADEC groundwater cleanup levels. They were included because their concentrations exceeded the human health risk assessment screening criteria. The remaining COPCs exceeding the ADEC groundwater cleanup levels (benzene, dibenz[a,h]anthracene, DRO, ethylbenzene, GRO, and toluene) also were selected as human health COPCs.

3.3 SOIL VAPOR

A chemical was identified as a COPC if its concentration exceeded one-tenth of the levels from Appendix F (deep soil gas) in the *Draft Vapor Intrusion Guidance for Contaminated Sites* (ADEC 2009). The following COPCs were identified at Area 303:

- 1,2,4-Trimethylbenzene
- 1,3,5-Trimethylbenzene
- Benzene
- Ethylbenzene
- GRO
- Isopropylbenzene
- Tetrachloroethene (PCE)
- m,p-Xylene

With the exception of isopropylbenzene and PCE, the same COPCs identified in soil vapor were identified in groundwater as exceeding groundwater screening levels protective of the vapor intrusion pathway, providing additional evidence that groundwater is the source of chemicals in soil vapor. Since the groundwater data set is more extensive then the soil vapor data set both spatially and temporally, it serves as support for the chemicals selected and evaluated for vapor intrusion and indicates that all COPCs for soil vapor have been identified. While isopropylbenzene was not on the analyte list for groundwater, it is a petroleum compound and likely associated with the known source. Furthermore, isopropylbenzene concentrations in soil vapor were not a health risk (see Section 5). PCE and other chlorinated solvents were not included in the analytical suite for groundwater, because there is no known source of PCE at Area 303. However, based on the detection of PCE in soil gas, PCE may be present in groundwater at the site. Groundwater beneath Area 303 has not been tested for PCE. By the fall of 2012, the Navy will test for PCE in groundwater samples from wells MW-303-28, MW-303-29, MW-303-30, 03-107, HMW-303-5, and HMW-303-6, which are near the soil vapor probe

where PCE was detected. PCE has been detected historically in groundwater at some locations in the downtown area of Adak, although not upgradient of the Area 303 site.

Table 3-1
Chemicals of Potential Concern in Soil, Groundwater, and Soil Vapor at Area 303

Media	Criteria for Inclusion	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	Benzene	Bis(2-ethylhexl)phthalate	C6-C10 Aliphatics	C8-C10 Aromatics	C10-C21 Aromatics	Dibenz(a,h)anthracene	DRO	Ethylbenzene	GRO	Isopropylbenzene	Lead	Naphthalene	RRO	Toluene	Tetrachloroethene	m,p-Xylene	o-Xylene	Xylenes
Soil	ADEC criteria	●	●	●		●	●	●		●	●	●					●				●
	Human health COPC	●	●							●	●	●				●	●				●
Groundwater	ADEC criteria			●					●	●	●	●		●			●				
	Human health COPC	●	●	●	●				●	●	●	●			●	●	●		●	●	●
Soil vapor	Human health COPC	●	●	●							●	●	●					●	●		

Notes:
ADEC - Alaska Department of Environmental Conservation
COPC - chemical of potential concern
DRO - diesel-range organics
GRO - gasoline-range organics
RRO - residual-range organics

4.0 CONTAMINANT CONCENTRATIONS AND ESTIMATED EXTENT OF CONTAMINATION

Decisions documented in this DD are based on information gathered from various environmental field investigations the Navy performed in the vicinity of Area 303 between 1988 and 2010. Table 2-1 summarizes the environmental field investigations that have been performed at or in the vicinity of Area 303. During these investigations, petroleum-related chemicals, primarily GRO, SVOCs, VOCs, and lead, were detected in samples of subsurface soil, groundwater, and/or soil vapor collected from various locations at Area 303. In addition, free product was detected in wells at the site. Detailed characterization information for the site is provided in the FFS (U.S. Navy 2011b) and summarized below.

4.1 EXTENT OF FREE PRODUCT

During the 2006 remedial investigation, free product was observed in four wells at thicknesses ranging from 0.01 to 0.12 foot, as shown in Table 4-1, when all wells in Area 303 were gauged for free product. Free product was observed on the groundwater surface at wells HMW-303-5, HMW-303-11, MW-303-30, and MW-303-31. Since 2006, wells HMW-303-5 and HMW-303-11 were gauged annually, and MW-303-30 was gauged in 2008 and 2009. Table 4-2 lists the dates and results of the free-product monitoring at the four wells where free product was detected. Free product has not been detected in HMW-303-5 and HMW-303-11 since 2008 and 2006, respectively. The current extent of free product is shown on Figure 4-1.

It is believed that free product is still present in the south-central portion of Area 303 near wells MW-303-30 and MW-303-31. The maximum free-product thickness (0.13 foot) was measured in well MW-303-30. Free product was measured at 0.09 foot in well MW-303-31, which is located approximately 300 feet northeast of MW-303-30.

The previously existing free product at the southern border of Area 303 near wells HMW-303-5 and HMW-303-11 likely originated from the SWMU 62, Eagle Bay Housing area, because no free product was observed in wells 03-107, HMW-303-6, and MW-303-29, and SWMU 62 is upgradient. Wells HMW-303-5 and HMW-303-11 are part of SWMU 62, where free product removal and MNA are part of the remedy, as described in Section 2.4.4. The absence of free product in these two wells in the past few years may be a result of the SWMU 62 remedy.

No free-product recovery has been performed at Area 303, because the planned remedial alternative has yet to be finalized and implemented.

4.2 ESTIMATED EXTENT OF CONTAMINATION IN SOIL, GROUNDWATER, AND SOIL VAPOR

The extent of contamination was estimated by comparing site concentrations from samples collected between 1992 and 2006 to the ADEC cleanup levels. Locations where the concentrations exceeded ADEC cleanup levels were identified and then used to delineate the area of estimated contamination for groundwater and soil on Figures 4-1 and 4-2.

The ADEC Method Two cleanup levels established to prevent migration of contaminants from soil to groundwater in the "over 40 inches of rainfall" zone (18 AAC 75.341, Tables B1 and B2) were used to estimate the extent of soil impacted by petroleum contamination at Area 303. The groundwater cleanup levels found in18 AAC 75.345[b][1], Table C were used to estimate the extent of groundwater impacted by petroleum contamination at the site.

The estimated extents of contamination for soil and groundwater shown in Figures 4-1 and 4-2 are based solely on exceedances of the ADEC cleanup levels. They do not necessarily represent areas where risks are unacceptable or where cleanup actions will be required. However, these areas were considered to be of potential concern and therefore required further evaluation in a risk assessment. In addition to groundwater and soil data, a soil vapor investigation conducted in 2010 provided data in support of the supplemental human health risk assessment, which included evaluation of the possible vapor intrusion pathway. The site data, including the soil vapor data collected in 2010, were used in the risk assessment to determine whether chemical concentrations at the site pose an unacceptable risk to humans and ecological receptors.

Appendix B summarizes analytical results for the soil and groundwater COPCs, as well as the analytical results for GRO, benzene, ethylbenzene, toluene, xylenes, VOCs, and aliphatic/aromatic hydrocarbons for soil vapor. Analytical results obtained for 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, benzene, toluene, ethylbenzene, xylenes, dibenz(a,h)anthracene, GRO, DRO, C6-C10 aliphatics, C8-10 aromatics, C10-C21 aromatics, and lead were included in the analysis conducted to establish the estimated extent of contamination for soil and groundwater at the site. No other chemicals were detected at concentrations greater than ADEC cleanup levels. Table 4-3 provides basic summary statistics for all COPCs (identified in Section 3) in soil, groundwater, and soil vapor. These statistics include the following:

- The minimum concentration used in the risk assessment
- The maximum concentration used in the risk assessment
- The location of the maximum concentration used in the risk assessment
- The detection frequency
- The range of detection limits

The concentrations of contaminants at the site were compared to ADEC cleanup criteria and/or human health and ecological risk-based screening criteria to identify the COPCs in soil, groundwater, and soil vapor. Therefore, some chemicals listed in Table 4-3 may have been detected only at concentrations that exceeded the human health and/or ecological risk-based screening criteria and not the ADEC cleanup levels.

4.2.1 Soil

Table B-1 in Appendix B presents analytical results for COPCs in soil samples collected at Area 303. The extent of contamination in soil at the site was estimated by comparing analytical results to the most stringent ADEC soil cleanup criteria established for the protection of groundwater in the "over 40 inches of rainfall" zone. Detected concentrations of 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, DRO, GRO, C6-10 aliphatics, C8-C10 aromatics, C10-C21 aromatics, benzene, ethylbenzene, toluene, and xylenes greater than their respective ADEC soil cleanup levels were reported in soil samples collected from nine locations. These nine locations, shown on Figure 4-2, occur over an area from southwest near East Canal to northeast near the Sandy Cove Housing area. The dashed line on Figure 4-2 indicates the estimated extent of soil contamination, based on detected concentrations of chemicals in soil at concentrations greater than their respective most stringent ADEC soil criteria. This area is estimated to be approximately 5.7 acres. Note that soil in the vicinity of locations MRP-MW1, HMW-102-10, and HMW-303-12 with detected concentrations of chemicals greater than the most stringent ADEC Method Two criteria are not included in the extent of contamination, because these exceedances are associated with the SWMU 62, New Housing Fuel Leak site (Sandy Cove Housing and Eagle Bay Housing areas).

4.2.2 Groundwater

Tables B-2 and B-3 in Appendix B present analytical results for COPCs in groundwater samples collected at Area 303. The estimated extent of contamination in groundwater was estimated by comparing analytical results to their respective ADEC groundwater cleanup levels, which were established for groundwater used as a drinking water source. Detected concentrations of benzene, ethylbenzene, toluene, dibenz(a,h)anthracene, GRO, DRO, and lead were reported in the most recent groundwater samples collected from 25 locations at concentrations greater than their respective ADEC groundwater cleanup criteria for groundwater used as a drinking water source. These 25 locations are shown on Figure 4-1. They occur over an area from south of the air terminal building across Main Road to the northwestern portion of the Eagle Bay Housing area at the south end, and to the western edge of the Sandy Cove Housing area at the north end. Figure 4-1 shows the estimated extent of groundwater contamination, based on detected petroleum-related chemicals in groundwater at concentrations greater than the ADEC criteria for groundwater used as a drinking water source.

The estimated area of groundwater contamination shown on Figure 4-1 is approximately 18.0 acres and consists of chemicals originating from Area 303 and from SWMU 62 (Sandy Cove Housing and Eagle Bay Housing areas). As shown the figure, the groundwater plumes associated with SWMU 62 and Area 303 commingle near the northern and southern portions of Area 303. The approximate areal extent of the Area 303 plume, SWMU 62 plumes, and commingled plumes are, 11.6, 4.5, and 1.9 acres, respectively.

4.2.3 Soil Vapor

Table B-4 in Appendix B presents analytical results for GRO, benzene, ethylbenzene, toluene, xylenes, VOCs, and aliphatic/aromatic hydrocarbons. These data were used for the supplemental human health risk assessment conducted as part of the FFS (U.S. Navy 2011b). Because soil vapor was only analyzed for at three locations, the extent of contamination was not estimated for soil vapor. However, soil vapor locations were selected based on the locations of the maximum concentrations of GRO and benzene in groundwater, presence of free product, and proximity to commercial, industrial, and residential land use areas. Therefore, the soil vapor data are likely to represent the maximum concentrations in soil vapor at the site.

LEGEND

- Generalized Extent of Groundwater Where Petroleum-Related Chemicals Exceed the Most Stringent ADEC Criteria
- Estimated Extent of Free Product
- Locations Where Detected Concentrations of Chemicals in Groundwater Exceed the Most Stringent ADEC Criteria
- Groundwater Plume Associated With Area 303
- Groundwater Plume Associated With SWMU 62
- Approximate Area of Combined Plumes From Area 303 and SWMU 62
- Fence
- Monitoring Well
- Geoprobe Well
- URS Geoprobe Sampling Location
- Pipeline Location as Traced
- Pipeline Termination
- Pipeline Location Not Found
- Groundwater Flow Direction

U.S. NAVY

0 90 180
SCALE IN FEET

Figure 4-1
Estimated Extent of Free Product and Groundwater Contamination
Area 303

Adak Island, AK
DECISION DOCUMENT

T:\ADAK\IDIQ\Sub-Tasks\DO 31\Area 303 LTM\FIG 4-1 Free Prod_GW Contam.dwg
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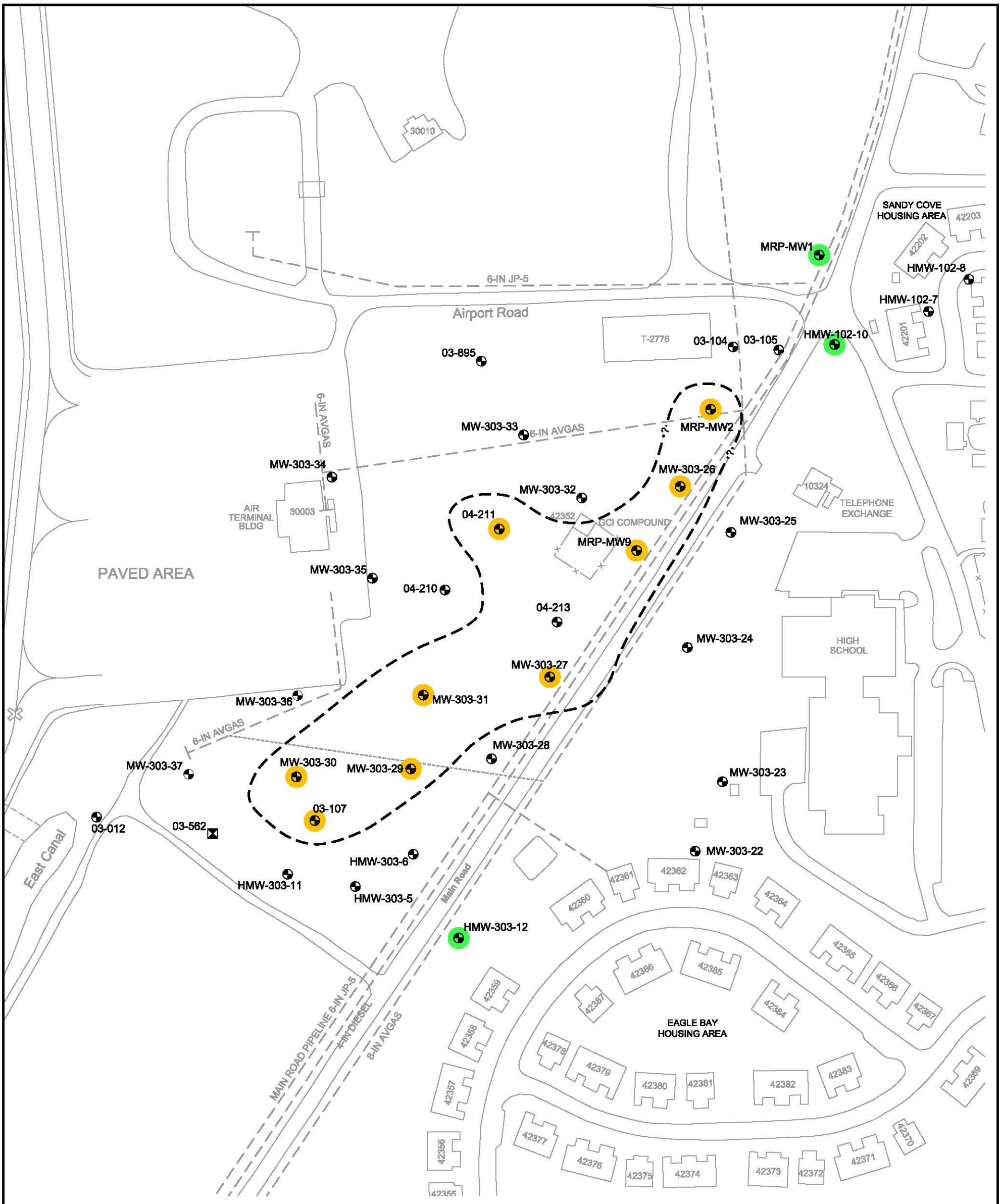

LEGEND

- Soil Containing Chemical Concentrations Exceeding the Most Stringent ADEC Method Two Soil Criterion
- Chemicals Associated With Area 303 in Soil Exceed ADEC Method Two Soil Criteria
- Chemicals Associated With SWMU 62 in Soil Exceed ADEC Method Two Soil Criteria
- Fence
- Monitoring Well Sampled
- Recovery Well
- Geoprobe Well
- Pipeline Location as Traced
- Pipeline Termination
- Former Pipeline Location Not Found

Note:
Soil samples collected from locations MRP-MW1, HMW-102-10, and HMW-303-12 had detected concentrations of chemicals greater than the most stringent ADEC Method Two Criteria. These locations are not included in the extent of contamination because the exceedances are associated with SWMU 62 (Sandy Cove Housing Area and Eagle Bay Housing Area).

U.S. NAVY

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Figure 4-2
Estimated Extent of Soil Contamination
Area 303

Adak Island, AK
DECISION DOCUMENT

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Table 4-1
Groundwater Elevations at Area 303 on July 18, 2006

Well ID	Top of Casing Elevation (feet above MLLW)	Depth to Free Product from Top of Casing (feet)	Depth to Water from Top of Casing (feet)	Free-Product Thickness (feet)	Elevation of Groundwater Surface (feet above MLLW)
03-012	9.27	NA	7.80	NA	1.47
03-107	31.30	NA	27.65	NA	3.65
03-562[a]	18.59	NA	NA	NA	NA
03-895	26.21	NA	21.80	NA	4.41
04-210	29.22	NA	24.91	NA	4.31
04-211	28.45	NA	23.89	NA	4.56
04-213	28.70	NA	23.84	NA	4.86
03-104	25.13	NA	19.55	NA	5.58
03-105	25.29	NA	19.50	NA	5.79
HMW-102-7	24.79	NA	18.11	NA	6.68
HMW-102-10	23.27	NA	17.10	NA	6.17
HMW-303-5	31.19	27.38	27.41	0.03	3.80[b]
HMW-303-6	32.54	NA	28.38	NA	4.16
HMW-303-11	30.35	26.86	26.87	0.01	3.49[b]
HMW-303-12	29.59	NA	25.10	NA	4.49
MRP-MW1	25.89	NA	19.73	NA	6.16
MRP-MW2	26.99	NA	21.25	NA	5.74
MRP-MW9	28.95	NA	23.72	NA	5.23
HMW-102-8	25.46	NA	18.59	NA	6.87
MW-303-22	33.07	NA	27.55	NA	5.52
MW-303-23	29.60	NA	23.96	NA	5.64
MW-303-24	32.86	NA	27.37	NA	5.49
MW-303-25	29.31	NA	12.30	NA	17.01
MW-303-26	29.17	NA	23.74	NA	5.43
MW-303-27	32.80	NA	28.20	NA	4.60
MW-303-28	32.83	NA	28.31	NA	4.52
MW-303-29	30.98	NA	26.87	NA	4.11
MW-303-30	31.20	27.67	27.79	0.12	3.51[b]
MW-303-31	31.82	27.65	27.74	0.09	4.15[b]
MW-303-32	29.16	NA	24.26	NA	4.90
MW-303-33	29.53	NA	24.96	NA	4.57
MW-303-34	15.75	NA	12.09	NA	3.66
MW-303-35	19.20	NA	15.31	NA	3.89

Table 4-1 (Continued)
Groundwater Elevations at Area 303 on July 18, 2006

Well ID	Top of Casing Elevation (feet above MLLW)	Depth to Free Product from Top of Casing (feet)	Depth to Water from Top of Casing (feet)	Free-Product Thickness (feet)	Elevation of Groundwater Surface (feet above MLLW)
MW-303-36	17.09	NA	13.55	NA	3.54
MW-303-37	16.23	NA	13.33	NA	2.90

[a]No water level measurement to the nearest 0.01 foot could be measured because the water level probe could not be inserted into this 0.5-inch-diameter Geoprobe well.
[b]Groundwater elevation was adjusted where free product was present. Assuming the specific gravity of the free product is approximately 0.80 of water, the adjusted elevation equals measured elevation of the groundwater/ free-product interface plus the thickness of the free product times 0.80.

Notes:
MLLW - mean lower low water
NA - not applicable

Table 4-2
Free-Product Thickness Measurement Summary for Area 303

Location	Date of Measurement	Measured Free-Product Thickness (foot)
HMW-303-5	8/29/2001	0.28
	5/11/2002	0.01
	10/14/2003	0
	7/18/2006	0.01
	9/15/2006	1.35
	9/24/2007	0
	9/23/2008	0
	9/9/2009	0
	9/14/2010	0
	9/13/2011	0
HMW-303-11	8/29/2001	0.37
	5/11/2002	0.35
	10/14/2003	0.01
	7/18/2006	0.03
	9/15/2006	0
	9/24/2007	0
	9/23/2008	0.09
	9/9/2009	0
	9/14/2010	0
	9/13/2011	0
MW-303-30	7/18/2006	0.12
	9/23/2008	0.13
	9/11/2009	0.03
MW-303-31	7/18/2006	0.09

Table 4-3
Summary of Analytical Results for Chemicals of Potential Concern at Area 303

Chemical	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Cleanup/ Screening[b,c,d] Criteria
Soil (mg/kg)						
Volatile Organic Compounds						
1,2,4-Trimethylbenzene	0.0269	160	MW-303-27	9/28	0.00553 - 0.0114	23
1,3,5-Trimethylbenzene	0.0113	76.6	MW-303-27	9/28	0.00553 - 0.0114	23
Benzene	0.00518	0.555	MW-303-26	6/42	0.00166 - 11.4	0.025
Ethylbenzene	0.00845	203	MW-303-31	14/42	0.00443 - 10	6.9
Toluene	0.08	216	MW-303-31	7/42	0.00166 - 10	6.5
Xylenes	0.0264	833	MW-303-27	16/42	0.0111 - 10	63
Petroleum Hydrocarbon Fractions						
C6-C10 aliphatics	11.185	6,100 J	MW-303-31	7/9	5.84 - 6.17	240
C8-C10 aromatics	382 J	1,090 J	MW-303-31	3/9	5.84 - 12.7	130 (C6-C10)
C10-C21 aromatics	21.77	281.2 J	MW-303-30	5/9	9.355 - 21.245	90 (C10-C25)
Total Petroleum Hydrocarbons						
Diesel-range organics	10.4	20,000	MRP-MW1	30/63	4.28 - 1,100	230
Gasoline-range organics	3.9 J	6,830 J	MW-303-31	18/44	0.3 - 500	260
Residual-range organics	29.5	929 J	MW-303-29	8/28	26.7 – 152	9,700
Groundwater (µg/L)						
Semivolatile Organic Compounds						
Bis(2-ethylhexyl)phthalate	4 J	4 J	MRP-MW2	1/2	10	6
Dibenz(a,h)anthracene	0.106	0.441	MW-303-28	4/48	0.02 - 11	0.12
Volatile Organic Compounds						
1,2,4-Trimethylbenzene	0.61	300	GP-303-23A	29/51	0.25 - 1	1,800
1,3,5-Trimethylbenzene	0.53	650	GP-303-23A	29/51	0.25 - 1	1,800
Benzene	0.435 J	220	MRP-MW2	37/98	0.139 - 50	5
Ethylbenzene	1.27	1,800	GP-303-23	43/91	0.2 - 2	700

Table 4-3 (Continued)
Summary of Analytical Results for Chemicals of Potential Concern at Area 303

Chemical	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Cleanup/ Screening[b,c,d] Criteria
Naphthalene	0.1	86.9	HMW-303-11	28/48	0.0952 - 11	730
Toluene	0.27	1,980	MW-303-27	38/91	0.25 - 50	1,000
m,p-Xylene	0.5	3,400	GP-303-23	6/20	0.4 - 2	NE
o-Xylene	0.96	1,700	GP-303-23	4/20	0.2 - 2	NE
Xylenes	0.2	5,300	GP-303-23A	44/71	0.4 - 3	10,000
Total Inorganics						
Lead	1.85	440	MRP-MW2	12/37	1 - 1	15
Total Petroleum Hydrocarbons						
Diesel-range organics	76 J	21,400 J	HMW-303-5	58/89	96.2 - 2590	1,500
Gasoline-range organics	31 J	78,000	GP-303-23A	58/95	20 - 199	2,200
Residual-range organics	130 J	130 J	03-895	1/39	280 - 7430	1,100
Soil Vapor (µg/m^3)[a]						
Volatile Organic Compounds						
Benzene	3.5 U	3,600 U	SV-303-2-C	0/5	3.5 – 3,600	160
Ethylbenzene	0.9 J	77,000	SV-303-2-D	6/9	47 - 35,000	1,100
Isopropylbenzene	1.8 J	94,000	SV-303-2-C	4/5	320,000	17,500
Tetrachloroethene	3,500 J	3,500 J	SV-303-2-C	1/5	7.5 - 7,200	210
1,2,4-Trimethylbenzene	2,400 J	2,400 J	SV-303-2-D	1/5	5.4 - 5,500	310
1,3,5-Trimethylbenzene	60 J	3,000 J	SV-303-2-D	2/5	5.4 - 5,500	310
m,p-Xylene	1.3 J	93,000	SV-303-2-D	8/9	610 - 28,000	4,400[e]
Total Petroleum Hydrocarbons						
Gasoline-range organics	1,100,000	100,000,000	SV-303-2-D	8/9	220	35,000

Table 4-3 (Continued)
Summary of Analytical Results for Chemicals of Potential Concern at Area 303

[a]Locations east of Main Road were screened against residential screening values, and locations west of Main Road were screened against commercial screening values. No location east of Main Road exceeded the screening values and, therefore, the data are not shown here.
[b]Soil screening criteria (ADEC Method Two to prevent migration to groundwater) were used to determine estimated extent of contamination.
[c]Groundwater cleanup criteria (18 Alaska Administrative Code 75.345[b][1], Table C) were used to determine estimated extent of contamination and as cleanup levels for remediation.
[d]Soil vapor screening criteria (1/10 of ADEC 2009 vapor intrusion guidance, Appendix F) were used to assess potential risks at locations with highest potential soil vapor concentrations.
[e]Screening criteria shown is for total xylenes.

Notes:
ADEC - Alaska Department of Environmental Conservation
J - estimated value
µg/L - microgram per liter
µg/m^3 - microgram per cubic meter
mg/kg - milligram per kilogram
U - not detected above reporting limit

5.0 SUMMARY OF RISK ASSESSMENT

Baseline human health risk assessments (the 2007 human health risk assessment and the 2011 supplemental human health risk assessment) were conducted to evaluate whether potential health risks were present if people encountered chemically impacted materials in their environment, according to the risk assessment procedures specified by ADEC (ADEC 2000, 2005, and 2010). A screening-level ecological risk assessment was also performed to determine whether any contaminants and/or environmental media warranted detailed evaluation in a baseline ecological risk assessment. Chemical concentrations reported in Section 4 were used to identify COPCs and calculate risks and hazards. Risks and hazards calculated for human exposures to chemicals in soil, groundwater, and soil vapor were found to be below target health goals.

In addition, the screening-level ecological risk assessment did not identify any chemical of potential ecological concern (COPEC) and concluded that no significant ecological threat exists to terrestrial receptors in the vicinity of Area 303. The groundwater plume from Area 303 has not reached the off-site surface water body (East Canal). Impacts to surface water in East Canal have been addressed under SWMU 62 evaluations. Ecological exposure to surface water in East Canal was considered to be a minor or insignificant exposure pathway.

Target health goals established for free-product petroleum sites at the former Adak Naval Complex are:

- Human health cancer risk of 1×10^{-5}
- Human health hazard index of 1, based on compounds other than total petroleum hydrocarbon (TPH) compounds
- Human health hazard index of 1, based on TPH
- Ecological hazard index of 1

5.1 HUMAN HEALTH RISK ASSESSMENT

ADEC provides guidance for four methods of determining cleanup levels (Methods One through Four) that increase in level of effort and site specificity. Method Four uses risk assessment to determine site-specific cleanup levels (ADEC 2000). Sufficient site information was available to use Method Four, and the results are summarized in this section. This section summarizes the 2007 human health risk assessment and the 2011 supplemental human health risk assessment that were conducted for this site. Site assessment activities identified petroleum compounds in soil

and groundwater above regulatory levels at the site from leakage of subsurface fuel lines. Petroleum vapors were also detected in soil gas at the site in 2010. The risk assessments evaluated whether potential health risks were present, should people encounter these chemically impacted materials in their environment, according to the risk assessment procedures specified by ADEC (ADEC 2000, 2005, and 2010).

Exposure pathways were determined to be complete and significant based on the site-specific human health conceptual site model (CSM) for Area 303 (Figure 5-1). The complete, detailed human health risk assessments can be found in Appendices H and L of the FFS report (U.S. Navy 2011b).

A baseline human health risk assessment typically consists of four major steps: (1) data evaluation, (2) exposure assessment including development of a CSM, (3) toxicity assessment, and (4) risk characterization and calculation of cleanup levels. A final step is a qualitative analysis of the major uncertainties involved in risk assessment calculations. Details of the procedures used to calculate the health risks are summarized below.

5.1.1 Data Evaluation

The first step in a human health risk assessment is to evaluate the data in order to select COPCs for human health. The 2007 risk assessment identified the 2003 and 2006 groundwater monitoring well data and the 2006 subsurface soil data (as well as some historical soil data collected from 1992 to 1998 for locations with no more recent data) as applicable to the human health risk assessment. For the 2011 supplemental risk assessment, the 2010 soil vapor data were used in the quantitative assessment of health risks in the supplemental evaluation. The 2011 supplemental risk assessment also evaluated the 2006 to 2009 groundwater data and the 2006 subsurface soil data as supporting information for the vapor intrusion pathway.

At step one, the data applicable to human health exposures are selected and compared to de minimis health-based screening levels. Chemicals with concentrations greater than the de minimis levels are selected as COPCs for evaluation in the risk assessment. For selecting COPCs in the 2007 risk assessment, one-tenth the ADEC cleanup levels presented on Table B.1 from AAC 75.341 and Table C from AAC 75.345 for soil and groundwater, respectively, were used as human health screening values. One-tenth the cleanup values are used to select COPCs for risk assessment to account for additive toxic effects if exposure to multiple chemicals is occurring. The 2007 risk assessment selected 14 chemicals as COPCs in groundwater:

- Benzene
- Bis(2-ethylhexyl)phthalate
- Dibenz(a,h)anthracene

- DRO (includes C10-C21 aliphatics)
- Ethylbenzene
- GRO (includes C6-C10 aliphatics)
- Naphthalene
- RRO
- Toluene
- 1,2,4-Trimethylbenzene
- 1,3,5-Trimethylbenzene
- m,p-Xylene
- o-Xylene
- Total xylenes

The 2007 risk assessment selected eight chemicals as COPCs in soil:

- DRO (includes C10-C21 aromatics)
- Ethylbenzene
- GRO (includes C6-C10 aliphatics and C8-C10 aromatics)
- RRO
- Toluene
- 1,2,4-Trimethylbenzene
- 1,3,5-Trimethylbenzene
- Xylenes

Note that the COPC list for soil in Section 3.1 also includes benzene. Benzene is not a COPC for human health, because exceedances were below health-based screening levels, except at locations deeper than 15 feet bgs (see discussion in Section 5.1.2).

For selecting COPCs for the 2011 supplemental risk assessment, screening values for soil vapor and groundwater were one-tenth the levels from the 2009 ADEC *Draft Vapor Intrusion Guidance for Contaminated Sites*, Appendices F (deep soil gas) and G (groundwater to indoor air), respectively. The 2011 supplemental risk assessment selected eight chemicals as COPCs in soil vapor:

- 1,2,4-Trimethylbenzene
- 1,3,5-Trimethylbenzene
- PCE
- Ethylbenzene
- m,p-Xylene
- Isopropylbenzene

- Benzene
- GRO

As previously mentioned, the 2011 supplemental risk assessment also evaluated the 2006 to 2009 groundwater data and the 2006 subsurface soil data as supporting information for the vapor intrusion pathway. The 2011 supplemental risk assessment found that, with the exception of isopropylbenzene and PCE, the same COPCs identified in soil vapor were identified in groundwater as exceeding groundwater screening levels protective of the vapor intrusion pathway. This provided additional evidence that groundwater is the source of chemicals in soil vapor. Since the groundwater data set is more extensive then the soil vapor data set both spatially and temporally, it serves as support for the chemicals selected and evaluated for vapor intrusion and indicates that all COPCs for soil vapor have been identified. While isopropylbenzene was not on the analyte list for groundwater, it is a petroleum compound and likely associated with the known source. Furthermore, isopropylbenzene concentrations in soil vapor were not a health risk (Section 5.1.4). PCE and other chlorinated solvents have not been included in the analytical suite for groundwater, because there is no known source of PCE at Area 303. However, based on the detection of PCE in soil gas, PCE may be present in groundwater at the site. PCE has been detected historically in groundwater at some locations in the downtown area of Adak, although not upgradient of the Area 303 site.

5.1.2 Exposure Assessment

Once COPCs are selected, the second step in risk assessment is evaluating the exposure pathways by which people could encounter chemicals. The exposure assessment identifies the populations potentially exposed to chemicals at the site, the means by which exposure occurs, and the amount of the chemical received from each exposure medium (i.e., the dose). Only complete exposure pathways are quantitatively evaluated. Complete pathways consist of four elements: (1) a source and mechanism of chemical release, (2) a retention or transport medium (e.g., groundwater), (3) a point of potential human contact with the affected medium, and (4) a means of entry into the body at the contact point. Figure 5-1 presents the CSM, which depicts the complete pathways for this site.

For the initial risk assessment, no residential exposure was considered. Area 303 currently has no regular use by people, other than minimal crossing of a small area between Main Road and the GCI Compound when there is a need to enter the compound (a distance of some 30 to 50 feet). The land is designated as “commercial” by TAC, but given the small population and availability of empty buildings, future development is unlikely. Therefore, future workers were also not considered a population of concern in the initial risk assessment. Some underground utility lines run through portions of the area and may require maintenance in the future. Consequently, populations of concern for direct exposures to subsurface soils are construction workers involved in utility maintenance or future construction of a building or road in the area.

Construction workers are also a population of concern for exposure to groundwater in the areas where groundwater is shallower than 15 feet and exposure may occur during intrusive activities (construction activities are assumed to go as deep as 15 feet bgs).

The following exposure pathways were selected for quantitative evaluation under current and future conditions in the initial risk assessment:

- Construction workers potentially disturbing soil in the course of construction activity could be exposed through incidental ingestion, dermal contact, inhalation of fugitive dust (to a depth of 15 feet), and inhalation of volatile chemicals in soil as deep as the water table (approximately 20 to 25 feet bgs).

- Construction workers conducting intrusive subsurface work could be exposed to chemicals in shallow groundwater (less than 15 feet bgs) through dermal contact and inhalation. Construction workers could also be exposed to volatile chemicals in deeper groundwater through inhalation of volatile chemicals vaporizing through the subsurface.

Ingestion of groundwater is considered an incomplete pathway for all receptors. Institutional controls are currently in place for groundwater, which restrict the use of groundwater as drinking water.

In the supplemental risk assessment, the vapor intrusion pathway was evaluated. It was assumed that a commercial building would be constructed in the future west of Main Road, but that east of Main Road a residential exposure to vapors might occur because of residential housing adjacent to Area 303 in this area. Chemicals in soil vapor exceeded screening levels only at location SV-303-2, which is west of Main Road. No exceedance of residential vapor screening levels was noted east of Main Road, and the vapor intrusion pathway was considered insignificant for residential receptors. Therefore, only future on-site worker exposure to indoor air was considered a complete and significant pathway of concern, and this pathway was the only additional pathway quantitatively evaluated in the supplemental risk assessment. It was assumed that a small building (smaller buildings are more likely to have an indoor air problem) the size of the nearest existing small building, Building T-2776, would be constructed at the site and occupied full time by a future worker (8-hour days, 5 days per week for 25 years). Because the worker populations are not the same for the 2007 and 2011 risk assessments (construction workers versus indoor workers), there is no cumulative risk concern with respect to the two risk evaluations for Area 303. Although a building of specific dimensions was analyzed for vapor intrusion risk, the risk will be reassessed with real dimensions should a new building be constructed on the site.

Tables 5-1 and 5-2 summarize the exposure factors used in the risk calculations for construction worker exposures to groundwater and soil, respectively, and Table 5-3 summarizes the exposure factors used for indoor worker exposures to soil vapor.

5.1.3 Toxicity Assessment

The third step in risk assessment is evaluating the toxicity of the COPCs by assessing the relationship between the dose of a chemical and the occurrence of toxic effects. Chemical toxicity criteria, which are based on this relationship, consider both cancer effects and noncancer effects. In 2009, EPA developed new guidance for evaluating inhalation exposures (USEPA 2009). The 2011 supplemental risk assessment incorporated the new guidance; thus, the inhalation toxicity criteria used in the 2011 supplemental risk assessment differs from those used in the 2007 risk assessment. Tables 5-4 and 5-5 present the cancer and noncancer criteria, respectively, used in the 2007 risk assessment, and Tables 5-6 and 5-7 present the cancer and noncancer criteria, respectively, used in the 2011 supplemental risk assessment. The toxicity criteria are combined with the exposure factors when quantifying potential health risks for each COPC. Benzene, PCE, ethylbenzene, dibenz(a,h)anthracene, and bis(2-ethylhexyl)phthalate were evaluated for cancer effects, and the other COPCs (where toxicity information exists) were evaluated for noncancer effects.

Because only noncancer toxicity criteria are available for the petroleum groups, carcinogenic effects are not evaluated for the petroleum ranges. Rather, the individual carcinogenic compounds present in petroleum (i.e., benzene) are evaluated separately.

5.1.4 Risk Characterization

The last step in human health risk assessment is characterizing the health risks. The exposure factors, media concentrations, and toxicity criteria are combined to calculate health risks. Health risks are calculated differently for chemicals that cause cancer and chemicals that cause noncancer effects. The calculation of cancer risk assumes that no level of the chemical is without some risk, whereas for chemicals with noncancer effects, a "threshold" dose exists. Risks (for cancer) and hazards (for noncancer effects) are calculated for the reasonable maximum exposure for each pathway, a calculation that overestimates risks for the majority of the population to ensure that public health is protected. Cancer risk estimates represent the potential for cancer effects by estimating the probability of developing cancer over a lifetime as a result of site exposures. Noncancer hazards assume there is a level of chemical intake that is not associated with an adverse health effect, even in sensitive individuals. ADEC target health goals for cancer chemicals are no more than a 1×10^{-5} chance of developing cancer, and target health goals for noncancer chemicals are a hazard quotient of 1.

The following bulleted text summarizes the results of the risk characterization. Table 5-8 presents the exposure-point concentrations used to calculate these risks and hazards.

- **Construction Workers.** The 2007 risk assessment quantified risks to construction workers from exposures to soil and groundwater. Total cancer risk (2×10^{-8}) for combined exposures to soil and groundwater are below target health goals (Table 5-9), and non-TPH noncancer hazards are equal to the target health goal of 1. For TPH compounds, hazards were calculated using the site-specific aliphatic and aromatic percent compositions (as calculated in Appendix H of the FFS [U.S. Navy 2011b]). At the request of ADEC, TPH hazards were also calculated assuming the ADEC default aliphatic and aromatic percent composition. The TPH noncancer hazard calculated using site-specific aliphatic and aromatic percent compositions was 0.6, and the TPH noncancer hazard calculated using ADEC default percent compositions was 0.7. Both values are less than the target health goal of 1. Therefore, COPCs in soil and groundwater at the site are not present at concentrations that are a health concern for construction worker exposures.

- **On-Site Workers.** The 2011 supplemental risk assessment evaluated future on-site workers for inhalation exposures to soil vapor migrating into the indoor air of a hypothetical building. Total cancer risks (4×10^{-9}) and non-TPH and TPH noncancer hazards (0.0003 and 0.09, respectively) for inhalation exposures to soil vapor in indoor air are well below target health goals (Table 5-10).

Some discontinuous free product has been observed in recent monitoring well investigations. While exposures to free product cannot be quantitatively evaluated in risk assessments, exposures to free product may represent an unacceptable health risk. However, free product has been detected in monitoring wells where groundwater is approximately 22 to 25 feet bgs. Since construction activities are not assumed to occur deeper than 15 feet bgs, direct exposure to free product during construction activities is unlikely. Although direct exposure is not a concern, the high vapor concentrations at depth (15 feet bgs and greater) identified in the free-product area at sampling location SV-303-2 indicate a potential hot spot for construction workers (no indoor air hazard at this location). If construction activities (digging) were to occur over this location, and assuming no attenuation of vapor concentrations has occurred, appropriate protective measures should be implemented to protect workers. According to the Interim Conveyance, a soil excavation notification is required for the entire downtown area, which includes Area 303.

Because no chemical exceeded target health goals or contributed to exceedances above target health goals at its present contamination level, site-specific alternative cleanup levels were not calculated for soil, groundwater, or soil vapor at Area 303. Therefore, for soil and soil vapor, the existing concentrations at the site are protective of human health. Section 4 discusses the

minimum and maximum concentrations of COPCs detected in soil and soil vapor at the site. Through enforcement of institutional controls, the higher concentrations presented in Table 4-3 should pose no threat to human health or the environment.

Site-specific cleanup levels for groundwater were not calculated. The proposed groundwater cleanup levels for Area 303 are the ADEC cleanup levels established for groundwater used as a drinking water source, because groundwater is considered to be a reasonably expected potential source of drinking water. Institutional controls are currently in place for groundwater, which restrict the current and future use of groundwater as a drinking water source.

5.2 ECOLOGICAL RISK ASSESSMENT

Ecological hazards to terrestrial receptors resulting from exposure to petroleum compounds in soil were evaluated for Area 303. Exposure pathways were determined to be complete and significant, based on the site-specific ecological CSM. The ecological CSM for Area 303 is depicted on Figure 5-2. The ecological risk assessment concluded that no significant ecological threat exists to terrestrial receptors from chemicals of concern in soil in the vicinity of Area 303. This section provides a summary of the ecological risk assessment conducted for this site. The complete, detailed ecological risk assessment is included as Appendix I of the FFS report (U.S. Navy 2011b).

5.2.1 Ecological Risk Assessment Procedures

Ecological risk assessment procedures begin with determining whether a detailed ecological risk assessment is required. A detailed ecological risk assessment of a given site is required whenever the potential for an ecological threat exists. The decision whether or not to perform a detailed ecological risk assessment is made during the problem formulation stage of the risk assessment process. Before a decision can be made regarding the need for a detailed ecological risk assessment of a given site, a determination is made regarding the following:

- The presence of sensitive environments, critical habitats, or sensitive species at a site
- The presence of complete exposure pathways that result in the exposure of ecological receptors to site COPECs

If it is determined that no sensitive environment, critical habitat, or sensitive species is present at a given site and complete exposure pathways cannot be identified, ADEC guidance permits the ecological risk assessment process for that site to be terminated.

5.2.2 Problem Formulation

An ecological checklist (included in Appendix I of the FFS [U.S. Navy 2011b]) was completed that described the location and characteristics (e.g., environmental setting, land use, environmental fate and transport, and ecological receptors) of specific environments within the boundaries of Area 303. Based on the completed checklist, it was determined that no federal- or state-designated critical habitat is present at Area 303.

An ecological CSM was prepared for Area 303, describing the completeness and significance of exposure pathways by which ecological receptors may potentially be exposed to site COPECs (Figure 5-2). The CSM revealed that a complete exposure pathway exists at Area 303 that results in the ecologically significant exposure of ecological receptors to site COPECs: Terrestrial receptors may be exposed to site contaminants in surface soil 0 to 6 feet bgs.

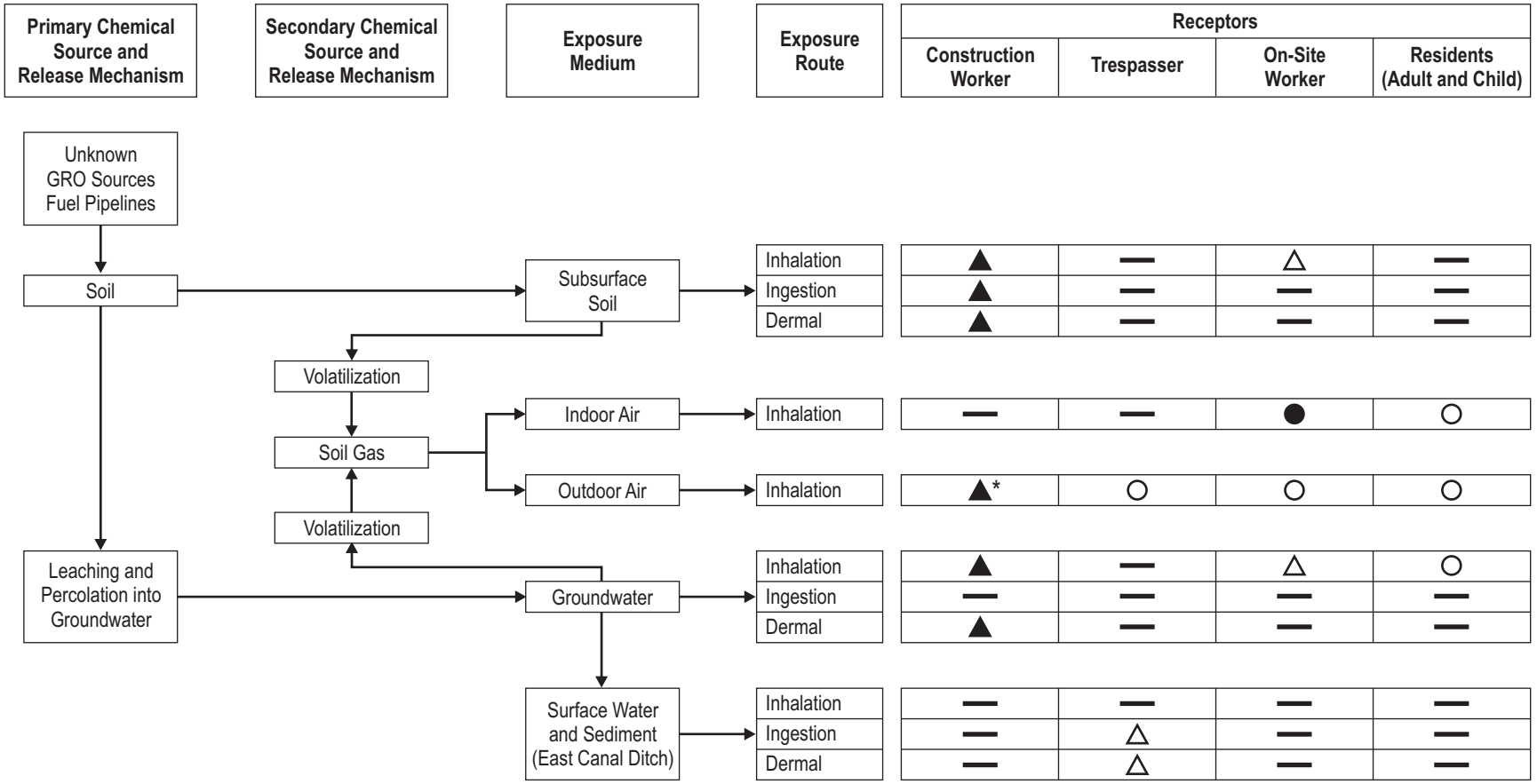
Based on this assessment, it was concluded that a potential ecological threat exists to ecological receptors from petroleum-release products at Area 303. Therefore, an ecological effects evaluation that quantitatively described the potential ecological risk associated with exposure to site COPECs was conducted. Details of this evaluation are provided in Appendix I of the FFS report (U.S. Navy 2011b).

5.2.3 Screening-Level Ecological Risk Assessment

A screening-level ecological risk assessment (Appendix I of the FFS report [U.S. Navy 2011b]) was performed to identify the COPECs and environmental media, if any, that warranted detailed evaluation in a baseline risk assessment. Table 5-11 presents the results of the screening-level ecological risk assessment for soil. Site-specific soil data revealed that the only COPEC detected in surface soil (0 to 6 feet bgs) was DRO. All detected concentrations of DRO were below levels of ecological concern. Therefore, DRO in soil was not retained as a COPEC for a more detailed risk assessment.

No ecological threat exists to ecological receptors from DRO and other petroleum-release products at Area 303. Therefore, no further ecological risk assessment is warranted for this site.

33759533_01.cdr

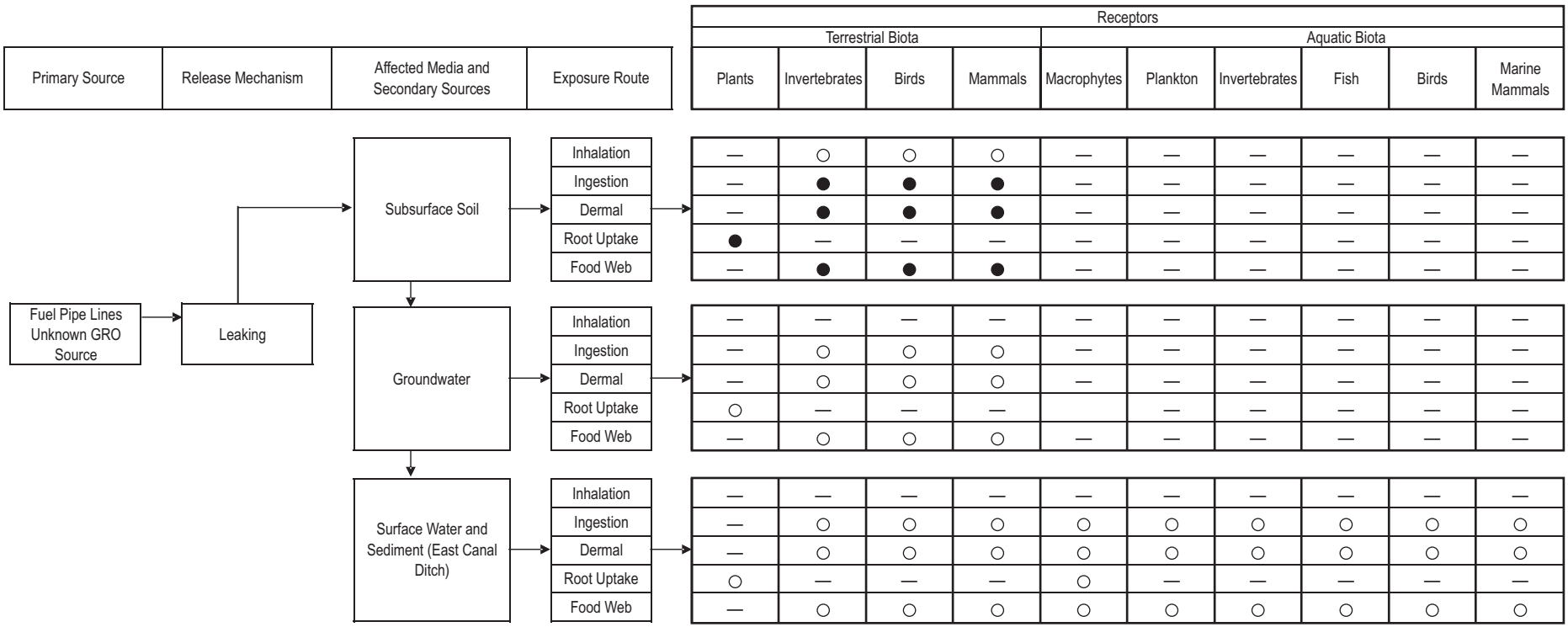


LEGEND

- ● Complete pathway under current and/or future conditions (evaluated in 2011)
- ○ Complete but insignificant pathway under current and/or future conditions (evaluated in 2011)
- ▲ Complete pathway under current and/or future conditions (evaluated in 2007)
- △ Complete but insignificant pathway under current and/or future conditions (evaluated in 2007)
- — Not applicable or incomplete pathway

* This pathway is examined in the supplemental assessment in the uncertainty section using the new soil gas data.

U.S.NAVY	**Figure 5-1** **Human Health Conceptual Site Model** **Area 303**	Adak Island, AK DECISION DOCUMENT



LEGEND

- ● Complete pathway under current and future conditions
- ○ Complete but insignificant pathway under current and/or future conditions
- — Not applicable or incomplete pathway

U.S.NAVY

Figure 5-2
Ecological Conceptual Site Model
Area 303

Adak Island, AK
DECISION DOCUMENT

Table 5-1
Construction Worker Exposures to Groundwater—
Exposure Assumptions and Intake Equations

Equations:

Chemical intake (mg/kg-day) = CW * SIF

$$SIF_{derm} = \frac{CF1 \cdot CF2 \cdot SA \cdot EF \cdot ET \cdot ED \cdot PC}{BW \cdot AT}$$

$$SIF_{inh} = \frac{CF1 \cdot InhR \cdot EF \cdot ED \cdot VFw}{BW \cdot AT}$$

Where:

SIF_{derm} (L-mg/µg-kg-day) = summary intake factor for dermal contact with groundwater
SIF_{inh} (L-mg/µg-kg-day) = summary intake factor for inhalation of groundwater vapors

Parameter	Definition	Value	Unit	Source
CW	Chemical concentration in groundwater	Chemical specific	µg/L	Analytical data
CF1	Conversion factor	1.00E-03	mg/µg	Not applicable
CF2	Conversion factor	1.00E-03	L/cm^3	Not applicable
SA	Skin surface area	3,300	cm^2	Default value, USEPA 2002
PC	Dermal permeability constant	Chemical specific	cm/hour	USEPA 2004
InhR	Inhalation rate	20	m^3/day	Default value, USEPA 2002
VF_w	Volatilization factor for water	0.01	L/m^3	Site-specific, USEPA 1999
EF	Exposure frequency	190	Days/year	Site-specific
ET	Exposure time	8	Hours/day	Site-specific
ED	Exposure duration	1	Year	Site-specific
BW	Body weight	70	kg	Default value, USEPA 2002
AT_{nc}	Averaging time (noncarcinogen)	ED x 365 days/year	Days	Default value, USEPA 2002
AT_{ca}	Averaging time (carcinogen)	25,550	Days	Default value, USEPA 2002

Notes:
cm^2 - centimeter squared
cm^3 - cubic centimeter
hr - hour
kg - kilogram
L - liter
m^3 - cubic meter
µg - microgram
mg - milligram

Table 5-2
Construction Worker Exposures to Soil—
Exposure Assumptions and Intake Equations

Equations:

Chemical intake (mg/kg-day) = CS * SIF

$$SIF_{ing} = \frac{IR \cdot CF \cdot EF \cdot ED}{BW \cdot AT}$$

$$SIF_{derm} = \frac{CF \cdot SA \cdot AF \cdot ABS \cdot EF \cdot ED}{BW \cdot AT}$$

$$SIF_{inh} = \frac{InhR \cdot EF \cdot ED \cdot (1/PEF \text{ or } VF)}{BW \cdot AT}$$

Where:

SIF_{ing} (day^{-1}) = summary intake factor for ingestion of soil
SIF_{derm} (day^{-1}) = summary intake factor for dermal contact with soil
SIF_{inh} (day^{-1}) = summary intake factor for inhalation of fugitive dust or soil vapors

Parameter	Definition	Value	Unit	Source
CS	Chemical concentration in soil	Chemical specific	mg/kg	Analytical data
IR	Ingestion rate	330	mg/day	Default value, USEPA 2002
CF	Conversion factor	1.00E-06	kg/mg	Not applicable
SA	Surface area	3,300	cm^2	Default value, USEPA 2002
AF	Soil to skin adherence factor	0.3	mg/cm^2-day	Default value, USEPA 2002
ABS	Absorption factor	Chemical specific	Unitless	USEPA 2004
InhR	Inhalation rate	20	m^3/day	Default value, USEPA 2002
PEF	Particulate emission factor	5.09E+08	m^3/kg	Site specific, USEPA 2002
VF	Volatilization factor	Chemical specific	m^3/kg	Site specific, USEPA 2002
EF	Exposure frequency	190	days/year	Site specific
ED	Exposure duration	1	Year	Default value, USEPA 2002
BW	Body weight	70	kg	Default value, USEPA 2002
AT_{nc}	Averaging time (noncarcinogen)	ED x 365 days/year	Days	Default value, USEPA 2002
AT_{ca}	Averaging time (carcinogen)	25,550	Days	Default value, USEPA 2002

Notes:
cm^2 - centimeter squared
kg - kilogram
m^3 - cubic meter
mg - milligram

Table 5-3
On-Site Worker Exposures to Indoor Air—
Exposure Assumptions and Intake Equations

Equations:

Chemical intake ($\mu g/m^3$) = CA * SIF

$$SIF_{inh} = \frac{ET \bullet EF \bullet ED}{AT}$$

Where:

SIF_{inh} (unitless) = summary intake factor for inhalation of indoor air

Parameter	Definition	Value	Unit	Source
CA	Chemical concentration in indoor air	Chemical specific	$\mu g/m^3$	Modeled from soil vapor analytical data
EF	Exposure frequency	250	Days/year	Default value, USEPA 1991
ED	Exposure duration	25	Years	Default value, USEPA 1991
ET	Exposure time	8	Hours/day	Default value, USEPA 1991
AT_{nc}	Averaging time (noncarcinogen)	ED x 365 days/year x 24 hours	Hours	Default value, USEPA 2009
AT_{ca}	Averaging time (carcinogen)	25,550 x 24 hours	Hours	Default value, USEPA 2009

Note: $\mu g/m^3$ - microgram per cubic meter

Table 5-4
Carcinogenic Toxicity Criteria Used in the 2007 Risk Assessment

Chemical	Oral Cancer: Slope Factor $(mg/kg\text{-}day)^{-1}$	Inhalation Cancer: Slope Factor $(mg/kg\text{-}day)^{-1}$	Tumor Type	EPA Cancer Classification[a]	Reference
1,2,4-Trimethylbenzene	None	None	NA	EPA Group D carcinogen	USEPA 2006
1,3,5-Trimethylbenzene	None	None	NA	EPA Group D carcinogen	USEPA 2006
Benzene	0.055	0.027	Leukemia (human)	EPA Group A carcinogen	USEPA 2006
Bis(2-ethylhexyl)phthalate	None	0.014	Hepatocellular carcinoma and adenoma (male mice)	EPA Group B2 carcinogen	USEPA 2006
Dibenzo(a,h)anthracene	7.3	3.1	Forestomach, larynx, and esophagus tumors (oral); pharynx, larynx tumors (inhalation)	EPA Group B2 carcinogen	USEPA 2006 (oral) USEPA 1994 (inhalation)
Ethylbenzene	None	None	NA	EPA Group D carcinogen	USEPA 2006
Naphthalene	None	None	NA	Cannot be determined	USEPA 2006
Xylenes	None	None	NA	EPA Group D carcinogen	USEPA 2006
DRO aliphatics	None	None	NA	Not classified	ADEC 2004
DRO aromatics	None	None	NA	Not classified	ADEC 2004
GRO aliphatic	None	None	NA	Not classified	ADEC 2004
GRO aromatics	None	None	NA	Not classified	ADEC 2004
RRO aliphatic	None	None	NA	Not classified	ADEC 2004
RRO aromatics	None	None	NA	Not classified	ADEC 2004

[a] EPA's Weight-of-Evidence Classification System:
Group A - human carcinogen (sufficient evidence in humans)
Group B1 - probable human carcinogen (limited human data available)
Group B2 - probable human carcinogen (sufficient evidence in animals, inadequate or no evidence in humans)
Group C - possible human carcinogen (limited evidence in animals)
Group D - not classifiable as to human carcinogenicity

Notes:
DRO - diesel-range organics
EPA - U.S. Environmental Protection Agency
GRO - gasoline-range organics
mg/kg-day - milligram per kilogram per day
NA - not applicable
RRO - residual-range organics

Table 5-5
Noncarcinogenic Toxicity Criteria Used in the 2007 Risk Assessment

Chemical	Chronic RfD (mg/kg-day)	Toxic Endpoint	Critical Study	Chronic RfD UF[a]	RfD Source	Adjustment from Chronic to Subchronic	Subchronic RfD (mg/kg-day)	EPA Subchronic Source[b]
Inhalation Exposures								
1,2,4-Trimethylbenzene	0.0017	CNS symptoms	Subchronic human occupational	3,000	NCEA	Remove UF of 10 for subchronic to chronic	0.017	NCEA (SRC TR-02-021/09-19-2002)
1,3,5-Trimethylbenzene	0.0017	CNS symptoms	Subchronic human occupational	3,000	NCEA	Remove UF of 10 for subchronic to chronic	0.017	NCEA (SRC TR-02-021/09-19-2002)
Benzene	0.009	Decreased lymphocyte count	Subchronic human occupational	300	IRIS	No adjustment for subchronic warranted; primary study is already occupational	0.009	
bis(2-ethylhexyl)phthalate	None	--	--		IRIS		0.003	NCEA (96-013a/03-18-
Dibenzo(a,h)anthracene	None[c]	--	--	--	--	--	--	
Ethylbenzene	0.29	Developmental toxicity	Subchronic female rats	300	IRIS	Based on developmental effects during gestational exposures. No subchronic to chronic UF used; therefore, no subchronic value proposed.	0.29	
Naphthalene	0.00086	Nasal effects	Chronic mouse	3,000	IRIS	Remove adjustment from 5 to 7 days[d]	0.0043	
Xylenes	0.029	Hyperactivity, decreased body weight, and increased mortality	Subchronic male rats	300	IRIS	Remove UF of 3 for subchronic to chronic	0.09	
DRO aliphatics	0.29	Hepatic and hematological changes	NA	NA	ADEC 2004	The petroleum fraction RfD values presented in ADEC guidance were not adjusted because of their status in state guidance and because of insufficient information on how those values were derived.	0.29	
DRO aromatics	0.06	Decreased body weight	NA	NA	ADEC 2004		0.06	
GRO aliphatics	5.3	Neurotoxicity	NA	NA	ADEC 2004		5.3	
GRO aromatics	0.11	Hepatotoxicity and nephrotoxicity	NA	NA	ADEC 2004		0.11	
RRO aliphatics	2	Neurotoxicity	NA	NA	ADEC 2004		2	
RRO aromatics	0.03	Hepatotoxicity and nephrotoxicity	NA	NA	ADEC 2004		0.03	
Oral Exposures								
1,2,4-Trimethylbenzene	0.05	Decreased body weight	Subchronic rats	3,000	NCEA	Remove UF of 10 for subchronic to chronic	0.5	NCEA (SRC TR-02-021/09-19-2002)
1,3,5-Trimethylbenzene	0.05	Decreased body weight	Subchronic rats	3,000	NCEA	Remove UF of 10 for subchronic to chronic	0.5	NCEA (SRC TR-02-021/09-19-2002)
Benzene	0.004	Decreased lymphocyte count	Subchronic human occupational	300	IRIS	No adjustment for subchronic warranted, primary study is already occupational	0.004	
Bis(2-ethylhexyl)phthalate	0.02	Increased liver weight	Subchronic to chronic guinea pig bioassay	1,000	IRIS		0.02	NCEA (96-013b/03-28-96)

Table 5-5 (Continued)
Noncarcinogenic Toxicity Criteria Used in the 2007 Risk Assessment

Chemical	Chronic RfD (mg/kg-day)	Toxic Endpoint	Critical Study	Chronic RfD UF[a]	RfD Source	Adjustment from Chronic to Subchronic	Subchronic RfD (mg/kg-day)	EPA Subchronic Source[b]
Oral Exposures (cont.)								
Dibenzo(a,h)anthracene	none[c]	--	--	--	--	--	--	
Ethylbenzene	0.10	Liver and kidney toxicity	Subchronic mouse	1,000	IRIS	Remove UF of 10 for subchronic to chronic	1	
Naphthalene	0.02	Decreased body weight	Subchronic rat	3,000	IRIS	Remove UF of 10 for subchronic to chronic	0.2	
Xylenes	0.2	Hyperactivity, decreased body weight, and increased mortality	Chronic rat	1,000	IRIS	Remove adjustment from 5 to 7 days[d]	0.25	
DRO aliphatics	0.1	Hepatic and hematological changes	NA	NA	ADEC 2004	The petroleum fraction RfD values presented in ADEC guidance were not adjusted because of their status in state guidance and because of insufficient information on how those values were derived.	0.1	
DRO aromatics	0.04	Decreased body weight	NA	NA	ADEC 2004		0.04	
GRO aliphatics	5.00	Neurotoxicity	NA	NA	ADEC 2004		5.00	
GRO aromatics	0.2	Hepatotoxicity and nephrotoxicity	NA	NA	ADEC 2004		0.2	
RRO aliphatics	2.00	Neurotoxicity	NA	NA	ADEC 2004		2.00	
RRO aromatics	0.03	Hepatotoxicity and nephrotoxicity	NA	NA	ADEC 2004		0.03	

[a]EPA indicates that there are generally 5 areas of uncertainty where an application of a UF may be warranted:

1. Variation between species (applied when extrapolating from animal to human)
2. Variation within species (applied to account for differences in human response and sensitive subpopulations)
3. Use of a subchronic study to evaluate chronic exposure
4. Use of a LOAEL, rather than a NOAEL
5. Deficiencies in the database

[b]If a subchronic value was obtained from a published source, rather than calculated, the source is listed in this column.

[c]This chemical is not a concern based on noncancer health effects. Therefore, there is no noncancer toxicity criterion for this chemical.

[d]EPA adjusted the 5-day-per-week exposure of the NOAEL to a 7-day NOAEL to account for continuous exposure (chronic), rather than subchronic, exposures.

Notes:
ADEC - Alaska Department of Conservation
DRO - diesel-range organics
EPA - U.S. Environmental Protection Agency
GRO - gasoline-range organics
IRIS - EPA's Integrated Risk Information System (online database) (USEPA 2006)
LOAEL - lowest observed adverse effect level
NA - not applicable
NCEA - EPA's National Center for Environmental Assessment
NOAEL - no observed adverse effect level
RfD - reference dose
RRR - residual-range organics
UF - uncertainty factor

Table 5-6
Carcinogenic Toxicity Criteria Used in the 2011 Supplemental Risk Assessment

Chemical	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	Cancer/Tumor Type	EPA Cancer Classification	Reference
Tetrachloroethene	5.9×10^{-6}	Liver tumors (male mice)	Under reassessment by EPA	Cal/EPA 2010[b]
Benzene	7.8×10^{-6}	Leukemia (human)	Carcinogenic to humans[a]	IRIS
Ethylbenzene	2.5×10^{-6}	Kidney tumors (male)	Under reassessment by EPA	Cal/EPA 2010[b]

[a]Formerly Group A – human carcinogen (sufficient evidence in humans) (USEPA 2005)
[b]Value is in EPA's RSL table (USEPA 2010b)

Notes:
EPA - U.S. Environmental Protection Agency
IRIS - Integrated Risk Information System (online database) (USEPA 2010a)
$\mu g/m^3$ - microgram per cubic meter

Table 5-7
Noncarcinogenic Toxicity Criteria Used in the 2011 Supplemental Risk Assessment

Chemical	RfC[a] (mg/m^3)	Toxic Endpoint	Critical Study	Confidence Rating	UF[b]	RfC Source
Benzene	0.03	Decreased lymphocyte count	Human occupational	Medium	300	IRIS
Ethylbenzene	1	Developmental toxicity	Rat and rabbit developmental	Low	300	IRIS
Isopropylbenzene (Cumene)	0.4	Increased kidney weights in female rats and adrenal weights in	Rat inhalation	Medium	1,000	IRIS
Tetrachloroethene	0.27	Neurological (prolonged reaction	Human occupational	Not provided	NA	ATSDR[e]
1,2,4-Trimethylbenzene	0.007	Central nervous system symptoms	Subchronic human occupational	Low	3,000	USEPA 2010b[c]
1,3,5-Trimethylbenzene	None[d]	--	--	--	--	--
Xylenes	0.1	Impaired motor coordination	Subchronic inhalation study in	Medium	300	IRIS
Gasoline-range organics aliphatics	18	Neurotoxicity	Not provided	Not provided	NA	ADEC 2008
Gasoline-range organics aromatics	0.4	Hepatotoxicity and nephrotoxicity	Not provided	Not provided	NA	ADEC 2008

[a]Inhalation exposure

[b]EPA indicates that there are generally five areas of uncertainty where an application of a UF may be warranted:

1. Variation between species (applied when extrapolating from animal to human)
2. Variation within species (applied to account for differences in human response and sensitive subpopulations)
3. Use of a subchronic study to evaluate chronic exposure
4. Use of a LOAEL, rather than a NOAEL
5. Deficiencies in the database

[c]EPA's Regional Screening Level table (USEPA 2010b) lists the source of this criterion as EPA's provisional peer-reviewed toxicity value database.

[d]No inhalation toxicity criterion is available for 1,3,5-trimethylbezene. Risk calculations use the RfC for 1,2,4-trimethylbenzene as a surrogate.

[e]Value is in EPA's RSL table (USEPA 2010b)

Notes:
ATSDR - Agency for Toxic Substances and Disease Registry
EPA - U.S. Environmental Protection Agency
IRIS - EPA's Integrated Risk Information System (online database) (USEPA 2010a)
LOAEL - lowest observed adverse effect level
NOAEL - no observed adverse effect level
RfC - reference concentration
UF - uncertainty factor

Table 5-8
Summary of Exposure-Point Concentrations at Area 303

Chemical	EPC	Units	Basis for EPC
Soil (Construction Worker Ingestion, Dermal, and Inhalation Exposures [2007 Risk Assessment])			
Ethylbenzene	70.5	mg/kg	UCL95
Toluene	65.8	mg/kg	UCL95
Xylenes	312.4	mg/kg	UCL95
1,2,4-Trimethylbenzene	82.7	mg/kg	UCL95
1,3,5-Trimethylbenzene	14.4	mg/kg	UCL95
GRO	2099.4	mg/kg	UCL95
C6-C10 Aliphatic (site specific)	1805.5	mg/kg	Assumes 86 percent aliphatic
C6-C10 Aromatic (site specific)	293.9	mg/kg	Assumes 14 percent aromatic
C6-C10 Aliphatic (ADEC default)	1469.6	mg/kg	Assumes 70 percent aliphatic
C6-C10 Aromatic (ADEC default)	419.2	mg/kg	Assumes 50 percent aromatic
DRO	838.4	mg/kg	UCL95
C10-C21 Aliphatic (site specific)	704.3	mg/kg	Assumes 84 percent aliphatic
C10-C21 Aromatic (site specific)	134.1	mg/kg	Assumes 16 percent aromatic
C10-C21 Aliphatic (ADEC default)	670.7	mg/kg	Assumes 80 percent aliphatic
C10-C21 Aromatic (ADEC default)	335.4	mg/kg	Assumes 40 percent aromatic
RRO	201.1	mg/kg	UCL95
C21-C35 Aliphatic (site specific)	201.1	mg/kg	Assumes 100 percent aliphatic
C21-C35 Aromatic (site specific)	0.0	mg/kg	Assumes 0 percent aromatic
C21-C35 Aliphatic (ADEC default)	181.0	mg/kg	Assumes 90 percent aliphatic
C21-C35 Aromatic (ADEC default)	60.3	mg/kg	Assumes 30 percent aromatic
Groundwater (Construction Worker Inhalation Exposures [2007 Risk Assessment])			
Benzene	30.5	µg/L	UCL95
Ethylbenzene	869.5	ug/L	UCL95
Toluene	937.7	µg/L	UCL95
Xylenes	2714.7	µg/L	UCL95
1,2,4-Trimethylbenzene	177.7	µg/L	UCL95
1,3,5-Trimethylbenzene	248.2	µg/L	UCL95
Naphthalene	37.2	µg/L	UCL95
Bis(2-ethylhexyl)phthalate	4	µg/L	Maximum detected concentration (too few samples available to calculate a 95 UCL)
Dibenz(a,h)anthracene	0.18	µg/L	UCL95
GRO	13369.9	µg/L	UCL95
C6-C10 Aliphatic (site specific)	8289.4	µg/L	Assumes 62 percent aliphatic
C6-C10 Aromatic (site specific)	5080.6	µg/L	Assumes 38 percent aromatic
C6-C10 Aliphatic (ADEC default)	9359.0	µg/L	Assumes 70 percent aliphatic
C6-C10 Aromatic (ADEC default)	6685.0	µg/L	Assumes 50 percent aromatic
DRO	9400.5	µg/L	UCL95
C10-C21 Aliphatic (site specific)	3572.2	µg/L	Assumes 38 percent aliphatic
C10-C21 Aromatic (site specific)	5828.3	µg/L	Assumes 62 percent aromatic
C10-C21 Aliphatic (ADEC default)	7520.4	µg/L	Assumes 80 percent aliphatic
C10-C21 Aromatic (ADEC default)	3760.2	µg/L	Assumes 40 percent aromatic
RRO	--	µg/L	Chemical was not detected in most recent groundwater sample results
Groundwater (Construction Worker Dermal Exposures [2007 Risk Assessment])			
Benzene	2.36	µg/L	Maximum detected concentration (only detected in one shallow zone well)
Ethylbenzene	2.1	µg/L	Maximum detected concentration (only detected in one shallow zone well)
Toluene	1.54	µg/L	Maximum detected concentration (only detected in one shallow zone well)
Xylenes	12.4	µg/L	Maximum detected concentration (only detected in one shallow zone well)

Table 5-8 (Continued)
Summary of Exposure-Point Concentrations at Area 303

Chemical	EPC	Units	Basis for EPC
1,2,4-Trimethylbenzene	2.9	µg/L	Maximum detected concentration (only detected in one shallow zone well)
1,3,5-Trimethylbenzene	2.9	µg/L	Maximum detected concentration (only detected in one shallow zone well)
Naphthalene	1.35	µg/L	Maximum detected concentration (too few samples available to calculate a 95 UCL)
Bis(2-ethylhexyl)phthalate	--	µg/L	Chemical not analyzed for in shallow zone wells
Dibenz(a,h)anthracene	--	µg/L	Chemical was not detected in shallow zone wells
GRO	902	µg/L	Maximum detected concentration (only detected in one shallow zone well)
C6-C10 Aliphatic (site specific)	514.1	µg/L	Assumes 62 percent aliphatic
C6-C10 Aromatic (site specific)	387.9	µg/L	Assumes 38 percent aromatic
C6-C10 Aliphatic (ADEC default)	631.4	µg/L	Assumes 70 percent aliphatic
C6-C10 Aromatic (ADEC default)	451	µg/L	Assumes 50 percent aromatic
DRO	1140	µg/L	Maximum detected concentration (too few samples available to calculate a 95 UCL)
C10-C21 Aliphatic (site specific)	433.2	µg/L	Assumes 38 percent aliphatic
C10-C21 Aromatic (site specific)	706.8	µg/L	Assumes 62 percent aromatic
C10-C21 Aliphatic (ADEC default)	912	µg/L	Assumes 80 percent aliphatic
C10-C21 Aromatic (ADEC default)	456	µg/L	Assumes 40 percent aromatic
RRO	--	µg/L	Chemical not detected in shallow zone wells
Soil Vapor and Modeled Indoor Air (On-Site Worker Inhalation Exposures [2010 Supplemental Risk Assessment])			
Benzene	34 U (0.0026)	µg/m^3	W:\53304\1203.004\Final DD Area 303 March 2012.doc
Ethylbenzene	150 (0.011)	µg/m^3	Max. Conc. from 5-foot depth interval of SV-303-2 (indoor air concentration modeled from the JE Model)
Isopropylbenzene	7.1 (0.0005)	µg/m^3	Max. Conc. from 5-foot depth interval of SV-303-2 (indoor air concentration modeled from the JE Model)
1,2,4-Trimethylbenzene	53 U (0.0036)	µg/m^3	Max. Conc. from 5-foot depth interval of SV-303-2 (indoor air concentration modeled from the JE Model)
1,3,5-Trimethylbenzene	53 U (0.0036)	µg/m^3	Max. Conc. from 5-foot depth interval of SV-303-2 (indoor air concentration modeled from the JE Model)
m,p-Xylene	22 (0.0016)	µg/m^3	Max. Conc. from 5-foot depth interval of SV-303-2 (indoor air concentration modeled from the JE Model)
Tetrachloroethene	73 U (0.0052)	µg/m^3	Max. Conc. from 5-foot depth interval of SV-303-2 (indoor air concentration modeled from the JE Model)
GRO	4100000	µg/m^3	Max. Conc. from 5-foot depth interval of SV-303-2 (indoor air concentration modeled from the JE Model)
C6-C10 Aliphatic (ADEC default)	2,870,000 (223)	µg/m^3	Assumes 70 percent aliphatic
C6-C10 Aromatic (ADEC default)	2,050,000 (160)	µg/m^3	Assumes 50 percent aromatic

Notes:
ADEC - Alaska Department of Environmental Conservation
DRO - diesel-range organics
EPC - exposure-point concentration
GRO - gasoline-range organics
JE Model - Johnson and Ettinger Model for Subsurface Vapor Intrusion
Max. conc. - maximum concentration
µg/L - microgram per liter
µg/m^3 - microgram per cubic meter
mg/kg - milligram per kilogram
RRO - residual-range organics
UCL95 - 95th percentile upper confidence limit
U - not detected above reporting limit

Table 5-9
Summary of Total Risks and Hazards for the Construction Worker From Groundwater and Soil at Area 303

Chemical	Total		Groundwater		Soil	
	HI	**CR**	**HI**	**CR**	**HI**	**CR**
Non-TPH						
Benzene	0.007	0.00000002	0.007	0.00000002	(a)	(a)
Bis(2-ethylhexyl)phthalate	--	--	(c)	(c)	(a)	(a)
Dibenz(a,h)anthracene	--	--	(c)	(c)	(a)	(a)
Ethylbenzene	0.04	(b)	0.004	(b)	0.03	(b)
Naphthalene	0.01	(b)	0.01	(b)	(a)	(a)
Toluene	0.1	(b)	0.01	(b)	0.1	(b)
1,2,4-Trimethylbenzene	0.2	(b)	0.02	(b)	0.2	(b)
1,3,5-Trimethylbenzene	0.1	(b)	0.02	(b)	0.08	(b)
Xylenes	0.5	(b)	0.05	(b)	0.5	(b)
Total	1	0.00000002	0.1	0.00000002	0.9	--
TPH COPCs (Site-Specific Percent Composition)						
C_6-C_{10} Aliphatic	0.1	(b)	0.002	(b)	0.1	(b)
C_6-C_{10} Aromatic	0.4	(b)	0.07	(b)	0.3	(b)
C_{10}-C_{21} Aliphatic	0.02	(b)	--	(b)	0.02	(b)
C_{10}-C_{21} Aromatic	0.01	(b)	--	(b)	0.01	(b)
C_{21}-C_{35} Aliphatic	0.0003	(b)	--	(b)	0.0003	(b)
C_{21}-C_{35} Aromatic	--	(b)	--	(b)	--	(b)
Total	0.6	--	0.07	--	0.5	--
TPH (ADEC Default Percent Composition)						
C_6-C_{10} Aliphatic	0.1	(b)	0.003	(b)	0.1	(b)
C_6-C_{10} Aromatic	0.6	(b)	0.09	(b)	0.5	(b)
C_{10}-C_{21} Aliphatic	0.02	(b)	--	(b)	0.02	(b)
C_{10}-C_{21} Aromatic	0.03	(b)	--	(b)	0.03	(b)
C_{21}-C_{35} Aliphatic	0.0003	(b)	--	(b)	0.0003	(b)
C_{21}-C_{35} Aromatic	0.006	(b)	--	(b)	0.006	(b)
Total	0.7	--	0.09	--	0.6	--

[a]Chemical not selected as a chemical of potential concern in this medium
[b]Chemical not associated with carcinogenic effects
[c]No complete pathway of exposure of this chemical in groundwater

Notes:
CR - cancer risk
DEC - Department of Environmental Conservation
HI - hazard index
TPH - total petroleum hydrocarbon
-- no values to sum

Table 5-10
Summary of Risks and Hazards for Future On-Site Worker Exposures to Soil Vapor From Indoor Air at Area 303

Chemical	Soil Vapor Total	
	Hazard Index	**Cancer Risk**
Non-TPH		
Benzene	0.00002	1.6×10^{-9}
Ethylbenzene	0.0000025	2.2×10^{-9}
Isopropylbenzene	0.00000028	(a)
m,p-Xylene	0.0000037	(a)
1,2,4-Trimethylbenzene	0.00012	(a)
1,3,5-Trimethylbenzene	0.00012	(a)
Tetrachloroethene	0.0000044	2.5×10^{-9}
Total	**0.0003**	**4×10^{-9}**
TPH		
C_6–C_{10} aliphatic	0.0028	(a)
C_6–C_{10} aromatic	0.091	(a)

[a]Chemical not associated with carcinogenic effects.

Note: TPH - total petroleum hydrocarbon

Table 5-11
Results of Screening-Level Ecological Risk Assessment for Receptors Exposed to Surface Soil at Area 303

Analyte	Detection Frequency	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Mean Detected Concentration (mg/kg)	Detection Limit	Background Concentration (mg/kg)	Ecological Benchmark Concentration (mg/kg)	Ecological Benchmark Source	Hazard Quotient (MDC/RBSC)	Poses Potential for Ecological Risk?	Rationale for Conclusion
Total petroleum hydrocarbons-diesel	3 / 9	32	964	482	4.9	NA	20,148	This document	0.048	NO	Site chemical concentration lower than RBSC

Notes:
MDC - maximum detected concentration
NA - not applicable
RBSC - risk-based screening criteria

6.0 REMEDIAL ACTION OBJECTIVES AND CLEANUP LEVELS

This section describes the remedial action objectives (RAOs) and the cleanup levels established for Area 303.

6.1 REMEDIAL ACTION OBJECTIVES

Based on the risk analysis conducted for this site and the regulatory requirements, the following RAOs were developed for the protection of human health at Area 303:

- Reduce petroleum hydrocarbons or VOCs in groundwater to concentrations less than or equal to the ADEC groundwater cleanup levels established for groundwater used as a drinking water source
- Minimize exposure to free-phase product
- Prevent migration of petroleum hydrocarbons or VOCs to surface water at levels that would result in an exceedance of the ADEC surface water quality standards

Because there is no current ecological threat, RAOs to protect ecological receptors are not needed at Area 303. Furthermore, the third human health RAO listed above addresses potential future ecological threats.

6.2 CLEANUP LEVELS

The human health risk assessment for this site established that the existing concentrations in soil and soil vapor do not pose a risk to humans above target health goals. Therefore, soil and soil vapor concentrations identified during the site investigation and used in the risk assessment are protective of human health and the environment. Alaska State regulations do not establish cleanup levels for sediment. Therefore, sediment cleanup levels are established based on the results of the ecological risk assessment conducted for the site. The results of the screening-level ecological risk assessment indicated that no ecological threat exists for any ecological receptor from any petroleum-release product at Area 303. Therefore, cleanup levels are not necessary for sediment. Cleanup criteria for groundwater and surface water are described below.

The Alaska regulations establish two methods for determining cleanup levels for groundwater (18 AAC 75.345). The groundwater cleanup levels found in 18 AAC 75.345[b][1], Table C were used as screening criteria for all chemicals to estimate the estimated extent of groundwater impacted by petroleum or VOC contamination at the site (Section 4). Cleanup levels specified

for remediation of groundwater at Area 303 are based on the these groundwater cleanup levels, because groundwater is considered to be a reasonably expected potential source of drinking water. Table 6-1 provides the groundwater cleanup levels for the site.

Based on the 2006 analytical data from the remedial investigation for Area 303, there was no chemical exceedance in samples from wells MW-303-37 and 03-012 located between the southwestern extent of the Area 303 groundwater plume and the East Canal. Although petroleum hydrocarbons released in Area 303 have not impacted the East Canal, migration of petroleum hydrocarbons or VOCs in groundwater may result in a future exceedance of Alaska surface water quality standards. As specified in 18 AAC 75.345(f), groundwater that is closely connected hydrologically to nearby surface water may not cause an exceedance of the surface water quality standards in the nearby surface water body. 18 AAC Chapter 70 establishes water quality standards for surface water bodies of the state based on water use classes and subclasses. Unless a surface water body has been reclassified in accordance with 18 AAC 70.230, the water body is protected for all water use classes and subclasses. Because the canals of the airport ditch system, including the East Canal, have not been reclassified, all subclasses of the freshwater class apply to these water bodies. Therefore, the water quality standards potentially applicable to the airport ditch system, including the East Canal, are:

- Total aqueous hydrocarbons (TAqH) may not exceed 15 micrograms per liter (µg/L)
- Total aromatic hydrocarbons (TAH) may not exceed 10 µg/L
- Petroleum hydrocarbons in shoreline or bottom sediments may not cause deleterious effects to aquatic life
- Surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration (18 AAC 70.020[b][17][A][i], 18 AAC 70.020[b][17][B][ii], and 18 AAC 70.020[b][17][C])

6.3 EXTENT OF CONTAMINATION

The media of concern for which RAOs listed in Section 6.1 were established include groundwater and free-phase product. Based on the cleanup levels presented in Section 6.2, the area that potentially exceeds the ADEC criteria established for groundwater used as drinking water source as shown on Figure 4-1 totals approximately 18.0 acres which consists of Area 303 plume (11.6 acres), SWMU 62 plumes (4.5), and commingled plumes (1.9 acres). The approximate extent of free product remaining on the site is discussed in Section 4.1, and shown on Figure 4-1. Measurable thicknesses of free product were detected in two areas. The southern

area is most likely the result of release(s) from the SWMU 62, Eagle Bay Housing area and is not addressed as part of Area 303. This southern free-product plume is being addressed under cleanup actions implemented for SWMU 62. The northern area totals approximately 0.8 acre.

Table 6-1
Groundwater Cleanup Levels and Maximum Groundwater Concentrations, Area 303

Chemical	Maximum Groundwater Concentration (µg/L)	Cleanup Criteria (ADEC Table C) (µg/L)
Total Petroleum Hydrocarbons		
DRO	21,400 J	1,500
GRO	78,000	2,200
Volatile Organic Compounds		
Benzene	220	5
Toluene	1,980	1,000
Ethylbenzene	1,800	700
Carcinogenic Polycyclic Aromatic Hydrocarbons		
Dibenz(a,h)anthracene	0.441	0.12
Metals		
Total lead	440	15
Dissolved lead	56.1	15

Notes:
ADEC - Alaska Department of Environmental Conservation
DRO - diesel-range organics
GRO - gasoline-range organics
J - estimated concentration
µg/L - microgram per liter

7.0 REMEDIAL ACTION ALTERNATIVES

The Navy identified, developed, and evaluated a comprehensive array of remedial alternatives for the 128 previously identified petroleum-release sites at the former Adak Naval Complex during the 1998 FFS, as amended in 1999 (U.S. Navy 1998 and 1999a). The 1998 FFS, as amended, provided the information required to select the preferred remedies for the 128 petroleum-release sites in the OU A ROD, which was signed in 2000. As the Navy agreed with ADEC (URS 2007), the 2011 FFS (U.S. Navy 2011b) was based on the 1998 FFS, as amended, which provided the analysis that was used in selecting the final remedy for Area 303. As discussed in Section 2.2, there are institutional controls currently in place on Adak that limit exposure to chemical contamination. These institutional controls apply to Area 303, and additional institutional controls will not be required for Area 303.

The list of cleanup alternatives developed for petroleum-release sites during the 1998 FFS, as amended (U.S. Navy 1998 and 1999a), was used as the starting point for identifying alternatives for Area 303. The full list of alternatives from the 1998 FFS, as amended, is as follows:

- **Alternative 1, No Action.** This alternative is included as a baseline to represent current conditions. No remedial action is included with this alternative. It is used for comparison to the other alternatives.

- **Alternative 2, Limited Groundwater Monitoring.** Groundwater monitoring would be conducted to confirm that petroleum-related chemicals in groundwater are declining. This approach to cleanup relies on naturally occurring processes to reduce petroleum concentrations in groundwater. Microorganisms present in soil and groundwater break down petroleum compounds into harmless chemicals.

- **Alternative 3, Monitored Natural Attenuation and Institutional Controls**. Groundwater monitoring would be conducted to evaluate whether petroleum-related chemicals in groundwater are attenuating to concentrations below applicable ADEC groundwater cleanup levels. Petroleum-related chemicals that currently exceed applicable ADEC cleanup levels would be monitored, as well as natural attenuation indicator compounds. This approach to cleanup relies on naturally occurring processes to reduce petroleum concentrations in groundwater. This alternative also includes institutional controls as an additional means of reducing potential exposure to petroleum contamination.

- **Alternative 4, Product Recovery.** Free product on the groundwater surface would be collected to the maximum extent practicable using skimmers.

- **Alternative 5, Limited Soil Removal/Source Removal and Thermal Desorption.** Petroleum-contaminated soil would be excavated and then heated to drive off the petroleum compounds.

- **Alternative 6, Ex Situ Bioremediation of Soil.** Petroleum-contaminated soil would be excavated and placed in a lined pile for treatment. Air, water, and nutrients would be added to the soil to encourage microorganisms to break down the petroleum compounds to harmless chemicals.

- **Alternative 7, In Situ Bioremediation of Soil, Monitored Natural Attenuation, and Institutional Controls.** Petroleum-contaminated soil would be treated in the ground. This alternative relies on the same naturally occurring microorganisms as natural attenuation. However, the growth of the microorganisms is encouraged by increasing air flow in the ground by either blowing air into the ground or by pulling air through the soil. This alternative also would include institutional controls.

- **Alternative 8, Soil Cover, Monitored Natural Attenuation, and Institutional Controls.** Contaminated surface soil would be covered with a layer of clean soil to prevent contact with petroleum. Institutional controls would be used to further limit contact with petroleum chemicals in soil and groundwater. Natural attenuation would cause the petroleum concentrations to decrease.

- **Alternative 9, Soil Vapor Extraction/Air Sparging, Monitored Natural Attenuation, and Institutional Controls.** A vacuum system would be used to cause light petroleum compounds to move to vapor extraction wells. It is only effective for lighter petroleum materials, such as those present in gasoline. Institutional controls would be used to limit potential contact with petroleum.

8.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

The results of the 1998 FFS, as amended (U.S. Navy 1998 and 1999a), were applied to the analysis of remedial alternatives for Area 303 in accordance with the agreement that the Navy reached with ADEC (URS 2007). The criteria used to complete the alternative evaluation in the 1998 FFS were based on EPA guidance. Table 8-1 compares the EPA criteria used in the 1998 FFS to the ADEC guidance criteria, and demonstrates that evaluations performed using EPA criteria are inclusive of ADEC's criteria and, thus, meet the requirements of ADEC's regulations.

Alternatives were evaluated separately for each of the 128 petroleum-release sites at the former Adak Naval Complex in the 1998 FFS, as amended (U.S. Navy 1998 and 1999a), using the EPA criteria. To summarize the results of the evaluations for the 128 petroleum-release sites, the 1998 *Proposed Plan for Cleanup Action at Petroleum Sites on Adak Island* (U.S. Navy, USEPA, and ADEC 1998) presented the evaluations for nine categories of petroleum sites (Table 8-2). Sites with similar characteristics were grouped together into the nine categories, and a single alternative evaluation was presented for each category. The categories applicable to Area 303 are the following:

- Category 1 – free-product sites
- Category 2 – gasoline only sites

The alternative evaluation performed for the Category 1 sites in the 1998 Proposed Plan (U.S. Navy, USEPA, and ADEC 1998) is applicable to Area 303, because free product has been detected at the site and free-product recovery activities have not been implemented at the site. The alternative evaluation performed for the Category 2 sites is applicable to Area 303, because gasoline is the main contaminant at the site. The alternative evaluations performed for Category 3, 4, 5, 6, 7, 8, and 9 sites are not applicable to Area 303, because these categories address sites with primarily diesel contamination.

The alternative evaluations for Categories 1 and 2 sites presented in the 1998 Proposed Plan (U.S. Navy, USEPA, and ADEC 1998) were used as the starting point for the evaluation of alternatives for Area 303. The resulting evaluation is included as Figure 8-1. Alternatives 7 and 8 are not applicable to the Category 2 sites and, therefore, these alternatives are not included in Figure 8-1. Alternative 7 is not applicable, because this alternative applies only to sites with heavier petroleum compounds, such as diesel. Alternative 8 is not applicable because this alternative applies only to sites with surface soil contamination.

Because site conditions do not currently pose an unacceptable risk to human health or the environment at Area 303, remedial alternatives developed for sites that do pose a risk above target health goals (Alternatives 5, 6, and 9) were eliminated as potential preferred remedial

alternatives. In addition, concentrations of petroleum hydrocarbons in soil above the most stringent ADEC cleanup levels were generally found in soils at depths greater than 15 feet. As a result, Alternatives 5 and 6, which require excavation and ex situ treatment of soil, were also eliminated as potential preferred remedial alternatives. Therefore, the list of preferred remedial alternatives that may be selected for this site is limited to Alternatives 1, 2, 3, and/or 4.

The preferred cleanup alternative for this site was selected by comparing site-specific conditions to the criteria used to determine the suitability of an alternative (Table 8-3). A solid bullet in this table adjacent to a suitability criterion indicates that site-specific conditions match the alternative's suitability criterion. An alternative is identified as the preferred remedy when site-specific conditions most closely match the alternative's suitability criteria.

The questions presented in Table 8-3 pertain to whether the stated alternative meets the two "Threshold Criteria" that must be ultimately satisfied by a cleanup alternative such that it can be selected as the preferred alternative. The "Petroleum-related chemicals and volatile organic compounds …." question responds to the requirement that the alternative will provide for the *Overall Protection of Human Health and the Environment* (yes or no). The remainder of the questions pertains to whether the stated alternative *Complies with ARARs* (yes or no). An answer of "no" to any of the questions eliminates the alternative. The basis for this approach was established in the Final Focused Feasibility Study for Petroleum Sites (1998).

Based on this comparison, Alternative 3, Monitored Natural Attenuation and Institutional Controls, and Alternative 4, Free-Phase Product Recovery, are combined to form the preferred remedy for Area 303. These two alternatives will provide cost-effective remedies that protect human health and environment and can be implemented at the earliest possible time. Alternative 3 is selected for this site because groundwater concentrations are above the ADEC cleanup levels. MNA is needed to demonstrate that contaminant concentrations are reduced to levels less than the ADEC cleanup levels, and institutional controls are needed as long as concentrations are above ADEC cleanup levels. MNA also will be used to determine whether dissolved petroleum compounds and VOCs are migrating toward East Canal. Therefore, Alternative 3 is protective of human health and the environment and complies with Alaska regulations.

Alternative 4 is selected as a preferred remedial alternative at the site because free product has been detected at the site. Removal of free product will reduce the risk of exposure to free product and will reduce the risk of free product migrating to East Canal. Monitoring in wells downgradient of the free-product plume and upgradient of surface water will be used to detect any free product migrating toward the East Canal. Alternative 4 will be performed concurrently with Alternative 3. Free-product recovery will comply with Alaska regulations and will reduce the source of petroleum dissolving into groundwater. In addition, ADEC concurs with the selection of these alternatives. No comments were received from the public. Finally, Alternatives 3 and 4 are readily implementable.

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EPA CRITERIA	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7[a]	Alt 8[b]	Alt 9
Overall protectiveness of human health and the environment	○	◔	◒	◒	◔	◒			◒
Compliance with ARARs	○	◔	◒	◒	◔	◒			◒
Long-term effectiveness and permanence	○	◔	◒	○	●	◔			◒
Reduction of toxicity, mobility, or volume through active treatment	○	○	○	◒	◔	◒			◒
Short-term effectiveness	◔	◔	◔	◔	◒	◒			◒
Implementability	●	◔	◔	◒	◔	◒			◒
State Acceptance	○	◔	◒	◒	◒	◒			◒
Community Acceptance	○	◔	◒	◒	◒	◒			◒
Cost ($ millions)[c]	0	0.5	2.1	1.1	NE	NE			NE

ALTERNATIVES	
Alternative 1	No Action
Alternative 2	Limited Groundwater Monitoring
Alternative 3	Monitored Natural Attenuation and Institutional Controls
Alternative 4	Free-Phase Product Recovery
Alternative 5	Limited Soil Removal/Source Removal and Thermal Desorption
Alternative 6	Ex Situ Bioremediation of Soil
Alternative 7	In Situ Bioremediation of Soil, Monitored Natural Attenuation, and Institutional Controls
Alternative 8	Soil Cover, Monitored Natural Attenuation and Institutional Controls
Alternative 9	Soil Vapor Extraction/Air Sparging, Monitored Natural Attenuation, and Institutional Controls

LEGEND

- ● Superior
- ◔ Excellent
- ◒ Good
- ◔ Fair
- ○ Poor
- Technology and/or alternative not applicable for Category 2 sites
- NE Not estimated

a This alternative only applies to sites with heavier petroleum compounds, such as diesel. Since gasoline is the main contaminant at Area 303, this alternative does not apply.

b This alternative only applies to sites with surface soil contamination. Since surface soil is not contaminated at Area 303, this alternative does not apply.

c The cleanup time frame for Alternatives 2 and 3 is estimated to be 40 years. The cleanup time frame for Alternative 4 is estimated to be 2 years.

U.S.NAVY

Figure 8-1
Evaluation of Alternatives for Area 303

Adak Island, AK
DECISION DOCUMENT

Table 8-1
EPA Criteria

EPA Criteria	Comparable ADEC Criteria	Description
Overall protection of human health and the environment	Protectiveness	Whether a cleanup action provides adequate protection and how potential risks are eliminated, reduced, or controlled through treatment or control
Compliance with regulations	Regulations	Whether a cleanup action will meet cleanup levels
Long-term effectiveness and permanence	Short- and long-term effectiveness	The ability of a cleanup action to reliably protect human health and the environment over time
Reduction of toxicity, mobility, or volume through active treatment	None	How well treatment technologies that may be used in a cleanup action work; how well the cleanup treatment may work to make the chemicals less harmful, make them less likely to spread, or reduce the amount of contaminated material
Short-term effectiveness	Short- and long-term effectiveness	How quickly the cleanup action is able to protect human health and the environment and what is its potential to create adverse effects during construction and implementation
Implementability, suitability	Practicable	How readily the cleanup can be accomplished: Are needed materials and services available? How appropriate is the solution to the problem?
Cost	Practicable	Costs to build, operate, and maintain the cleanup remedy
State acceptance	None	Whether, based on its review of the project documents and proposed plan, the state agrees with, opposes, or has no comment on the preferred alternative
Community acceptance	Public input	Whether the public agrees with, opposes, or has no comment on the preferred alternative (determined after reviewing the public comments received on the focused feasibility study or proposed plan)

Source: Final FFS Report, Revision 1 (U.S. Navy 2011b)

Notes:
ADEC - Alaska Department of Environmental Conservation
EPA - U.S. Environmental Protection Agency

Table 8-2
Categories of Petroleum Sites on Adak Island

Category	Site Description
1	Free-product sites
2	Gasoline only sites
3	Diesel sites, soil concentrations below screening levels, near surface water, with buildings over the source area
4	Diesel sites, soil concentrations below screening levels, near surface water, without buildings over the source area
5	Diesel sites, soil concentrations above screening levels, near surface water, with buildings over the source area
6	Diesel sites, soil concentrations above screening levels, without buildings over the source area, groundwater risk is below acceptable risk
7	Diesel sites, soil concentrations above screening levels, without buildings over the source area, groundwater risk above acceptable risk
8	Diesel sites, soil concentrations above screening levels, without buildings over the source area, predicted ecological risk above acceptable risk
9	Diesel sites, soil concentrations above screening levels, with buildings over the source area, predicted ecological risk above acceptable risk

Table 8-3
Evaluation of Suitability of Cleanup Alternative

Criteria to Determine the Suitability of Alternative	Area 303
Alternative 1: No Action	
Petroleum-related chemicals and volatile organic compounds do not pose an imminent threat to human health or the environment.	●
Petroleum-related chemicals and volatile organic compounds on site do not exceed ADEC soil or groundwater cleanup levels.	○
Selected as Preferred Alternative	NO
Alternative 2: Limited Groundwater Monitoring	
Petroleum-related chemicals and volatile organic compounds do not pose an imminent threat to human health or the environment (exclusive of the human health groundwater ingestion pathway).	●
Groundwater at the site is not a reasonably expected potential future source of drinking water based on 18 AAC 75.350(2).	○
Groundwater that is closely connected hydrologically to nearby surface water does not cause a violation of the Alaska Water Quality Standards, 18 AAC 70.	●
Soil contains petroleum-related chemicals at concentrations above the most stringent tabulated ADEC soil cleanup levels.	●
Groundwater monitoring indicates the presence of petroleum-related chemicals at concentrations below ADEC groundwater cleanup levels established for groundwater used as drinking water.	○
Selected as Preferred Alternative	NO
Alternative 3: Monitored Natural Attenuation and Institutional Controls	
Petroleum-related chemicals and volatile organic compounds do not pose an imminent threat to human health or the environment (exclusive of the human health groundwater ingestion pathway).	●
Groundwater at the site is a reasonably expected potential future source of drinking water based on 18 AAC 75.350(2).	●
Groundwater that is closely connected hydrologically to nearby surface water does not cause a violation of the Alaska Water Quality Standards, 18 AAC 70.	●
Soil contains petroleum-related chemicals at concentrations above the most stringent tabulated ADEC soil cleanup levels.	●
Groundwater monitoring indicates the presence of petroleum-related chemicals and volatile organic compounds at concentrations above ADEC groundwater cleanup levels established for groundwater used as drinking water.	●
Selected as Preferred Alternative	YES
Alternative 4: Free-Phase Product Recovery	
Site has quantities of residual free product on the groundwater surface that is considered practicable to recover.	●
Selected as Preferred Alternative	YES

Source: Final FFS Report, Revision 1 (U.S. Navy 2011b)

Notes:
● true
○ false
AAC - Alaska Administrative Code
ADEC - Alaska Department of Environmental Conservation

9.0 DESCRIPTION OF SELECTED CLEANUP ACTION

MNA, institutional controls, and free-phase product recovery are selected as the cleanup remedy for Area 303. This remedy is a combination of Alternative 3, Monitored Natural Attenuation and Institutional Controls and Alternative 4, Free-Phase Product Recovery. This cleanup remedy was selected for Area 303 based on its ability to meet the three human health RAOs:

- Reduce petroleum hydrocarbons or VOCs in groundwater to concentrations less than or equal to the ADEC groundwater cleanup levels established for groundwater used as a drinking water source
- Minimize exposure to free-phase product
- Prevent migration of petroleum hydrocarbons or VOCs to surface water that would result in an exceedance of the ADEC surface water quality standards

The selected cleanup remedy consists of institutional controls for soil and groundwater, MNA for groundwater, and product recovery. Petroleum concentrations in groundwater will be reduced through natural attenuation. Institutional controls will be used to protect human health and the environment until groundwater no longer exceeds ADEC groundwater cleanup levels. Removal of free product will reduce the risk of exposure to free product and reduce the risk of free product migrating to East Canal. Free product recovery will also reduce the source for the dissolved phase hydrocarbons in groundwater.

The MNA time frame for the site cannot be accurately predicted at this time. Therefore, the time frame needed to achieve ADEC groundwater cleanup levels will be estimated after 5 years of monitoring have been completed. Once groundwater concentrations have been reduced to levels lower than the applicable ADEC groundwater cleanup levels, residual risks at the site are expected to be acceptable. Note that pockets of free product may remain at the site, even if none is detected in on-site wells. Therefore, some residual risk may remain at a site once cleanup actions have been completed. However, if groundwater concentrations are below cleanup levels throughout the site, the extent of free product is expected to be very limited. Short-term risks associated with MNA will be controlled through the use of personal protective equipment.

The institutional controls that already have been implemented in the downtown area of Adak consist of use restrictions, including restrictions on land development (i.e., residential land development would be prohibited in all areas of Area 303, except as shown on Figure 2-5), downtown groundwater use prohibition, and soil excavation notification requirements. Institutional controls have been implemented in accordance with the Interim Conveyance document and the OU A ROD (U.S. Navy, USEPA, and ADEC 2000). The Navy has an

established institutional controls program that was developed to ensure that institutional controls selected in the OU A ROD remain effective and reliable. The Navy has prepared an ICMP (U.S. Navy 2010a, Appendix D) documenting the approach the Navy is using to ensure that the controls remain protective. The ICMP provides details of the institutional control management program, and, therefore, a detailed description is not included here. Although institutional controls are already in place preventing the use of the downtown aquifer and requiring notification of excavation activities in the downtown area, Area 303 would be added to the ICMP to ensure that compliance with the groundwater use prohibition and soil excavation notification requirements are verified annually at the site. Furthermore, verification that land use remains commercial to the west of Main Road and public facilities and residential to the east of Main Road would be performed annually at the site and documented in the annual institutional control site inspection report.

Monitoring of natural attenuation would involve periodic groundwater sampling at the site for a period of time sufficient to assess the progress of the natural degradation of petroleum hydrocarbons in groundwater. Details of the monitoring program would be incorporated into subsequent versions of the comprehensive monitoring plan (CMP) (U.S. Navy 2010a). The CMP describes the existing monitoring program for groundwater as prescribed in the OU A ROD (U.S. Navy, USEPA, and ADEC 2000) and other decision documents for petroleum sites on Adak. Groundwater monitoring would be conducted at a frequency to be established by the Navy and ADEC, to evaluate whether petroleum-related chemicals in the groundwater are attenuating to concentrations below applicable ADEC groundwater cleanup levels at locations to be specified in the monitoring plan. (For purposes of estimating costs, it was assumed that 30 wells would be monitored annually for natural attenuation.) Concentrations of petroleum-related chemicals currently exceeding the ADEC cleanup levels would be monitored, as well as natural attenuation indicator parameters. Monitoring data would be used to confirm the progress of natural attenuation, evaluate the rate at which petroleum concentrations are being reduced, and determine whether the appropriate institutional controls are being implemented. Periodic groundwater monitoring at Area 303 would be coordinated with the ongoing monitoring activities described in the CMP.

Once the annual monitoring data evaluation is completed, the Navy will make recommendations for modifying or discontinuing the monitoring program, as appropriate. If the groundwater contaminant plume is shown to be stable or shrinking during two consecutive annual monitoring events, then the Navy will petition ADEC for less frequent monitoring. The Navy will petition ADEC to discontinue MNA once the ADEC groundwater cleanup levels in Table 6-1 are achieved during three consecutive monitoring events in all site wells selected for monitoring in the CMP. This criteria for cessation of MNA is consistent with the criteria used for the other petroleum sites on Adak.

A minimum of six new wells would be installed at locations east of Main Road (Figure 9-1). There are currently no groundwater monitoring wells located within the area of plume that had the highest detected concentrations of GRO (GP-303-23 and GP303-23a) during the RI, because groundwater samples were collected from temporary wells from this area. Therefore, three new wells would be installed to monitor natural attenuation, as discussed in the previous paragraph. In order to delineate the plume better in the northwest part of Eagle Bay Housing area, two wells would be installed just to the south of GP-303-22 and GP-303-22a. In order to delineate the plume better to the north of the Telephone Exchange Building, one new well would be installed to the east of existing well MRP-MW2. Additional wells may need to be installed to monitor or further define the extent of the plume after the cleanup remedy is implemented, if the results from the existing and planned wells indicate it is warranted. Furthermore, if contaminants are not detected above cleanup levels in one or more of the new wells, monitoring of those wells may be discontinued.

Table 9-1 presents the costs for MNA and institutional controls. These costs are based on the conceptual design presented in the 2011 FFS (U.S. Navy 2011b). This cost estimate includes capital costs and operation and maintenance (O&M) costs. The capital costs for installation of the six new wells, including mobilization and demobilization, are estimated to be $560,000. Annual costs to implement MNA for groundwater are estimated to be $86,000. The costs associated with MNA are the incremental costs associated with Area 303, which are above the base program costs associated with monitoring activities specified in the CMP. The MNA estimate includes the costs associated with sample collection at Area 303, sample analysis, and the incremental reporting and mobilization costs.

The present-worth cost for MNA and institutional controls, assuming a 5 percent discount rate and a 40-year natural attenuation monitoring period, is $2.1 million. Total capital and O&M costs (no present worth) for MNA and institutional controls are estimated to be $4 million. Costs associated with the implementation of institutional controls at this site were not estimated, because existing island-wide institutional controls would cover site-specific restrictions. The duration of monitoring may vary substantially from the estimated 40-year value.

The other component to the selected remedy, free-phase product recovery, consists of installing four new wells and free-phase product recovery. Recoverable product would be removed from new wells and existing site wells using passive skimmers. Passive skimmers would be installed in two existing wells: MW-303-30 and MW-303-31. Free product present in wells HMW-303-11 and HMW-303-5 is being addressed as part of SWMU 62 remedial actions. Four new wells would be installed in locations near the two wells containing product (Figure 9-1) to better define the extent of free product. The goal of installing new wells would be to increase the effective area of product recovery and decrease the recovery duration, thereby optimizing recovery. If free product is detected in these new wells, passive skimmers would be installed. Free-product recovery in all new and existing wells would occur on a schedule commensurate

with skimmer capacity. This schedule may be modified to optimize the recovery rate. In addition, the wells used to recover product may change because of changes in site conditions. Furthermore, additional wells may need to be installed to monitor or further define the extent of free product after the cleanup remedy is implemented if the results from the existing and planned wells indicate it is warranted. The new wells and the existing two wells with free product may be used for MNA once free-product recovery activities have been completed in these wells. Each of these wells without free product will be used for MNA.

Free-product occurrence would be measured in additional wells to determine whether free product is migrating and whether additional wells should be added to the recovery system in the future. Removal of free-phase product would continue until the technically practicable endpoint for passive free-phase product recovery, as defined in the OU A ROD (U.S. Navy, USEPA, and ADEC 2000), is achieved. It is estimated that the technically practicable endpoint for passive free-phase product-recovery in the new wells and existing wells can be reached within 2 years. However, product-recovery rates are extremely dynamic. Criteria established in the OU A ROD for cessation of free-product recovery for systems that are not dependent on water table depression (passive skimmers) are as follows:

- When the monthly volume of recovered product averaged over the most recent 6 months (6-month moving average) is less than 5 gallons of product recovered per month, the technically practicable endpoint for recovery has been reached

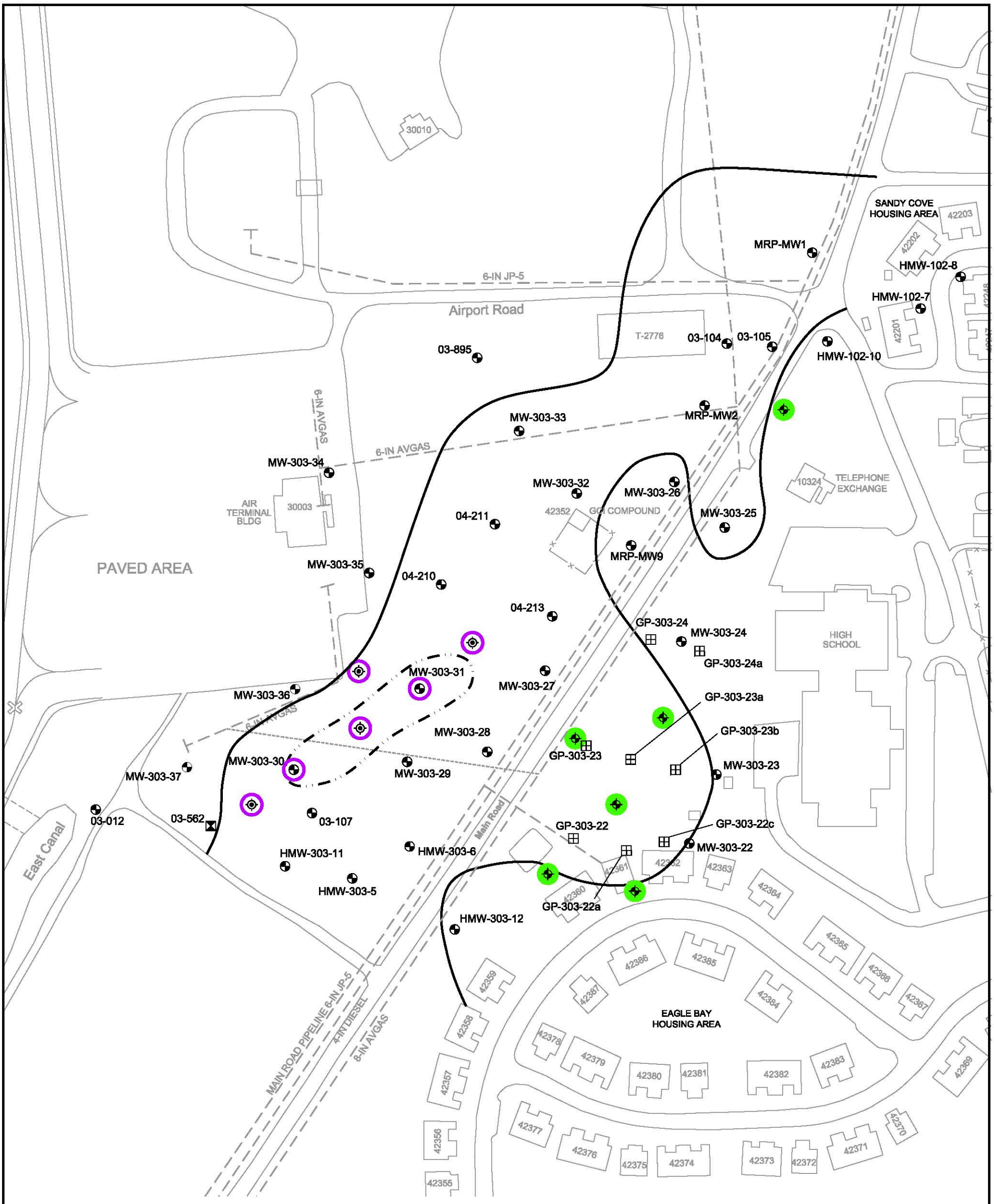
- If this endpoint criterion has been met for a period of 12 months of product recovery, the system is considered to meet the technically practicable endpoint and recovery can be discontinued (U.S. Navy, USEPA, and ADEC 2000)

Table 9-2 presents the costs for free-phase product recovery. This cost estimate includes capital costs and O&M costs. The capital costs for installing four new wells with passive skimmers and installing passive skimmers in two existing wells are estimated to be $580,000. Annual O&M costs to recover free product from the six wells are $280,000 per year for 2 years.

The present-worth cost for free-product recovery, assuming a 5 percent discount rate and 2 years of passive free-phase recovery from the new and existing wells, is $1.1 million. Total capital and O&M costs (no present worth) for free-product recovery are estimated to be $1.1 million. The duration of product recovery may vary from the estimated value.

As part of the 5-year reviews required by Amendment Number 3 to the Adak FFA (U.S. Navy, USEPA, and ADEC 2002) and Amendment Number 0001 to the SAERA between the Navy and ADEC (U.S. Navy and ADEC 2002), the Navy will summarize the results of monitoring and submit this summary to ADEC for review. The 5-year reviews will evaluate the effectiveness of

the selected remedy at Area 303. Based on these reviews, the Navy and the ADEC will decide whether continued monitoring or additional actions are necessary at the site.



U.S. NAVY	0 90 180 SCALE IN FEET	**Figure 9-1** **Selected Cleanup Remedy - Free-Product Recovery and Proposed Locations of New Free-Product Recovery and Groundwater Monitoring Wells** **Area 303**	Adak Island, AK DECISION DOCUMENT

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Table 9-1
Area 303 Cost Estimate for Monitored Natural Attenuation and Institutional Controls

Item	Unit Cost	Units	Quantity	Cost
CAPITAL DIRECT COSTS (INSTALLED)				
Well Installation Costs				
Mobilize/Demobilize crew/equipment	$35,000	LS	1	$35,000
Mobilize/Demobilize Drill Rig*	$100,000	LS	1	$100,000
Shipping	$1.60	LB	2,000	$3,200
Lodging and Per Diem	$836	Day	14	$11,704
Equipment Rental	$2,200	Week	2	$4,400
Vehicle Rental	$100	Day	14	$1,400
Well Construction (Labor)	$15,000	Week	2	$30,000
Well Construction (Materials)	$1,000	Well	6	$6,000
SUBTOTAL CAPITAL COSTS				$191,704
Contingency Allowances		%	25	$47,926
TOTAL CAPITAL DIRECT COSTS				$240,000
CAPITAL INDIRECT COSTS				
Preliminary Design	DC	%	25	$60,000
Engineering Design	DC	%	20	$48,000
Regulatory Compliance	DC	%	15	$36,000
Construction QA and Management	DC	%	20	$48,000
System Startup	DC	%	20	$48,000
Closure Documentation	DC	%	15	$36,000
TOTAL CAPITAL INDIRECT COSTS				$280,000
TOTAL DIRECT AND INDIRECT CAPITAL COSTS				$520,000
Site Inspection and Overhead Costs	Total Costs	%	8	$41,600
TOTAL CAPITAL COSTS				**$560,000**
ANNUAL O&M COSTS				
Annual MNA Costs				
Mobilization				
Mobilize/Demobilize**	$2,000	LS	1	$2,000
Shipping	$1.60	LB	2,000	$3,200
Monitoring				
Project Management/Coordination	$120	Well	30	$3,600
Field Labor	$480	Well	30	$14,400
Hydrogeologist	$100	Well	30	$3,000
Lodging and Per Diem	$418	Day	14	$5,852
Equipment Rental	$1,620	Week	2	$3,240
Vehicle Rental	$100	Day	14	$1,400
Sampling Supplies	$45	Well	30	$1,350

Table 9-1 (Continued)
Area 303 Cost Estimate for Monitored Natural Attenuation and Institutional Controls

Item	Unit Cost	Units	Quantity	Cost
Analytical (DRO, GRO, BTEX, S/VOCs)	$850	Well	30	$25,500
SUBTOTAL MNA COSTS				$63,542
Contingency Allowances		%	25	$15,886
Site Inspection and Overhead Costs		%	8	$6,354
TOTAL ANNUAL MNA COST				**$86,000**
Cost Projection for 40 years				**$3,400,000**
40-Yr Present Worth MNA* **				**$1,500,000**
TOTAL CAPITAL COSTS				**$560,000**
TOTAL O&M COSTS (40 YEARS)				**$3,400,000**
TOTAL CAPITAL AND O&M COSTS				**$4,000,000**
PRESENT-WORTH O&M COSTS* **				**$1,500,000**
TOTAL PROJECT PRESENT WORTH* **				**$2,100,000**

Notes:
*There is currently no drill rig on Adak.
**Mobilization costs are the estimated fraction of the total mobilization costs, assuming that other sites will be monitored at the same time and mobilization costs will be shared among multiple sites.
*** Present-worth costs were calculated using a 5% discount rate.
BTEX - benzene, toluene, ethylbenzene, and total xylenes
DRO - diesel-range organics
GRO - gasoline-range organics
LB - pound
LS - lump sum
MNA - monitored natural attenuation
QA - quality assurance
O&M - operation and maintenance
S/VOCs - semivolatile/volatile organic compounds
YR - year

Table 9-2
Area 303 Cost Estimate for Free-Phase Product Recovery

Item	Unit Cost	Units	Quantity	Cost
CAPITAL DIRECT COSTS (INSTALLED)				
Well Installation Costs				
Mobilize/Demobilize crew/equipment	$35,000	LS	1	$35,000
Mobilize/Demobilize Drill Rig*	$100,000	LS	1	$100,000
Shipping	$1.60	LB	1,400	$2,240
Lodging and Per Diem	$836	Day	7	$5,852
Equipment Rental	$2,200	Week	1	$2,200
Vehicle Rental	$100	Day	7	$700
Well Construction (Labor)	$15,000	Week	1	$15,000
Well Construction (Materials)	$1,000	Well	4	$4,000
Automated Passive Skimmer Installation				
Shipping	$1.60	LB	6,000	$9,600
Lodging and Per Diem	$418.00	Day	7	$2,926
Equipment purchase	$2,500	Well	6	$15,000
Equipment Install	$8,000	Week	1	$8,000
Vehicle Rental	$100	Day	7	$700
SUBTOTAL CAPITAL COSTS				$201,218
Contingency Allowances		%	25	$50,305
TOTAL CAPITAL DIRECT COSTS				$250,000
CAPITAL INDIRECT COSTS				
Preliminary Design	DC	%	25	$62,500
Engineering Design	DC	%	20	$50,000
Regulatory Compliance	DC	%	15	$37,500
Construction QA and Management	DC	%	20	$50,000
System Startup	DC	%	20	$50,000
Closure Documentation	DC	%	15	$37,500
TOTAL CAPITAL INDIRECT COSTS				$290,000
TOTAL DIRECT AND INDIRECT CAPITAL COSTS				$540,000
Site Inspection and Overhead Costs	Total Costs	%	8	$43,200
TOTAL CAPITAL COSTS				**$580,000**

Table 9-2 (Continued)
Area 303 Cost Estimate for Free-Phase Product Recovery

Item	Unit Cost	Units	Quantity	Cost
ANNUAL O&M COSTS				
Annual Free-Phase Product Recovery Costs				
Mobilization				
Mobilize/Demobilize	$6,000	LS	12	$72,000
Shipping	$1.60	LB	800	$1,280
Monitoring				
Project Management/Coordination	$1,440	Well	6	$8,640
Field Labor	$5,760	Well	6	$34,560
Lodging and Per Diem	$418	Day	84	$35,112
Supplies	$3,000	Well	6	$18,000
Vehicle Rental	$100	Day	60	$6,000
Hazardous Waste Disposal	$10,000	YR	1	$10,000
Battery/remote system repair/replacement	$25,000	YR	1	$25,000
SUBTOTAL RECOVERY COSTS				$210,592
Contingency Allowances		%	25	$52,648
Site Inspection and Overhead Costs		%	8	$21,059
TOTAL ANNUAL RECOVERY COST				**$280,000**
Cost Projection for 2 years				**$560,000**
2-Yr Present Worth Recovery**				**$520,000**
TOTAL CAPITAL COSTS				**$580,000**
TOTAL O&M COSTS (2 YEARS)				**$560,000**
TOTAL CAPITAL AND O&M COSTS				**$1,100,000**
PRESENT WORTH O&M COSTS**				**$520,000**
TOTAL PROJECT PRESENT WORTH**				**$1,100,000**

Notes:
*There is currently no drill rig on Adak.
** Present-worth costs were calculated using a 5% discount rate.
LB - pound
LS - lump sum
MNA - monitored natural attenuation
O&M - operation and maintenance
QA - quality assurance
YR - year

10.0 PUBLIC INVOLVEMENT

10.1 PUBLIC INVOLVEMENT ACTIVITIES

The Navy established a community involvement program in 1994 to provide interested Alaska citizens and Adak residents with timely and updated information on the environmental cleanup and the transfer and reuse of Navy land and facilities. The community involvement program also provides a mechanism for public input on environmental cleanup decisions. Information is conveyed to the public through fact sheets and newsletters, Restoration Advisory Board (RAB) meetings and other formal public meetings, website announcements (www.adakupdate.com), information repositories on Adak Island (Bob Reeve High School building, second floor) and in Anchorage (University of Alaska library, reserve room), the Naval Facilities Engineering Command Northwest website (https://portal.navfac.navy.mil/portal/page/ portal/NAVFAC/ NAVFAC_WW_PP/NAVFAC_EFANW_PP), and the administrative record file located at Naval Facilities Engineering Command Northwest in Silverdale, Washington. In addition, a mailing list is maintained and updated in order to send concerned citizens newsletters, fact sheets, and announcements of upcoming meetings and significant activities, such as public comment periods. Public input is obtained through RAB meetings and other formal public meetings, community interviews, requests for public comments, and a telephone hotline.

The Proposed Plan (U.S. Navy 2011c) was provided to the public for review during the 30-day public comment period beginning on August 16, 2011. In addition, TAC (the current landowner) was provided a copy of the final FFS (URS 2011b) and the Proposed Plan (U.S. Navy 2011c) and was invited to comment on these documents.

10.2 FUTURE CONTACTS

Adak community members are encouraged to contact Navy and ADEC site managers with questions or comments. The Navy and ADEC site managers are:

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11.0 RESPONSIVENESS SUMMARY

No comments were received during the public comment period for the Proposed Plan (U.S. Navy 2011c).

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APPENDIX A

Property Owner Concurrence

This Decision Document was developed as a result of two iterations of a Focused Feasibility Study (FFS). Upon the completion of the first Final FFS dated March 2008, the property owner and the Alaska Department of Environmental Conservation (ADEC) commented that the FFS did not address Human Health Risk issues, and the Navy did not sufficiently include the property owner in the FFS process. The Navy revised the FFS to include a human health risk assessment (HHRA) with property owner involvement. The second iteration, the Final FFS Rev 1 dated March 2011, is the basis on which this DD was developed.

The property owner was involved throughout the development of the Final FFS Rev 1; they were provided the draft sampling and analysis plan for soil vapor sampling in support of the HHRA, the draft supplemental human health risk assessment, and draft FFS Rev 1. In addition, a meeting was held at the property owner's offices on February 4, 2011 to discuss the results of the draft supplemental human health risk assessment at which the ADEC attended. During this meeting the property owner did not express concerns regarding the FFS process, nor direction this study was concluding, i.e., monitored natural attenuation and free product removal.

While the property owners have not formally concurred with the remedy selected during the development of the Decision Document, it is the opinion of both the Navy and the ADEC that they were given ample opportunity to provide input into the Final Revision 1 FFS and the selected remedy outlined in this document.

APPENDIX B

Analytical Results

Table B-1
Soil Analytical Results for Chemicals of Potential Concern at Area 303

				Volatile Organic Compounds						Petroleum Hydrocarbon Fractions			Total Petroleum Hydrocarbons		
Location ID	**Location Cross Reference**	**Sample Date**	**Depth Range (feet bgs)**	**1,2,4-Trimethyl-benzene (mg/kg)**	**1,3,5-Trimethyl-benzene (mg/kg)**	**Benzene (mg/kg)**	**Ethylbenzene (mg/kg)**	**Toluene (mg/kg)**	**Total Xylenes (mg/kg)**	**C6-C10 Aliphatics (mg/kg)**	**C8-C10 Aromatics (mg/kg)**	**C10-C21 Aromatics (mg/kg)**	**Diesel-Range Organics (mg/kg)**	**Gasoline-Range Organics (mg/kg)**	**Residual-Range Organics (mg/kg)**
822	MW-303-22 (B)	6/24/06	14 - 15	0.00674 U	0.00674 U	0.00202 U	0.0054 U	0.00202 U	0.0135 U	NA	NA	NA	43.5	4.25 U	34.9 U
822	MW-303-22 (B)	6/24/06	24 - 25	0.00619 U	0.00619 U	0.00186 U	0.00495 U	0.00186 U	0.0124 U	NA	NA	NA	4.63 U	3.38 U	28.9 U
823	MW-303-23 (C)	6/22/06	16 - 17	0.00672 U	0.00672 U	0.00202 U	0.00537 U	0.00202 U	0.0134 U	NA	NA	NA	4.28 U	3.44 U	26.7 U
823	MW-303-23 (C)	6/22/06	25 - 26	0.00672 U	0.00672 U	0.00202 U	0.00538 U	0.00202 U	0.0134 U	NA	NA	NA	5.21 U	3.52 U	32.5 U
824	MW-303-24 (B)	6/22/06	15.5 - 16.5	0.00751 U	0.00751 U	0.00225 U	0.00601 U	0.00225 U	0.015 U	NA	NA	NA	5.84 U	15	36.5 U
824	MW-303-24 (B)	6/22/06	25 - 26	0.00668 U	0.00668 U	0.002 U	0.00534 U	0.002 U	0.0134 U	NA	NA	NA	5.09 U	3.57 U	31.8 U
825	MW-303-25	6/22/06	9 - 10	0.00633 U	0.00633 U	0.0019 U	0.00506 U	0.0019 U	0.0127 U	NA	NA	NA	5.19 U	3.78 U	32.5 U
826	MW-303-26	6/12/06	16 - 17	0.909	0.404	0.555	0.348	0.258 U	16	NA	NA	NA	32.3	53.5 J	463
826	MW-303-26	6/12/06	21 - 22	0.00606 U	0.00606 U	0.00182 U	0.00485 U	0.00182 U	0.0121 U	NA	NA	NA	4.99 U	3.7 U	31.2 U
827	MW-303-27	6/13/06	14 - 15	0.318	0.189	0.00886	0.472	0.0906	2.39	51.945 J	8.69 U	21.245 U	6.7 U	58.3 J	41.8 U
827	MW-303-27	6/13/06	24 - 25	160	76.6	11.4 U	152	117	833	4,440 J	816 J	21.77	15.9	3,290 J	30.8 U
828	MW-303-28	6/19/06	8.5 - 9	0.897	0.594	0.201 U	1.9	0.201 U	5.24	NA	NA	NA	7.12 U	39.9 J	44.5 U
828	MW-303-28	6/19/06	26 - 27	0.0063 U	0.0063 U	0.00189 U	0.00504 U	0.00189 U	0.0126 U	NA	NA	NA	4.45 U	3.55 U	27.8 U
829	MW-303-29	6/20/06	16.5 - 17	0.00616 U	0.00616 U	0.0404	0.0985	0.00185 U	0.199	5.84 U	5.84 U	29.55	603 J	51.8 J	929 J
829	MW-303-29	6/20/06	25 - 26	0.49	0.29	0.126 U	2.78	7.04	6.88	72.27 J	12.7 U	9.525 U	52.4	106 J	84.3
830	MW-303-30	6/23/06	15.5 - 16.5	0.0269	0.0113	0.00195 U	0.00845	0.00195 U	0.013 U	11.185	6.51 U	105.8	713	8.23	166
830	MW-303-30	6/23/06	24 - 25	30.4	27.6	0.128 U	57.1	3.36	93.9	2,618 J	382 J	281.2 J	1,000	2,700 J	146 U
831	MW-303-31	6/23/06	18 - 19	0.682	0.409	0.243 U	1.51	0.243 U	6.47	34.4 J	12.2 U	14.475 U	30.7	44.4 J	245
831	MW-303-31	6/23/06	25 - 26	126	60.3	0.28 J	203	216	800	6,100 J	1,090 J	36.7	516	6,830 J	152 U
832	MW-303-32	6/12/06	15.5 - 16	0.0105 U	0.0105 U	0.00314 U	0.00838 U	0.00314 U	0.0271 J	NA	NA	NA	19.1	10 U	333
832	MW-303-32	6/12/06	21 - 21.5	0.00659 U	0.00659 U	0.00518	0.00527 U	0.00198 U	0.0264	NA	NA	NA	5.22 U	4.01 U	32.6 U
833	MW-303-33	6/19/06	12 - 13	0.00553 U	0.00553 U	0.00166 U	0.00443 U	0.00166 U	0.0111 U	NA	NA	NA	10.4	4.35	29.5
833	MW-303-33	6/19/06	19 - 20	0.00582 U	0.00582 U	0.00175 U	0.00466 U	0.00175 U	0.0116 U	NA	NA	NA	4.34 U	3.42 U	27.1 U
834	MW-303-34	6/16/06	11 - 12	0.00606 U	0.00606 U	0.00182 U	0.00485 U	0.00182 U	0.0121 U	NA	NA	NA	4.81 U	3.27 U	30.1 U
835	MW-303-35	6/16/06	7.5 - 8	0.0114 U	0.0114 U	0.00341 U	0.00909 U	0.00341 U	0.0227 U	NA	NA	NA	18	7.05 U	359
835	MW-303-35	6/16/06	9.5 - 10	0.00636 U	0.00636 U	0.00191 U	0.00509 U	0.00191 U	0.0127 U	NA	NA	NA	4.75 U	3.97 U	29.7 U
836	MW-303-36	6/16/06	9.5 - 10.5	0.00663 U	0.00663 U	0.00199 U	0.0053 U	0.00199 U	0.0133 U	NA	NA	NA	4.85 U	3.02 U	30.3 U
837	MW-303-37	6/20/06	9 - 10	0.00617 U	0.00617 U	0.00185 U	0.00493 U	0.00185 U	0.0123 U	6.17 U	6.17 U	9.355 U	4.99 U	3.37 U	31.2 U
12	03-012	8/22/98	5.5 - 6	NA	NA	0.03 U	0.03 U	0.03 U	0.03 U	NA	NA	NA	4.9 U	3 U	NA
104	03-104	6/21/97	18.2 - 19.2	NA	NA	0.01 U	0.87	0.01 U	4.3	NA	NA	NA	228	26 J	NA
105	03-105	6/21/97	18.3 - 19.3	NA	NA	0.01 U	0.01 U	0.01 U	0.03 U	NA	NA	NA	5 U	0.3 U	NA
107	03-107	6/18/97	22.5 - 23.5	NA	NA	0.01 U	0.41	0.01 U	5.1	NA	NA	NA	7,500 J	79	NA
562	03-562	5/2/97	9 - 11	NA	NA	0.027 U	0.027 U	0.027 U	0.027 U	NA	NA	NA	11 U	1.1 U	NA
895	03-895	7/16/98	17 - 18	NA	NA	0.03 U	0.031	0.12	0.28	NA	NA	NA	4.8 U	3 U	NA

Table B-1 (Continued)
Soil Analytical Results for Chemicals of Potential Concern at Area 303

				Volatile Organic Compounds						Petroleum Hydrocarbon Fractions			Total Petroleum Hydrocarbons		
Location ID	Location Cross Reference	Sample Date	Depth Range (feet bgs)	1,2,4-Trimethyl-benzene (mg/kg)	1,3,5-Trimethyl-benzene (mg/kg)	Benzene (mg/kg)	Ethylbenzene (mg/kg)	Toluene (mg/kg)	Total Xylenes (mg/kg)	C6-C10 Aliphatics (mg/kg)	C8-C10 Aromatics (mg/kg)	C10-C21 Aromatics (mg/kg)	Diesel-Range Organics (mg/kg)	Gasoline-Range Organics (mg/kg)	Residual-Range Organics (mg/kg)
210	04-210	10/9/96	25 - 27	NA	NA	0.032 UJ	0.032 UJ	0.032 UJ	0.032 UJ	NA	NA	NA	13 U	1.3 UJ	NA
210	04-210	10/9/96	30 - 32	NA	NA	0.031 UJ	0.031 UJ	0.031 UJ	0.031 UJ	NA	NA	NA	12 U	1.3 UJ	NA
211	04-211	10/10/96	15 - 17	NA	NA	0.06	0.38	0.08	1.4	NA	NA	NA	12	12	NA
211	04-211	10/10/96	20 - 22	NA	NA	0.026 U	0.026 U	0.026 U	0.026 U	NA	NA	NA	4.3 U	2.6 U	NA
211	04-211	10/10/96	25 - 27	NA	NA	0.031 U	0.031 U	0.031 U	0.041	NA	NA	NA	5.1 U	4.6 U	NA
213	04-213	10/9/96	20 - 22	NA	NA	0.027 UJ	0.027 UJ	0.027 UJ	0.027 UJ	NA	NA	NA	11 U	1.1 UJ	NA
213	04-213	10/9/96	25 - 27	NA	NA	0.032 UJ	0.032 UJ	0.032 UJ	0.032 UJ	NA	NA	NA	13 U	3.9 J	NA
769	HMW-102-10	8/21/93	7.5 - 7.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA	NA
769	HMW-102-10	8/21/93	17.5 - 17.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	5,330 J	NA	NA
767	HMW-102-8	8/13/93	10 - 10	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA	NA
582	HMW-303-12	8/31/93	2.5 - 2.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	964	NA	NA
582	HMW-303-12	8/31/93	7.5 - 7.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	44	NA	NA
575	HMW-303-5	8/10/93	7.5 - 7.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	11 U	NA	NA
576	HMW-303-6	8/10/93	7.5 - 7.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA	NA
750	MRP-MW1	8/1/93	8 - 10	NA	NA	NA	NA	NA	NA	NA	NA	NA	34	NA	NA
750	MRP-MW1	8/1/93	12-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	160	NA	NA
750	MRP-MW1	8/1/93	16 - 18	NA	NA	NA	NA	NA	NA	NA	NA	NA	20,000	410	NA
750	MRP-MW1	8/1/93	18 - 20	NA	NA	NA	NA	NA	NA	NA	NA	NA	16	NA	NA
750	MRP-MW1	8/1/93	22 - 24	NA	NA	NA	NA	NA	NA	NA	NA	NA	50	NA	NA
751	MRP-MW2	8/1/93	5 - 7	NA	NA	NA	NA	NA	NA	NA	NA	NA	450	NA	NA
751	MRP-MW2	8/1/93	9 - 11	NA	NA	NA	NA	NA	NA	NA	NA	NA	24	NA	NA
751	MRP-MW2	8/1/93	14 - 15	NA	NA	NA	NA	NA	NA	NA	NA	NA	50 U	NA	NA
751	MRP-MW2	8/1/93	17 - 19	NA	NA	NA	NA	NA	NA	NA	NA	NA	33	43	NA
751	MRP-MW2	8/1/93	21 - 23	NA	NA	NA	NA	NA	NA	NA	NA	NA	50 U	NA	NA
109	MRP-MW9	9/17/92	5 - 7	NA	NA	NA	NA	NA	NA	NA	NA	NA	32	NA	NA
109	MRP-MW9	9/17/92	9 - 11	NA	NA	NA	NA	NA	NA	NA	NA	NA	22	NA	NA
109	MRP-MW9	9/17/92	14 - 15	NA	NA	NA	NA	NA	NA	NA	NA	NA	1,600	NA	NA
109	MRP-MW9	9/17/92	17 - 19	NA	NA	10 U	10 U	10 U	10 U	NA	NA	NA	54	500 U	NA
109	MRP-MW9	9/17/92	21 - 23	NA	NA	NA	NA	NA	NA	NA	NA	NA	1,100 U	NA	NA

Notes:

bgs - below ground surface
ID - identification
J - estimated value
mg/kg - milligram per kilogram
NA - not analyzed
U - not detected above reporting limit

Table B-2
Groundwater Analytical Results for Volatile and Semivolatile Organic Compounds,
Chemicals of Potential Concern at Area 303

			Volatile Organic Compounds									Semivolatile Organic Compounds	
Location ID	**Location Cross Reference**	**Sample Date**	**1,2,4-Trimethyl-benzene (µg/L)**	**1,3,5-Trimethyl-benzene (µg/L)**	**Benzene (µg/L)**	**Ethyl-benzene (µg/L)**	**Napthalene (µg/L)**	**Toluene (µg/L)**	**m,p-Xylene (µg/L)**	**o-Xylene (µg/L)**	**Total Xylenes (µg/L)**	**Bis(2-ethylhexyl) phthalate (µg/L)**	**Dibenz(a,h)-anthracene (µg/L)**
12	03-012	10/14/98	NA	NA	1 U	1 U	NA	1 U	NA	NA	1 U	NA	NA
12	03-012	08/25/99	NA	NA	0.2 U	0.2 U	NA	0.3 U	NA	NA	0.4 U	NA	NA
12	03-012	11/18/99	NA	NA	0.2 U	0.2 U	NA	0.3 U	NA	NA	0.2	NA	NA
12	03-012	02/14/00	NA	NA	0.2 U	0.2 U	NA	0.3 U	0.4 U	0.2 U	NA	NA	NA
12	03-012	07/04/00	NA	NA	0.2 U	0.2 U	NA	0.3 U	0.4 U	0.2 UJ	NA	NA	NA
12	03-012	09/04/01	NA	NA	0.2 U	0.5 U	NA	0.5 U	NA	NA	1 U	NA	NA
12	03-012	10/04/01	NA	NA	0.5 U	2 U	NA	2 U	2 U	2 U	NA	NA	NA
12	03-012	10/01/02	NA	NA	1 U	1 U	NA	1 U	NA	NA	3 U	NA	NA
12	03-012	05/23/06	1 U	1 U	1 U	1 U	0.098 U	1 U	NA	NA	3 U	NA	0.098 U
104	03-104	09/03/01	NA	NA	0.2 U	2.24	NA	0.684	NA	NA	18.6	NA	NA
104	03-104	05/20/06	19.2	5.62	1 U	1.27	4.3	1 U	NA	NA	10.1	NA	0.1 U
105	03-105	05/22/06	5.74	14.6	1 U	1 U	4.91	1 U	NA	NA	8.29	NA	0.0971 U
107	03-107	01/14/98	NA	NA	21	730	4.15 J	1,100	NA	NA	2,000 J	NA	0.02 U
107	03-107	09/03/01	NA	NA	68.6	712	NA	938	NA	NA	1,820	NA	NA
107	03-107	09/03/01	NA	NA	82.1	NA	NA	NA	NA	NA	NA	NA	NA
107	03-107	05/24/06	143	55.8	14.9	636	46.9	455	NA	NA	1,620	NA	0.098 U
562	03-562	05/31/97	NA	NA	1 U	1 U	2.2 U	1.2	NA	NA	1.4	NA	0.02 UJ
562	03-562	09/04/01	NA	NA	0.2 U	0.5 U	NA	0.5 U	NA	NA	1 U	NA	NA
562	03-562	05/23/06	1 U	1 U	1 U	1 U	0.098 U	1 U	NA	NA	3 U	NA	0.098 U
895	03-895	08/10/98	NA	NA	1 U	1 U	NA	1 U	NA	NA	1 U	NA	NA
895	03-895	08/25/99	NA	NA	0.2 U	0.2 U	NA	0.3 U	NA	NA	0.4 U	NA	NA
895	03-895	11/19/99	NA	NA	0.2 U	0.2 U	NA	0.3 U	0.4 U	0.2 U	NA	NA	NA
895	03-895	02/21/00	NA	NA	0.2 U	0.2 U	NA	0.3 U	0.4 U	0.2 U	NA	NA	NA
895	03-895	06/26/00	NA	NA	0.2 U	0.2 U	NA	0.3 U	0.4 U	0.2 U	NA	NA	NA
895	03-895	10/08/01	NA	NA	0.5 U	2 U	NA	2 U	2 U	2 U	NA	NA	NA
895	03-895	10/01/02	NA	NA	1 U	1 U	NA	1 U	NA	NA	3 U	NA	NA
895	03-895	05/22/06	1 U	1 U	1 U	1 U	0.098 U	1 U	NA	NA	3 U	NA	0.098 U
100	04-100	10/05/03	NA	NA	2 U	1.6 J	NA	0.98 J	1.9 J	2 U	NA	NA	NA
100	04-100	09/24/04	NA	NA	0.95	13.1	NA	2.44	NA	NA	26.6	NA	NA
100	04-100	09/20/05	NA	NA	0.95 J	12.7 J	NA	2.3 J	NA	NA	33.4 J	NA	NA
210	04-210	10/15/96	NA	NA	36	260	19	170	NA	NA	1,000	NA	0.02 U
210	04-210	08/01/02	NA	NA	12	110	NA	29	NA	NA	330	NA	NA

Table B-2 (Continued)
Groundwater Analytical Results for Volatile and Semivolatile Organic Compounds,
Chemicals of Potential Concern at Area 303

			Volatile Organic Compounds									Semivolatile Organic Compounds	
Location ID	Location Cross Reference	Sample Date	1,2,4-Trimethyl-benzene (µg/L)	1,3,5-Trimethyl-benzene (µg/L)	Benzene (µg/L)	Ethyl-benzene (µg/L)	Napthalene (µg/L)	Toluene (µg/L)	m,p-Xylene (µg/L)	o-Xylene (µg/L)	Total Xylenes (µg/L)	Bis(2-ethylhexyl) phthalate (µg/L)	Dibenz(a,h)-anthracene (µg/L)
210	04-210	09/20/05	NA	NA	5.66 J	127 J	NA	81.5 J	NA	NA	331 J	NA	NA
210	04-210	05/20/06	68.4	23.1 J	3.49 J	97.2	9.65	6.33 J	NA	NA	280	NA	0.099 U
211	04-211	10/15/96	NA	NA	20 U	43	3.98	20 U	NA	NA	130	NA	0.02 U
211	04-211	08/01/02	NA	NA	6.9	18	NA	5	NA	NA	47	NA	NA
211	04-211	05/20/06	33.9 J	16.1 J	1.72 J	17.6 J	1.61	1.38 J	NA	NA	54.4 J	NA	0.1 U
213	04-213	10/15/96	NA	NA	10 U	20	3.61	10 U	NA	NA	73	NA	0.02 U
213	04-213	08/01/02	NA	NA	3	5.4	NA	3.6	NA	NA	14	NA	NA
213	04-213	05/23/06	74.8	32	1 U	7.39	1.89	1 U	NA	NA	22.8	NA	0.099 U
816	GP-303-22	06/10/06	200	480	29	170	NA	4.1	860	180	NA	NA	NA
817	GP-303-22A	06/14/06	31	43	1 U	1.8	NA	1.6	NA	NA	2 U	NA	NA
818	GP-303-22C	06/21/06	42	37	0.25 U	4.5	NA	4.9	0.5 U	0.96	NA	NA	NA
813	GP-303-23	06/10/06	180	360	100 J	1,800	NA	1,500	3,400	1,700	NA	NA	NA
814	GP-303-23A	06/14/06	300	650	50 U	1,200	NA	50 U	NA	NA	5,300	NA	NA
815	GP-303-23B	06/14/06	5.8	2.4	1 U	7.6	NA	10	NA	NA	2.6	NA	NA
812	GP-303-24	06/09/06	0.25 U	0.25 U	0.25 U	0.25 U	NA	0.25 U	0.5 U	0.25 U	NA	NA	NA
819	GP-303-24A	06/14/06	1 U	2	1 U	1 U	NA	1 U	NA	NA	1.7 U	NA	NA
769	HMW-102-10	05/23/06	1 U	1 U	1 U	1 U	0.1	1 U	NA	NA	3 U	NA	0.098 U
766	HMW-102-7	02/07/97	NA	NA	1 U	1 U	2.11 U	1 U	NA	NA	1 U	NA	0.02 U
766	HMW-102-7	05/24/06	1 U	1 U	1 U	1 U	1.35	1 U	NA	NA	3 U	NA	0.0971 U
767	HMW-102-8	02/07/97	NA	NA	1 U	1 U	2.11 U	1 U	NA	NA	1 U	NA	0.02 U
767	HMW-102-8	05/26/06	1 U	1 U	1 U	1 U	0.098 U	1 U	NA	NA	3 U	NA	0.098 U
581	HMW-303-11	05/25/06	136	23	1.2	22.6	86.9	1.48	NA	NA	65.8	NA	0.5 U
582	HMW-303-12	05/22/06	1 U	1 U	1 U	1 U	0.098 U	1 U	NA	NA	3 U	NA	0.098 U
575	HMW-303-5	05/24/06	104	34.5	1 U	13.3	17	3.25	NA	NA	77.7	NA	0.099 U
576	HMW-303-6	04/29/97	NA	NA	10 U	100	50.5 J	14	NA	NA	400	NA	0.02 U
576	HMW-303-6	05/19/06	184	36.4	1 U	6.52	46.6	1 U	NA	NA	68.7	NA	0.5 U
750	MRP-MW1	02/05/97	NA	NA	5 U	18	65.5 J	28	NA	NA	220	NA	0.21 U
750	MRP-MW1	09/03/01	NA	NA	0.435 J	25.6 J	NA	2.02 J	NA	NA	93.3 J	NA	NA
750	MRP-MW1	09/03/01	NA	NA	0.139 U	NA	NA	NA	NA	NA	NA	NA	NA
750	MRP-MW1	05/22/06	35.8	18	1 U	4.64	13.5	1 U	NA	NA	6.29	NA	0.106
751	MRP-MW2	11/06/92	NA	NA	NA	NA	11 U	NA	NA	NA	NA	4 J	11 U
751	MRP-MW2	02/05/97	NA	NA	220	20	3.24	620	NA	NA	3,500	NA	0.02 U
751	MRP-MW2	11/05/97	NA	NA	180	720 J	NA	25	NA	NA	2,606.40	NA	NA

Table B-2 (Continued)
Groundwater Analytical Results for Volatile and Semivolatile Organic Compounds,
Chemicals of Potential Concern at Area 303

			Volatile Organic Compounds									Semivolatile Organic Compounds	
Location ID	Location Cross Reference	Sample Date	1,2,4-Trimethyl-benzene (µg/L)	1,3,5-Trimethyl-benzene (µg/L)	Benzene (µg/L)	Ethyl-benzene (µg/L)	Napthalene (µg/L)	Toluene (µg/L)	m,p-Xylene (µg/L)	o-Xylene (µg/L)	Total Xylenes (µg/L)	Bis(2-ethylhexyl) phthalate (µg/L)	Dibenz(a,h)-anthracene (µg/L)
751	MRP-MW2	09/03/01	NA	NA	133	440	NA	25 U	NA	NA	3,040	NA	NA
751	MRP-MW2	09/03/01	NA	NA	137	NA	NA	NA	NA	NA	NA	NA	NA
751	MRP-MW2	05/24/06	60.9	40.8	45.9	147	1.04	3.69	NA	NA	1,190	NA	0.098 U
109	MRP-MW9	11/06/92	NA	NA	NA	NA	10 U	NA	NA	NA	NA	10 U	10 U
109	MRP-MW9	09/19/96	NA	NA	3.5 J	1 U	2.06 U	1 U	NA	NA	1.4	NA	0.02 U
109	MRP-MW9	08/01/02	NA	NA	0.77 J	1 U	NA	1 U	NA	NA	3 U	NA	NA
109	MRP-MW9	05/19/06	1 U	1 U	1 U	1 U	0.1 U	1 U	NA	NA	3 U	NA	0.1 U
822	MW-303-22 (B)	06/21/06	0.25 U	0.25 U	0.25 U	0.25 U	NA	0.25 U	0.5 U	0.25 U	NA	NA	NA
822	MW-303-22 (B)	06/27/06	1 U	1 U	1 U	1 U	0.0952 U	1 U	NA	NA	3 U	NA	0.0952 U
823	MW-303-23 (C)	06/17/06	0.25 U	0.25 U	0.25 U	0.25 U	NA	0.25 U	0.5 U	0.25 U	NA	NA	NA
823	MW-303-23 (C)	06/26/06	1 U	1 U	1 U	1 U	0.099 U	1 U	NA	NA	3 U	NA	0.099 U
824	MW-303-24 (B)	06/17/06	0.25 U	0.25 U	0.25 U	0.25 U	NA	0.25 U	0.5 U	0.25 U	NA	NA	NA
824	MW-303-24 (B)	06/26/06	1 U	1 U	1 U	1 U	0.099 U	1 U	NA	NA	3 U	NA	0.099 U
825	MW-303-25	06/09/06	0.25 U	0.25 U	0.25 U	0.25 U	NA	0.25 U	0.5	0.25 U	NA	NA	NA
825	MW-303-25	06/26/06	69.9	32.2	1 U	45.4	0.708	11.7	NA	NA	1,280	NA	0.435
826	MW-303-26	06/23/06	8.96	2.21	1.57	1 U	0.433	1 U	NA	NA	85.2	NA	0.098 U
827	MW-303-27	06/27/06	258	91.6	2.69 J	818	5.47	1,980	NA	NA	4,190	NA	0.098 U
828	MW-303-28	06/26/06	182	82.4	1.06 J	1,090	2.33	143	NA	NA	1,880	NA	0.441
829	MW-303-29	06/28/06	8.63	3.79	1 U	42.6	0.1 U	56	NA	NA	88.9	NA	0.1 U
830	MW-303-30	06/28/06	168	76.4	1.02 J	1,790	5.55	1,800	NA	NA	3,940	NA	0.368
831	MW-303-31	06/28/06	79.2	37.8	6.49 J	443	1.1	1,680	NA	NA	1,620	NA	0.098 U
832	MW-303-32	06/22/06	1.48	1 U	12	1 U	0.1 U	1 U	NA	NA	64.7	NA	0.1 U
833	MW-303-33	06/11/06	0.61	0.53	0.25 U	0.25 U	NA	0.27	0.78	0.25 U	NA	NA	NA
833	MW-303-33	06/27/06	18.5	5.91	20.4	1 U	1.29	1.73	NA	NA	170	NA	0.0952 U
834	MW-303-34	06/10/06	1.4	2.9	2.1	2.1	NA	1.2	8.2	2.4	NA	NA	NA
834	MW-303-34	06/23/06	2.89	1.08	2.36	1.92	0.304	1.54	NA	NA	12.4	NA	0.0962 U
835	MW-303-35	06/10/06	0.25 U	0.25 U	0.25 U	0.25 U	NA	0.25 U	0.5 U	0.25 U	NA	NA	NA
835	MW-303-35	06/23/06	1 U	1 U	1 U	1 U	0.0962 U	1 U	NA	NA	3 U	NA	0.0962 U
836	MW-303-36	06/10/06	0.25 U	0.25 U	0.25 U	0.25 U	NA	0.25 U	0.5 U	0.25 U	NA	NA	NA
836	MW-303-36	06/23/06	1 U	1 U	1 U	1 U	0.0971 U	1 U	NA	NA	3 U	NA	0.0971 U
837	MW-303-37	06/27/06	1 U	1 U	1 U	1 U	0.0962 U	1 U	NA	NA	3 U	NA	0.0962 U

Notes:
ID - identification
J - estimated value
µg/L - microgram per liter
NA - not analyzed
U - not detected above reporting limit

Table B-3
Groundwater Analytical Results for Total Petroleum Hydrocarbons and Lead, Chemicals of Potential Concern at Area 303

Location ID	Location Cross Reference	Sample Date	Total Petroleum Hydrocarbons			Total Inorganics
			Diesel-Range Organics (µg/L)	Range Organics (µg/L)	Residual-Range Organics (µg/L)	Lead (µg/L)
12	03-012	10/14/98	200 U	100 U	NA	NA
12	03-012	08/25/99	NA	20 U	NA	NA
12	03-012	11/18/99	NA	20 U	NA	NA
12	03-012	02/14/00	NA	20 U	NA	NA
12	03-012	07/04/00	NA	20 U	NA	NA
12	03-012	09/04/01	100 U	50 U	NA	NA
12	03-012	10/04/01	549 U	90 U	1,100 U	NA
12	03-012	10/01/02	160 U	50 U	280 U	NA
12	03-012	05/23/06	97.1 U	50 U	728 U	1 U
104	03-104	09/03/01	11,500	199 UJ	NA	NA
104	03-104	05/20/06	14,800	116	7,430 U	1 U
105	03-105	05/22/06	21,300 J	194	7,210 U	1 U
107	03-107	01/14/98	3,000	10,000	NA	NA
107	03-107	09/03/01	19,300	10,600	NA	NA
107	03-107	05/24/06	987	13,500 J	750 U	20.1
562	03-562	05/31/97	250 U	100 U	NA	NA
562	03-562	09/04/01	100 U	50 U	NA	NA
562	03-562	05/23/06	96.2 U	50 U	721 U	1 U
895	03-895	08/10/98	190 U	100 U	NA	NA
895	03-895	08/25/99	NA	20 U	NA	NA
895	03-895	11/19/99	NA	20 U	NA	NA
895	03-895	02/21/00	NA	20 U	NA	NA
895	03-895	06/26/00	NA	20 U	NA	NA
895	03-895	10/08/01	568 U	90 U	1,140 U	NA
895	03-895	10/01/02	170 U	50 U	130 J	NA
895	03-895	05/22/06	97.1 U	50 U	728 U	1 U
100	04-100	10/05/03	430	1,600	NA	NA
100	04-100	09/24/04	376	5,300 J	NA	NA

Table B-3 (Continued)
Groundwater Analytical Results for Total Petroleum Hydrocarbons and Lead, Chemicals of Potential Concern at Area 303

Location ID	Location Cross Reference	Sample Date	Total Petroleum Hydrocarbons			Total Inorganics
			Diesel-Range Organics (µg/L)	Range Organics (µg/L)	Residual-Range Organics (µg/L)	Lead (µg/L)
100	04-100	09/20/05	440 J	4,420 J	NA	NA
210	04-210	10/15/96	600	14,000	NA	NA
210	04-210	08/01/02	420	5,000	NA	NA
210	04-210	05/20/06	294	8,090	765 U	3.72
211	04-211	10/15/96	740	5,800	NA	NA
211	04-211	08/01/02	190	2,500	NA	NA
211	04-211	05/20/06	225	4,890 J	765 U	1 U
213	04-213	10/15/96	1,800	8,000	NA	NA
213	04-213	08/01/02	150 J	4,000	NA	NA
213	04-213	05/23/06	123	3,990 J	728 U	16.4
816	GP-303-22	06/10/06	550	28,000	NA	NA
817	GP-303-22A	06/14/06	460	4,800	NA	NA
818	GP-303-22C	06/21/06	2,200	6,800	NA	NA
813	GP-303-23	06/10/06	560	60,000	NA	NA
814	GP-303-23A	06/14/06	1,900	78,000	NA	NA
815	GP-303-23B	06/14/06	400	5,800	NA	NA
812	GP-303-24	06/09/06	250 U	880	NA	NA
819	GP-303-24A	06/14/06	250 U	140	NA	NA
769	HMW-102-10	08/24/93	17,330 J	NA	NA	NA
769	HMW-102-10	05/23/06	330	50 U	728 U	1 U
766	HMW-102-7	08/20/93	250 U	NA	NA	NA
766	HMW-102-7	02/07/97	250 U	100 U	NA	NA
766	HMW-102-7	05/24/06	1,140	50 U	721 U	1 U
767	HMW-102-8	08/20/93	280	NA	NA	NA
767	HMW-102-8	02/07/97	250 U	100 U	NA	NA
767	HMW-102-8	05/26/06	138	50 U	833 U	1 U
581	HMW-303-11	09/06/93	11,300	NA	NA	NA
581	HMW-303-11	05/25/06	4,150 J	1,540 J	4,030 U	1 U

Table B-3 (Continued)
Groundwater Analytical Results for Total Petroleum Hydrocarbons and Lead, Chemicals of Potential Concern at Area 303

Location ID	Location Cross Reference	Sample Date	Total Petroleum Hydrocarbons			Total Inorganics
			Diesel-Range Organics (µg/L)	Range Organics (µg/L)	Residual-Range Organics (µg/L)	Lead (µg/L)
582	HMW-303-12	09/04/93	330	NA	NA	NA
582	HMW-303-12	05/22/06	97.1 U	50 U	728 U	1 U
575	HMW-303-5	05/24/06	21,400 J	575	7,430 U	1 U
576	HMW-303-6	04/29/97	9,900	1,100	NA	NA
576	HMW-303-6	05/19/06	6,460	708	1,530 U	2.27
750	MRP-MW1	02/05/97	18,000	620	NA	NA
750	MRP-MW1	09/03/01	9,790	359 J	NA	NA
750	MRP-MW1	05/22/06	3,490	227	3,640 U	1 U
751	MRP-MW2	11/06/92	8,600	NA	NA	440
751	MRP-MW2	02/05/97	3,200	7,500	NA	NA
751	MRP-MW2	11/05/97	1,400	9,400 J	NA	NA
751	MRP-MW2	09/03/01	2,590 UJ	18,200	NA	NA
751	MRP-MW2	05/24/06	428	6,210 J	735 U	2.15
109	MRP-MW9	11/06/92	820	NA	NA	17
109	MRP-MW9	09/19/96	480	400	NA	NA
109	MRP-MW9	08/01/02	76 J	31 J	NA	NA
109	MRP-MW9	05/19/06	102 U	61.8	765 U	1 U
822	MW-303-22 (B	06/21/06	250 U	100 U	NA	NA
822	MW-303-22 (B	06/27/06	147	50 U	758 U	1 U
823	MW-303-23 (C	06/17/06	250 U	100 U	NA	NA
823	MW-303-23 (C	06/26/06	131	50 U	806 U	1 U
824	MW-303-24 (B	06/17/06	250 U	100	NA	NA
824	MW-303-24 (B	06/26/06	150	160	708 U	1 U
825	MW-303-25	06/09/06	250 U	100 U	NA	NA
825	MW-303-25	06/26/06	209	4,820 J	773 U	1 U
826	MW-303-26	06/23/06	187	545	765 U	1 U
827	MW-303-27	06/27/06	364	27,400 J	798 U	49.4
828	MW-303-28	06/26/06	806	14,900 J	798 U	53.6
829	MW-303-29	06/28/06	220	5,840 J	798 U	1 U

Table B-3 (Continued)
Groundwater Analytical Results for Total Petroleum Hydrocarbons and Lead, Chemicals of Potential Concern at Area 303

Location ID	Location Cross Reference	Sample Date	Total Petroleum Hydrocarbons			Total Inorganics
			Diesel-Range Organics (µg/L)	Range Organics (µg/L)	Residual-Range Organics (µg/L)	Lead (µg/L)
830	MW-303-30	06/28/06	813	36,600 J	833 U	77.6
831	MW-303-31	06/28/06	105 U	17,600 J	789 U	1.85
832	MW-303-32	06/22/06	2,040	608	806 U	1 U
833	MW-303-33	06/11/06	270	110	NA	NA
833	MW-303-33	06/27/06	728	975	781 U	1 U
834	MW-303-34	06/10/06	250 U	720	NA	NA
834	MW-303-34	06/23/06	502	902	765 U	1 U
835	MW-303-35	06/10/06	250 U	100 U	NA	NA
835	MW-303-35	06/23/06	103 U	50 U	773 U	1 U
836	MW-303-36	06/10/06	250 U	100 U	NA	NA
836	MW-303-36	06/23/06	102 U	50 U	765 U	1 U
837	MW-303-37	06/27/06	101 U	50 U	758 U	8.44

Notes:
ID - identification
J - estimated value
µg/L - micrograms per liter
NA - not analyzed
U - not detected above reporting limit