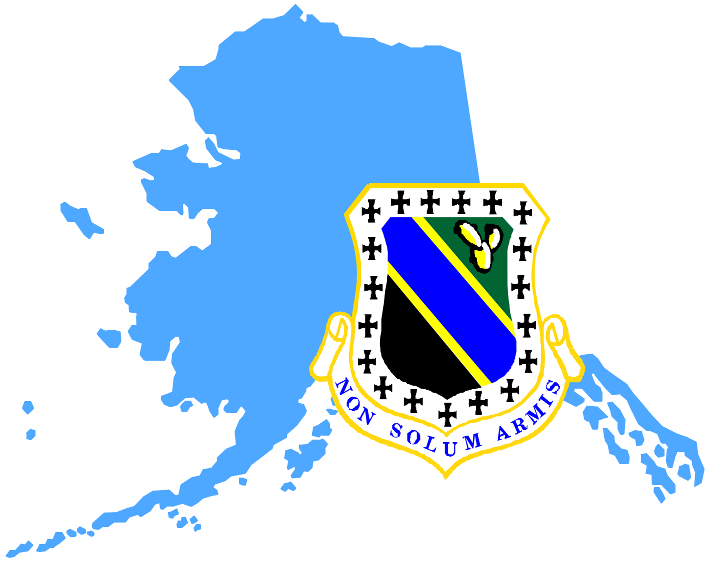

UNITED STATES AIR FORCE
ELMENDORF AIR FORCE BASE, ALASKA

ENVIRONMENTAL RESTORATION PROGRAM

FIVE-YEAR REVIEW

THIRD FIVE-YEAR REVIEW REPORT

FINAL

DECEMBER 2008

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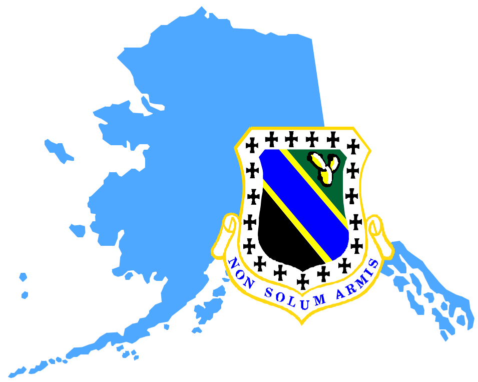

FINAL
FIVE-YEAR REVIEW

Elmendorf Air Force Base

Prepared for:

3rd Civil Engineer Squadron
and
Air Force Center for Engineering and the Environment

December 2008

LEAD AGENCY ACCEPTANCE
THIRD FIVE-YEAR REVIEW
ELMENDORF AIR FORCE BASE

This signature sheet documents the United States Air Force acceptance of the third Five-Year Review for Elmendorf Air Force Base.

RICHARD J. WALBERG
Colonel, United States Air Force
Vice Commander

27 Jan 09
Date

SUPPORT AGENCY ACCEPTANCE
THIRD FIVE-YEAR REVIEW
ELMENDORF AIR FORCE BASE

This signature sheet documents the United States Environmental Protection Agency acceptance of the third Five-Year Review for Elmendorf Air Force Base.

DANIEL D. OPALSKI, Director
Office of Environmental Cleanup
United States Environmental Protection Agency
Region 10

3/17/09
Date

RECEIVED

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SUPPORT AGENCY ACCEPTANCE
THIRD FIVE-YEAR REVIEW
ELMENDORF AIR FORCE BASE

This signature sheet documents the State of Alaska Department of Environmental Conservation's (ADEC's) acceptance of the Third Five-Year Review Report for Elmendorf Air Force Base. As presented in the report, ADEC looks forward to working with Elmendorf and EPA to address chlorinated solvent groundwater plumes associated with the Operable Unit 1 Landfill.

April 3, 2009

Jennifer Roberts, Federal Facilities Program Manager
ADEC Contaminated Sites

Date

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

TABLE OF CONTENTS (Continued)

LIST OF TABLES (Continued)

LIST OF ACRONYMS AND ABBREVIATIONS

µg/L	microgram per liter
AAC	Alaska Administrative Code
ACM	Alaska cleanup matrix
ADEC	Alaska Department of Environmental Conservation
AFB	Air Force Base
amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirement
ARLIS	Alaska Resources Library and Information Service
ARRC	Alaska Railroad Corporation
ATSDR	Agency for Toxic Substance and Disease Registry
BGP	Base General Plan
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CEB	Community Environmental Board
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CES	Civil Engineer Squadron
CFR	Code of Federal Regulations
cis-1,2-DCE	*cis*-1,2-dichloroethene
COC	contaminant of concern
COPC	contaminant of potential concern
1,1-DCE	1,1-dichloroethene
DNAPL	dense nonaqueous-phase liquids
DRO	diesel-range organics
ESD	explanation of significant differences
FFA	Federal Facility Agreement
GRO	gasoline-range organics
HVE	high-vacuum extraction
IRA	Interim Remedial Action
JP-4	Grade 4 Jet Fuel
LUC	land use control
MCL	maximum contaminant level
mg/kg	milligram per kilogram
mg/kg/day	milligram per kilogram per day
MNA	monitored natural attenuation
NCP	National Contingency Plan
NFA	No Further Action
NPL	National Priorities List
O&M	operations and maintenance
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyl

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

PCE	tetrachloroethene
RAO	remedial action objective
RI/FS	remedial investigation and feasibility study
RIPS	Remedial Process Optimization Inventory and Prioritization Software
ROD	record of decision
RPM	Remedial Project Managers
RPO	remedial process optimization
RRO	residual-range organics
SARA	Superfund Amendments and Reauthorization Act
SVE	soil vapor extraction
SWQC	surface water quality criteria
TAH	total aromatic hydrocarbons
TAqH	total aqueous hydrocarbons
TBC	“to-be-considereds”
TCE	trichloroethene
TFH	total fuel hydrocarbons
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
UST	underground storage tank
UU/UE	unlimited use and unrestricted exposure
VOC	volatile organic compound
WGI	Wing Instruction
WRS	wetland remediation system

EXECUTIVE SUMMARY

The purpose of this five-year review is to evaluate the implementation and performance of the remedial actions that were selected in the record of decision (ROD) for each operable unit (OU) at Elmendorf Air Force Base (AFB). The contaminant sources at Elmendorf AFB, Alaska are grouped into six areas including OUl, OU2, OU4, OU5, OU6, and DP98. The remedies vary by site and have included contaminated soil and debris removal; institutional controls also known as land use controls (LUCs); monitoring and natural attenuation of contaminated groundwater; and operation and monitoring of several active remediation systems such as high-vacuum extraction (HVE), a constructed wetland treatment cell, and in-situ bioventing. This is the third review for Elmendorf AFB. The trigger for this review was the date the Air Force signed the second five-year review report, which was December 17, 2003.

The Five-Year Review Summary Form on the following pages presents the issues that were identified during the review, associated recommendations and follow-up actions, and protectiveness statements for each area.

The assessment of this five-year review found that the remedies were constructed and, in general, are operating and functioning as intended by decision documents. For the source areas within OU1, OU2, OU4, OU5, and OU6 that have not met groundwater cleanup levels, the remedies are expected to be protective of human health and the environment upon attainment of groundwater cleanup levels through natural attenuation. At OU2, OU4, OU5, and OU6, it is expected to take longer to achieve these goals than predicted in the RODs. In the interim, exposure pathways that could result in unacceptable risks are being controlled with LUCs.

This is the first five-year review for DP98. The remedy at DP98 is expected to be protective of human health and the environment upon attainment of groundwater cleanup levels through natural attenuation. In the interim, exposure pathways that could result in unacceptable risks are being controlled with LUCs.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name: Elmendorf Air Force Base		
EPA ID: AK8570028649		
Region: X	**State:** Alaska	**City/County:** Anchorage
SITE STATUS		
NPL status: Currently on the Final NPL		
Remediation status Operating		
Multiple OUs?* YES	**Construction completion date:** May 2012	
Has site been put into reuse? NO (some areas are being used)		
REVIEW STATUS		
Lead agency: U.S. Air Force		
Author name: 3rd Civil Engineer Squadron, Asset Management Flight, Natural Resources Management Element, Cleanup Section		
Author title:	**Author affiliation:**	
Review period: December 2007 to December 2008		
Date(s) of site inspection: May 2008		
Type of review: Post-SARA		
Review number: 3 (third)		
Triggering action: Previous Five-Year Review Report		
Triggering action date: 17 December 2003		
Due date *(five years after triggering action date)*: 17 December 2008		

* ["OU" refers to operable unit.]

** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd.

Issues (refer to the next section/page for associated recommendations and follow-up actions):

1. The trichloroethene (TCE) plume at Operable Unit (OU) 1 LF59 appears to be originating, at least in part, from the upgradient OU1 landfills. There are insufficient data to determine the impact to long-term groundwater quality and the estimated cleanup date at LF59.

2. The OU2 surface water point of compliance (SW-13) in the center of the wetland area was not monitored between 2003 and 2007 due to confusion over its location. The location of point of compliance was re-established and surface water was sampled in 2008. The 2008 results demonstrate that surface water contaminants attenuate between contaminated seep ST41-SP01 and the surface water point of compliance. Annual sampling is needed to demonstrate protectiveness.

3. The cleanup levels for 1,2-dichloroethane, tetrachloroethene (PCE), and TCE for FT23 groundwater, and diesel- and gasoline-range organics (DRO and GRO) for SD24 and SD25 soil, as presented in OU4 record of decision (ROD), are inconsistent with their referenced standards. The cleanup levels for 1,2-dichloroethane, PCE, and TCE at FT23 are listed as 6 μg/L instead of the maximum contaminant level (MCL) standard of 5 μg/L. The cleanup levels identified for DRO and GRO at SD24 and SD25 are 1,000 and 2,000 milligrams per kilogram (mg/kg) respectively, which is the reverse of their referenced Alaska Cleanup Matrix Level D standard. These inconsistencies appear to be typographical errors because there is no discussion in the ROD about deviation from the referenced standards.

4. The downgradient extent of the OU5 Fairchild Avenue plume is delineated at the water table but not in wells screened deeper in the shallow aquifer. TCE has not been detected in downgradient seeps, downgradient early warning/sentry wells, or in Ship Creek, but was detected in a downgradient Alaska Railroad Corporation (ARRC) well in 2002.

5. In 2005 and 2006, the TCE concentration in OU5 Seep 7 increased to just above the cleanup level. The decision guide for restarting an existing seep collection area or adding a new seep collection area for treatment (Attachment F, Figure F-4) indicates that the response for this seep should be quarterly monitoring.

6. Monitoring shows that the natural attenuation remedies are generally decreasing contaminants of concern (COC) concentrations. At several sites in OU2, OU4, OU5, and OU6, the process is slower than anticipated in the ROD. For most of the affected sites, the slower attenuation rates are limited to a few individual wells or just a few additional years until cleanup goals are met. The slower rates of natural attenuation have the largest impact at OU5, where natural attenuation may take several additional decades to reach cleanup levels. OU5 has a large monitoring program and a relatively expensive treatment system for contaminants discharging at seeps, so the impact on cleanup costs could be significant. In the interim, land use controls (LUCs) are in place to ensure protectiveness.

Five-Year Review Summary Form, cont'd.

Recommendations and Follow-up Actions (item #s refer to issue #s in previous section):

1. At OU1 LF59, incorporate data from upgradient wells LF05GW-2B and OU1LF-19 into evaluation of natural attenuation and analysis of contaminant trends, and update the conceptual site model for the TCE plume at LF59.

2. Monitor the OU2 ST41 surface water point of compliance (SW-13) annually and seep ST41-SP01 every five years to assess the natural attenuation remedy for OU2 surface water. Document these updates to the OU2 monitoring program in a memorandum to the site file.

3. Update the ROD-specified cleanup levels for 1,2-dichloroethane, PCE, and TCE for OU4 FT23 groundwater, and DRO and GRO for SD24 and SD25 groundwater, so that they are consistent with their referenced standards. Document the updated cleanup levels in a memorandum to the site file.

4. Define the downgradient limit of the OU5 Fairchild Avenue plume in the deeper portions of the shallow aquifer.

5. Increase the monitoring frequency for OU5 Seep 7 to quarterly in accordance with the decision guide in the 2005 OU5 memorandum to the site file.

6. Continue monitoring until cleanup levels are met. Continue to use trend analysis to evaluate the natural attenuation remedies. Adjust estimated dates for achieving groundwater cleanup in accordance with trend projections. For OU5, attempt to identify sources of TCE contamination for Fairchild Avenue, OU5MW-02, SP1-02, Kenney Avenue, and Slammer Avenue plumes. If sources can be identified, evaluate alternative remedial strategies to accelerate attainment of the TCE cleanup level in OU5 groundwater. LUCs shall remain in place to ensure protectiveness until cleanup goals are met.

In addition to the recommendations that respond to issues cited above, several recommendations are included to optimize the remedy and/or minimize unnecessary costs. These include the following:

- Incorporate wells ST41-28 (North Plume) and ST41-16 (South Plume) back into the monitoring program for OU2 when free product is no longer present in these wells. These wells have historically had some of the highest COC concentrations and are important for trend analysis estimates for meeting cleanup levels. Reduce sampling frequency or eliminate well ST41-07 because cleanup levels appear to be met at this location. Document sampling frequency of seeps (every 5-years) versus surface water point of compliance (annually) in a memo to site file. Document changes to sampling program in a memorandum to the site file.

Five-Year Review Summary Form, cont'd.

Recommendations and Follow-up Actions cont'd:

- Conduct soil sampling for OU4 FT23 in 2010 or earlier. If soil meets cleanup levels, prepare memorandum to the site file, shut down the bioventing system and remove bioventing components.

- At OU4 SD24 and SD29, increase monitoring frequency of wells OU4MW-04 and IS6-01 to annually to document attainment of cleanup levels and expedite closure of these sites.

- Prepare a Site Closure report documenting that groundwater meets cleanup levels at OU4 SD28 and recommend no further action (NFA) for this site.

- At OU5, resample well OU3MW-25 (OU3MW-25 plume) to confirm that TCE concentration remains below the cleanup level. If confirmed, prepare memorandum to the site file to document that sampling for this plume should be discontinued.

- At OU5, optimize early warning and sentry monitoring well networks to eliminate wells that are not downgradient of plumes and consider additional wells where there is a greater probability of contaminant migration.

- At OU5, high operations and maintenance costs for the wetland remediation system (WRS) are attributed primarily to the moving parts (pumping systems). Evaluate the feasibility of shutting down pump stations. Pump station 2 can be mothballed in accordance with the decision guide for shutting down pumping stations because Seep 3 has met cleanup levels for the past five years. Seep 1 may be diverted from Pump Station 1 since it has also met cleanup levels for the past five years. This would leave only Seep 2 discharging to Pump Station 1, which would then only have to operate at a fraction of its current flow rate. These alternatives, if determined to be feasible, could be implemented through a memorandum to the site file.

Five-Year Review Summary Form, cont'd.

Recommendations and Follow-up Actions cont'd:

- At OU5, evaluate the feasibility of alternatives to the WRS for treating contaminated seeps. The WRS was designed to treat petroleum contaminants. Although it is also effective at treating the current TCE contamination, it is not very efficient. Seep 2 is collected in a lined, gravel-filled drain, and most of the contaminants at the seep appear to volatilize or biodegrade as water flows from the seep to Pump Station 1. The magnitude of the dilution effect at mixing clean water from Seep 1 with contaminated water from Seep 2 is unknown. If contaminant treatment in the lined drain can be confirmed, similarly constructed lined drains may be able to treat contaminants in other seeps (Seeps 7, 9, 10, and 11) in a passive (i.e., no pumping) treatment system with a much smaller footprint than the current WRS. This alternative, if feasible, would likely require an explanation of significant differences (ESD) or ROD amendment to be implemented.

- Sample LF02 groundwater for all contaminants of potential concern (COPCs) for one sample round. If LF02 groundwater meets all cleanup levels, prepare a site closure report to document response complete for LF02.

- Conduct groundwater monitoring and evaluations in the context of LF04 South requirements of the OU6 ROD. Sample well OU6MW-61 to determine if OU6 LF04 South groundwater meets cleanup levels for chlorinated solvent COCs.

- Incorporate well OU6MW-77 back into the monitoring program for OU6 WP14 once free product is no longer present in the well. This well has historically had some of the highest COC concentrations and is important for trend analysis estimates for meeting cleanup levels.

- Increase the sampling frequency of well 41755WL-08, located in the smaller COC plume, to twice annually. The DP98 ROD requires this frequency of monitoring if wells are upgradient of a receptor and COC concentrations are increasing. Sample surface water in the vicinity of Well 41755WL-08 concurrently with groundwater samples.

- For DP98, prepare a Remedial Action report now that all components of the remedy are implemented.

- For OU1, OU2, OU4 and OU5, update the documentation of LUC implementation in a memorandum to the site file to comply with Air Force policy.

Five-Year Review Summary Form, cont'd.

Protectiveness Statements:

The remedy at OU1 is expected to be protective of human health and the environment upon attainment of groundwater cleanup levels at one remaining site (LF59). In the interim, exposure pathways that could result in unacceptable risks are being controlled.

The remedy at OU2 is expected to be protective of human health and the environment upon attainment of groundwater cleanup levels, through natural attenuation, at ST41. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

The remedy at OU4 is expected to be protective of human health and the environment upon attainment of deep soil cleanup levels through bioventing at one remaining site (FT23) and attainment of groundwater cleanup levels through natural attenuation at sites FT23, SD24, SD25 and SD29. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

- The remedy at site SD28 is protective of human health and the environment. Groundwater samples from the time of the ROD show that no contamination above background levels/regulatory cleanup levels remains and the site is acceptable for unlimited use and unrestricted exposure.

The remedy at OU5 is expected to be protective of human health and the environment upon attainment of groundwater and seep cleanup levels through natural attenuation, capture and treatment of contaminated seeps, and confirmation through sentry and early warning well monitoring networks that the point of compliance at Ship Creek is not impacted by OU5 contaminants. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

The remedy at OU6 is expected to be protective of human heath and the environment for all sites. The remedy at LF04 North is expected to be protective of human health and the environment through the annual removal of exposed landfill debris. The remedies at LF04 South, WP14 and SD15 are expected to be protective of human health and the environment upon attainment of groundwater cleanup goals through natural attenuation. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

The remedy at DP98 is expected to be protective of human health and the environment upon completion. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

SECTION 1.0

INTRODUCTION

1.1 PURPOSE

The purposes of this five-year review are to evaluate the implementation and performance of the remedial actions that were selected in each record of decision (ROD) for Operable Unit (OU) 1, OU2, OU4, OU5, OU6 and DP98 at Elmendorf Air Force Base (AFB), Alaska and to determine whether these actions are protective of human health and the environment. A location map for these areas is provided as Figure A-1 of Attachment A. The methods, findings, and conclusions of reviews are documented in Five-Year Reviews. Five-year reviews identify issues found during the review, if any, and provide recommendations to address them. This five-year review covers activities and conditions since the previous five-year review for Elmendorf AFB, which was conducted in 2003.

This is the third five-year review for Elmendorf AFB. This review is a post-Superfund Amendments and Reauthorization Act (SARA) United States Environmental Protection Agency (USEPA) policy review that is required because contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure (UU/UE). The start of construction of the OU2 Interim Remedial Action (IRA) on August 5, 1993 triggered the first five-year review requirement, which was completed and signed by the United States Air Force (USAF) representative on October 20, 1998 (USAF, 1998i). The second five-year review was completed and signed by the USAF representative on December 17, 2003 (USAF, 2003j), which serves as the trigger date for this five-year review.

The USAF 3rd Civil Engineer Squadron (CES) has conducted this policy five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9621(c), the National Contingency Plan (NCP), Executive Order 12580 (January 23, 1987), and Section 19.1 of the Federal Facility Agreement (FFA) for Elmendorf AFB dated September 1991. CERCLA §121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The USEPA interpreted this requirement further in the NCP; 40 Code of Federal Regulations (CFR) § 300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

Section 19.1 of the FFA for Elmendorf AFB states:

> *If a remedial action is selected that results in any hazardous substances, pollutants, or contaminants remaining at the Site, the Parties shall review such remedial action no less often than each five (5) years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. The U.S. EPA Project Manager and the ADEC Project Manager shall advise the USAF Project Manager of their findings in this regard. If any Party determines that additional action is required, the Agreement may be amended pursuant to Part XXXIII.*

USAF guidance on Five-Year reviews is not yet available and therefore this document is consistent with the USEPA Office of Solid Waste and Emergency Response (OSWER), Comprehensive Five-Year Review Guidance, No. 9355.7-03B-P (USEPA, 2001). Consistent with the FFA, the project managers for the USEPA and the State of Alaska Department of Environmental Conservation (ADEC) have participated in this review. This review is limited to only those sites being remediated under CERCLA authority and includes OU1, OU2, OU4, OU5, OU6, and DP98. A brief description of OU3 and SA100 are included in Table 1-1, but these areas are not covered in depth because contaminants are below cleanup levels and the sites are closed, as documented in the 1998 and 2003 five-year review reports (USAF, 1998i and 2003j). These areas were not included in this five-year review because there are no remedies to evaluate. SS22 was also not evaluated in this five-year review because it is still in the investigation phase, and risks have not yet been assessed and remedies have not yet been selected. Two other areas, SS83 and SA99, were also mentioned in the 2003 five-year review, but these sites were subsequently removed from CERCLA and addressed under state programs due to the nature of contaminants. Therefore, SS83 and SA99 are not required to be evaluated under this five-year review.

1.2 OVERVIEW

This five-year review was conducted between December 2007 and December 2008 by the project team consisting of the USAF Remedial Project Managers (RPMs) with contracted environmental engineering support. This effort included a review and evaluation of the ROD requirements and any decisions, changes and/or recommendations that were put in place after the ROD was signed, the work that has been done to satisfy those requirements, current and past monitoring data, and the current status of the remedies and the physical condition of the sites. Visits were made to each open CERCLA site where an action has been performed or is still in progress. This review addresses only active sites. Some of the OUs include sites designated as no further action (NFA) at the time the ROD was signed, or have since met cleanup requirements. NFA and closed sites within active OUs were not included in this review. Land use controls (LUCs), discussed in detail in Section 4.7, are maintained at each active site until it is demonstrated that site contaminant concentrations are at or below levels that allow for UU/UE.

Note that the USAF term *LUCs* is equivalent to the term *institutional controls* used in several of the RODs. Following written regulatory concurrence, where applicable, that all response actions are complete (i.e., cleanup levels have been met, no LUCs are in effect, and no additional funds will be expensed), the USAF considers a site "closed." A brief description and status of all OUs or active sites at Elmendorf AFB is presented in Table 1-1.

Table 1-1
Operable Units Status, Elmendorf Air Force Base

OU	Sites	Included in this review?	Description	Status
OU1	LF05 (NFA), LF07 (NFA), LF13 (NFA), OT56 (NFA), and LF59	Yes	OU1 consists of five general waste disposal areas where various types of material were disposed. The ROD (1994) focused on groundwater monitoring and LUCs. A memorandum to the site file in 1997 provided greater detail on implementation of LUCs. NFA pursuant to formal closure was achieved for LF05, LF07, LF13 and OT56 in July 2004.	Groundwater monitoring and LUCs are ongoing at LF59.
OU2	ST20 (NFA), and ST41	Yes	OU2 includes two former underground storage tank (UST) sites: ST20 and ST41. The tank at ST20 was cleaned and demolished in 1990. An interim ROD (1992) for the groundwater contamination at ST41 resulted in the installation of a free product and dissolved phase recovery treatment system in 1993. The ROD (1995) designated ST20 as NFA and focused on ST41. Four USTs and wood piping were cleaned and buried in place, the tanks were filled with inert material in 1996 and the contaminated soil was treated on base. The steel piping was removed, decontaminated, and recycled.	The treatment system performed as designed. Beginning in February 1997, no recoverable quantities of fuel product were observed and the system was shut down in April 1999. Long-term groundwater and surface water monitoring is ongoing.

Table 1-1 (Continued)
Operable Units Status, Elmendorf Air Force Base

OU	Sites	Included in this review?	Description	Status
OU3	SD16 (NFA), SS21 (NFA), SD31 (NFA), and SD52 (NFA)	No	OU3 consisted of three sources and one receptor area. Polychlorinated biphenyl (PCB)-contaminated soils were excavated and disposed in 1998. The 1998 five-year review reported confirmation samples were below ROD-defined cleanup levels, allowing UU/UE.	Not included in this five-year review because this OU has been closed. The 1998 five-year review documented that cleanup levels have been met.
OU4	SS10 (NFA), SS18 (NFA), FT23, SD24, SD25, SD26 (NFA), SD27 (NFA), SD28, SD29, and SD30 (NFA)	Yes	OU4 consists of 10 source areas including maintenance facilities, a fire training area, and an asphalt drum storage/processing area. During 1993 and 1994, asphalt and asphalt-containing soils at SS10 were removed. The ROD focused on monitoring to assess contaminant migration and natural attenuation progress and LUCs to attain cleanup levels in shallow groundwater, and shallow soils and in-situ bioventing to treat deep soils. Soils are monitored to evaluate migration and timely reduction of contaminants by the remedy. A memorandum to the site file established a decision guide for monitoring well sampling frequency in 2003. At SS10, cleanup goals were met, the bioventing system was shut down and the site was closed in 2006.	LUCs (at all active sites), groundwater monitoring and natural attenuation (FT23, SD24, SD25, and SD29), and bioventing (FT23) efforts are ongoing. Deep soil sampling is conducted at the remaining bioventing site (FT23) as required in preparation for closure. Cleanup levels have been met for shallow soils at all OU4 sites.
OU5	ST37, ST38 (NFA), SD40 (NFA), SS42 (NFA), ST46 (NFA) and SS53 (NFA)	Yes	OU5 is located along the southern boundary of the base, and upgradient shallow groundwater that migrates to this area is treated in OU5. The 1995 ROD called for removal and treatment of soil at ST37; natural attenuation and monitoring to estimate rate of natural attenuation	WRS was constructed in 1996. Contaminated soils from ST37 were removed and treated by 1999. Natural attenuation and monitoring, operations and maintenance (O&M)

Table 1-1 (Continued)
Operable Units Status, Elmendorf Air Force Base

OU	Sites	Included in this review?	Description	Status
			of shallow aquifer, seep, and surface water; passive drainage of seep water to a constructed wetland remediation system (WRS); gravel placed at seep areas; and LUCs prohibiting groundwater usage. A memorandum to the site file established a decision guide for monitoring well sampling frequency in 2003. A memorandum to the site file in 2005 incorporated additional contaminated seeps into the WRS for treatment, and established decision guides that establish how seeps will be incorporated into or removed from the WRS in the future based on contaminant concentrations.	of the WRS, and LUCs are ongoing.
OU6	LF02, LF03, LF04, SS19 (NFA), WP14, SD15, and SD73 (NFA)	Yes	OU6 consists of six source areas. Another source area, SS19, was included in the OU6 ROD and cleaned up in 1995. The 1997 ROD designated SS19 and SD73 as NFA and selected remedies for the remaining sites included groundwater monitoring at LF02, LF04 South, WP14 and SD15, removal of free product from the water table at LF04 and WP14, debris removal at LF04, groundwater treatment at SD15, surface debris removal and limited soil cover at LF02, and LUCs at all active sites. A memorandum to the site file established a decision guide for monitoring well sampling frequency in 2003. An explanation of significant differences (ESD) in 2007 established that the SD15 high vacuum extraction (HVE) system	LF02 surface debris removal and limited soil cover placement have been completed. The SD15 HVE treatment system removed all recoverable contaminants and was shut down in 2007, and the groundwater remedy transitioned to MNA. Free-product removal at LF04 South and WP14 monitoring wells is essentially complete since no recoverable free product has been detected since 2005. Groundwater monitoring at LF02, LF04 South, WP14, and SD15; LF04 debris removal; and

Table 1-1 (Continued)
Operable Units Status, Elmendorf Air Force Base

OU	Sites	Included in this review?	Description	Status
			could be terminated when operations became ineffective, and established monitored natural attenuation (MNA) as the remedy for contaminated groundwater. The ESD also updated the cleanup level for 1,1,2,2-tetrachloroethane and clarified implementation of LUCs.	LUCs are ongoing. Groundwater meets cleanup levels at LF02.
NA	SS22	No	SS22 is located one mile east of the east/west runway at the Defense Reutilization and Marketing Office storage facility. This 22-acre site was closed with a no further remedial action plan in 1991 but was reopened when two tar seeps were discovered in 2002. The tar seeps were cleaned up and subsequent geophysical investigations indicated 15 subsurface anomalies. Site reconnaissance revealed a debris pile and a stressed vegetation area. The anomalies, debris pile, stressed vegetation area, and underlying groundwater have undergone field screening and will be sampled for definitive analyses through 2009. A remedial investigation/feasibility study (RI/FS) report is scheduled for completion in 2010.	Not included in this five-year review because it is in the investigative stage. Investigations began in 2007 and a ROD is anticipated in 2011.
NA	SS83	No	SS83 is a World War II-vintage anti-aircraft artillery site (Battery D, 96th Antiaircraft Artillery) located near Six-Mile Creek on the northwest side of the base, adjacent to Knik Arm. This area is uninhabited, vegetated, and restricted.	Since the 2003 five-year review, this site was transferred from CERCLA to a state program due to the nature of the contaminants. This site will not be included in subsequent five-year reviews because it is no

Table 1-1 (Continued)
Operable Units Status, Elmendorf Air Force Base

OU	Sites	Included in this review?	Description	Status
				longer part of the CERCLA program.
NA	DP98	Yes	DP98 consists of a single source area. The 2004 ROD selected limited source removal of chlorinated contaminants in soils, offsite treatment and disposal, MNA, and LUCs as remedies for DP98. The MNA component consists of: 1) natural attenuation of contaminants in groundwater, soil, and sediment; 2) a treatability study to determine the effectiveness of the natural attenuation at/around the 190-foot topographic contour; and 3) an evaluation/compilation of groundwater data collected during the first five years of monitoring.	The limited source removal was completed in 2005. MNA and LUCs are ongoing. The treatability study was initiated in 2005 and was completed in September 2006. The evaluation and compilation of groundwater data was completed in October 2008.
NA	SA99	No	SA99 is a former drum dump located on the north side of Airlifter Drive, across from Hangar 18. Drums were discovered during the replacement of aboveground storage tanks in 1998.	Since the 2003 five-year review, this site was transferred from CERCLA to a state program due to the nature of the contaminants. This site will not be included in subsequent five-year reviews because it is no longer part of the CERCLA program.
NA	SA100 (NFA)	No	SA100 is a rubble debris dump that was discovered during construction of new housing in 2001. Suspect contaminated soils resulted in the site being designated under CERCLA. Contaminated soils were excavated from the site and confirmation samples were within acceptable limits. A closure	This site has been closed. SA100 will not be included in subsequent five-year reviews because no contaminants remain at the site above levels that would prevent UU/UE.

Table 1-1 (Continued)
Operable Units Status, Elmendorf Air Force Base

OU	Sites	Included in this review?	Description	Status
			decision document was signed in May 2002.	

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; ESD = Explanation of Significant Differences; HVE = high-vacuum extraction; LUC = land use control; MNA = monitored natural attenuation; NFA = No Further Action; O&M = operations and maintenance; OU = operable unit, PCB = polychlorinated biphenyl; RI/FS = Remedial Investigation/Feasibility Study; ROD = record of decision; UST = underground storage tank; UU/UE = unlimited use and unrestricted exposure; WRS = wetland remediation system

SECTION 2.0

SITE CHRONOLOGY

Important site events and relevant dates in the site chronology for each site covered in this five-year review are shown in Table 2-1.

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Table 2-1
Chronology of Site Events, Elmendorf Air Force Base

Event	OU1	OU2	OU4	OU5	OU6	DP98	SS22
Initial discovery of contamination and/or Preliminary Assessment[a] (sites in parentheses)	• 1983 (LF05, LF07, LF13) • 1990 (OT56) • 1991 (LF59)	• 1982 (ST41) • 1986 (ST20)	• 1983 (FT23, SD24, SD25, SD26, SD27, SD28, SD29, SD30) • 1988 (SS10, SS18)	• 1983 (ST37, ST38, SS42, SD40, ST46) • 1988 (SS53)	• 1983 (LF03, LF04, WP14, SD15) • 1988 (LF02) • 1993 (SD73)	1995	1988
Site Investigations	1986, 1988, 1990	1986, 1988, 1990	1986, 1990	1990	1988, 1990, 1993	1996, 1997, 1998, 1999	1988, 2002
National Priorities List (NPL)	August 1990: Elmendorf Air Force Base was placed on the NPL list.						
FFA Signature	November 1991: FFA negotiated between Elmendorf, USEPA and ADEC.						
Removal Actions (sites in parentheses)	1995-96 (LF59)	1990 (ST20)	1993-94 (SS10)	--	1995 (SS19)	--	--
IRA ROD	--	December 1992	--	--	--	--	--
RI/FS Completed	January 1994	March 1994	September 1994	March 1994	December 1995	June 2003	--
ROD Signed	September 1994	May 1995	October 1995	February 1995	January 1997	June 2004	--
NFA Decision Documents (sites in parentheses)	--	1995 (ST20)	1993 (SD26, SD27, SD30, SS18)	1994 (ST38, SS42, SD40, ST46, SS53)	1997 (SS19, SD73)	--	October 1991[b] (site reopened in 2002)
Remedial Design/Remedial Action Scope of Work	May 1995	June 1995	October 1995	February 1996	April 1997	November 2004	--
Remedial Design Complete	--	November 1995	September 1995	January 1996	September 1996	--	--
LUCs Implemented	March 1994	• March 1995	June 1998	July 1998	August 1998	• May 2002	--
Remedial Action Start	May 1995	• September 1993: IRA • July 1996: Tank Closure	November 1995	June 1996	June 1996	• June 2004: Groundwater MNA • 2005: Removal Action and Treatability Study	--
Construction Dates (start – finish)	August 1995 – November 1996	1993 (IRA), May – October 1996 (tank closure)	October – November 1995	June 1996-1997	October – November 1996	June 2004 – October 2008	--
ROD Amendments, ESDs, or Memoranda to the Site File	June 1997	--	September 2003	September 2003, March 2005	September 2003, March 2007, May 2008	--	--
Closure Reports	2004 (LF05, LF07, LF13, OT56)	--	2006 (SS10)	--	--	--	--
Previous Five-Year Reviews	1998, 2003	1998, 2003	1998, 2003	1998, 2003	1998, 2003	--	--
NPL Site Completion data	*May 2012 – Expected NPL Completion Date for Elmendorf Air Force Base*						
Final Close-Out Report	*October 2079 – Expected date for final Close-Out Report for Elmendorf Air Force Base*						
Deletion from NPL	*October 2080 – Expected date for Elmendorf Air Force Base to be taken off NPL List.*						

[a]The Preliminary Assessment was a records search conducted as part of the USAF Installation Restoration Program.
[b]As documented in *Elmendorf Air Force Base, Alaska, Installation Restoration Program Site Summary*, October 1991.
ADEC = Alaska Department of Environmental Conservation; ESD = explanation of significant differences; FFA = federal facilities agreement; IRA = interim remedial action; MNA = monitored natural attenuation; LUC = land use control; NFA = No Further Action; NPL = National Priorities List; OU = operable unit; RI/FS = Remedial Investigation/Feasibility Study; ROD = record of decision; USEPA = United States Environmental Protection Agency

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SECTION 3.0

BACKGROUND

3.1 ELMENDORF AIR FORCE BASE LAND USE AND SITE DESCRIPTION

3.1.1 Land Use

Elmendorf AFB is composed of 13,804 acres and is within the Municipality of Anchorage, Alaska. It is bound on the west and north by the Knik Arm of Cook Inlet and on the east by Fort Richardson Army Installation (see Figure A-1, Attachment A). Immediately to the south of Elmendorf AFB lies urban development within the Municipality of Anchorage. Land use varies across the base and consists of military support uses including industrial, commercial, residential, recreational, and undisturbed/vacant. The vast majority of the contaminated sites are located in or adjacent to industrial/commercial areas. Land use in adjacent, off-base locations is a mixture of industrial and residential. Two residential areas (Mountain View and Government Hill) are immediately adjacent to Elmendorf AFB. No CERCLA sites are located in the immediate vicinity of these areas.

Past, current, and anticipated future specific land uses at the active CERCLA sites have not changed since the time of the ROD, and are summarized in Table 3-1.

Table 3-1
Site Specific Land Use

OU (Site)	Land Use in ROD	Current Land Use[1]	Long-Term Planning[2]
1 (LF59)	Outdoor recreation.	Open space and buffer zone. LF59 is a restricted use area[3].	No development planned.
2 (ST41)	Outdoor recreational and unmanned industrial use only, excluding the development of commercial aquaculture	Listed as manufacturing and production, but land is currently vacant and used for outdoor recreation.	No development planned.
4 (FT23, SD24, SD25, SD28, SD29)	Light industrial, aircraft operations and maintenance, and airfield.	Airfield use area, aerospace maintenance.	Development plans are for continued airfield uses, similar to current uses.

Table 3-1 (Continued)
Site Specific Land Use

OU (Site)	Land Use in ROD	Current Land Use[1]	Long-Term Planning[2]
5 (ST37)	Primarily light industrial, but also includes residential, open space, railroad right-of-way, Post Road, picnic area and golf course, and fish hatchery.	Primarily light industrial, but also includes residential, open space, railroad right-of-way, Post Road, picnic area and golf course, and fish hatchery	Industrial warehouses, office/administrative, residential, and Air National Guard uses, similar to current land uses.
6 (LF02, LF03, LF04, SD15, WP14)	Open space, outdoor recreation, and "restricted" use.	Open space and buffer zone. LF02, LF03, and LF04 are restricted use areas[3].	No development planned.
(DP98)	Administrative, open space, outdoor recreation, and industrial.	Administrative, open space, and buffer zone.	No development planned.

[1] Based on current land use in *Base General Plan* and 3rd Wing Instruction 32-7003.
[2] Based on 50-year vision in *Base General Plan*.
[3] Restricted use areas provide for recreational use and construction of unmanned facilities such as parking lot, storage building or taxiway, but prohibit construction of any sort of manned facility such as an office building or a residence.
OU = operable unit; ROD = record of decision

The Port of Anchorage expanded its facilities in 2007 and 2008 just outside of the Elmendorf AFB OU6 LF04 boundary. The beach below LF04 was covered with fill material. The expanded port facilities are outside of the Elmendorf AFB LF04 boundary. The expanded port facilities are not anticipated to impact implementation of the LF04 remedies, nor result in increased exposure to contaminants. Fill material for the Port expansion project was quarried from the Cherry Hill borrow pit, located to the south of and outside the LF04 North soil LUC boundary, LF04 South and WP14. The borrow pit area was designated in the *Base General Plan* as “open space.” Prior to quarrying operations, extensive soil borings were made to define the groundwater table at the Cherry Hill borrow pit. Quarrying was conducted to avoid contact with groundwater by leaving a five-foot buffer zone between the bottom of the excavation and the shallow aquifer groundwater table. Borrow pit activities did not result in a significant change in land use or any increased exposure to contaminants. The areas of the Port expansion project and Cherry Hill borrow pit relative to LF04 and WP14 are illustrated in Attachment A, Figure A-3.

3.1.2 Geology

Glacial and related deposits including terminal moraines, ground moraines, and glacial outwash plains are the dominant regional landforms on Elmendorf AFB and in the surrounding area. The most distinctive landform at Elmendorf AFB is the Elmendorf Moraine, a southwest-northeast trending terminal moraine. The moraine consists of horizontally and vertically discontinuous, unconsolidated glacial till with poorly sorted boulders, gravel, sand and silt deposits. Clay lens deposits are found throughout the moraine and may result in zones of perched groundwater. The southern boundary of the moraine is visible as a rising bluff line along the north side of Elmendorf's east-west runway. Moraine elevations range from 200 to 300 feet above mean sea level (amsl).

Landform features formed by glacial activity can be seen north of the Elmendorf Moraine in the form of drumlins, eskers, kame terraces, and kettle lakes. Elevations in this area range from 125 to 210 feet and gently slope to the east.

South of the Elmendorf Moraine lies the glacial outwash plain alluvium. The alluvium deposits were formed by a series of coalescing streams resulting from glacial melt water. These outwash plain deposits consist of unconsolidated fine- to medium-grained, poorly sorted sand and gravel. Elevations range from 100 to 225 feet amsl. Relief is generally flat and gently sloping to the south-southwest. Most of the developed areas on Elmendorf AFB are built on the outwash plain alluvium and over 90 percent of the contaminated sites are located in this area.

Underlying glacial moraine and outwash deposits are shallow marine deposits of the Bootlegger Cove formation. The Bootlegger Cove formation is a fine-grained glacioestuarine deposit consisting of silt and clay. Depth to the Bootlegger Cove formation ranges from 1 to 60 feet below ground surface (bgs) near the moraine and from 75 to 100 feet bgs throughout the outwash plain. Overall, the Bootlegger Cove formation is estimated to be at least 125 feet thick and may be more than 250 feet thick in some locations.

3.1.3 Groundwater

Two principal groundwater aquifers have been identified in the glacial outwash plain alluvium and on the Elmendorf Moraine. These aquifers include a shallow unconfined aquifer (shallow aquifer), and a deeper confined regional aquifer. The Bootlegger Cove formation acts as the confining layer between the shallow and deep aquifers. In general, groundwater flow direction in the shallow aquifer matches closely that of the surface topography. Groundwater flow is to the northwest along the north limb of the moraine, and to the southeast along the south limb. A local groundwater divide coincides with the crest of the moraine. The shallow aquifer on Elmendorf AFB is not used for drinking water.

The deeper confined aquifer is a regional aquifer that underlies all of Elmendorf AFB. Groundwater flow direction to the confined aquifer is westerly from the Chugach Mountains toward Knik Arm. Groundwater from the deeper confined aquifer at Elmendorf AFB serves only as a standby drinking water supply when surface water supplies cannot meet the demand. However, the municipal area bordering the Elmendorf AFB uses groundwater for various services including industrial, commercial, domestic, and public supply.

Groundwater monitoring data show that there is contamination in portions of the shallow aquifer on-site. There is no evidence that contaminant releases from Elmendorf AFB have impacted the deeper, confined aquifer. Groundwater samples were collected from four wells in the deeper confined aquifer during the OU5 remedial investigation (USAF, 1994g). The four wells were Elmendorf AFB Supply Wells 2 and 52, and offsite water supply wells for two businesses along Post Road, IGM and the Inlet Co. No organic contaminants were detected in any of these wells. As such, the Bootlegger Cove formation appears to serve as an effective barrier between the aquifers, and there is no evidence that the shallow and deep aquifers are hydraulically connected under Elmendorf AFB.

3.1.4 Surface Water

Elmendorf AFB has four major drainage basins and a number of natural and man-made lakes and ponds. The major drainage systems include Ship Creek, Six-Mile Creek, EOD Creek, and Cherry Hill Ditch. Ship Creek is the largest surface water drainage system on Elmendorf AFB (Figure A-1, Attachment A). It originates in the Chugach Mountains to the east, runs along the southern boundary of Elmendorf AFB and empties into the Knik Arm. The upper Ship Creek basin is an important recharge area for the deeper confined aquifer and provides approximately one quarter of total recharge to the system. Six-Mile Creek and EOD Creek are located north of the Elmendorf Moraine and over a mile north of any of the CERCLA sites. Six-Mile Creek originates as springs located near the Elmendorf AFB and Fort Richardson boundary. Cherry Hill Ditch is the major storm water drainage system for the main base area south of the Elmendorf Moraine. Elmendorf AFB has 12 natural and manmade lakes and ponds varying from one acre to 123 acres in size. The vast majority of these water bodies are located north of the Elmendorf Moraine.

3.2 Site History

3.2.1 History of Contamination

Elmendorf AFB operations since the mid-1940s have generated varying quantities of hazardous and non-hazardous wastes from industrial and airfield operations, fire training, and fuels management. In August 1990, Elmendorf AFB was placed on the National Priorities List (NPL), bringing it under the federal facility provisions of CERCLA § 120.

To date, the USAF has identified 85 sources of contamination from historic operations that occurred prior to 1984. These sources have been grouped into three divisions: CERCLA sources, state program sources, and other program sources.

Thirty-eight of the 85 source areas are designated as CERCLA sources. Thirty-five of these have been grouped into six OUs (Table 1-1), and remedial activities are being conducted under the FFA. Three other sites, SS22, DP98, and SA100, were addressed separately from the OUs. Only 15 of these sites are considered active; all others were either designated as requiring no further action at the time of the ROD, or subsequently closed. SS22 is not included in this five-year review because it is currently undergoing a remedial investigation/feasibility study and a remedy has not yet been selected. Only 14 active CERCLA sites are addressed in this five-year review (LF59, ST41, FT23, SD24, SD25, SD28, SD29, ST37, SD15, LF02, LF03, LF04, WP14, and DP98).

Forty-two source areas have been designated as state program sources and are being remediated according to State of Alaska regulations. State program source areas are not included in this five-year review. The remaining five source areas were initially identified as historical sources but on further investigation were determined to be Resource, Conservation and Recovery Act sources. These sites were transferred to Elmendorf's Environmental Compliance Section, and are not included in this five-year review.

3.2.2 Initial Response

Initial response actions, prior to the signing of the ROD(s), were conducted at some OUs:

- An asphalt recovery effort was conducted at LF59 (OU1) during the 1995 and 1996 field seasons. Over 10,000 gallons of liquid asphalt were excavated and recycled as part of the State of Alaska cleanup program.

- At ST41 (OU2), an oil/water separator was installed in 1976 to reduce the amount of fuel being discharged to a drainage ditch adjacent to Fairchild Avenue. Monitoring wells were sampled in 1984 and 1988. In 1989 a small dam was placed in a nearby drainage ditch. After the IRA ROD was signed in 1992, a free product and dissolved-phase recovery treatment system was installed at ST41.

- In 1983, storage of waste liquids in a tank at ST20 (OU2) was prohibited. In 1986, about 105,000 gallons of liquid waste were removed from the tank. The source of contamination at ST20 (i.e., the tank, associated piping, and 1,300 cubic yards of contaminated soil) was removed and the soil treated during 1990. The OU2 ROD (USAF, 1995a) recommended NFA for ST20 because soil was remediated to concentrations less than cleanup levels and the source of groundwater contamination was due to upgradient sources (i.e., ST48 in the state program).

- During the fall of 1993 and summer of 1994, a response action at SS10 (OU4) removed both liquid asphalt and asphalt-containing soils left over from former asphalt batch operations. More than 100,000 gallons of asphalt were recovered and recycled for reuse on base. In-situ bioventing to treat deep unsaturated soils potentially contributing to contaminants in groundwater operated until 2006.

- Removal of the underground storage tank (UST) and contaminated soils in the vicinity of Pump House Building (PL81) was completed in 1996 as part of the State cleanup program. The pump house was also removed from service at this time. The former pipeline and valve pit area associated with PL81 is an adjacent upgradient source area to WP14 and LF04 South (OU6).

- At LF02 (OU6), landfill debris on top of or protruding from the ground surface was removed in October 1996. At that time, a limited soil cover was applied in three areas that had elevated lead contamination, mitigating that exposure pathway.

3.2.3 Basis for Taking Action

Due to past operations, substances have been released at Elmendorf AFB that resulted in contamination of soil, sediment, surface water, and groundwater at various locations (refer to individual RODs listed in Section 12 for more detail). The initial risk assessment determined the human and/or ecological risks exceeded USEPA's average or reasonable maximum exposure risk management criteria. Final contaminants of concern (COCs) specified in the RODs for each OU are summarized in Table 3-2.

Table 3-2
Contaminants of Concern, Elmendorf Air Force Base

Contaminants	OU1	OU2	OU4	OU5	OU6	DP98
Surface Water						
Benzene		X				
Ethylbenzene		X				
Toluene		X				
Total Aromatic Hydrocarbons				X		
Total Aqueous Hydrocarbons				X		
Sheen				X		
Groundwater						
1,1,1-Trichloroethane			X			
1,1,2-Trichloroethane					X	
1,1,2,2-Tetrachloroethane					X	
1,1-Dichloroethene			X			X
1,2-Dibromoethane	X					
1,2-Dichloroethane			X		X	
cis-1,2-Dichloroethene			X			X
Benzene		X	X	X	X	
Ethylbenzene		X	X		X	
Manganese	X					
Methylene Chloride					X	
Tetrachloroethene			X			X
Toluene		X	X		X	
Trichloroethene	X		X	X	X	X
Vinyl Chloride	X					X
Xylenes		X				

Table 3-2 (Continued)
Contaminants of Concern, Elmendorf Air Force Base

Contaminants	OU1	OU2	OU4	OU5	OU6	DP98
Soil						
Benzene, Toluene, Ethylbenzene and Xylenes (BTEX)					X	
1,1-Dichloroethene						X
cis-1,2-Dichloroethene						X
Diesel-Range Organics (DRO)			X		X	
Gasoline-Range Organics (GRO)			X		X	
Jet Fuel			X			
Tetrachloroethene						X
Total Fuel Hydrocarbons (TFH) - diesel				X		
Trichloroethene						X
Xylenes			X			
Exposed landfill debris					X	
Lead					X	
Sediment						
cis-1,2-Dichloroethene						X
Trichloroethene						X

BTEX = benzene, toluene, ethylbenzene, and xylenes; ; DRO = diesel-range organics; GRO = gasoline-range organics; OU = operable unit; TFH = total fuel hydrocarbons

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SECTION 4.0

REMEDIAL ACTIONS

Initial plans, remedial action objectives (RAOs), selected remedy descriptions, remedy implementation history, and current status of the remedies associated with each OU are presented in this section. In addition, LUCs (referred to in the OU1, OU2, OU4, OU5, and OU6 RODs as institutional controls) that have been implemented on site are also discussed separately.

4.1 OPERABLE UNIT 1

OU1 is located in the southeastern portion of the base, next to Vandenberg Avenue and immediately north of Ship Creek (Figure A-1, Attachment A). OU1 is currently over 60 acres in size. In the past, it consisted of five general waste disposal areas designated LF05, LF07, LF13, OT56, and LF59. Various types of material were disposed of, including general refuse, scrap metal, used chemicals, construction debris, and drums of asphalt. Table 2-1 includes a brief chronology of milestone events at OU1.

The OU1 ROD was signed on September 28, 1994 (USAF, 1994f) and selected a remedial action that included LUCs and groundwater monitoring. A CERCLA Site Closure Report documented no further action pursuant to formal closure of LF05, LF07, LF13, and OT56 at Elmendorf AFB on July 21, 2004 (USAF, 2004c) because groundwater contaminants at these sites were consistently below cleanup levels. All four sites were removed from the CERCLA program, but some of them continue to be managed as part of a landfill closure permit under the jurisdiction of the Alaska Solid Waste regulations. LF59 remains part of OU1 under CERCLA. The LUC remedy component was updated/clarified in a memorandum to the site file dated September 9, 1997 (USAF, 1997h).

RAOs were developed to specify actions needed to protect human health and the environment. The RAO, stated as a “goal” in the OU1 ROD (USAF, 1994f), is to prevent ingestion/direct contact with groundwater containing contaminants having concentrations in excess of background or USEPA maximum contaminant levels (MCLs), whichever is greater.

The RAO defines the site-specific COC, exposure routes and receptors, and remediation goals, which are defined as acceptable contaminant levels for each exposure route. COCs and their cleanup levels, as defined in the OU1 ROD, are presented in Table 4-1.

Table 4-1
Cleanup Levels at Operable Unit 1

Contaminant of Concern	ROD-Established Cleanup Level	Source of Requirement
Groundwater (µg/L)		
1,2-Dibromoethane	0.05	MCL
Manganese	9,100	background
Trichloroethene	5.0	MCL
Vinyl Chloride	2.0	MCL

µg/L = micrograms per liter; MCL = maximum contaminant level; ROD = record of decision

1,2-Dibromoethane is an additive to leaded gasoline. Trichloroethene (TCE) and vinyl chloride are solvents most likely present due to past disposal activities. Manganese is a naturally occurring metal in the soil around Anchorage and was the only compound consistently observed throughout the OU.

4.1.1 Operable Unit 1 Remedy Implementation and Status

Implementation of the ROD components was documented in a remedial action report (USAF, 1998d). The major components of the selected remedy and current status of each is provided in Table 4-2.

Table 4-2
Operable Unit 1 Remedy Implementation Status

Remedy Component	Brief Status
Implement LUCs, which include: • Develop site map showing the areas currently and potentially impacted by groundwater contaminants. • Restrict land use and areas designated for recreational use. • Enforce base policy prohibiting installation of groundwater wells into the shallow aquifer. These controls will remain in effect as long as the USAF maintains active control of the area or until the groundwater contamination dissipates to such levels that will no longer pose any unacceptable human health or environmental risks.	Implemented March 1994. Details on LUC implementation are clarified in a memorandum to the site file in 1997.

Table 4-2 (Continued)
Operable Unit 1 Remedy Implementation Status

Remedy Component	Brief Status
Monitor groundwater for five years, or until the groundwater no longer poses an unacceptable health risk by meeting cleanup levels.	On going at LF59. Cleanup levels were met for 1,2-dibromoethane in 1996, vinyl chloride in 1997, and manganese in 2001. TCE remains above the cleanup level at LF59. Groundwater cleanup levels for all COCs were met at LF05, LF07, LF13 and OT56, leading to the removal of these sites from CERCLA in 2004.
Five-year review to assess the protectiveness of the remedial action.	On-going (1998, 2003 and 2008).
Periodic evaluation of monitoring results to determine if there is a need for further remedial action.	On-going for LF59.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; COC = contaminant of concern; LUC = land use control; OU = operable unit; TCE = trichloroethene; USAF = United States Air Force

All remedial actions are operational and functional. LUCs (see Section 4.7) have been established (USAF, 1997h, 1998d) and are being maintained to prevent exposure until cleanup levels are attained.

Groundwater monitoring is ongoing at the one remaining site (LF59). Groundwater monitoring plans are updated annually (USAF, 2003g,h, 2004h, 2006c, 2007e, 2008d, Weston Solutions, Inc., 2007c) to ensure the program remains comprehensive and protective. The number of wells sampled each year under the CERCLA program at OU1 over the past 10 years is presented in Table 4-3.

Table 4-3
Number of Wells Sampled at Operable Unit 1, 1998 to 2007

Year	Number of Wells Sampled
1998	13
1999	14
2000	14
2001	12
2002	4
2003	2
2004	2
2005	2
2006	2
2007	2

The decrease in the number of wells monitored after 2001 is directly attributed to the closeout of LF05, LF07, LF13 and OT56. Monitoring at these wells was discontinued, and the sites were removed from CERCLA in 2004 because groundwater contaminants at these sites were consistently below cleanup levels (USAF, 2004c). Since 2003, groundwater monitoring at LF59 has focused on annual monitoring of two wells for volatile organic compounds (VOCs). Analysis for manganese was discontinued after 2002 because manganese was consistently below the cleanup level (USAF, 2003a). Figure C-1 in Attachment C presents the concentrations of COCs that exceed cleanup levels found at the wells at OU1.

Groundwater monitoring results are evaluated annually, including trend analysis of COCs and assessment of natural attenuation parameters (USAF, 2004b, 2005i, 2006d, 2008b). TCE is the only groundwater COC that remains above its cleanup level. The most recent data (USAF, 2008b) show that the remedy is performing as envisioned in the ROD. Trend analysis shows that TCE concentrations are decreasing and should meet the cleanup level by 2018, consistent with the ROD estimated cleanup date of 2024. The presence of the intermediate degradation product *cis*-1,2-dichloroethene (*cis*-1,2-DCE) provides strong evidence for anaerobic reductive dechlorination, which is a process by which TCE concentrations are decreasing.

As discussed previously, LF05, LF07, LF13 and OT56 were closed under CERCLA in 2004 (USAF, 2004c), when the sites were transferred to the Elmendorf AFB Compliance Program, which conducts activities necessary to manage former landfills such as erosion control and groundwater sampling as required by 18 Alaska Administrative Code (AAC) 60. Under the Compliance program, former OU1 sites LF05, LF07, and LF13 were capped with evapotranspiration covers in 2005 through 2007 to comply with Alaska Solid Waste regulations. These caps were designed to prevent storm water infiltration into the landfills, limiting leachate migration to groundwater. During the Compliance program's routine groundwater monitoring at well LF05GW-2B in 2006, elevated levels of TCE were observed (see Attachment C, Figure C-1). Consequently, the Compliance program commissioned a characterization study to determine the nature and extent of the groundwater contamination; this study was performed in 2006 (USAF 2007f). The study identified two chlorinated solvent plumes, including a TCE plume that appears to originate at or near LF07 and may be the source of TCE contamination at LF59. Compliance program monitoring showed that TCE concentrations continued to be elevated, though decreasing, at well LF05GW-2B in 2007 and 2008. While the cause of the increased TCE concentrations downgradient of the landfill area is unknown, it is suspected that the evapotranspiration landfill covers may be causing changes to the hydraulics of the area. The full impact of the covers may not be realized until the plants reach maturity, which is predicted to occur approximately seven years after cap construction/planting (about 2013 for LF07). Monitoring at LF05GW-2B should continue under the Compliance program, and the data should be used to evaluate potential impacts to the remedy effectiveness at LF59.

4.1.2 Operable Unit 1 System Operations and Maintenance

Annual system operations and maintenance (O&M) costs include planning and management, sampling, monitoring, reporting, and five-year reviews. In the ROD, annual costs for the OU1 remedy were estimated to be $48,000 per year. Total costs for the review period FY1995 through FY2008 are presented in Table 4-4.

Table 4-4
Operations and Maintenance Costs for Operable Unit 1, FY1995 through FY2007

Fiscal Year	Groundwater Monitoring	Land Use Controls Plan	Five-Year Review	Total Costs*
1995	$ 120,000	--	--	$ 120,000
1996	$ 190,000	--	--	$ 190,000
1997	$ 66,000	--	--	$ 66,000
1998	$ 66,000	--	--	$ 66,000
1999	$ 78,000	--	--	$ 78,000
2000	$ 60,000	--	--	$ 60,000
2001	$ 74,000	--	--	$ 74,000
2002	$ 76,228	$1,742	$2,764	$ 81,000
2003	$ 30,000	--	--	$ 30,000
2004	$ 13,725	--	--	$ 14,000
2005	$ 12,899	--	--	$ 13,000
2006	$ 8,955	--	--	$ 9,000
2007	$ 9,233	--	$19,264	$ 28,000
Total Cost:				$ 829,000

*Total Costs are rounded to nearest $1,000.

O&M costs for 2003 through 2007 were obtained from the Air Force Remedial Process Optimization Inventory and Prioritization Software (RIPS). Monitoring costs for OU1 were originally greater than predicted in the ROD. Monitoring costs reduced dramatically after 2002, due primarily to the elimination of CERCLA monitoring at all OU1 sites except for LF59.

4.2 OPERABLE UNIT 2

OU2 consists of two source areas, ST20 and ST41 (Figure A-1, Attachment A), located in the central and western portion of the base, respectively (USAF, 1995a). ST20 is the former site of a 338,000-gallon UST that was used to store Bunker C fuel oil, waste oils, used solvents, and other wastes. Elmendorf AFB removed the tank, associated piping, and contaminated soils at ST20 in 1990, which resulted in a NFA determination in the OU2 ROD (see Section 3.2.2.). ST20 is not included in this five-year review.

ST41 is the former site of four one-million-gallon USTs. An IRA ROD was signed September 1, 1992 (USAF, 1992), resulting in the design, installation and operation of a free-product and dissolved-phase recovery and treatment system at ST41 beginning in October 1993. The OU2 ROD was signed on May 19, 1995 (USAF, 1995a) and included source removal (tanks, piping and contaminated soil), continued operation of the free-product recovery system, groundwater and surface water monitoring to assess natural attenuation, and LUCs to prevent access to contaminated groundwater and soils at ST41. The free product recovery system met its requirements and was shutdown in 1999 (USAF, 1999b). A brief chronology of events occurring at OU2 has been provided in Table 2-1.

RAOs were developed to specify actions needed to protect human health and the environment (USAF, 1995a). The RAOs define the COCs, exposure routes and receptors, and remediation goals, which are defined as an acceptable contaminant level for each exposure route. RAOs specified in the OU2 ROD are:

- Prevent ingestion and contact with groundwater containing contaminants in concentrations in excess of background or MCLs, whichever is greater;
- Prevent use for aquaculture, or if aquaculture use is proposed in the future, treat water to an acceptable level;
- Prevent contaminated seep water (surface water) from entering wetlands;
- Reduce further migration of contaminants due to free-phase product currently at the water table and of any residual product that may exist in piping and underground tanks;
- Prevent migration of contaminants found in soil that would result in groundwater contamination in excess of MCLs or health-based levels;
- Attain residual contaminant levels which would restore groundwater as a potential source of drinking water; and
- Compliance with all action-, chemical-, and location-specific applicable or relevant and appropriate requirements (ARARs).

Final remediation goals for groundwater include preventing ingestion or direct contact with groundwater containing contaminants with concentrations in excess of background levels or federal drinking water standards (primary MCLs, 40 CFR 141), as shown in Table 4-5.

Table 4-5
Cleanup Levels at Operable Unit 2

Contaminant of Concern	ROD Established Cleanup Level	Source of Requirement
Groundwater (µg/L)		
Benzene	5	MCL
Ethylbenzene	700	MCL
Toluene	1,000	MCL
Xylenes	10,000	MCL
Surface Water (µg/L)		
Benzene	10	18 AAC 70
Ethylbenzene	10	18 AAC 70
Toluene	10	18 AAC 70

µg/L = micrograms per liter; AAC = Alaska Administrative Code; MCL = maximum contaminant level; ROD = record of decision

Final remediation goals for surface water include compliance with location and chemical specific ARARs. The location specific goal is avoidance of long-term and short-term adverse impacts associated with destruction or modification of the wetlands area. The chemical-specific cleanup levels include compliance with State of Alaska surface water quality criteria (SWQC) as established in 18 AAC 70, which are based on Total Aromatic Hydrocarbons (TAH). The chemical-specific cleanup levels for surface water COCs benzene, ethylbenzene, and toluene were defined in the ROD based on the TAH cleanup level in 18 AAC 70. During development of the 2002 monitoring plan, ADEC comments (ADEC, 2002), and response from the USAF (USAF, 2002b), resulted in the understanding that the 10 μg/L cleanup standard applies to the sum of the benzene, ethylbenzene, and toluene concentrations. The 2003 five-year review (USAF, 2003j) recommended that OU2 surface water at the point of compliance be monitored for TAH and Total Aqueous Hydrocarbons (TAqH). However, the 2003 five-year review did not add TAH and TAqH as COCs for OU2 surface water, nor did it establish the SWQC for those parameters as cleanup levels for OU2.

The COCs for both groundwater and surface water are fuel-related chemicals that are attributed to past operations and/or spills associated with the USTs.

4.2.1 Operable Unit 2 Remedy Implementation and Status

The free-product and dissolved-phase recovery and treatment system portion of the remedy (USAF, 1992, 1993e) began operation in October 1993. All components of the ROD-specified remedy were documented as completed, inspected, operational, and functional as of April 1998 (USAF, 1998g). The major components and current status of the selected remedy for OU2 (ST41) are provided in Table 4-6.

Table 4-6
Operable Unit 2 Remedy Implementation Status

Remedy Component	Brief Status
Groundwater	
Continuing operation of the IRA free-product recovery system until all technically practicable free product has been recovered to mitigate the continuing source of contamination.	The recovery system met the requirements and was shut down in April 1999.
Continuing operation of the IRA system in place for seep mitigation until it can be determined that State of Alaska Water Quality Criteria are being met by the seep water. In addition, long term monitoring must show that natural attenuation will continue to be protective of the wetlands in the area.	The recovery system met the requirements at the surface water points of compliance and was shut down in April 1999. Seep and wetland monitoring is ongoing to ensure protection.
Monitoring the groundwater beneath and adjacent to the site to evaluate contaminant migration and timely reduction of contaminant concentrations by natural attenuation within 21 years. This will include five-year reviews to assess the protectiveness of the remedial action as long as contamination remains above unacceptable levels. Monitoring will be conducted in accordance with the long term monitoring plan schedule set forth in the Remedial Design/Remedial Action Statement of Work.	Monitoring has been on-going since 1996. The monitoring plan was updated in 2003 and 2006.

Table 4-6 (Continued)
Operable Unit 2 Remedy Implementation Status

Remedy Component	Brief Status
Maintaining institutional controls that restrict access to groundwater and contaminated surface and subsurface soils, as well as groundwater development at the site, as long as hazardous substances remain on the site at levels that preclude unrestricted use. The specific institutional controls to be implemented and/or maintained at OU2 are as follows: • Development of a site map showing the areas currently and potentially impacted by groundwater contaminants that will be included in the *Base General Plan*. • Zoning the affected area outdoor/recreational use and unmanned industrial use only, excluding the development of commercial aquaculture. • Continued enforcement of base policy prohibiting installation of groundwater wells (other than for monitoring purposes) into the shallow aquifer underlying OU2 at Elmendorf Air Force Base. • Prohibiting unauthorized access to existing water supply and groundwater monitoring wells. LUCs will be enforced as long as hazardous substances remain on site at levels that preclude unrestricted use.	Implemented in March 1995 and on-going. Land use designations were updated in the Remedial Action Report in 1998.
In addition, to ensure long-term integrity of the above LUCs, the Air Force will ensure that, to the extent that groundwater remains above unacceptable levels, deed restrictions or equivalent safeguards will be implemented in the event that property containing such contamination is transferred by the Air Force. The measures shall include: • Five-year review to assess the protectiveness of the remedial action; and • Periodic evaluation of monitoring results to determine if there is a need for further remedial action.	Implemented in March 1995 and on-going. Five-Year Reviews have been conducted in 1998, 2003 and 2008.
Source Control	
Cleaning of the four one-million gallon underground storage tanks, disposal of the residuals according to applicable statutes, and filling them with an inert material such as sand or gravel. Abandoning the tanks in situ reduces the potential adverse human health and environmental risks associated with removing tanks of this size.	Completed in September 1996
Excavating, removing, and disposal/recycling of the piping system.	Completed in September 1996

Table 4-6 (Continued)
Operable Unit 2 Remedy Implementation Status

Remedy Component	Brief Status
Removal of contaminated soil associated with the piping which contains leachable concentrations of fuel-related contaminants, and offsite disposal and low temperature thermal treatment of those soils.	Completed in September 1996
Revegetating the area.	Completed in September 1996

IRA = interim remedial action; LUC = land use control; OU = operable unit

In addition to the remedies outlined in Table 4-6, the OU2 ROD contained a contingent remedy for groundwater. The contingent remedy for ST41 groundwater was to be implemented only if the USAF, in consultation with the USEPA and ADEC, determined that natural attenuation was not occurring at an acceptable rate. Natural attenuation has been documented to be occurring at an acceptable rate, and the contingent remedy has not been implemented.

The free-product and dissolved-phase recovery and treatment system operated from 1993 until 1999. The system removed about 145 gallons of product as of November 1994. Only small quantities of free product were recovered through 1996, and no recoverable free product was observed from February 1997 to February 1999. In April 1999, the system was shut down (USAF, 1999a,b) and hand-bailing methods are used to recover remaining small quantities of floating free product at wells with more than 0.1 foot free-product thickness. Free product thickness, when detected at all, has been less that 0.1 foot since 2003 (USAF, 2004b, 2008f).

Operation of the IRA system for mitigation of contaminated seeps was clarified in the remedial action report (USAF, 1998g). One of the conditions for shutting down the treatment system was to demonstrate protectiveness of surface water (wetlands) or seeps. The endpoint for shutting down the treatment system was not established in the ROD, but was subsequently defined in a technical evaluation of the ST41 treatment system (USAF, 1997g). The endpoint was defined as contaminant concentrations in surface water below SWQC at point-of-compliance locations for one year with the system operating, and an additional year with the system shut off. The points of compliance (see Figure C-2, Attachment C) were defined as sampling locations SW-02 (on the south side in a ditch along Loop Road) and SW-13 (on the north side in the wetland area) (USAF, 1999b). Contaminant concentrations at points-of-compliance were below the SWQC in 1997 (USAF, 1998g). Other reports indicate sampling at the points-of-compliance were performed in 1998, 1999, 2000, and 2001 (USAF, 1999b, 2001a, 2003j), but only results for the 1999 and 2000 sampling events were located during the data review. Since 2003, sampling has been conducted at one seep (ST41-SP01) and one surface water sampling location (ST41-SW01), but these locations are considerably upgradient of the point-of-compliance SW-13. Due to confusion over its location, SW-13 was not sampled again until 2008.

Groundwater and surface water monitoring at OU2 has been conducted at least annually since the IRA. Groundwater monitoring plans are reviewed annually (USAF, 2003g,h, 2004h, 2006c, 2007g, 2008f) to ensure the program remains comprehensive and protective. The number of wells, surface water locations, and seeps sampled each year at OU2 is presented in Table 4-7.

Table 4-7
Number of Wells and Seeps Sampled at Operable Unit 2, 1998 to 2007

Year	Number of Wells Sampled	Wetlands Point of Compliance Sampled	Number of Seeps Sampled
1998	14	1	0
1999	14	1	0
2000	13	1	0
2001	12	1	0
2002	5	0	1
2003	3	0	1
2004	3	0	1
2005	3	0	1
2006	2[a]	0	1
2007	5[b]	0	1

[a] Three wells scheduled to be sampled in 2006; however well ST41-07 was dry.
[b] Six wells are scheduled to be sampled every 5 years; however well ST41-34 could not be found.

Groundwater and surface water monitoring plans were updated in 2003 (USAF, 2003a). Sampling was initiated for wells ST41-07 and ST41-25 once every five years, and ST41-10R annually. Wells EW-2, ST41-16, and ST41-28 were removed from the groundwater monitoring program until free product is absent. Seep location ST41-SP01 was recommended for sampling once every five years, but it has been sampled annually. The groundwater monitoring plan was updated again in 2006 (USAF, 2006d). Annual monitoring for wells ST41-07 and ST41-25 was initiated. Monitoring every five years, including 2007, was initiated for three down-gradient wells (ST41-20, ST41-30, and ST41-34). Well ST41-34 could not be found, and therefore was not sampled in 2007 (USAF, 2007h).

Groundwater and surface water monitoring results are evaluated annually, including trend analysis of COCs and assessment of natural attenuation parameters (USAF, 2004b, 2005i, 2006d, 2007g,h, 2008f). Figure C-2 in Attachment C presents COC concentrations over time for key wells and surface water locations in OU2. Performance of the natural attenuation remedy for OU2 groundwater and seeps was most recently assessed in 2007 (USAF, 2007h).

Of groundwater COCs, only benzene concentrations remain above the cleanup level in wells sampled in 2007. Concentrations of benzene are decreasing in groundwater, indicating that natural attenuation is occurring. Current trends indicate that benzene may remain above the cleanup level at some wells longer than the ROD-predicted cleanup date of 2016.

Seep (at ST41SP-01) and surface water (at ST41SW-01) samples contain concentrations of benzene above the OU2 cleanup level, but the data series is too short to reliably predict a date when cleanup levels will be met. Contaminant concentrations at surface water (wetland) sampling location ST41-SW01, located just below the seep ST41-SP01, are nearly as high as those collected from the seep. The point of compliance for the wetland to the north of ST41 was identified as SW-13 (USAF, 1999b), and is located at the center of the surface water body located downgradient of the seep (nearly 200 feet downgradient of surface water sample location ST41-SW01). SW-13 was sampled at least five times between 1995 and 2000 (USAF, 1997g, 1998g, 1999b, 2001a, 2003a), but due to confusion over its location, surface water at SW-13 was not sampled during 2003 through 2007. SW-13 was sampled again in 2008, and all contaminants were below OU2 cleanup levels. Groundwater and surface water trends are evaluated in more detail in Section 6.4.2.

LUCs were implemented in 1995 (USAF, 1998g) and are described in more detail in Section 4.7. OU2 land use is designated as industrial use only, excluding the development of commercial aquaculture. However, OU2 is comprised of vacant land that is sometimes used for outdoor recreation (Table 3-1). The *Operable Unit 2 Remedial Action Report* (USAF, 1998g) documents that the agencies agreed to interpret the ROD as allowing for outdoor/recreational use and unmanned industrial use.

The remedial actions of UST decommissioning and removal of piping and contaminated soil remedies were implemented, completed, and documented in 1996 (USAF, 1996f, 1998g).

4.2.2 Operable Unit 2 Systems Operations and Maintenance

Annual system O&M costs include planning and management, operation and maintenance of the free product recovery system (through 1999), sampling, monitoring, reporting, and five-year reviews. O&M costs were estimated at $27,500 per year for the free product recovery system (USAF, 1992) and $79,000 per year for the natural attenuation remedy for groundwater (USAF, 1995a). After 1999, the free product recovery system was shut down and its costs were eliminated. Total costs for FY 1994 through 2007 are presented in Table 4-8.

Table 4-8
Operations and Maintenance Costs for Operable Unit 2, FY1994 through FY2007

Fiscal Year	Free Product Recovery System Operation	Groundwater and Seep Monitoring	Land Use Controls Plan	Five-Year Review	Total Costs*
1994	$189,200	--	--	--	$ 189,000
1995	$ 294,761	--	--	--	$ 295,000
1996	--	$ 38,007	--	--	$ 38,000
1997	$ 92,300	$ 84,000	--	--	$ 176,000
1998	$ 102,647	$ 84,000	--	--	$ 187,000
1999	$ 225,788	$ 74,012	--	--	$ 300,000
2000	--	$ 79,902	--	--	$ 80,000
2001	--	$ 69,126	--	--	$ 69,000
2002	--	$ 72,089	$ 1,792	$ 2,074	$ 76,000
2003	--	$ 53,989	--	--	$ 54,000
2004	--	$ 21,208	--	--	$ 21,000
2005	--	$ 25,079	--	--	$ 25,000
2006	--	$ 29,357	--	--	$ 29,000
2007	--	$ 61,673	--	$19,264	$ 81,000
Total Cost:					$ 1,620,000

*Total Costs are rounded to nearest $1,000.

O&M costs for 2003 through 2007 were obtained from RIPS. Operational costs of the free-product recovery system were much greater than estimated in the ROD, but this system was shut down in 1999 and its costs were eliminated. Initial monitoring costs appear to have been accurately estimated in the ROD, and these costs have reduced over time due to optimization.

4.3 OPERABLE UNIT 4

OU4 is located in the central portion of Elmendorf AFB, near the main runways, and is divided into OU4 East and OU4 West areas. OU4 covers an area of approximately 360 acres (Figure A-1, Attachment A). Floor drains in eight maintenance buildings (SS18 and SD24 through SD30), a fuel training area (FT23), and an asphalt drum storage and processing area (SS10) were the primary sources of contamination at OU4. Contamination included fuel spills, leaking asphalt storage drums, leaking fuel distribution systems and USTs, aircraft refueling operations, aircraft maintenance activities within hangar facilities, and incomplete combustion of fire training materials in the fire training area. Table 2-1 summarizes a brief chronology of milestone events at OU4. Due to minimal soil contamination, sites SS18, SD26, SD27, and SD30 were designated as NFA for soil in decision documents signed in May 1993 (USAF, 1993a,b,c,d). In 1993 and 1994 (prior to the OU4 ROD), a response action at SS10 removed both liquid asphalt and asphalt-containing soils left over from former asphalt batch plant operations. Over 100,000 gallons of asphalt were recovered and recycled for reuse on base. The remaining source areas included in the OU4 ROD were SS10, FT23, SD24, SD25, SD28, and SD29.

The OU4 ROD was signed on October 10, 1995 (USAF, 1995b) and selected a remedial action that included LUCs and bioventing for subsurface soil contamination, and natural attenuation and LUCs for groundwater contamination. A minor modification to the ROD remedy was documented in a memorandum to the site file that established a sampling frequency decision guide in 2003 (USAF, 2003d). The sampling frequency decision guide is presented in Attachment F, Figure F-1.

RAOs were developed to specify actions needed to protect human health and the environment. RAOs specified in the OU4 ROD are applicable for all contaminated groundwater and soil areas and include:

- Protect human health and the environment by preventing ingestion of and contact with contaminated media by people;
- Protect uncontaminated media by preventing releases from sources;
- Use treatment techniques whenever practicable; and
- Implement a cost effective solution that can achieve the cleanup levels for the final COCs.

The RAOs define the site-specific COCs, exposure routes and receptors, and remediation goals, which are defined as acceptable contaminant levels for each exposure route. The COCs and cleanup levels to be achieved as outlined in the OU4 ROD (USAF, 1995b) are summarized in Table 4-9.

Table 4-9
Cleanup Levels at Operable Unit 4

Location	Contaminant of Concern	ROD-Established Cleanup Level	Source of Requirement
Groundwater (µg/L)			
FT23	1,1,1-Trichloroethane	200	MCL[1]
	1,1-Dichloroethene	7	MCL[1]
	1,2-Dichloroethane	6[3]	MCL[1]
	Tetrachloroethene	6[3]	MCL[1]
	Trichloroethene	6[3]	MCL[1]
	1,2-Dichloroethene	70	MCL[1]
	Benzene	5	MCL[1]
SD25	Benzene	5	MCL[1]
	Ethylbenzene	700	MCL[1]
	Toluene	1,000	MCL[1]
SD24, SD26, SD27	Benzene	5	MCL[1]
SD28, SD29	Tetrachloroethene	5	MCL[1]
	Trichloroethene	5	MCL[1]
Soil (milligram per kilogram, mg/kg)[4]			
FT23	Diesel-Range Organics	2,000	ACM[2]
	Gasoline-Range Organics	1,000	ACM[2]
SD24, SD25	Diesel-Range Organics	1,000[3]	ACM[2]
	Gasoline-Range Organics	2,000[3]	ACM[2]
SS10	Diesel-Range Organics	2,000	ACM[2]
	Jet Fuel	2,000	ACM[2]
	Xylene	100	ACM[2]
	Gasoline-Range Organics	1,000	ACM[2]

[1]40 CFR § 131, and 18 ACC Chapter 70.010a and d, 70.015 through 70.0110.18 AAC 80.070
[2]ACM – Alaska Cleanup Matrix Level D, 18 AAC 78.315.
[3]The cleanup levels for 1,2-dichloroethane, tetrachloroethene, and trichloroethene in groundwater at FT23, and diesel-range organics and gasoline-range organics in soil at SD24 and SD25, as presented in OU4 ROD are inconsistent with their referenced standards.
[4]There are no cleanup levels for soil at SD26, SD27, SD28, and SD29 because contaminant levels were below regulatory standards at the time of the ROD.
µg/L = microgram per liter; AAC = Alaska Administrative Code; MCL = maximum contaminant level; mg/kg = milligram per kilogram; ROD = record of decision

4.3.1 Operable Unit 4 Remedy Implementation and Status

The major components of the selected remedy for OU4 include LUCs and bioventing for subsurface soil contamination, and natural attenuation and LUCs for groundwater contamination. The selected remedies and their current status are provided in Table 4-10.

Table 4-10
Operable Unit 4 Remedy Implementation Status

Remedy Component	Brief Status
Groundwater	
Institutional controls (also known as LUCs) on land use and water use restrictions will restrict access to the contaminated groundwater throughout OU4 until cleanup levels have been achieved. OU4 is designated “Airfield Use Area” for aircraft operations and maintenance, to include active and inactive runways, taxiways, and parking aprons for aircraft. Existing land use restrictions as presented in the *Base General Plan* will continue to be used to limit access to contaminated groundwater.	Implemented June 1998.
Groundwater will be monitored on a frequency determined by the “Basewide Monitoring Program Well Sampling Frequency Decision Guide” and evaluated to assess contaminant migration and timely reduction of contaminant concentrations by intrinsic remediation (i.e., natural attenuation). This will include five-year reviews to assess the protectiveness of the remedial action, as long as contamination remains above cleanup levels. A monitoring plan will be prepared to address the details involved in sampling.	On going since 1996. Monitoring frequency decision guide was implemented in 2003. Five-year reviews were conducted in 1998, 2003 and 2008.
All groundwater is expected to be cleaned up within thirteen years (2008).	COC concentrations are decreasing at all sites. All sites except SD25 should meet cleanup levels by 2009.
Soil	
Institutional controls (also known as LUCs) on land use will restrict access to the contaminated shallow soils throughout OU 4 until cleanup levels have been achieved. OU4 is designated “Airfield Use Area” for aircraft operations and maintenance, to include active and inactive runways, taxiways, and parking aprons for aircraft. Existing land use restrictions as presented in the *Base General Plan* will continue to be used to limit access to contaminated soil.	Implemented June 1998. All shallow soils in OU4 met cleanup levels as of 1998.

Table 4-10 (Continued)
Operable Unit 4 Remedy Implementation Status

Remedy Component	Brief Status
Deep soils at specified locations and depths at the Fire Training Area (FT23), the asphalt drum storage area (SS10), and Hangar 11 (SD25) will be treated with bioventing to accelerate degradation of contaminants in those locations. Deep soils at other source areas will be allowed to degrade through intrinsic remediation.	Bioventing is ongoing at FT23. SS10 and SD25 have reached cleanup levels and bioventing systems were shut down in 2006 and 2003, respectively.
Both shallow and deep soils will be monitored and evaluated to assess contaminant migration and timely reduction of contaminant concentrations by intrinsic remediation (i.e., natural attenuation). This will include five-year reviews to assess the protectiveness of the remedial action, as long as contamination remains above cleanup levels.	Soils meet cleanup levels at all sites except for deep soils at FT23. Sampling locations and frequency are updated periodically. Five-year reviews were conducted in 1998, 2003 and 2008.
When concentrations in the bioventing areas are below cleanup levels, bioventing will be discontinued. A monitoring plan will be prepared to address the details involved in sampling.	Closure sampling conducted for SD25 in 2002 and SS10 in 2003. Both bioventing systems have been shut down.
All soils are expected to be cleaned up within eleven years (2006).	Soils meet cleanup levels at all sites except for one sampling location at FT23.

COC = concentration of concern; LUC = land use control; OU = operable unit

All remedial actions were implemented as of 1998 (USAF, 1998b). Soil and groundwater LUCs (see Section 4.7) were established (USAF, 1998b) and are maintained to prevent exposure until cleanup levels are attained. Cleanup levels have been attained for shallow soils at all OU4 sites (USAF, 1998b).

Bioventing systems were installed and activated at FT23, SS10, and SD25 in November 1995 (USAF, 1998b). Site locations are illustrated in Figure C-3 of Attachment C. The system at FT23 continues to operate as of 2008. Closure soil sampling conducted at SD25 in 2002 demonstrated that cleanup objectives were achieved for all soil contaminants. Based on these data, the SD25 bioventing system was shut down in 2003 (USAF, 2003b). Although SD25 soils meet cleanup levels, SD25 is still an open site due to the presence of contaminants in groundwater above the cleanup levels. Closure soil sampling conducted at SS10 in 2003 demonstrated that cleanup objectives were achieved for all soil contaminants. Based on these data, the SS10 bioventing system was shut down in 2006, and NFA was achieved pursuant to formal closure of SS10 (USAF, 2006b).

The FT23 bioventing system is the only system still operating at OU4. Operation, maintenance and monitoring activities were performed at the FT23 bioventing during the last five years. Currently, only one blower (FTA-1) is operating at FT23. The blower is connected to four injection vents (BV-2, BV-3, BV-4, and BV-5). In-situ respiration tests were performed in 2004 and the data suggest that little to no hydrocarbon degradation was occurring at the BV-2, BV-3 and BV-4 soil vapor implants. However, active biodegradation appears to have been occurring at nearly all soil vapor implants near BV-5, with an estimated biodegradation rate of 3.4 milligrams per kilogram per day (mg/kg/day) at BV-5B upper (USAF, 2005d). A soil sampling effort performed in 2005 consisted of one boring (near BV-5) and two soil samples collected from both the deep and shallow zones. Results indicated that diesel-range organics (DRO) was slightly above the cleanup level at 15 feet bgs. The bioventing system continues to operate to address remaining soil contamination above the cleanup level (USAF, 2006g). When soil sampling demonstrates that DRO in the vicinity of BV-5 has met the cleanup level (the next soil sampling event is scheduled for 2010), the FT23 bioventing system can be shutdown.

Groundwater monitoring is ongoing at OU4. Groundwater monitoring plans are updated annually (USAF, 2003g,h, 2004h, 2006c, 2007e, 2008c) to ensure the program remains comprehensive and protective. Figure C-3 in Attachment C presents the concentrations of selected COCs found at key wells in OU4. The number of wells sampled each year at OU4 since 1998 is included in Table 4-11.

Table 4-11
Number of Wells Sampled at Operable Unit 4, 1998 to 2007

Year	Number of Wells Sampled
1998	14
1999	13
2000	13
2001	7
2002	6
2003	3
2004	3
2005	4
2006	3
2007	4

Groundwater was monitored annually at FT23 and SD25, and every three years at SD29 and every five years at SD24, in accordance with the Basewide Monitoring Program Well Sampling Frequency Decision Guide (USAF, 2003d; also included in Attachment F, Figure F-1). No wells associated with SD28 were monitored. Groundwater at all other OU4 sites meets cleanup levels, and the sites either require NFA or are closed. Groundwater monitoring results were evaluated four times in the past five years (USAF, 2004b, 2005i, 2006d, 2008a). Evaluations included trend analysis of COCs and assessment of natural attenuation parameters. Also, a USEPA scoring model (Wiedemeier et al., 1998) assessment for natural attenuation of chlorinated solvents was performed for FT23 (USAF, 2005i). COC concentrations are rapidly decreasing at FT23, SD24 and SD29. Natural attenuation processes appear to be working and trending predicts that cleanup levels will be met by 2009. Natural attenuation appears to also be working at SD25, but the accidental abandonment of well OU4MW-08 after 2002 and installation of replacement well OU4MW-08R has complicated predictions for meeting cleanup goals. Contaminant concentration data will be discussed in more detail in Section 6.4.3.

The 2003 five-year review indicated that it was unclear whether natural attenuation of chlorinated solvents would be limited by the amount of carbon available at FT23. Benzene, toluene, ethylbenzene, and xylenes (BTEX) over the last five years has been present in well OU4W-11 at concentrations above 400 micrograms per liter (µg/L), which is sufficient to stimulate reductive dechlorination of TCE. Analysis shows that chlorinated solvents concentrations are on track to meet cleanup levels within the next two years (USAF, 2008a), therefore it is expected that the amount of available carbon will be sufficient.

4.3.2 Operable Unit 4 Systems Operations and Maintenance

FT23 bioventing system O&M procedures are specified in the O&M manual (USAF, 1996c), and include biweekly maintenance and system checks to inspect bioventing wells, blower units, and piping; annual in-situ respiration testing; soil gas checks to ensure bioventing sites are well oxygenated; and evaluation of contaminant trends. Performance of O&M activities are documented in various annual reports (USAF, 2004f, 2005d, 2006e, 2007d; Weston Solutions, Inc., 2007a). There were several minor maintenance issues addressed in the past five years, including replacement of an air filter, a valve, a sampling port, and an electrical component. One vent was blocked during December 2007/January 2008, probably due to frozen condensate. There were two sustained shutdowns. The system was shutdown June 2006 through May 2007 due to lack of power associated with construction activities at Hangar 17. The system was not operational during October 2007 to March 2008 time frame due to a faulty electrical component. These shutdowns did not cause any long-term problems for remediation of FT23. The bioventing system was running during the site inspection conducted in May 2008.

Annual system O&M costs include planning and management, operation and maintenance of the bioventing systems, sampling, monitoring, reporting, and five-year reviews. In the ROD, annual costs for the OU4 remedy were initially estimated to be $173,000 per year ($50,000 for groundwater monitoring and LUCs, $32,000 for soil monitoring and LUCs, and $91,000 for bioventing operations), but were expected to decrease over time as sites reached cleanup goals. The ROD estimated that by 2003, O&M costs would be reduced to $65,000 per year ($37,000 for groundwater monitoring and LUCs, $11,000 for soil monitoring and LUCs, and $27,000 for bioventing operations); and by 2007, O&M costs would further decrease to $27,000 per year (groundwater monitoring and LUCs only). Total costs for FY 1996 through FY 2007 are presented in Table 4-12.

O&M costs for 2003 through 2007 were obtained from RIPS. The O&M costs are reasonably close to ROD estimates for individual remedy components. The increase in costs in 2007 is largely due to the cost of the five-year review. Because cleanup objectives have not been met as quickly as estimated in the ROD, O&M costs have not decreased as predicted. Current O&M costs include continued operation of the bioventing system at FT23 and monitoring at four source areas.

Table 4-12
Operations and Maintenance Costs for Operable Unit 4, FY1996 through FY2007

Fiscal Year	Bioventing System Operation	Groundwater Monitoring	Land Use Controls Plan	Five-Year Review	Total Costs*
1996	$ 71,561	$ 114,022	--	--	$ 186,000
1997	--	$ 73,000	--	--	$ 73,000
1998	$ 33,413	$ 73,000	--	--	$ 106,000
1999	$ 91,095	$ 71,043	--	--	$ 162,000
2000	$ 26,904	$ 71,024	--	--	$ 98,000
2001	$ 34,560	$ 74,443	--	--	$ 109,000
2002	$ 72,808	$ 42,052	$10,750	$12,443	$ 138,000
2003	$ 49,631	$ 42,358	--	--	$ 92,000
2004	$ 36,297	$ 28,070	--	--	$ 64,000
2005	$ 37,289	$ 28,662	--	--	$ 66,000
2006	$ 94,236	$ 23,440	--	--	$ 118,000
2007	$ 13,137	$ 84,336	--	$96,319	$ 194,000
Total Cost:					$ 1,406,000

*Total Costs are rounded to nearest $1,000.

4.4 OPERABLE UNIT 5

OU5 is located along the southern boundary of Elmendorf AFB and covers an area of about 200 acres (Figure A-1, Attachment A). Groundwater generally flows south from the flightline and industrial areas of the base through OU5. Some groundwater discharges in seeps along a steep bluff in the western part of the OU, or into a wetland area where there are several shallow connected water bodies and marshes in the eastern part of the OU. Bulk storage of diesel fuel, jet fuel and multi-product fuel pipelines were initially the primary source of contamination within OU5. Chlorinated solvents from sources south of the east-west runway are the significant sources of groundwater contamination in OU5. Any contaminants migrating toward Ship Creek via groundwater and seep/surface water are being treated through OU5 remedial actions. Table 2-1 includes a brief chronology of milestone events at OU5.

Due to minimal soil contamination, ST38, SD40, SS42, ST46, and SS53 were designated as NFA sources and decision documents were signed in August 1994 (USAF, 1994c,d,e). ST37 is the only remaining source area within OU5.

The OU5 ROD was signed on February 1, 1995 (USAF, 1995c) and selected a remedial action that included LUCs, monitoring and natural attenuation for groundwater, construction and operation of an engineered wetland remediation system (WRS) to treat contaminated seeps on the western and central bluffs, natural attenuation for the Beaver Pond wetland area, and contaminated soil excavation and treatment. Minor modifications to the ROD remedy have been documented in memoranda to the site file. The first memorandum to the site file (USAF, 2003e) adopted a sampling frequency decision guide (USAF, 2003e). The decision guide is presented in Attachment F, Figure F-1. A second memorandum incorporated newly discovered contaminated seeps into the WRS in 2005 (USAF, 2005b). Also in the 2005 memorandum, decision guides were adopted for shutting down WRS pumping stations (Attachment F, Figure F-3), and for restarting an existing seep collection area or incorporating a new seep collection area for treatment (Attachment F, Figure F-4).

RAOs were developed to identify actions needed to protect human health and the environment. The RAOs specified in the OU5 ROD include:

- Protect human health and the environment by preventing ingestion and contact with contaminated groundwater by people and preventing animal contact with contaminated seep water;
- Use treatment techniques whenever practicable;
- Implement a solution that is capable of managing impacts from upgradient sources as the contaminants reach OU5; and
- Implement a cost-effective solution that can achieve the cleanup levels for the final COCs.

These objectives define the site-specific COCs, exposure routes and receptors, and remediation goals, which are defined as acceptable contaminant levels for each exposure route. The primary types of contaminants are fuel-related chemicals and chlorinated solvents that are attributed to sources upgradient of OU5 where past spills or disposal occurred. The COCs and cleanup levels to be achieved as outlined in the ROD through implementation of the selected remedy are listed in Table 4-13.

Table 4-13
Cleanup Levels at Operable Unit 5

Contaminant of Concern	ROD-Established Cleanup Level	Source of Requirement
Groundwater (μg/L)		
TCE	5	MCL[1]
Benzene	5	MCL[1]
Surface Water (μg/L)		
Sheen	No Sheen	18 AAC 70.020, based on ecological risk
TAH[2]	10	18 AAC 70.020, based on ecological risk
TAqH[2]	15	18 AAC 70.020, based on ecological risk
Soil (mg/kg)		
TFH-diesel	1,000	18 AAC 78.315, ACM Level C

[1] 40 CFR 131, 18 AAC 70.010a and d, 70.015 through 70.110, and 18 AAC.070.
[2] The ROD-specified cleanup levels for TFH-diesel and TFH-gas were conceptually modified in 1998 to include TAH and TAqH (USAF, 1998e). Because there was no standard for these COCs in groundwater, and because groundwater emerges at the seeps that eventually flow into Ship Creek (an aquaculture resource), the aquaculture water standards for TAH and TAqH are referenced (18 AAC 70.020, based on ecological risk).
μg/L = micrograms per liter; AAC = Alaska Administrative Code; ACM = Alaska cleanup matrix; MCL = maximum contaminant level; mg/kg = milligram per kilogram; ROD = record of decision; TAH = total aromatic hydrocarbons; TAqH = total aqueous hydrocarbons; TCE = trichloroethene; TFH = total fuel hydrocarbons

The ROD selected total fuel hydrocarbons (TFH)-diesel and TFH-gas as COCs for groundwater, and TFH-gas and grade 4 jet fuel as COCs in surface water. Because there was no specific cleanup standard for these compounds, the ROD set the cleanup standard at the Alaska water quality criterion for TAH. The ROD-specified cleanup levels for TFH-diesel and TFH-gas were conceptually modified in 1998 to include TAH and TAqH (USAF, 1998e). Because there was no standard for these COCs in groundwater, and because groundwater emerges at the seeps that eventually flow into Ship Creek (an aquaculture resource), the aquaculture water standards for TAH and TAqH are referenced, as documented in the 2005 OU5 memorandum to the site file (USAF, 2005b).

4.4.1 Operable Unit 5 Remedy Implementation and Status

The ROD-selected remedy was designed in 1996 (USAF, 1996b) and constructed and implemented in 1997 (USAF, 1998e). The major components of the selected remedy, as updated, and the current status of each, are provided in Table 4-14.

Table 4-14
Operable Unit 5 Remedy Implementation Status

Remedy Component	Brief Status
Groundwater	
Institutional controls (also known as LUCs) on land use and water use restrictions will restrict access to the contaminated groundwater throughout OU5 until cleanup levels have been achieved.	Implemented in July 1998.
Groundwater will be monitored to estimate the rate of natural attenuation, to provide an early warning of potential off-site contaminant migration, and to ensure protection of human health and the environment.	Ongoing. Monitoring frequency decision guide was adopted in 2003.
Seeps	
Seep water will be passively extracted from areas of contamination along the western and central bluffs. The water will be drained to the constructed wetland where enhanced natural chemical, physical and biological processes will reduce contamination below cleanup levels. Baffles will be installed to control flow of water and maintain retention time, and native vegetation will be put in place to help degrade contaminants.	Ongoing. Five newly discovered contaminated seeps were incorporated into the WRS in 2005. Decision guides for modifying the WRS due to changes in seep contaminant concentrations were adopted in 2005.
The constructed wetland was built in the recommended location at the snowmelt pond, and a layer of gravel was placed over pond sediment.	Completed in 1997.
Water will be monitored near the exit of the WRS to ensure that the wetland is reducing concentrations below Alaska water quality standards.	Ongoing.
Natural attenuation will be relied upon to treat seep and surface water in the beaver pond wetland area.	Ongoing.

Table 4-14 (Continued)
Operable Unit 5 Remedy Implementation Status

Remedy Component	Brief Status
Water from seeps and beaver pond wetland areas will be monitored to estimate the rate of natural attenuation and make sure that contamination does not reach Ship Creek.	Ongoing.
Soil	
Approximately 3,000 cubic yards of fuel-product contaminated soil will be excavated in the western and central areas and transported to an on-base treatment facility. Soil removed from the areas of contamination will be replaced by treated soil or clean fill from on base. Soil in the treatment facility will be monitored for contaminant concentration reduction. When the concentrations are below cleanup levels, the soil will be removed and used as fill around the base.	Excavation completed in 1997, and treatment completed in 1999.

LUC = land use control, OU = operable unit, WRS = wetland remediation system

All remedial actions are operating and functional. LUCs (see Section 4.7) have been established (USAF, 1998e) and are being maintained to prevent exposure until cleanup levels are attained.

Groundwater, seep, surface water, and sediment monitoring is ongoing for OU5, though sediment sampling has been discontinued in all except one location due to consistent non-detection. Monitoring plans are updated annually (USAF, 2003g,h, 2004h, 2006c, 2007e, Weston Solutions, Inc., 2007c) to ensure the program remains comprehensive and protective. Groundwater monitoring frequencies are established in accordance with the Basewide Monitoring Program Well Sampling Frequency Decision Guide (see Attachment F, Figure F-1). The concentrations of TCE (the primary remaining COC) at key locations in OU5 are presented in seven figures in Attachment C:

- Figure C-4 illustrates the entire OU5 area and provides a frame of reference for the areas illustrated in subsequent figures;
- Figure C-5 illustrates plume monitoring wells from the west side of OU5;
- Figure C-6 illustrates plume monitoring wells from the east side of OU5;
- Figure C-7 illustrates OU5 early warning and sentry monitoring wells;
- Figure C-8 illustrates OU5 seep and surface water monitoring locations;
- Figure C-9 illustrates monitoring data associated with the “toe” of the Fairchild Avenue plume; and
- Figure C-10 illustrates Ship Creek monitoring locations.

The number of wells, seeps and surface water locations sampled each year at OU5 since 1998 is included in Table 4-15.

Table 4-15
Number of Wells, Seeps and Surface Water Locations Sampled at Operable Unit 5, 1998 to 2007

Year	Number of Wells Sampled	Number of Seeps Sampled	Number of Beaver Pond Seeps and Surface Water Locations Sampled	Number of Ship Creek Surface Water Locations Sampled
1998	20	4	1	7
1999	20	4	1	7
2000	20	4	1	7
2001	17	14	4	7
2002	33	11	6	7
2003	28	12	4	2
2004	44	17	4	2
2005	39	17	4	2
2006	39	17	4	2
2007	39	10	4	None

The groundwater, seep, and surface water sampling program for OU5 is designed to demonstrate protectiveness at the point of compliance, Ship Creek. There are 22 plume wells that are monitored to track natural attenuation of source contamination. Between the plume wells and Ship Creek are six early warning wells and 11 sentry wells (Figure C-7 in Attachment C) that are monitored to determine if the plumes are migrating toward Ship Creek. Seeps along the western and central bluff (many of which are captured by the WRS) and surface water/seeps in the Beaver Pond wetland area are monitored to track contaminant loading into the WRS and Beaver Pond wetland. The effluent from the WRS and the Beaver Pond wetland are monitored prior to their discharge into Ship Creek. Finally, Ship Creek is monitored at two locations. The performance of the natural attenuation remedy is discussed below in the context of each of these components of the monitoring program.

Groundwater monitoring results are evaluated annually, including trend analysis of COCs and assessment of natural attenuation parameters (USAF, 2004b, 2005i, 2006d, 2008b). Over the past five years, several efforts have contributed to and extended this evaluation process, including:

- Updated natural attenuation modeling for Fairchild Avenue and Kenney Avenue plumes in 2003 (USAF, 2004b);
- Six additional groundwater monitoring wells installed in 2003 to better delineate the Fairchild Avenue and Kenney Avenue plumes (USAF, 2004b);
- Three additional groundwater monitoring wells installed in 2004 to better delineate the Fairchild Avenue, SP1-02, and OU5MW-02 contaminant plumes (USAF, 2004h);

- Slammer plume / Beaver Pond wetlands area general review and evaluation in 2004 (USAF, 2004h, 2005i);

- Sampling an expanded suite of wells in 2004 (USAF, 2004h, 2005i) to better delineate Slammer Avenue, Fairchild Avenue, and OU5MW-02 plumes;

- Characterization (including five new monitoring wells) and enhanced bioremediation pilot test at Kenney Avenue plume in 2006 and 2007 (Henry, 2007a); and

- Characterization at Slammer plume in 2006 (Henry, 2007b) and follow-on TRIAD characterization efforts in 2007 (USAF, 2008b).

The results of these efforts have impacted the understanding of the size and shape of the TCE plumes as shown in Attachment C, Figures C-5 (OU 5 West) and C-6 (OU5 East). One of the key findings was that the Slammer Avenue plumes are two separate TCE plumes. In between these two plumes (i.e., in and around Building 7535), TCE concentrations in direct-push samples collected in September 2007 were less than 5 micrograms per liter (µg/L). There was a strong odor and visual evidence of petroleum contamination in groundwater samples collected during the direct-push effort. It is possible that this petroleum contamination provided a source of organic carbon for chlorinated VOC degradation, thereby causing TCE to degrade between these two plumes.

Assessment of the performance of the natural attenuation remedy for groundwater contaminants in OU5 plume wells continues to evolve as more information becomes available during annual evaluations and other studies. The performance of natural attenuation is somewhat mixed. In some wells contaminants are degrading at a rate that will meet the cleanup levels by 2026, while in other wells natural attenuation rates are much slower and some wells do not show decreasing concentration trends (see Section 6.4.4).

More aggressive remedies to accelerate attainment of cleanup levels are being considered (USAF, 2008b), and a pilot-scale test of enhanced bioremediation at the Kenney Avenue plume was initiated in 2006 (Henry, 2007a). The enhanced bioremediation pilot test was not successful due to high groundwater flow rates, and because the organic substrate emulsion was not well retained in the large pore spaces of the aquifer. The technology may be successful if configured differently, such as a bioreactor mode, in a contaminant source area. Additional wells and characterization have improved the delineation of plumes, but, with the exception of the Kenney Avenue plume, source areas have not been identified. If they can be identified, treatment of source areas offers the best opportunity to accelerate attainment of cleanup levels for OU5 plumes. Given that TCE concentrations in OU5 plumes are low (relative to solubility) and spread over a large area, identifying the source areas may prove difficult.

Early warning and sentry wells (Attachment C, Figure C-7) located between the identified plumes and Ship Creek are monitored to detect potential off site migration. The purpose of the early warning well system is to provide an indication of migration sufficiently early (two years) so that funding can be obtained in time to implement contingency measures. Contaminant concentrations in early warning and sentry wells are generally below cleanup levels and are non-detect for many of the wells, indicating that contaminated groundwater from OU5 is not impacting Ship Creek.

The WRS design was completed in 1996 (USAF, 1996b) and construction/installation was complete by August 1997 (USAF, 1998e). Although the WRS was designed to treat petroleum contaminants, it is currently treating chlorinated solvent contaminants. Despite the change in contaminant type, the WRS is effectively treating contaminants (USAF, 1998h, 2004e, 2005i, 2006i, 2007e, Weston Solutions, Inc., 2007d), and is routinely maintained according to the O&M Manual (USAF, 2005f, Weston Solutions, Inc., 2007d). Originally, the WRS included four seep collection areas (Seeps 1, 2, 3 and 4, see Attachment C, Figure C-8 [Seeps]) that passively drained to three pump stations. Water collected in the pump stations is pumped to the Overland Flow Cell where it is aerated before entering the engineered wetland cell. In May 2007, because contaminants in Seep 4 have consistently been below detection, the pump station associated with Seep 4 was mothballed (Weston Solutions, Inc., 2007d) and Seep 4 water no longer flows through the WRS. This action was conducted in accordance with the Decision Guide for Shutting Down WRS Pumping Stations (Attachment F, Figure F-3). Data show that COC concentrations in Seeps 1 and 3 have also been below the cleanup level for the past five years (Figure C-8, Attachment C).

The WRS was modified in 2005 to treat Seeps 9, 10, 11, 17 and 18 (USAF, 2005a,b); these seeps flow directly into the wetland cell without being pumped to the Overland Flow Cell. Since the Overland Flow Cell was designed to add oxygen to seep water to promote aerobic biodegradation of petroleum contaminants, and Seeps 9, 10, 11, 17 and 18 contain TCE that degrades by an anaerobic process, bypassing the Overland Flow Cell does not impact effectiveness of the WRS treatment process.

Water samples are collected from four WRS locations (Attachment C, Figure C-8) to monitor the effectiveness of treatment. Water samples from the WRS influent (WCSW-01) and effluent (WCSW-02) locations have been monitored for COCs since January 1998 (USAF, 1999c). Monitoring at an intermediate location (WCSW-03, near the influent for Seeps 9, 10 and 11) was initiated in 2005 (USAF, 2006i). A second intermediate location (WCSW-04, near the influent for Seeps 17 and 18) has been monitored since 2006 (USAF, 2007e). WRS locations have generally been sampled quarterly. Contaminant concentrations in WRS effluent have consistently met the cleanup levels (USAF, 2004e, 2005i, 2006i, 2007e, 2008d, Weston Solutions, Inc., 2007d). WRS sediment is monitored near where Seeps 9, 10, and 11 discharge into the wetland cell (near surface water sampling location WCSW-03). Sediment has been sampled six times between 2004 and 2006 and analyzed for VOCs. VOC concentrations have usually been below detection and always been below 18 AAC 75 Table B1 cleanup levels for soil.

The majority of the shallow aquifer at the eastern end of OU5 discharges into wetlands adjacent to Ship Creek (Beaver Pond wetland area), which in turn discharges into Ship Creek. In 2007, groundwater samples were collected along the northern perimeter of the Beaver Pond and drainage ditch that flows into the Beaver Pond. Surface water samples (Attachment C, Figure C-6 [OU5 East]) were also collected from these two water bodies. TCE concentrations in both surface water and groundwater samples collected east of GW-4A were among the highest levels detected during the September 2007 mobilization, up to 39 µg/L. TCE concentrations in all groundwater samples collected on the northern perimeter of the Beaver Pond were below detection, with *cis*-1,2-DCE (an intermediate degradation product of both tetrachloroethene [PCE] and TCE) detected in one of the four sampled locations. This combination of observations suggests that groundwater discharge to the drainage ditch may be a primary source of TCE contamination in the Beaver Pond, with little or no TCE discharging directly from groundwater into the northern portion of the Beaver Pond due to a weaker contaminant source and/or natural attenuation. A petroleum hydrocarbon sheen and strong diesel odor were observed in the northern portion of the Beaver Pond, suggesting that petroleum hydrocarbons may provide a carbon source for degradation of TCE and other chlorinated VOCs in this area. The Beaver Pond wetland area is monitored quarterly, and the discharge point consistently meets cleanup levels (USAF, 2004e, 2005i, 2006i, 2007e, 2008b, Weston Solutions, Inc., 2007d).

Surface water in Ship Creek (Attachment C, Figure C-10) was monitored annually in 2003 through 2006 at locations up- and downstream of OU5 (USAF, 2004b,h, 2006c, 2007e). Ship Creek surface water was not monitored in 2007 due to a funding shortfall, but will be monitored again in 2008.

4.4.2 Operable Unit 5 Systems Operations and Maintenance

The WRS system operated 100 percent of the time in 2007. Several pump failures (usually due to a failed seal) were experienced, but pumps were replaced and repaired, and seep water did not bypass the WRS. Annual technical reports (USAF, 2004e, 2005a,i, 2006i, 2007e, Weston Solutions, Inc., 2007b,d), produced each year since system startup, provide detailed information regarding system monitoring, operation, and maintenance tasks that have been performed. Several practices are in place at the WRS to ensure continued operation of the system as designed. They include the following:

- An updated O&M manual (USAF, 2005f, Weston Solutions, Inc., 2007d) was developed to provide standard procedures to ensure protectiveness of the system. The manual also provides procedures for troubleshooting and sampling;

- The influent and effluent of the WRS are sampled quarterly. The resulting analytical data are reviewed and evaluated annually;

- Flow is monitored in the wetland cell to ensure proper residence time;

- Maintenance of the WRS includes daily, weekly, quarterly, and annual site visits and procedures. The system was installed with an automated system that notifies the operating team in the case of a power outage, pump failure, high water levels, or other critical system malfunction. Visual inspections of the system occur on a weekly basis. The inspections include visual checks of system components, water conditions, and any site conditions that may adversely affect operation of the system. Water in the pump stations, overland flow cell, and wetlands are checked for the presence of sheen or odor. Further, seep areas are checked for the presence of any new seeps, and contamination if new seeps are found; and

- Typical maintenance tasks include pump maintenance, pump station and transport piping cleanout, and iron precipitate removal.

Annual system O&M costs include planning and management, operation and maintenance of the WRS, sampling, monitoring, reporting, and five-year reviews. In the ROD, annual costs for the OU5 remedy were estimated to be $80,000 per year. Total costs for the review period FY2004 through FY2008 are presented in Table 4-16.

Table 4-16
Operations and Maintenance Costs for Operable Unit 5, FY1995 through FY2007

Fiscal Year	Wetland Remediation System Operation	Groundwater and Seep Monitoring	Land Use Controls Plan	Five-Year Review	Total Costs*
1995	--	$51,140	--	--	$51,000
1996	--	$38,007	--	--	$38,000
1997	--	$129,000	--	--	$129,000
1998	$53,827	$129,000	--	--	$183,000
1999	$203,275	$119,353	--	--	$323,000
2000	$225,317	$124,292	--	--	$350,000
2001	$208,986	$106,322	--	--	$315,000
2002	$212,485	$101,193	$1,792	$2,074	$317,000
2003	$286,530	$162,316	--	--	$449,000
2004	$437,163	$172,188	--	--	$609,000
2005	$332,110	$148,027	--	--	$480,000
2006	$315,105	$98,053	--	--	$413,000
2007	$104,123	$101,558	--	$19,264	$225,000
Total Cost:					$3,882,000

*Total Costs rounded to nearest $1,000.

O&M costs for 2003 through 2007 were obtained from RIPS. The ROD-based estimate of O&M costs appears to have been underestimated. Actual monitoring costs alone are 25 to 100 percent greater than the ROD O&M estimate. O&M of the WRS has been the largest portion of the O&M cost over the last ten years. Optimization of treatment of seeps and surface water at OU5 could result in substantial cost savings. The O&M contractor reported that some of the high O&M costs can be attributed to maintenance of pumps and a high frequency of alarms due to corrupted program control logic in the automated alarm system.

4.5 OPERABLE UNIT 6

OU6 consists of three source areas located north of the Elmendorf Moraine (LF04, WP14, and SD15) and three source areas located south of Ship Creek (LF02, LF03, and SD73) (Figure A-1, Attachment A). LF02, LF03, and LF04 are former landfills. LF04, which overlooks Knik Arm of Cook Inlet, was used as a surface dump from 1945 to 1957. Exposed debris from LF04 North frequently drifts down the bluff. WP14 and SD15 were petroleum, oil, and lubricant sludge disposal pits. SD73 consisted of surface drains in a building once used as a rock-testing laboratory with a surface disposal area next to the building. Table 2-1 provides a brief summary of the chronology of events at OU6.

A seventh source area, SS19, was included in the OU6 ROD even though it was not technically part of OU6. During 1995, an expedited response action to remove soil that was contaminated with the pesticide dieldrin was completed at SS19. As a result of the successful completion of the response action, the agencies have agreed this source area qualifies as NFA because the contaminated soils at SS19 have been satisfactorily removed and the residual risk is at an acceptable level. The 1997 ROD for OU6 documents the removal action and NFA designation for SS19.

Pre-ROD response actions included the removal of a UST and petroleum contaminated soils in the vicinity of the pump house building (state program site PL81) in 1996. Although this is a state program site, the source is suspected to contribute to contamination at LF04 South. In addition, at LF02 removal of surface debris was conducted in fall 1996 and soil covers were constructed over three areas to minimize potential human exposure to lead contaminated soils.

The OU6 ROD was signed on January 27, 1997 (USAF, 1997b). Remedial actions were specified for each individual source area, including a high-vacuum extraction (HVE) system to treat contaminated groundwater and soil at SD15; excavation of contaminated soil at SD15; periodic free product recovery at WP14 and LF04; annual removal of landfill debris along the beach (now Port of Anchorage expansion area) below LF04; exposed debris removal and limited covers at LF02; groundwater, surface water, and soil sampling at various source areas; and LUCs for LF02, LF03, LF04, WP14 and SD15. Due to minimal contamination, the OU6 ROD designated SD73 as NFA and selected LUCs as the only remedy for LF03.

The ROD was updated by a memorandum to the site file to update monitoring frequency and establish a sampling frequency decision guide (USAF, 2003f) in September 2003. The sampling frequency decision guide is presented in Attachment F, Figure F-1. The ROD was updated with an explanation of significant differences (ESD) in March 2007 (USAF, 2007a). The ESD modified the SD15 remedy so that HVE system operations could be terminated because that system was no longer effective, and monitored natural attenuation (MNA) was selected as the remedy for the remaining contaminants. The ESD also adopted a new state cleanup standard for 1,1,2,2-tetrachloroethane in groundwater at LF02 and SD15. The OU6 ROD identified 1,1,2,2-tetrachloroethane as a COC for LF02 and SD15 groundwater, but no ARAR existed at that time. Finally, the ESD also provided details on how LUCs would be implemented to comply with Air Force policy. The ESD did not change the LUC performance objectives from the ROD. The ROD was updated again by a memorandum to the site file in 2008 (USAF, 2008e) to indicate that the beach below LF04 North has been filled as part of the Port of Anchorage expansion. The USAF will continue to remove debris annually from the base of the bluff (i.e., the location of the former beach). The expansion of the port facilities will reduce wave-action erosion at LF04, and has also covered what was once the beach area, where sediment samples were formerly collected. Sediment samples are no longer collected and were last collected in 2002.

Specific RAOs were developed for each source area at OU6.

- Prevent the ingestion, dermal contact, and inhalation of vapors from the groundwater at LF04 South having benzene, toluene, ethylbenzene, 1,2-dichloroethane and methylene chloride in excess of MCLs and/or resulting in a cancer risk greater than 1.0×10^{-6} or Hazard Index greater than 1.0;

- Mitigate human dermal exposure, to the extent practicable, to landfill waste or debris at LF04 North;

- Mitigate exposure, to the extent practicable, of environmentally sensitive receptors to landfill waste at LF04 North. Relevant exposure pathways for wildlife include incidental ingestion of contaminated soil, ingestion of contaminated vegetation, and ingestion of contaminated animals (e.g., insects and earthworms);

- Prevent the ingestion, dermal contact, and inhalation of vapors from the groundwater at WP14 having benzene, ethylbenzene, and toluene in excess of MCLs and/or resulting in a cancer risk greater than 1.0×10^{-6} or Hazard Index greater than 1.0;

- Prevent the domestic use (i.e., use resulting from ingestion and dermal contact of water, and inhalation of vapors) of water in the perched aquifer at SD15, having benzene, ethylbenzene, toluene, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,2-dichloroethane, and TCE in excess of MCLs and/or resulting in a cancer risk greater than 1.0×10^{-6} or Hazard Index greater than 1.0;

- Prevent the possible migration of contaminants from soils at SD15 that have DRO, gasoline-range organics (GRO), and BTEX concentrations exceeding Alaska cleanup matrix (ACM) Level D;

- Prevent the ingestion and dermal contact of water, and inhalation of vapors from water while bathing, for water from LF02 having 1,1,2,2-tetrachloroethane in excess of cleanup goals and/or resulting in a cancer risk greater than 1.0×10^{-6};

- Mitigate, to the extent practicable, human dermal exposure with lead contaminated shallow soils and exposed landfill waste or debris present on the LF02 landfill surface; and

- Preserve existing vegetation and ecological habitat at LF02 to the extent practicable.

The cleanup levels identified in the OU6 ROD and ROD updates, which are generally based on MCLs for groundwater and ACM Level D for soil contamination, are summarized in Table 4-17.

Table 4-17
Cleanup Levels at Operable Unit 6

Location	Contaminant of Concern	ROD-Established Cleanup Level	Source of Requirement
Groundwater (µg/L)			
LF04 (South)	Benzene	5	MCL[1]
	Ethylbenzene	700	MCL[1]
	Toluene	1,000	MCL[1]
	1,2-Dichloroethane	5	MCL[1]
	Methylene Chloride	5	MCL[1]
WP14	Benzene	5	MCL[1]
	Ethylbenzene	700	MCL[1]
	Toluene	1,000	MCL[1]

Table 4-17 (Continued)
Cleanup Levels at Operable Unit 6

Location	Contaminant of Concern	ROD-Established Cleanup Level	Source of Requirement
SD15	Benzene	5	MCL[1]
	Ethylbenzene	700	MCL[1]
	Toluene	1,000	MCL[1]
	1,1,2,2-Tetrachloroethane	4	18 AAC 75.345[2]
	1,1,2-Trichloroethane	5	MCL[1]
	1,2-Dichloroethane	5	MCL[1]
	Trichloroethene	5	MCL[1]
LF02	1,1,2,2-Tetrachloroethane	4	18 AAC 75.345[2]
Soils (mg/kg)			
LF04 (North)	Exposed landfill debris	--	18 AAC 60.390
SD15	Gasoline-Range Organics	1,000	ACM, Level D[3]
	Diesel-Range Organics	2,000	ACM, Level D[3]
	BTEX	100	ACM, Level D[3]
LF02	Lead	--[4]	
	Exposed landfill debris	--[4]	18 AAC 60.390

[1]Basis for cleanup level is MCL; 40 CFR § 141.61 for federal MCLs and 18 AAC 80.070 for state standards established in the OU6 ROD (USAF, 1997a).
[2]Basis for cleanup level is 18 AAC 75.345. ROD cleanup level updated in the OU6 ESD (USAF, 2007a).
[3]Basis for cleanup level is ACM; 18 AAC 78.315 established in the OU6 ROD (USAF, 1997a).
[4]ROD des not specify cleanup levels because risk analysis resulted in hazard index below standards. A lead uptake/biokinetic model was the basis of listing lead as a COC. For exposed landfill debris, Alaska Solid Waste regulations 18 AAC 60.390 for landfill closure apply (USAF, 1997a).
μg/L = micrograms per liter; AAC = Alaska Administrative Code; ACM = Alaska cleanup matrix; BTEX = benzene, toluene, ethylbenzene, and xylenes; MCL = maximum contaminant level; mg/kg = milligram per kilogram; ROD = record of decision

4.5.1 Operable Unit 6 Remedy Implementation and Status

The major components of the selected remedy and current status of each is provided in Table 4-18.

Table 4-18
Operable Unit 6 Remedy Implementation Status

Remedy Component	Status
Source Area WP14	
Groundwater at WP14	
Institutional controls (also known as LUCs) on land and water use, as specified in the *Base General Plan*, will restrict access to the contaminated groundwater throughout WP14. Installation of wells in the contaminated plume for residential, industrial, and agricultural use will be prohibited by the *Base General Plan*. (LUCs will be managed and implemented in accordance with the June 2007 ESD, Section 4.3.)	Implemented in August 1998. LUC procedures were updated and clarified in the 2007 ESD.
Groundwater will be monitored and evaluated on a frequency determined by the "Basewide Monitoring Program Well Sampling Frequency Decision Guide" to determine contaminant migration and to track the progress of contaminant degradation and dispersion, as well as to provide an early indication of unforeseen environmental or human health risk. Five-year reviews will also assess the protectiveness of the remedial action, including an evaluation of any changed site conditions, as long as contamination remains above cleanup levels.	Monitoring is ongoing to evaluate natural attenuation. Monitoring frequency decision guide was adopted in 2003. Five-year reviews were conducted in 1998, 2003 and 2008.
Recoverable quantities of free product found on top of the water table at WP14 will be regularly removed during groundwater monitoring events.	Ongoing. No recoverable quantities of free product have been detected since 2005.
Groundwater monitoring will be discontinued if contaminant levels are below cleanup levels during two consecutive monitoring events. In that case, no further action for groundwater will be required. During the final round of monitoring, samples will be collected and analyzed for all constituents that exceeded MCLs during the 1994 investigation including VOCs, semivolatile organic compounds, and metals. These results will be evaluated before a final determination is made that groundwater meets all cleanup requirements.	Groundwater monitoring is ongoing at all sites as required by the OU6 ROD. Contaminant concentrations are below cleanup levels at LF02. Final monitoring has been recommended for LF02.
All groundwater is expected to be cleaned up within 14 years.	Groundwater cleanup is on-going and current trends predict it will be completed in 16 years (2013).
Soil at WP14	
No further action will be required for the soil at WP14.	No further action.

Table 4-18 (Continued)
Operable Unit 6 Remedy Implementation Status

Remedy Component	**Status**
Source Area LF04	
Groundwater at LF04 North/Beach	
No further action is required for the groundwater at LF04 North/Beach.	No further action.
Groundwater at LF04 South	
Access to groundwater at LF04 South will be institutionally controlled. LF04 is currently designated as a "restricted use area" in the *Base General Plan*. This designation provides for recreational use of the parcel (e.g., cross country skiing) and for construction of unmanned facilities such as a parking lot, storage building, or taxiway, but prohibits the construction of any sort of manned facility such as an office building or a residence. Drilling into the shallow aquifer is also restricted by the *Base General Plan* to prohibit residential or agricultural use of contaminated groundwater. (LUCs will be managed and implemented in accordance with the June 2007 ESD, Section 4.3.)	Implemented August 1998. LUC procedures were updated and clarified in the 2007 ESD.
Groundwater will be monitored and evaluated on a frequency determined by the "Basewide Monitoring Program Well Sampling Frequency Decision Guide" to determine contaminant migration and to track the progress of contaminant degradation and dispersion, as well as to provide an early indication of unforeseen environmental or human health risk. Five-year reviews will also assess the protectiveness of the remedial action, including an evaluation of any changed site conditions, as long as contamination remains above cleanup levels.	Monitoring is ongoing to evaluate natural attenuation. Monitoring frequency decision guide was adopted in 2003. Five-year reviews were conducted in 1998, 2003 and 2008.
Recoverable quantities of free product found on top of the water table at LF04 South will be regularly removed during groundwater monitoring events.	Ongoing. No recoverable quantities of free product have been detected since 2005.
Groundwater monitoring will be discontinued if contaminant levels are below cleanup levels during two consecutive monitoring events. In that case, no further action for groundwater will be required. During the final round of monitoring, samples will be collected and analyzed for all constituents that exceeded MCLs during the 1994 investigation including VOCs, semivolatile organic compounds, and metals. These results will be evaluated before a final determination is made that groundwater meets all cleanup requirements.	Groundwater monitoring is ongoing as required by the OU6 ROD.

Table 4-18 (Continued)
Operable Unit 6 Remedy Implementation Status

Remedy Component	**Status**
All groundwater is expected to be cleaned up within 14 years.	Groundwater cleanup is on-going and current trends predict it will be completed in 16 years (2013).
Soil at LF04 North	
Access to soil at LF04 North will be institutionally controlled. LF04 is currently designated as a "restricted use area" in the *Base General Plan*. This designation provides for recreational use of the parcel (e.g., cross country skiing) and for construction of unmanned facilities such as a parking lot, storage building, or taxiway, but prohibits the construction of any sort of manned facility such as an office building or a residence. (LUCs will be managed and implemented in accordance with the June 2007 ESD, Section 4.3.) .	Implemented August 1998. LUC procedures were updated and clarified in the 2007 ESD. Reference to "beach" in the ROD was removed by the 2008 memorandum to the site file when the Port of Anchorage filled in the former beach below LF04 North with soil and gravel as part of its facility expansion in 2007.
No further action is required for soil contamination at LF04 North; however, landfill debris on the Port of Anchorage fill that is adjacent to LF04 will be removed annually as the specific remedy for this area. The removal of debris will include all LF04 landfill material that has fallen onto the newly constructed Port of Anchorage fill and can be reasonably collected for disposal, as well as debris on the bluff slope or other low lying areas which can be accessed and removed without hazard. Hazardous materials encountered during the annual removal events will be handled according to appropriate regulations. The removal of debris from LF04 is expected to continue annually for 30 years or as long as the landfill remains subject to erosional action. Five-year reviews will assess the protectiveness of the remedial action, including an evaluation of any changed site conditions.	Debris removal conducted annually since 1997. The Port of Anchorage filled in the former beach below LF04 North with soil and gravel as part of its facility expansion in 2007, and this changed condition was documented in a 2008 memorandum to the site file. Five year reviews were conducted in 1998, 2003 and 2008.
No further action will be required as a means of closing the LF04 landfill.	No further action.
Soil at LF04 South	
No further action is required for the soil at LF04 South.	No further action.
Source Area SD15	
Perched Aquifer Groundwater at SD15	
Institutional controls (also known as LUCs) on land and water use, as specified in the *Base General Plan*, will restrict access to the contaminated groundwater throughout SD15. Installation of wells in the contaminated plume for	Implemented in August 1998. LUC procedures were updated and clarified in the 2007 ESD.

Table 4-18 (Continued)
Operable Unit 6 Remedy Implementation Status

Remedy Component	**Status**
residential, industrial, and agricultural use will be prohibited by the *Base General Plan*. (LUCs will be managed and implemented in accordance with the June 2007 ESD, Section 4.3.)	
Groundwater in the perched aquifer at SD15 will be treated by HVE and MNA to remove fuel related contaminants and halogenated VOCs. Treated water will be reinjected into the subsurface beyond the boundary of the contaminated aquifer. Reinjected water will be regularly monitored to ensure it meets cleanup and risk requirements. Recoverable quantities of free product found on top of the water table at SD15 will be removed through the HVE process. HVE will be terminated when operations become ineffective. MNA will be used to reduce remaining groundwater contaminant concentrations to below cleanup levels.	The HVE was installed and began operating in 1996, and operated for over 10 years. Remedy modified by 2007 ESD. The HVE system was permanently shut down in May 2007 when it was no longer effectively removing contaminants. The 2007 ESD selected MNA as the remedy for the remaining groundwater contamination at SD15, which is ongoing.
Groundwater in the perched aquifer at SD15 will be monitored and evaluated on a frequency determined by the "Basewide Monitoring Program Well Sampling Frequency Decision Guide" to determine contaminant migration, to track the progress of contaminant degradation and dispersion and progress of the SD15 HVE treatment, as well as to provide an early indication of unforeseen environmental or human health risk. Five-year reviews will also assess the protectiveness of the remedial action, including an evaluation of any changed site conditions, as long as contamination remains above cleanup levels.	Monitoring is ongoing to evaluate MNA. Monitoring frequencies decision guide was adopted in 2003. HVE treatment at SD15 was completed and shut down in 2007, and MNA was selected as the remedy for the remaining groundwater contamination. Five-year reviews were conducted in 1998, 2003, and 2008.
During the final round of monitoring, samples will be collected and analyzed for all constituents that exceeded MCLs during the 1994 investigation including VOCs and arsenic. These results will be evaluated before a final determination is made that groundwater meets all cleanup requirements.	Groundwater monitoring is ongoing at all sites as required by the OU6 ROD.
All groundwater is expected to be cleaned up within 5 years.	Groundwater cleanup is on-going and current trends predict it will be completed in 27 years (2023).
Deep Aquifer Groundwater at SD15	
No further action is required for the deep aquifer groundwater at SD15.	No further action.
Soil at SD15	

Table 4-18 (Continued)
Operable Unit 6 Remedy Implementation Status

Remedy Component	Status
Shallow soils (less than five feet deep) with contamination above cleanup levels will be excavated, removed, and thermally treated to eliminate fuel-related contaminants. After treatment, no further action will be required for the shallow soils. Shallow soil will also be included in the HVE extraction treatability study.	Excavation/thermal treatment completed in 1997. Additional contaminated shallow soils were treated with HVE and soil vapor extraction (SVE). All shallow soils met cleanup levels as of 2005.
Deep soils at SD15 will be actively treated through air stripping associated with the HVE process described for the perched aquifer groundwater.	All SD15 soils met cleanup levels as of 2005.
Soils with contamination above cleanup levels will be sampled one year after HVE system start up and every three years thereafter to evaluate contaminant migration and timely reduction of contaminant concentrations by HVE. If cleanup levels are not being achieved, further remedial action will be evaluated. This will include five-year reviews to assess the protectiveness of the remedial action, including an evaluation of any changed site conditions, as long as contamination remains above cleanup levels.	All SD15 soils met cleanup levels as of 2005. Five-year reviews were conducted in 1998, 2003, and 2005.
HVE will be terminated when operations become ineffective. MNA will be used to reduce groundwater contaminant concentrations below cleanup levels.	The HVE system was permanently shut down in May 2007 when it was no longer effective removing contaminants, in accordance with the 2007 ESD. The 2007 ESD selected MNA as the remedy for the remaining groundwater contamination at SD15, which is ongoing.
All soils are expected to be cleaned up within 5 years.	All soils were cleaned up in nine years (since 2005).
Source Area LF02	
Groundwater at LF02 (Including Seeps)	
Access to groundwater at LF02 will be institutionally controlled. LF02 is currently designated as a "restricted use area" in the *Base General Plan*. This designation provides for recreational use of the parcel (e.g., cross country skiing) and for construction of unmanned facilities such as a parking lot, storage building, or taxiway, but prohibits the construction of any sort of manned facility such as an office building or a residence. Drilling into the shallow aquifer is also restricted by the *Base General Plan* to prohibit	Implemented September 1997. LUC procedures were updated and clarified in the 2007 ESD.

Table 4-18 (Continued)
Operable Unit 6 Remedy Implementation Status

Remedy Component	Status
residential or agricultural use of contaminated groundwater. (LUCs will be managed and implemented in accordance with the June 2007 ESD, Section 4.3.)	
Groundwater will be monitored and evaluated on a frequency determined by the "Basewide Monitoring Program Well Sampling Frequency Decision Guide" to determine contaminant migration and to track the progress of contaminant degradation and dispersion, as well as to provide an early indication of unforeseen environmental or human health risk. Five-year reviews will also assess the protectiveness of the remedial action, including an evaluation of any changed site conditions, as long as contamination remains above cleanup levels.	Monitoring is ongoing to evaluate natural attenuation. Monitoring frequency decision guide was adopted in 2003. Five-year reviews were conducted in 1998, 2003 and 2008.
Groundwater monitoring will be discontinued if contaminant levels are below cleanup levels during two consecutive monitoring events. In that case, no further action for groundwater will be required. During the final round of monitoring, samples will be collected and analyzed for all constituents that exceeded MCLs during the 1994 investigation including VOCs and semivolatile organic compounds. These results will be evaluated before a final determination is made that groundwater meets all cleanup requirements.	Groundwater monitoring is ongoing as required by the OU6 ROD. Contaminant concentrations are below cleanup levels at LF02 and final monitoring has been recommended.
All groundwater is expected to be cleaned up within 23 years.	Groundwater cleanup for LF02 appears to be complete after six years (since 2003).
Soil at LF02	
Access to soil at LF02 will be institutionally controlled. LF02 is currently designated as a "restricted use area" in the *Base General Plan*. This designation provides for recreational use of the parcel (e.g., cross country skiing) and for construction of unmanned facilities such as a parking lot, storage building, or taxiway, but prohibits the construction of any sort of manned facility such as an office building or a residence. (LUCs will be managed and implemented in accordance with the June 2007 ESD, Section 4.3.)	Implemented September 1997. LUC procedures were updated and clarified in the 2007 ESD.
A limited soil cover will be applied in three areas with elevated lead concentrations at LF02. This will eliminate the pathway for contact with the lead contamination. Five-year reviews will be conducted to evaluate the integrity of the cover, evaluate impacts from any changed site conditions, and assess the continued protectiveness of this remedial	Soil covers and exposed debris removal completed in October 1996. Five-year reviews were conducted in 1998, 2003 and 2008.

Table 4-18 (Continued)
Operable Unit 6 Remedy Implementation Status

Remedy Component	**Status**
action. Landfill debris on top of or protruding from the ground surface at LF02 will also be removed as part of the specific remedy for this area. Hazardous materials encountered during the removal event will be handled according to appropriate regulations. No further action will be required as a means of closing the LF02 landfill.	
LF03 Source Area	
Groundwater at LF03	
Access to groundwater at LF03 will be institutionally controlled. LF03 is currently designated as a "restricted use area" in the *Base General Plan*. This designation provides for recreational use of the parcel (e.g., cross country skiing) and for construction of unmanned facilities such as a parking lot, storage building, or taxiway, but prohibits the construction of any sort of manned facility such as an office building or a residence. Drilling into the shallow aquifer is also restricted by the *Base General Plan* to prohibit residential or agricultural use of contaminated groundwater. (LUCs will be managed and implemented in accordance with the June 2007 ESD, Section 4.3.)	Implemented August 1998. LUC procedures were updated and clarified in the 2007 ESD.
Soil at LF03	
Access to soil at LF03 will be institutionally controlled. LF03 is currently designated as a "restricted use area" in the *Base General Plan*. This designation provides for recreational use of the parcel (e.g., cross country skiing) and for construction of unmanned facilities such as a parking lot, storage building, or taxiway, but prohibits the construction of any sort of manned facility such as an office building or a residence. (LUCs will be managed and implemented in accordance with the June 2007 ESD, Section 4.3.)	Implemented August 1998. LUC procedures were updated and clarified in the 2007 ESD.

μg/L = micrograms per liter; ESD = explanation of significant differences; HVE = high-vacuum extraction; LUC = land use control; MCL = maximum contaminant level; MNA = monitored natural attenuation; OU = operable unit; VOC= volatile organic compound; SVE = soil vapor extraction

The design and construction of the remedies were conducted as a series of treatability studies which, once proved successful, were adopted as the final remedy (USAF, 1997d). These treatability studies included:

- The initial landfill debris cleanup from the beach below LF04 conducted in June 1997 to determine the best practices for debris removal for future efforts (USAF, 1998a);
- Design (USAF, 1997a) and implementation (USAF, 1997c) of debris removal and limited soil cover at LF02, completed in October 1996;

- Excavation and thermal treatment of shallow soils at SD15, conducted and completed in June and July 1996 (USAF, 1996e); and

- Design (USAF, 1996d), construction, startup, and implementation of a treatability study (USAF, 1998c) of the HVE system at SD15, which became fully operational as of December 11, 1996.

Implementation of all components of the remedy was documented in the *Operable Unit 6 Remedial Action Report* (USAF, 1998f). As of February 20, 1998, USEPA and ADEC concurred that all OU6 remedy components were in place and functional. The OU6 remedy components continue to be operational and functional over the past five years, and the performance of each remedial action component is described below.

Groundwater is monitored at LF02, LF04 South, WP14, and SD15. LF04 South monitoring wells are evaluated in annual reports as part of the monitoring programs for WP14 and a state program site, PL81. The groundwater monitoring program is updated annually (USAF, 2003g,h, 2004h, 2006c, 2007e,g, 2008f, Weston Solutions, Inc., 2007a) in accordance with the monitoring frequency decision guide (Attachment F, Figure F-1) to ensure the program remains comprehensive and protective. Several key changes were made to the monitoring plan during the past five years. Four wells were eliminated from the LF04 South monitoring program beginning in 2003. Wells OU6MW-81 and OU6MW-82 were eliminated because they are screened in a deeper aquifer. Well OU6MW-67 was eliminated because it was a redundant sampling point, and well OU6MW-77 was eliminated because of the presence of free product (USAF, 2003a). Beginning in 2007, LF04 seeps LF04SP-01, LF04SP-05, LF04SP-06, and LF04SP-07 were eliminated from the sampling program due to consistent non-detection of contaminants (USAF, 2008f).

The purpose for monitoring at OU6 is to assess contaminant migration and the timely reduction of contaminant concentrations by natural attenuation, and, prior to its shutdown, to monitor progress of the HVE system at SD15. Figures C-11, C-12 and C-13 in Attachment C present the results of COCs that are above the cleanup level at key wells in OU6. The number of wells and seeps sampled each year at OU6 since 1998 is presented in Table 4-19.

Table 4-19
Number of Wells and Seeps and Surface Water Locations Sampled at Operable Unit 6, 1998 to 2007

Year	Number of Wells Sampled	Number of Seeps Sampled
1998	22	0
1999	22	0
2000	20	0
2001	19	0
2002	15	9
2003	9	9
2004	6	9
2005	7	9
2006	9	9
2007	11	5

Note: PL81 South wells and seeps are included in this table because they provide information about groundwater at LF04 South.

Groundwater monitoring results are evaluated annually, including trend analysis of COCs and assessment of natural attenuation parameters (USAF, 2004b, 2005i, 2006d, 2007g, 2008b,c,f). In addition, natural attenuation was assessed with an USEPA scoring model (Wiedemeier et al., 1998) for chlorinated solvents at SD15 and qualitatively for fuel contaminants at WP14 (USAF, 2005i). These assessments generally confirm that the natural attenuation components of the OU6 remedy are performing as originally envisioned. Groundwater at LF02 currently meets cleanup levels, and groundwater at LF04 South may also meet cleanup levels for chlorinated solvent COCs (see Section 6.4.5). Groundwater contaminants at WP14 and SD15 have reached, or are rapidly approaching, cleanup levels for most COCs in most wells. There are only a few exceptions which are discussed in detail in Section 6.4.5.

Wells at WP14 and LF04 South were checked annually for free product. If more than 0.1 foot of product is detected in a well, the free product is removed. Free product in excess of 0.1 foot was discovered in only one well at these sites during the past five years (1.16 feet in well OU6MW-77 in 2005, USAF, 2006c), and the product recovered was negligible. It is unlikely that any recoverable free product remains at existing well locations at these sites.

The beach or Port of Anchorage expansion area (since 2007) below LF04 was inspected periodically and debris was removed annually (USAF, 2004a, 2005e, 2006h, 2007g, 2008f). Debris collected has been disposed of in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan - Off-Site Disposal Rule, 40 CFR § 300.440. The debris removal activities are summarized in Table 4-20.

Table 4-20
Debris Removal from LF04 North

Year	Quantity Removed (Tons)	Material Classification	Other Material Removed
1997	98	General debris, mostly metal	One roll of asbestos wrap, one large battery, two small transformers, twenty-five 5-gallon drums and five 5- to 10-gallon drums with unknown contents.
1998	15 10	General debris Recyclable material	No UXO or asbestos-containing material identified.
1999	29	General debris	No asbestos-containing material identified. EOD personnel removed small arms ammunition, shells, casings, and one Howitzer shell casing.
2000	12	Nonhazardous solid waste	No UXO or asbestos-containing material identified
2001	34	Nonhazardous solid waste	No UXO or asbestos-containing material identified. A cylinder with unknown contents was secured in place and left for the next field season.
2002	18	Nonhazardous solid waste, mostly metal, some concrete, rubber, and vehicle parts	Forty rifle casings, one steel cylinder.
2003	16.9	Nonhazardous solid waste, mostly metal, some rubber, electrical components, and wood	One .30- and one .50-caliber shell casing, 820 pounds of asbestos-containing material (pipe).
2004	3.6	Nonhazardous solid waste, mostly metal, some rubber, electrical components, and wood	One previously perforated cylinder apparently containing sea water.
2005	11.1	Nonhazardous solid waste, mostly metal, some rubber, electrical components, and wood	One .50-caliber shell casing, two compromised batteries, 40 pounds of asphaltic material, and 200 pounds of asbestos-containing material (cementitious board and pipe).
2006	7.2	Nonhazardous solid waste, mostly metal, some rubber, electrical components, and wood	100 pounds of asbestos-containing material (pipe), one lighting ballast (PCB).

Table 4-20 (Continued)
Debris Removal from LF04 North

Year	Quantity Removed (Tons)	Material Classification	Other Material Removed
2007	8.5	Nonhazardous solid waste, mostly metal, some electrical components, and wood	Pack of solder rod, a water heater, one lead battery, 120 pounds of asbestos-containing material (cementitious board and pipe)

PCB = polychlorinated biphenyl

The mass of debris from LF04 North that is annually found and removed has generally decreased over the past 11 years. In 2007, the Port of Anchorage expanded its facilities, including filling over most of the former beach area below LF04 North (USAF, 2008e,f). The Port of Anchorage expansion will not change implementation of the LF04 remedies, but may decrease the erosional impact of tides at LF04 North.

Surface soil samples were collected from ten locations at LF04 North in 2007 to determine if contaminant concentrations have changed since the ROD (USAF, 2008f). Sediment samples were not collected because most of the former beach area has been filled by the Port of Anchorage expansion and the remaining sediment collection area will be filled in 2008, as documented in the 2008 memorandum to the site file (USAF, 2008e). Seep sampling at LF04 North was discontinued after 2006 because no significant contamination has ever been detected. Soil sampling results are discussed in Section 6.4.5.

The HVE system at SD15 operated from December 1996 until it was shutdown in May 2007 (USAF, 2004g, 2005h, 2006f, 2007a,d,g, Weston Solutions, Inc., 2007a). Over its 10.5 year lifecycle, the HVE system operated for 53,690 hours or an overall 58 percent operational rate. The HVE system was 68 percent operational between January 2003 and May 2007. The system removed more than 553,600 gallons of water and 7.2 pounds of VOCs through the liquid phase and more than 10,164 pounds of VOCs in the vapor phase. The efficiency of mass removal decreased with time, as shown in Table 4-21.

Table 4-21
Volatile Organic Compound Removal by the High-Vacuum Extraction System at SD15

Year	VOCs Removed (lbs)		
	In Liquid[1]	In HVE Vapor[1]	In SVE Vapor[2]
1997	0.2	7,543	0
1998	6.45	1,060	0
1999	0.52	797	0
2000	0.01	413	0
2001	0.018	220.4	0
2002	0.0005	53.32	0
2003	0.0033	6.24	0
2004	0.0197	0.66	61.16
2005	0.00349	0.30	9.66
2006	0.000095	0.23	0
Total	**7.23**	**10,164**	

[1]The HVE system also operated for four months in 2007, but no vapor concentration measurement was made so mass removal could not be estimated for this timeframe, but it was likely very low.
[2]The SVE system operated in 2004 and 2005 only.
HVE = high-vacuum extraction; SVE = soil vapor extraction; VOC = volatile organic compound

Several upgrades were attempted to improve efficiency, including upgrades to reduce down-time in late 2002 and installation of four shallow soil vapor extraction (SVE) wells in December 2003. These efforts temporarily improved efficiency; the SVE system removed over 90% of the total VOCs removed since 2003. However, the HVE system reached the end of its life-cycle by removing virtually all recoverable contaminants. The HVE system was shut down in May 2007 in accordance with the 2007 OU6 ESD (USAF, 2007a).

At SD15, only benzene and TCE remain above groundwater cleanup levels in wells OU6MW-17 and OU6MW-18. All COCs are below cleanup levels at well OU6MW-90 (USAF, 2008a). Soil sampling conducted in August 2005 confirmed that shallow and deep soil meet cleanup levels for all soil COCs at SD15 (USAF, 2006f).

At OU6, LUCs have been established and are being maintained to prevent exposure until cleanup levels are attained (see Section 4.7). Generally LUC processes include establishing and recording LUC boundaries in the *Base General Plan*, preventing incompatible construction on sites through the Work Clearance Request process, and conducting monitoring/inspections to look for any unauthorized or inappropriate activity (USAF, 2007a). Results of LUC inspections are recorded in annual monitoring reports (USAF, 2008c,f). In addition to these general LUCs, additional controls limit access to soil and debris at LF04:

- Fencing was installed on the south end of LF04 to limit access through the Port of Anchorage and gates were installed on Elmendorf AFB access roads to limit access through Elmendorf AFB. Signs were installed stating that hazards exist at the site and access is not allowed, and authorized visitors are required to sign in when accessing the area through the gate at Knik Bluff Trail; and

- Access control practices that include annual inspection and maintenance of fencing and signs, patrols of the LF04 bluff area by Elmendorf AFB Security Police, and coordination with Port of Anchorage security to monitor and minimize access through the Port of Anchorage were implemented.

4.5.2 Operable Unit 6 Systems Operations and Maintenance

O&M requirements for the SD15 HVE system are detailed in the O&M manual, which has been updated as needed (USAF, 1997f, 2005g). Implementation of these requirements is documented in annual reports. A significant issue encountered during the life of the HVE system was that the operational rate was lower than anticipated in the system design. Extensive troubleshooting identified and resolved several design flaws in late 2002 (USAF, 2003j). During the last five years other problems impacted the operational rate, including failure of the soft starter for the main motor in late 2003, and numerous shut-downs in 2004 due to ice forming in HVE wells in winter and vacuum overload/overheating in summer. The periodic shutdowns were addressed through troubleshooting and maintenance and the operational rate improved. A significant upgrade to the HVE remedy was installation of four shallow SVE wells in late 2003, which served to clean up remaining shallow soil contamination. The HVE and SVE systems were shutdown permanently in May 2007 (USAF, 2007a, Weston Solutions, Inc., 2007a). All soil cleanup goals have been met (USAF, 2006f). The remaining groundwater COCs are being addressed through MNA.

Debris removal at LF04 is conducted in accordance with operations and management plans that are periodically updated (USAF, 1998a, 2001b, 2003i, 2005c).

The estimated annual O&M costs for OU6 as presented in the ROD totaled a maximum of $178,400/year and included:

- WP14/LF04 South groundwater monitoring and free product removal: $46,500/year for 14 years;

- LF04 debris removal: $9,700/year for 30 years;

- SD15 HVE system: $93,900/year for 4.5 years; and

- LF02 groundwater monitoring: $28,300/year for 23 years.

Actual O&M costs for OU6 are presented in Table 4-22.

O&M costs for 2003 through 2007 were obtained from RIPS. O&M costs for OU6 are somewhat inconsistent, but on average are considerably higher than estimated at the time of the ROD. LF04 debris removal was conducted in 2003 and 2005 despite the missing cost data. The cost of LF04 debris removal may decrease in the future because the amount of debris recovered has decreased over time and the Port of Anchorage expansion project may further reduce erosion at LF04. The shutdown of the SD15 HVE system will also decrease future O&M costs. As such, there are no issues with the remaining OU6 O&M costs that indicate future problems with protectiveness of the remedy.

Table 4-22
Operations and Maintenance Costs for Operable Unit 6, FY1996 through FY2007

Fiscal Year	HVE System Operation	LF04 Debris Removal	Groundwater and Seep Monitoring	Land Use Control Plan	Five-Year Review	Total Costs[a]
1996	--[d]	$62,454	$152,029	--	--	$214,000
1997	$81,212	--[e]	$123,000	--	--	$204,000
1998	--[d]	$64,400	$117,500	--	--	$182,000
1999	$137,208	$69,475	$113,667	--	--	$320,000
2000	$130,920	$359,867[b]	$400,034	--	--	$891,000
2001	$154,168	$82,000	$116,982	--	--	$353,000
2002	$171,270	$465,105[c]	$125,018	$9,931	$10,037	$781,000
2003	$31,000	--[e]	$139,845	--	--	$171,000
2004	$206,300	$184,280	$94,013	--	--	$485,000
2005	$191,658	$73,985	$86,428	--	--	$352,000
2006	$164,815	--[e]	$65,999	--	--	$231,000
2007	--[d]	$49,600	$124,891	--	$96,319	$271,000
Total Cost:						$4,455,000

[a]Total costs to the nearest $1000
[b]Cost for LF04 debris removal in FY2000 also includes oral history and erosion studies.
[c]Cost for LF04 debris removal in FY2002 included $380,000 for preparation of Operations Management Plan, which included debris removal in 2003 as part of the plan preparation.
[d]The SD15 HVE system operated from December 1996 through May 2007. There is no record to explain the missing O&M costs for 1996, 1998, and 2007, but O&M costs for these years were likely included in other year totals.
[e]Records show LF04 debris removal has been performed annually since 1997. Costs for 1997 were probably provided in 1996, and 2003 costs were included in the 2002 budget. There is no explanation for the missing cost data for 2006.
HVE = high-vacuum extraction

4.6 SITE DP98

DP98 is located in the northwest portion of the base, northwest of Buildings 18220 and 18224 (formerly Buildings 41-755 and 41-760) (Figure A-1, Attachment A). DP98 is situated on the local topographic rise that slopes downward to the north into a wetland area approximately 400 feet from Building 18224 (USAF, 2004d). The underlying unconfined aquifer has a total saturated thickness ranging from 5 to 65 feet and generally flows to the north. The seeps are intermittent and occur during or following high rainfall events. The wetland receives runoff water in the spring and the rest of the year it is dry.

The DP98 ROD was signed on June 17, 2004 (USAF, 2004d). The selected remedial actions included a limited removal, off-site treatment, and disposal of contaminated soils; MNA for groundwater; and LUCs. A brief chronology of events leading up to the ROD signing has been provided in Table 2-1. Specific RAOs were developed for DP98 (USAF, 2004d) and are as follows:

- Reduce chlorinated solvent concentrations in soil, sediment, and groundwater to chemical-specific ARARs;
- Select remedial action alternatives that will minimize the damage to the wetland ecology;
- Prevent exposure (via ingestion, inhalation, and/or dermal contact) to groundwater until such time as the federal and state drinking water standards are met;
- Restrict excavations and the installation of water wells to reduce the possibility of exposure to contaminants and contaminant migration from the contaminated aquifer to the uncontaminated aquifers; and
- Maintain current land-use designations at this site.

The cleanup levels identified in the DP98 ROD, which are generally based on MCLs for groundwater and ADEC Method Two for soil contamination, are summarized in Table 4-23.

Table 4-23
Cleanup Levels at DP98

Chemical	ROD-Established Cleanup Level	Basis for Cleanup Level
Groundwater (μg/L)		
1,1-Dichloroethene	7	MCL[1]
cis-1,2-Dichloroethene	70	MCL[1]
Trichloroethene	5	MCL[1]
Tetrachloroethene	5	MCL[1]
Vinyl chloride	2	MCL[1]
Soil (mg/kg)		
1,1-Dichloroethene	0.03	18 AAC 75.341[2]
cis-1,2-Dichloroethene	0.2	18 AAC 75.341[2]
Tetrachloroethene	0.03	18 AAC 75.341[2]
Trichloroethene	0.027	18 AAC 75.341[2]
Sediment (mg/kg)		
cis-1,2-Dichloroethene	0.2	18 AAC 75.341[2]
Trichloroethene	0.027	18 AAC 75.341[2]

[1]Basis for cleanup level is MCL; 40 CFR 141.61 for federal MCLs and 18 AAC 75 for state standards established in the DP98 ROD (USAF, 2004d).
[2]Basis for cleanup level is 18 AAC 75.341 Table B1, Method Two (ADEC, 2006d).
μg/L = micrograms per liter; AAC = Alaska Administrative Code; MCL = maximum contaminant level; mg/kg = milligram per kilogram; ROD = record of decision

4.6.1 DP98 Remedy Implementation and Status

The major components and current status of the DP98 selected remedy are provided in Table 4-24.

Table 4-24
DP98 Remedy Implementation Status

Remedy Component	Status
Source Material Removal	
Excavation will be limited to soil within a 25-foot radius of soil boring DP98-SB01, where the greatest TCE concentrations were detected, adjacent to the end of the drain tile north of Building 18224.	Completed in 2005.
Monitored Natural Attenuation	
The MNA component of the selected remedy has three sub-components to assess the effectiveness of MNA: 1) natural attenuation of contaminants in groundwater, soil, and sediment; 2) a treatability study to determine the effectiveness of the natural attenuation at/around the 190-foot topographic contour; and 3) an evaluation/compilation of groundwater data collected during the first five years of monitoring.	Ongoing.
Natural Attenuation	
Natural attenuation is the remedy for low concentration contaminants remaining at DP98 after the limited soil removal is completed. The Air Force will monitor the actual performance of the natural attenuation remedy in accordance with the following monitoring guidelines. • Frequencies for groundwater and seep monitoring will be based on the sampling guidelines provided in the monitoring frequency decision guide from the DP98 ROD. • Surface water samples will be collected from the kettle pond annually as a point of compliance and sampled for the same sampling suite as the groundwater COCs. • The analytical testing of water samples will monitor concentrations of the COCs, daughter products, and other analytes, as appropriate. In addition, field-testing will monitor changes in site conditions. Analytes and field parameters will be measured to track changes in contaminant migration as well as to monitor the progress of natural attenuation. • Natural attenuation in soil and sediment will not be monitored prior to collecting soil confirmation samples. Confirmation sampling will be conducted to confirm effectiveness of the natural attenuation of soil and sediment only after groundwater chemical-specific ARARs have been achieved.	Ongoing.

Table 4-24 (Continued)
DP98 Remedy Implementation Status

Remedy Component	Status
Treatability Study	
After completion of the source removal, a treatability study will be undertaken in the area of the 190-foot topographic contour to evaluate the effectiveness of natural attenuation in this area. The objectives of this treatability study are: • To assess the feasibility of enhancing the natural attenuation process by evaluating the impact of adding an additional nutrient source; • To determine if this "enhanced" natural attenuation would significantly reduce the predicted cleanup time frames; • To fill data gaps from the remedial investigation and evaluate the possible presence of dense, nonaqueous-phase liquids (DNAPLs); and • To evaluate MNA in groundwater. Trends of declining COCs and predictive groundwater modeling will be used as lines of evidence to indicate that MNA is successfully remediating groundwater. The treatability study will be conducted within one year of implementing the selected remedy.	Completed in 2007.
Evaluation/Compilation of Groundwater Data	
After the first five years of groundwater monitoring, the Air Force will evaluate the progress of MNA. This evaluation will compile, analyze, and review all data collected, including information from the RI/FS, and the natural attenuation and treatability study remedy components described above. Additional groundwater modeling will be completed to provide updated estimates for the time frames to meet the cleanup goals. If during this evaluation, the data indicates contaminant concentrations in groundwater are not declining as estimated, the Air Force, USEPA, and ADEC may reconsider the remedy decision. One or more of the following observations could lead to reconsideration of the remedy: • Increase in parent contaminant concentrations indicating that other sources may be present; • Concentrations of parent contaminants and/or daughter products may indicate that the estimated cleanup time frames may not be reached; and • Plume of primary contaminants and/or daughter products increases significantly in areal or vertical extent and/or volume from that predicted by modeling estimates. These observations could trigger the implementation of enhanced monitored natural attenuation.	Completed in October 2008.
Land Use Controls	
LUCs are an integral part of the selected remedy at DP98. The LUCs are designed to prevent activities that could affect the performance of the other components of the selected remedy, prevent the migration of contaminants	Implemented in May 2002.

Table 4-24 (Continued)
DP98 Remedy Implementation Status

Remedy Component	Status
in groundwater, and maintain current land uses at DP98 to protect human health and the environment. The specific LUCs at DP98 are as follows: • Excavating, digging, or drilling in the ROD-specified area is restricted to reduce the possibility of migration or exposure to contaminants that exceed the chemical-specific ARARs. If contaminated soil that exceeds chemical-specific ARARs is excavated, it cannot be transported to or disposed of at another location on base. Excavated soil will be transported to a disposal facility in the lower 48 states, which is acceptable for disposal of CERCLA waste under the Off-site Disposal Rule (40 CFR §300.440). No dewatering of excavations or trenches will be allowed unless contaminated water is treated prior to use or disposal. Any excavations or drilling greater than ten feet bgs will require engineering controls to prevent downward migration of contamination and to protect the groundwater aquifer. • The use of contaminated groundwater throughout DP98 for any purpose including, but not limited to, drinking, irrigation, fire control, dust control or any other activity, is prohibited. • The current land use will be maintained to reduce the possibility of exposure to contaminants.	

ADEC = Alaska Department of Environmental Conservation; ARAR = applicable or relevant and appropriate requirement; bgs = below ground surface; CERCLA = Comprehensive Environmental Response, Compensation and Liability Act; CFR = Code of Federal Regulations; COC = contaminant of concern; DNAPL = dense nonaqueous-phase liquid; LUC = land use control; MNA = monitored natural attenuation; RI/FS = remedial investigation/feasibility study; ROD = record of decision; TCE = trichloroethene; USEPA = United States Environmental Protection Agency

The highest levels of soil contamination encountered during the remedial investigation and feasibility study (RI/FS) were in the outfall area of the drain tile that extended northwest from Building 18224. Approximately 768 tons of soil were removed to the ROD-specified depth of 10 feet within a 25-foot radius of suspected location of the drain tile (USAF, 2006a). The suspected drain tile was not encountered and soil samples collected at the excavation edge were above the cleanup levels for TCE and *cis*-1,2-DCE. TCE was detected at a maximum concentration of 3.1 milligram per kilogram (mg/kg) and *cis*-1,2-DCE was detected at a maximum concentration of 9.0 mg/kg. The excavation was backfilled with clean material.

Groundwater monitoring at DP98 has been conducted since 2004. The groundwater monitoring plan is updated annually (USAF, 2004h, 2006c, 2007g, 2008f) in accordance with the monitoring frequency decision guide (Attachment F, Figure F-2) to ensure the program remains comprehensive and protective. Several updates have been made to monitoring frequency since 2004, and in 2007 the monitoring program included monitoring 11 wells; seven annually, three every two years and one every five years. The purpose for monitoring at DP98 is to assess contaminant migration and the timely reduction of contaminant concentrations by natural attenuation. Figure C-14 in Attachment C presents concentrations of PCE, TCE and *cis*-1,2-DCE over time for key wells in DP98. PCE, TCE and *cis*-1,2-DCE are the DP98 COCs that exceed their cleanup levels by the greatest amount. The number of wells and seeps sampled each year at DP98 since the ROD is included in Table 4-25.

Table 4-25
Number of Wells and Surface Water Locations Sampled at DP98, 2004 to 2007

Year	Number of Wells Sampled[a]	Number of Surface Water Locations Sampled[b]
2004	6	0
2005	6	1
2006	8	1
2007	11	1

[a] Well sampling frequency varies between one and five years as determined by the Sampling Frequency Decision Tree (Figure 12-1, USAF, 2004d); included as Attachment F, Figure F-2.
[b] Surface water location is at the downstream former kettle pond. Contaminant levels for all COCs are non-detect (USAF, 2007h).

Groundwater monitoring results are evaluated annually. Because the monitoring program has a relatively short history, only a limited quantitative evaluation of MNA has been conducted to date. Application of the USEPA scoring model (Wiedemeier et al., 1998) concluded that conditions were favorable for natural attenuation of chlorinated solvents at DP98 (USAF, 2005i). Sufficient groundwater monitoring history for trend analysis became available only beginning in 2006 (USAF, 2007g, 2008f,g). Trend analysis using composite data generally confirm that the natural attenuation components of the DP98 remedy are performing as originally envisioned (USAF, 2008g). In 2007, groundwater samples were analyzed for DRO and GRO (which are contaminants of potential concern [COPCs] but not COCs for DP98) to help evaluate the contribution of petroleum compounds on the natural attenuation of the chlorinated solvent COCs (USAF, 2008f). An evaluation of the progress of natural attenuation is required by the ROD once groundwater data has been collected for five years. This evaluation was completed in 2008 (USAF, 2008j). COC concentrations at the surface water point of compliance (the kettle pond) have consistently been below detection limits.

The objectives of the treatability study were outlined in the ROD (USAF, 2004d):

- To assess the feasibility of enhancing the natural attenuation process (i.e., enhanced bioremediation of chlorinated aliphatic hydrocarbons in groundwater) by evaluating the impact of adding an additional nutrient source;
- To determine if this “enhanced” natural attenuation would significantly reduce the predicted cleanup time frames;
- To fill data gaps from the RI/FS and evaluate the possible presence of dense nonaqueous-phase liquids (DNAPL); and
- To evaluate MNA in groundwater.

The MNA evaluation, evaluation of data gaps, and possibility of DNAPL are addressed by the annual monitoring program (discussed above). The natural attenuation enhancement portions of the treatability study are documented in a treatability study report (USAF, 2007c). In July 2005, approximately 2,300 gallons of a vegetable oil-in-water emulsion followed by a sodium lactate solution push of approximately 1,000 gallons were injected into three wells in the shallow aquifer at DP98. Results indicate that concentrations of TCE decreased to non-detect in the injection area for the first 14 months of monitoring. Concentrations of *cis*-1,2-DCE (an intermediate degradation product of TCE) increased by more than double in the 10-months sampling event, and then decreased by approximately 10 to 30 percent between the 10- and 14-months sampling events. Additional monitoring is necessary to determine at what rate *cis*-1,2-DCE concentrations will continue to decrease once TCE has been degraded.

DP98 data gaps are being addressed through field investigations. In October 2007, the subsurface was profiled to 85 feet bgs using a membrane-interface probe to detect any DNAPL that might have migrated to the bottom of the shallow aquifer (USAF, 2008g). Results of this investigation were not available at the time of this five-year review.

The component of the remedy involving evaluation of groundwater MNA data was completed in October 2008 (USAF, 2008j). Modeling confirmed that the MNA remedy is working as envisioned. Most of the COC plume appears to be contracting and is not likely to expand beyond the LUC boundary. All components of the ROD-selected remedy are now fully implemented with the completion of this evaluation. Implementation of the ROD-selected remedy should be documented in a remedial action report.

LUCs have been established and are being maintained to prevent exposure until cleanup levels are attained (see Section 4.7). In general LUCs listed in the DP98 ROD limit excavating, digging, and drilling in certain areas, limit the use of contaminated groundwater throughout the site, and maintain the current land use. Results of annual LUC inspections, conducted to ensure compliance with LUCs, are documented in annual monitoring reports (USAF, 2008f).

4.6.2 DP98 Systems Operations and Maintenance

The estimated annual O&M costs for DP98, as presented in the ROD, totaled $120,000/year for the first five years of groundwater monitoring. Actual annual costs are provided in Table 4-26.

Table 4-26
Operations and Maintenance Costs for DP98, FY2004 through FY2007

Fiscal Year	Groundwater and Seep Monitoring	Treatability Study	Five-Year Review	Total Costs[*]
2004	$44,918	$1,000	--	$46,000
2005	$45,145	$87,200	--	$132,000
2006	$36,843	$39,400	--	$76,000
2007	$92,511[a]	$22,449	$19,264	$134,000
Total Cost:				$388,000

[*]Total costs to the nearest $1000
[a]Increase in cost of monitoring in 2007 corresponds to increase in number of wells sampled.

O&M costs were obtained from RIPS. DP98 O&M costs have generally been less than anticipated by the ROD.

4.7 LAND USE CONTROLS

Elmendorf AFB has established LUCs (formerly referred to as institutional controls) to limit exposure to contaminated soil and/or groundwater. LUCs are maintained until contaminant concentrations in the soil and groundwater decrease to levels that allow for UU/UE. The LUCs at Elmendorf AFB include restrictions on the use of the shallow aquifer, limitations on the types of buildings at specific areas, and designations of specific areas for certain uses only.

LUCs were established for OUs 1, 2, 4, 5, and 6 and DP98 in their respective RODs (USAF, 1994f, 1995a,b,c, 1997b, 2004d) as a component of their selected remedies, as described in the previous sections. Implementation of LUCs was clarified in a memorandum to the site file for OU1 (USAF, 1997h), and the clarified language is provided in Table 4-2. On October 7, 2003, the Secretary of the Air Force established an *Air Force Policy on Performance-based RODs for LUC Implementation*, which outlined specific LUC provisions to be included in Air Force RODs. These provisions were included in the DP98 ROD (USAF, 2004d) and incorporated into the OU6 remedies though the OU6 ESD (USAF, 2007a). A memorandum to the site file to incorporate the provisions of the Air Force policy is anticipated for OU1, OU2, OU4 and OU5 in the near future. While the Air Force policy provides guidance on specifying how LUCs are implemented, it does not change the nature of the LUCs as adopted by the RODs.

Elmendorf AFB currently implements LUCs through 3rd Wing Instruction (3 WGI) 32-7003 (USAF, 2007b). Prior to the development of 3 WGI 32-7003 in 2007, LUCs were implemented through a *Land Use Controls Management Plan* (USAF, 2003c). LUCs are also included in the *Base General Plan*, and locations and descriptions of the LUCs are included as a layer in GeoBase, which is a basewide geographical information system. There are some minor variances in LUC language between the *Base General Plan*, 3 WGI 32-7003, the 2003 Five-Year Review, and the most recent governing documents (RODs) for OUs 1, 2, 4, and 5. The most recent LUC language will be captured in a memorandum to the site file which would bring the RODs for those OUs into conformance with the *Air Force Policy on Performance-Based Records of Decision (RODs) for Land Use Control (LUC).*

LUC boundaries for active CERCLA sites are shown on Figure A-2 in Attachment A, and dates that LUCs were implemented at each OU are included in Table 2-1. Note that Attachment A, Figure A-2 does not show LUC boundaries for OU5 because the OU5 LUCs are implemented through a basewide groundwater use restriction. The most up-to-date LUC descriptions are provided to Elmendorf AFB personnel in an annual Environmental Restoration Program Atlas (USAF, 2008h). Current LUCs, as described in the 2008 atlas, are presented in Table 4-27.

Table 4-27
Site-Specific Land Use Controls, Elmendorf Air Force Base

OU (Site)	Land Use Control (LUC) Description[1]	Expected Year of LUC Expiration[2]
1 (LF59)	OU1 is currently designated as an "Outdoor Recreational Use Area." Land use and water use controls specifically aimed at restricting the use of the shallow aquifer at LF59 will be maintained. These controls will remain in effect as long as the Air Force maintains active control of the area or until the groundwater contamination dissipates to such levels that will no longer pose any unacceptable human health or environmental risks. The specific LUCs to be implemented and/or maintained at LF59 are as follows: 1) Development of a site zoning map showing the areas currently and potentially impacted by groundwater contaminants; 2) Zoning the affected areas for undeveloped outdoor/recreational use only; 3) Continued enforcement of base policy prohibiting installation of groundwater wells (other than for monitoring purposes) into the shallow aquifer underlying LF59; and 4) Securing of existing water supply and groundwater monitoring wells.	2033
2 (ST41)	LUCs will be enforced as long as hazardous substances remain on site at levels that preclude unrestricted use. In addition, deed restrictions or equivalent safeguards would be implemented in the event that property containing such contamination is transferred by the Air Force. The specific LUCs to be implemented and/or maintained at OU2 and are as follows: 1) Development of a site zoning map showing the areas currently and potentially impacted by groundwater contaminants; 2) Zoning the affected area for outdoor recreational and unmanned industrial use only, excluding the development of commercial aquaculture; 3) Continued enforcement of base policy prohibiting installation of groundwater wells (other than for monitoring purposes) into the shallow aquifer underlying OU2; and 4) Prohibiting unauthorized access to existing water supply and groundwater monitoring wells.	2018

Table 4-27 (Continued)
Site-Specific Land Use Controls, Elmendorf Air Force Base

OU (Site)	Land Use Control (LUC) Description[1]	Expected Year of LUC Expiration[2]
4 (FT23, SD24, SD25, SD26, SD27, SD28, SD29)	OU4 is currently designated as an “Airfield Use Area” for aircraft operations and maintenance which include active and inactive runways, taxiways, and parking aprons for aircraft. The BGP has designated this area for airfield and aircraft operations and maintenance in the future. Land use and water use controls are part of the BGP and will continue to be used to limit access to contaminated groundwater and soil. Hazardous areas will be posted with warning signs. These controls prohibit construction of residences and groundwater wells over areas with contamination plumes, and prohibit excavation of soil in areas of soil contamination that exceed unacceptable levels.	2026
5 (ST37)	Access to groundwater will be restricted throughout OU5 until such time as required cleanup levels, as outlined in the ROD, have been achieved.	2028
6 (LF02)	Access to groundwater and soil at LF02 will be institutionally controlled. LF02 is currently designated as a “restricted use area” in the BGP. This designation provides for a recreational use of the parcel (cross-country skiing) and for construction of unmanned facilities such as a parking lot, storage building, or taxiway, but prohibits the construction of any sort of manned facility such as an office building or a residence. Drilling into the shallow aquifer is also restricted by the BGP to prohibit residential or agricultural use of contaminated groundwater.	When ROD-specified UU/UE levels are achieved.
6 (LF03)	Access to groundwater and soil at LF03 will be institutionally controlled. LF03 is currently designated as a “restricted use area” in the BGP. This designation provides for a recreational use of the parcel (cross-country skiing) and for construction of unmanned facilities such as a parking lot, storage building, or taxiway, but prohibits the construction of any sort of manned facility such as an office building or a residence. Drilling into the shallow aquifer is also restricted by the BGP to prohibit residential or agricultural use of contaminated groundwater.	When ROD-specified UU/UE levels are achieved

Table 4-27 (Continued)
Site-Specific Land Use Controls, Elmendorf Air Force Base

OU (Site)	Land Use Control (LUC) Description[1]	Expected Year of LUC Expiration[2]
6 (LF04)	Access to groundwater at LF04 South will be institutionally controlled. LF04 is currently designated as a “restricted use area” in the BGP. This designation provides for recreational use of the parcel (e.g., cross-country skiing) and for construction of unmanned facilities such as a parking lot, storage building, or taxiway, but prohibits the construction of any sort of manned facility such as an office building or residence. Drilling into the shallow aquifer is also restricted by the BGP to prohibit residential or agricultural use of contaminated groundwater. LUCs will restrict access to soil at LF04 North.	When ROD-specified UU/UE levels are achieved
6 (SD15)	The land use designation for SD15 is “Industrial Area” in the BGP. Land use and water use controls, as specified in the BGP, will restrict access to the contaminated groundwater perched aquifer throughout SD15. Installation of wells in the contaminated plume for residential, industrial, or agricultural use will be prohibited by the BGP until cleanup levels have been achieved.	2015[3]
6 (WP14)	Institutional controls on land use and water use, as specified in the BGP, will restrict access to the contaminated groundwater throughout WP14. Installation of wells in the contaminated plume for residential, industrial, or agricultural use will be prohibited by the BGP until cleanup levels have been achieved.	2020
(DP98)	There are four types of current land use designations in the vicinity of DP98 according to the BGP: “Industrial,” “Administrative,” “Open Space,” and “Outdoor Recreation.” The specific land use and water use controls at DP98 are as follows: 1) Excavating, digging or drilling into the area is restricted to reduce the possibility of migration or exposure to contaminants that exceed the chemical-specific ARARs. If contaminated soil that exceeds the chemical-specific ARARs is excavated, it cannot be transported to or disposed of at another location on base. Excavated soil will be transported to a disposal facility in the lower 48 states, which is acceptable for disposal of CERCLA waste under the Off-site Disposal Rule (40 CFR 300.440). 2) No dewatering of excavations or trenches will be allowed unless the water is treated prior to disposal. 3) The use of contaminated groundwater, throughout DP98, for any purpose including, but not limited to, drinking, irrigation,	2075

Table 4-27 (Continued)
Site-Specific Land Use Controls, Elmendorf Air Force Base

OU (Site)	Land Use Control (LUC) Description[1]	Expected Year of LUC Expiration[2]
	fire control, dust control or any other activity is strictly prohibited. 4) The current land use will be maintained to reduce the possibility of exposure to contaminants.	

[1] LUC descriptions were obtained directly from the 2008 Environmental Restoration Program Atlas.
[2] Expected year of LUC expiration are listed in the BGP.
[3] The BGP lists the expected year of LUC expiration for SD15 as "to be determined." The 2015 date for expected LUC expiration was taken from OU6 ESD (USAF, 2007a).
ARAR = applicable or relevant and appropriate requirement; BGP = *Base General Plan;* CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; CFR = Code of Federal Regulations; LUC = land use control; OU = operable unit; ROD = record of decision; UU/UE = unlimited use/unrestricted exposure

In addition to the site-specific restrictions outlined in the various RODs and described in Table 4-27, Elmendorf AFB has implemented an administrative groundwater restriction on the use of groundwater from the shallow aquifer (USAF, 2007b). Use of the shallow aquifer within the groundwater control boundary for any purpose including, but not limited to, drinking, irrigation, fire control, dust control, or any other activity is strictly prohibited. Portions of the shallow aquifer are contaminated and may pose a health risk. The shallow aquifer is defined as any unconfined, saturated, water-bearing zone below the ground surface. The current groundwater control boundary can be found on the Environmental Restoration map located on the Elmendorf AFB GeoBase webpage.

Contamination exists outside of the Elmendorf AFB boundary at OU5 and immediately adjacent to the Elmendorf AFB boundary at OU6 LF04. Elmendorf AFB purchased an easement from the Alaska Railroad Corporation (ARRC) to contain and mitigate off-base contamination from OU5. The use of groundwater in this area is currently prohibited through the easement, which is valid through 2026. There is no off-base contamination at LF04, but a portion of LF04 adjoins the expanded Port of Anchorage facilities (Figure A-3, Attachment A). There was no transfer of property between the USAF and the Port of Anchorage for the port expansion project. The expanded port facilities are outside of the Elmendorf AFB LF04 boundary. The expanded port facilities are not anticipated to impact implementation of the LF04 remedies, and will not result in increased exposure to contaminants. Elmendorf AFB has coordinated closely with the Port of Anchorage to ensure that the USAF can continue to conduct the annual debris removal.

LUCs are implemented, managed, and enforced by offices within the 3rd Civil Engineer Squadron at Elmendorf AFB, as summarized below.

- Real Property ensures that LUCs are incorporated into all real estate instruments such as property leases, property transfers, tenant support agreements, permits, easements, and right-of-ways;

- Community Planning oversees base development, including initial planning and facility siting, preparation of construction contract documents, project design review, and project execution. Community Planning ensures that LUCs are incorporated into the *Base General Plan* and all new development projects. A Base Civil Engineer Work Request (Air Force Form 332) is required for the initial siting or planning of all projects at Elmendorf AFB. Form 332 describes the project in detail, including the type and location of work to be performed, whether digging or trenching will be conducted, and which base organization is responsible for the work. Community Planning coordinates reviews of Form 332 with Environmental Restoration if the project is in an area with LUCs. LUC boundaries are recorded in GeoBase and available for viewing through the Elmendorf AFB intranet;

- Environmental Planning reviews Work Clearance Requests (also known as Dig Permits) to ensure compliance with the LUCs. A Dig Permit (3 WG Form 3) must be prepared and coordinated for all projects executed at Elmendorf AFB in which mechanized equipment penetrates or disturbs the ground, or hand digging penetrates more than four inches below the ground surface (USAF, 2007b). This includes small construction that does not go through the Community Planning process. If a project requires excavation in a LUC area, the Dig Permit informs the requestor about the potential for contaminated groundwater or soil, as well as the requirements for handling contamination if any is encountered. The Dig Permit also requires the requestor to avoid damaging monitoring wells or any other components of the remedy; and

- LUC site inspections are performed annually to ensure LUCs are being followed, including checking for any needed maintenance for access controls and evidence of unauthorized wells or disturbance. Results of annual inspections are recorded in annual monitoring reports.

LUCs are protective and functioning as intended by the decision documents. The protectiveness of the remedies is described in detail in Section 7. Additional LUCs are not required at this time.

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SECTION 5.0

PROGRESS SINCE LAST FIVE-YEAR REVIEW

5.1 PROTECTIVENESS STATEMENTS FROM LAST FIVE-YEAR REVIEW

The second (2003) five-year review developed the following protectiveness statements in accordance with USEPA guidance (USEPA, 2001) for each OU where a remedial action has been initiated.

Operable Unit 1: The remedy at OU1 is expected to be protective of human health and the environment upon attainment of groundwater cleanup levels, through natural attenuation, at one remaining site (LF59). In the interim, exposure pathways that could result in unacceptable risks are being controlled.

Operable Unit 2: The remedy at OU2 is expected to be protective of human health and the environment upon attainment of groundwater cleanup levels, through natural attenuation at ST41. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

Operable Unit 4: The remedy at OU4 is expected to be protective of human health and the environment upon attainment of soil cleanup levels through bioventing at two remaining sites (FT23 and SS10) and attainment of groundwater cleanup levels through natural attenuation. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

Operable Unit 5: The remedy at OU5 currently protects human health and the environment in the short-term because at present, TCE has not exceeded cleanup levels at the point of compliance (i.e., Ship Creek). However, in order for the remedy to be protective in the long-term, Seeps 9, 10, and 11 must be captured and treated, and the investigation into the nature and extent of the TCE plume feeding the seeps at OU5 must be continued and evaluated to ensure long-term protectiveness.

Operable Unit 6: The remedy at LF04 North/Beach is protective of human health and the environment though the annual removal of exposed landfill debris. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

The remedies at LF02, LF04 South and WP14 are expected to be protective of human health and the environment upon attainment of groundwater cleanup goals through natural attenuation and recovery of free product (at LF04 South and WP14). In the interim, exposure pathways that could result in unacceptable risks are being controlled.

At SD15, the remedy currently protects human health and the environment in the short-term because the HVE has significantly reduced contamination and LUCs are in place to eliminate known points of exposure. However, in order for the remedy to be protective in the long-term, methods to treat the remaining areas of shallow soil contamination must be implemented or continued, as needed, following evaluation of the treatability study that is currently in progress.

5.2 FOLLOW-UP ACTIONS FROM LAST FIVE-YEAR REVIEW

The 2003 five-year review identified four issues and provided recommendations for follow-up actions. None of the four issues impacted the current protectiveness in 2003 and only two of the issues impacted future protectiveness. Progress on the 2003 issues and recommendations are summarized in Table 5-1.

Table 5-1
Progress on Follow-Up Actions Identified in the Last Five-Year Review

Issues from Previous Review	Recommendations/ Follow-up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
<u>OU 2 (ST41) Surface Water (no impact to protectiveness).</u> Levels of benzene in the seep on the north side of ST41 exceeded cleanup levels in 2002. The point of compliance established for protectiveness of the wetland at OU2 is downgradient of the current seep sampling location and it is expected that point of compliance contaminant concentrations will be below Alaska SWQC. This was confirmed in 2001; however, recent monitoring does not include TAH and TAqH analyses to ensure compliance with Alaska SWQC as established by the OU2 ROD. In the interim, LUCs ensure current protectiveness.	To ensure compliance of SWQC as established by the OU2 ROD, TAH and TAqH should be added to the sampling suite to ensure protectiveness of the wetlands at the point of compliance.	USAF	2004	Seep (ST41-SP01) samples from the north side of ST41 have been analyzed for TAH and TAqH since 2003 and 2004 respectively. Surface water (ST41-SW01) just below the seep has been analyzed for TAH and TAqH since 2005 (USAF, 2008g). The point-of-compliance, SW-13, is located at the center of the surface water body (USAF, 1998g, 1999b) about 200 feet downgradient of the seep and surface water sample location ST41-SW01 (see Attachment C, Figure C-2). Due to changes in Air Force and contractor personnel, location of point-of-compliance SW-13 was erroneously thought to be ST41-SW01 during 2004 - 2007. The true location of SW-13 was re-established in 2008. SW-13 surface water was sampled in June 2008 and contaminant concentrations were below OU2 cleanup levels. SW-13 will be sampled annually to ensure protectiveness of the wetlands.	2004
<u>OU5 (ST37) Additional Contaminated Seeps (impacts future protectiveness).</u> In 2001, the USAF sampled seeps that are not being treated in the WRS. Data from three seeps (Seeps 9, 10, and 11) indicated the presence of TCE contamination above cleanup levels. A study performed in 2002 determined that the existing wetland has the capacity to treat the additional TCE. In 2003, the USAF will contract design of additional discharge structures to capture the three seeps and divert them into the WRS. Construction of the discharge structures will take place in 2004. In addition, the USAF has initiated further investigation into the suspected source and extent of the Kenney Avenue plume and modeling is scheduled for later in 2003. To ensure that other contaminated seeps are not exiting the bluff, all seeps at OU5 have been sampled annually since 2001. All OU5 seeps will continue to be monitored at least annually until cleanup levels are met. This work will ensure current and future protectiveness.	Implement the plan to capture the recently discovered TCE-contaminated seeps and treat them in the existing Wetland Cell. Continue to investigate the source and extent of the Kenney Avenue TCE plume upgradient of the recently discovered seeps and evaluate the potential for increases in TCE concentrations.	USAF	2003 - 2004	Passive collection and drainage systems were constructed that route water from Seeps 9, 10, and 11 into the WRS (USAF, 2005a,b). Additional sampling and modeling was conducted for the Kenney Avenue plume in 2003 (USAF, 2004b). There was no indication of a DNAPL source, and no indication of high concentrations of TCE in groundwater that would cause concentrations in seeps to increase. There is no potential impact to future protectiveness.	2004 2003

Table 5-1 (Continued)
Progress on Follow-Up Actions Identified in the Last Five-Year Review

Issues from Previous Review	Recommendations/ Follow-up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
OU2 (ST41), OU4 (SS10, FT23, SD24, SD28, SD29), OU5 (ST37), and OU6 (SD15, LF04, WP14) Cleanup Schedules (no impact to protectiveness): Although monitoring has shown that the remedies are reducing contaminants, it appears to be occurring at a slower rate than predicted by RODs and/or models. Although LUCs are in place to ensure protectiveness in the interim, cleanup levels may not be achieved within the timeframes specified in the RODs. This includes:	For groundwater, conduct a thorough review of modeling results and evaluate the potential for natural attenuation to achieve cleanup levels in the timeframes specified in the RODs. Revise and/or recalibrate the models if needed. Continue groundwater monitoring according to the guidelines of the Basewide Groundwater Monitoring Program until cleanup levels are met. For OU4, continue bioventing at new site until soil cleanup levels are met. LUCs shall remain in place to ensure protectiveness.	USAF	See below	Follow-up actions were completed or, in some cases, are on-going as recommended in the last five-year review. For groundwater, several modeling efforts have been conducted since the last five-year review to evaluate the potential for natural attenuation to achieve cleanup levels in the timeframes specified in the RODs. These efforts include updating quantitative fate and transport models, developing qualitative fate and transport models, use of the USEPA scoring methodology for natural attenuation of chlorinated solvents (Wiedemeier et al., 1998), and development and implementation of a scoring methodology for petroleum hydrocarbons (USAF, 2005i). Quantitative trend analysis and qualitative natural attenuation evaluations are conducted annually to assess progress toward achieving cleanup levels (most recently USAF, 2008a, b,g). When trend analysis predicts that cleanup levels will not be achieved in the timeframes specified in the RODs, target dates will be adjusted and/or alternative remedies will be considered. The expanded bioventing system at OU4 (FT23) continues to operate. LUCs continue to remain in place to ensure protectiveness. Specific follow-up actions and outcomes are described below:	2003 and on-going
• BTEX at OU2 may not reach cleanup levels by 2016. However, data show that this plume is shrinking and is not migrating from the site.		USAF	2006	• OU2 BTEX: Natural attenuation processes were evaluated using SourceDK trend analysis (USAF, 2008f). As of the 2007 sampling event, groundwater samples met cleanup levels for all COCs except benzene. Benzene concentrations are on track to meet cleanup levels by 2016 in some wells. In other wells, fluctuations in benzene concentrations are too great to provide a reliable estimate of when cleanup levels will be met. Natural attenuation appears to be working at OU2, but it appears unlikely that contaminants will meet cleanup levels by 2016 for all sample locations.	
• At OU4, TCE concentrations in the East Plume are attenuating naturally, however it is likely that the cleanup duration may exceed the ROD-predicted timeframe, ending in 2008.		USAF	2008	• OU4 East Plume TCE: Contaminant trend analysis using SourceDK (USAF, 2008a) indicates that the East Plume will reach the specified TCE cleanup level of 5 μg/L by 2009 (within one year of the date estimated in the ROD).	

Table 5-1 (Continued)
Progress on Follow-Up Actions Identified in the Last Five-Year Review

Issues from Previous Review	Recommendations/ Follow-up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
• For FT23 plume (OU4), the chlorinated compounds are degrading more slowly than predicted by the models. TCE, PCE, and 1,2-dichloroethene may not reach cleanup levels by 2008.		USAF	2008	• OU4 FT23 plume: The two wells (OU4W-11 and FP-56) were sampled annually for the last five years and contaminant trend analysis using SourceDK was conducted in 2007 for the FT23 plume (USAF, 2008a). The cleanup levels for PCE and TCE in groundwater are predicted to be met by 2009 and 2008, respectively (USAF, 2008a). *Cis*-1,2-dichloroethene concentrations are below the cleanup level.	
• For OU4 West plumes (specifically, at wells OU4W-08 and OU4W-04), remediation of benzene may not reach the cleanup level by 2008.		USAF	2008	• OU4 West plumes: The Hangar 11 plume (SD25) was monitored by well OU4W-08, but this well was mistakenly abandoned in 2002 and is no longer available for monitoring. Replacement well OU4MW-08R was installed in 2003 near the abandoned well and was sampled annually for the last five years. The sampling history of OU4MW-08R is too short to discern a temporal trend, and cleanup levels for benzene and toluene will not be met until some time after the ROD-estimated date of 2008. Well OU4MW-04 (at SD24) was sampled once in the last five years and shows a benzene concentrations are decreasing. Concentrations of benzene at this well are expected to reach the cleanup level by 2009, which is within one year of the estimated date in the ROD.	
• The bioventing system at OU4 site FT23 was expanded in 2003 to address additional soil contamination discovered at this site. Soil cleanup levels in the new area may not be met by 2008.		USAF	2008	• OU4 FT23 Bioventing: The bioventing system has continued to operate at FT23 for the last five years (USAF, 2008a), and LUCs remain in place to ensure protectiveness. Soil sampling conducted in 2005 showed that DRO was the only contaminant that still exceeded cleanup levels. Soil will be sampled again in 2010.	

Table 5-1 (Continued)
Progress on Follow-Up Actions Identified in the Last Five-Year Review

Issues from Previous Review	Recommendations/ Follow-up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
• At OU5, groundwater sampling has show that TCE is remediating at a slower rate than predicted and cleanup levels for TCE may not be met by 2026.		USAF	2003 – 2004	• OU5: Contaminant transport models for the Fairchild Avenue and Kenney Avenue plumes were updated to reassess the impact of natural attenuation (USAF, 2004b). The models predicted that TCE would migrate further toward Ship Creek, and also predicted more rapid degradation than had been observed through monitoring. However, uncertainty about contaminant source flux limited model accuracy. The Slammer plume and Beaver Pond wetlands area were not quantitatively modeled, but site data were thoroughly reviewed to form a conceptual model for natural attenuation processes (USAF, 2004h, 2005i). Natural attenuation at the Fairchild Avenue, Kenney Avenue, Slammer Avenue, OU5MW-02, and SP1-02 plumes was evaluated (USAF, 2005i) using an USEPA scoring model for reductive dechlorination of chlorinated solvents (Wiedemeier et al., 1998). The scoring model suggested limited to inadequate evidence of reductive dechlorination for ST37 plumes. Contaminant trend analysis using SourceDK is conducted annually (most recently USAF, 2008b), and shows that the site is on track to meet target cleanup dates at some wells, but is significantly lagging at others. Monitoring shows that contaminant plumes have not impacted the point of compliance at Ship Creek, and do not appear to be threatening Ship Creek in the future. Investigations continue to refine the understanding of contaminant sources and transport. More aggressive remedial action is also being considered, and an enhanced bioremediation pilot study at the Kenney Avenue plume was initiated in 2006.	

Table 5-1 (Continued)
Progress on Follow-Up Actions Identified in the Last Five-Year Review

Issues from Previous Review	Recommendations/ Follow-up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
• At OU6, COCs in groundwater at the WP14/LF04 South area may not meet cleanup levels by 2025, as anticipated by the ROD. A performance-based contract is projected for the PL81 Valve Pit 1 area to treat contaminated soil in the vadose zone to ADEC cleanup levels (per State agreement), which is expected to decrease the suspected source of hydrocarbon contamination and improve the groundwater cleanup schedule.		USAF	2004 - 2005	• OU6 WP14/LF04 South: Groundwater monitoring results are evaluated annually, including trend analysis of COCs and assessment of natural attenuation parameters. In addition, natural attenuation was assessed qualitatively for fuel contaminants at WP14 (USAF, 2005i). These assessments have generally confirmed that the natural attenuation components of the OU6 remedy are performing as originally envisioned. In 2007, groundwater COCs met cleanup levels at LF04 South wells south of WP14 (USAF, 2008g). Groundwater COCs are predicted to reach cleanup criteria in most WP14 wells within the next one to eight years (much sooner than the 2025 estimate in the ROD) with only a few exceptions (USAF, 2008g). Benzene concentrations in downgradient well OU6MW-91 and downgradient seeps LF04SP-03 and LF04SP-04 are relatively low, but are fluctuating above and below the cleanup level. Some of the fluctuation may have been due to confusion about the sampling location for LF04SP-03. The PL81 field work was completed in 2005 (USAF, 2006j); contaminated soil was excavated and sampling confirmed the hydrocarbon source was removed. Further contaminant decreases in the upgradient portions of the site are probably necessary before definite decreasing trends can be discerned. However, the decreasing concentrations in other portions of the site indicate that the remedy is working as envisioned at the time of the ROD.	
• At SD15 (OU6) benzene and TCE concentrations remain above the cleanup levels and no discernable decreasing statistical trends have been established since 1997, with the exception of benzene at OU6MW-90 and TCE at OU6MW-17. This, in addition to a decline in HVE contaminant removal rates suggests the HVE system is approaching design limitations and natural attenuation will be more heavily relied upon to reach cleanup goals. This indicates that concentrations of these COCs may not reach cleanup levels within the timeframe (5-years of HVE operation) that was predicted in the OU6 ROD.		USAF	2004 - 2005	• OU6 SD15: Groundwater monitoring results are evaluated annually, including trend analysis of COCs and assessment of natural attenuation parameters. Natural attenuation was also assessed with a USEPA scoring model (Wiedemeier et al., 1998, USAF, 2005i). The HVE system was shut down in 2007 due to reduced efficiency, and remaining groundwater contaminants are addressed through MNA (USAF, 2007a, Weston Solutions, Inc., 2007a). Modeling predicted that COCs should meet groundwater cleanup levels through natural attenuation alone by 2012 (USAF, 2007a). COCs in groundwater exhibit decreasing trends, and have reached, or are predicted to reach cleanup levels in all wells by 2015 except for benzene in Well OU6MW-17 (projected for 2038) (USAF, 2008a).	

Table 5-1 (Continued)
Progress on Follow-Up Actions Identified in the Last Five-Year Review

Issues from Previous Review	Recommendations/ Follow-up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
OU6 (SD15) Shallow Soils (impacts future protectiveness): Possible migration of contaminants from soils having DRO, GRO, and BTEX concentrations exceeding ADEC ACM Level D cleanup criteria exists at two locations in relatively shallow soils above the perched aquifer. A treatability study is being implemented for the shallow soil locations to determine if the HVE system modifications will effectively treat these areas. In the interim, LUCs ensure current protectiveness.	Monitor effectiveness of the recently implemented treatability study (modifications to the HVE system) and verify effectiveness of treating shallow soils at the two known areas of contamination.	USAF	2004	The HVE system was supplemented with four SVE wells in the area of the remaining shallow soil contamination in late 2003. The SVE system operated through 2005 and removed over 70 lbs of VOCs. Soil sampling in August 2005 showed that shallow soils now meet cleanup criteria for all COCs. Potential impact to future protectiveness is eliminated.	2003 - 2005
In addition to the recommendations that respond to issues cited above, several recommendations were included in the last five-year review to optimize the remedy and/or minimize unnecessary costs. These include the following:	OU1 sites LF05, LF07, LF13, and OT56 have reached cleanup levels for all COCs. Based on the Decision Guide for Monitoring Well Selection and Analysis (Attachment F, Figure F-1), wells at these sites should be removed from the Basewide Groundwater Monitoring Program and the sites are recommended for closure (i.e., cleanup levels based on residential use have been achieved and no additional response actions, including LUCs are needed).	USAF	2004	LF05, LF07, LF13 and OT56 met the cleanup goals and objectives of the OU1 ROD and were formally closed as CERCLA sites in July 2004 (USAF, 2004c). The sites continue to be managed under Alaska solid waste regulations.	2004
	In OU4, close the bioventing system at SD25 because soil remediation objectives have been reached and analytical data document soil contaminants are below cleanup levels that are acceptable for residential use.	USAF	2004	Closure sampling was conducted at SD25 in 2002. GRO, benzene, and total BTEX concentrations in soil were significantly below the cleanup levels outlined in the ROD. Therefore, cleanup objectives for the deep soils identified in the 1995 ROD for OU4 have been achieved at SD25 (USAF, 2003b). In October 2003, the bioventing system at SD25 was dismantled and the injection well was properly abandoned. In the spring of 2004, the bioventing blower at SD25 was removed from the site and its electrical supply properly terminated. The bioventing blower was placed in storage at site SS43 (USAF, 1995b).	2004
	Monitor for natural attenuation of groundwater at a reduced frequency as determined by the Decision Guide for Monitoring Well Sampling Frequency (Attachment F, Figure F-1). • Discontinue monitoring for manganese at LF59 because manganese concentrations have been below the	USAF	2005	• Monitoring for manganese at LF59 was discontinued in 2006 (USAF, 2007e). • A minor modification to the OU4, OU5, and OU6 ROD remedy was documented in memoranda to the site file that included establishment of a sampling frequency decision guide (USAF, 2003d,e,f,h). Monitoring frequency and locations are assessed and updated annually in the context of the decision guide.	2006

Table 5-1 (Continued)
Progress on Follow-Up Actions Identified in the Last Five-Year Review

Issues from Previous Review	Recommendations/ Follow-up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
	ROD-specified cleanup level for two consecutive sampling rounds in all wells monitored in OU1. • Review and revise the frequency of sampling for some wells in OU4, OU5, and OU6 in accordance with the decision guide. Several wells in OU4 have been shown to meet COC cleanup levels and warrant less frequent monitoring; benzene monitoring may be reduced at wells within OU5 that have historically been below cleanup levels; TCE monitoring may be reduced at OU6 wells (except at SD15) that have been below cleanup levels, and some wells associated with unstable plumes in OU5 may require more frequent monitoring.				
	The OU5 ROD specified annual sediment sampling at ST37 for at least the first five years, and sediments have been collected in the wetland cell and Beaver Pond annually since 1997. The cleanup standard outlined in the ROD for soil was consistent with the State of Alaska cleanup levels at the time, or 1,000 mg/kg total diesel fuel hydrocarbons (TFH-diesel). None of the sediment samples have contained fuel constituents (i.e., TFH-diesel, BTEX, polynuclear aromatic hydrocarbon [PAH]) at concentrations above State regulatory cleanup levels. Because the soil material at ST37 has been removed it is not necessary to continue monitoring the sediment. Sediment results collected to date are sufficient to demonstrate that significant levels of COCs are not accumulating in the sediment in the wetland cell or Beaver Pond; therefore, sediment monitoring at ST37 should be discontinued.	USAF	2004	All ST37 sediment monitoring has been discontinued except for one sample location where Seeps 9, 10, and 11 discharge into the wetland cell. Sediment has been sampled six times between 2004 and 2006 and analyzed for VOCs. Concentrations of regulated compounds, when detected, have been below 18 AAC 75 Table B1 cleanup levels for soil.	2004

Table 5-1 (Continued)
Progress on Follow-Up Actions Identified in the Last Five-Year Review

Issues from Previous Review	Recommendations/ Follow-up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
	A site closure report demonstrates applicable cleanup levels, acceptable for residential use, have been met by removal actions and LUCs are not needed at SAl00; therefore, the USAF considers this site closed and it is not necessary to include SAl00 in subsequent five-year reviews.	USAF	2003	SA100 is closed and was not included in this five-year review (USAF, 2002a).	2002

AAC = Alaska Administrative Code; ACM = Alaska cleanup matrix; ADEC = Alaska Department of Environmental Conservation; BTEX = benzene, toluene, ethylbenzene, and xylenes; CERCLA = Comprehensive Environmental Response, Compensation and Liability Act; COC = contaminant of concern; DNAPL = dense nonaqueous-phase liquid; DRO = diesel-range organics; GRO = gasoline-range organics; HVE = high-vacuum extraction; LUC = land use control; mg/kg = milligram per kilogram; MNA = monitored natural attenuation; OU = operable unit; PAH = polynuclear aromatic hydrocarbon; PCE = tetrachloroethene; ROD = record of decision; SVE = soil vapor extraction; SWQC = surface water quality criteria; TAH = total aromatic hydrocarbons; TAqH = total aqueous hydrocarbons; TCE = trichloroethene; TFH = total fuel hydrocarbons; USAF = United States Air Force; USEPA = United States Environmental Protection Agency; VOC = volatile organic compound; WRS = wetland remediation system

SECTION 6.0

FIVE-YEAR REVIEW PROCESS

This five-year review was conducted using the guidelines outlined in USEPA OSWER publication number 9355.7-03B-P (USEPA, 2001) and USEPA OSWER working draft publication 9355.7-12 (USEPA, 2005).

6.1 ADMINISTRATIVE COMPONENTS

The USAF, lead agency for the Elmendorf AFB Environmental Restoration Program, held a kick-off meeting for the five-year review with ADEC, USEPA and five-year review support contractor Parsons Infrastructure and Technology Group, Inc. (Parsons) on August 14, 2007. The Community Environmental Board (CEB) was notified that the review was forthcoming at their October 2007 meeting. Newspaper notices, emails, and distribution of a fact sheet (described in Section 6.2) were also used in fall 2007 to notify potentially interested parties of the start of the five-year review.

The five-year review team consisted of individuals from Environmental Restoration (3 CES/CEANR), Public Affairs (3 WG/PA), 11th Air Force Judge Advocate office (11 AF/JACE), USEPA, and ADEC. Technical support was provided by support contractors to 3 CES/CEANR that had conducted recent O&M activities associated with the remedies at each site. Therefore, in addition to USAF personnel, these O&M site managers and staff participated in site inspections and interviews. Documentation of the inspections is located in Attachment D. Interview documentation is included in Attachment E.

The schedule of this five-year review extended from December 2007 through signature of the final report in December 2008. The five-year review included the following components: document reviews, site inspection, interviews with community members and contractor O&M personnel, an assessment of protectiveness of the remedies, community notification and involvement, and development and review of this basewide five-year review report.

6.2 COMMUNITY NOTIFICATION AND INVOLVEMENT

The community was notified of, and given opportunity to have input on, the five-year review. The five-year review was announced in a briefing to the Elmendorf CEB in October 2007. A fact sheet was distributed to CEB members and mailed to approximately 100 community members on the Elmendorf AFB Environmental Restoration Program mailing list in late October 2007. Copies were also supplied to the Alaska Resources Library and Information Service (ARLIS), which is the physical information repository. The general public was notified of the five-year review with public notices placed in the Anchorage Daily News on November 1, 2, and

3, 2007; in the Eagle River Alaska Star on November 1, 2007; and in the Sourdough Sentinel on November 2, 2007.

Public comments and input on the protectiveness of the Elmendorf AFB remedies were solicited from the community through email questionnaires. Questionnaires were emailed to 21 stakeholders on November 15, 2007, including all CEB members, regulators, contractors, the Port of Anchorage, and the ARRC. The fact sheet distributed in October 2007 and newspaper public notices published in November 2007 also invited the general public to request and respond to the questionnaire. Questionnaire responses were accepted until January 31, 2008 so that they could be addressed in the final document (Attachment E).

Following agency signature, a second fact sheet describing the findings of the review will be distributed. A copy of the third five-year review report will be available in the information repository.

6.3 DOCUMENT REVIEW

The RODs associated with each OU, along with updates to those RODs as documented in memoranda to site files or explanations of significant differences were reviewed to identify RAOs, COPCs, COCs, and cleanup levels.

The potential for changes to standards identified as ARARs in the ROD, newly promulgated standards, and/or changes to "to be considereds" (TBCs) identified in the ROD, to impact the protectiveness of the remedies are evaluated in Attachment B and discussed for each OU in Section 7. The following documents were reviewed for updates to ARARs and new toxicity information.

- ADEC, 18 AAC 70, Water Quality Standards, amended as of December 28, 2006 (ADEC, 2006c)

- ADEC, 18 AAC 75, Oil and Other Hazardous Substances Pollution Control, amended as of December 30, 2006 (ADEC, 2006d)

- ADEC, 18 AAC 80, Drinking Water, amended as of November 9, 2006 (ADEC, 2006b)

- ADEC, Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances, amended as of May 15, 2003 (ADEC, 2003)

- ADEC, Cleanup Levels Guidance, amended as of January 30, 2004 (ADEC, 2004)

- ADEC, Cumulative Risk Guidance, Division of Spill Prevention and Response Contaminated Sites Remediation Program, Public Review Draft, August 2007. (ADEC, 2007b)

- USEPA, 2006 Edition of the Drinking Water Standards and Health Advisories, amended as of 2006 (USEPA, 2006)

- USEPA, 40 CFR § 141 Subpart G, National Revised Primary Drinking Water Regulations: Maximum Contaminant Levels and Maximum Residual Disinfection Levels, amended as of 2003 (USEPA, 2003)

- USEPA, 40 CFR § 131.36 Surface Water Toxicity, amended as of July 2007 (USEPA, 2007)

- National Oceanic and Atmospheric Administration, 73 FR 62919, Endangered and Threatened Species; Endangered Status for the Cook Inlet Beluga Whale, 22 October 2008

In addition to the documents mentioned above, the following documents were also reviewed to assess the protectiveness of the remedies:

- Remedial action design and remedial action construction reports;

- RI/FS reports (when necessary to clarify information in the RODs);

- O&M manuals and status reports; and

- Monitoring plans, annual monitoring results reports, and annual Remedial Process Optimization (RPO) reports.

All documents reviewed for this five-year review are listed in Section 12 of this report.

6.4 DATA REVIEW

Contaminant monitoring results from groundwater monitoring wells, seeps, surface water sampling locations, and soil samples were reviewed for this five-year review. Natural attenuation parameter results were also reviewed for those sites where natural attenuation is part of the remedy. Data collected under the environmental restoration program are archived in the Air Force Environmental Restoration Program Information Management System database. Certain wells have also been sampled under the Elmendorf AFB environmental compliance program. All relevant data from the environmental restoration sites, regardless of the environmental mandate, are evaluated annually by Elmendorf AFB to assess progress of the ROD-selected remedies.

Data collected through the 2007 sampling events were evaluated in 2007 RPO reports (USAF, 2008a,b,g). The evaluation included statistical analysis of contaminant trends to determine whether or not sites are on track to meet cleanup levels by the ROD-specified completion dates. Slightly different, but similar, statistical approaches were taken in different reports.

Two statistical methods were used to evaluate trends in groundwater concentration data for OU1, OU4, OU5 and sites SD15 and LF02 in OU6 (USAF, 2008a,b). The Mann-Kendall nonparametric test for trends (Gilbert, 1987) was used to assess whether contaminant concentrations had no trend, or whether they were increasing or decreasing with time. This test is well suited for environmental data because it requires only small sample sizes (at least four data points) and does not assume any underlying distribution for the data. Trends were identified as “decreasing” or “increasing” if the significance of Mann-Kendall test was at least 90 percent, otherwise trends were classified as “no trend.” If appropriate, the data were further analyzed using the SourceDK Tier 1 model, which uses linear regression analysis, a parametric statistical procedure that is typically used for analyzing trends in data over time to estimate timeframes required to meet cleanup goals. SourceDK uses an exponential function (also known as first-order decay) to estimate the change in concentration over time. SourceDK provides a best estimate of when a COC will reach a cleanup level as well as a range of dates based on a 90-percent confidence interval. The range was presented along with the best estimate.

Statistical geometric regression was used for trend analysis for OU2, sites LF04 and WP14 at OU6, and DP98 (USAF, 2008g), which is the same approach used by the SourceDK Tier 1 model. Instead of confidence intervals, a “performance envelope” was defined to account for the degree of scatter about the regression line. Specifically, the performance envelope was taken to be 1.96 standard deviations either side of the regression line. The cleanup date is taken to be the intersection of the +1.96 standard deviation curve with the cleanup level, corresponding to the time at which a sample is expected to have a 95-percent chance of being less than the cleanup level.

Data, and the trend analyses, are discussed for individual OUs below. To simplify the discussion of whether or not sites are on track to meet cleanup levels by the ROD-specified completion dates, trend analysis results from the 2007 RPO reports are discussed in terms whether COCs at a monitoring location are:

- below the cleanup level;
- on track to reach the reach the cleanup level by the ROD-specified completion date;
- decreasing, but predicted to reach the cleanup level after the ROD-specified completion date; or
- not decreasing.

If there is more that one COC for a given site, the monitoring location is considered to exhibit the trend of the COC that is predicted to take the longest time to reach its cleanup goal. A more detailed presentation of data, discussion of results, and recommendations can be found in the annual RPO reports. Monitoring results for primary COCs are presented in Attachment C.

6.4.1 Operable Unit 1

The remedy at OU1 is groundwater monitoring and LUCs at the remaining site – LF59 (ongoing). TCE is the only COC that still remains above its cleanup level in groundwater at OU1 (see Attachment C, Figure C-1). Recent data trends and the presence of intermediate degradation products in OU1 groundwater monitoring wells demonstrate that TCE is degrading, and achievement of cleanup levels is likely within the timeframe predicted in the ROD.

Two wells at OU1 were monitored under the CERCLA program during 2003 through 2007. Only one well, LF59-MW-03, contained TCE concentrations above the ROD-established cleanup level. Trend analysis indicates that the cleanup level at well LF59MW-03 will be reached by 2018, which is similar to the ROD-estimated cleanup date of 2024 (USAF, 2008b).

Additional investigation activities were conducted in 2006 as part of the Compliance Program at Elmendorf AFB, and the results that pertain to LF59 are also shown in Figure C-1. TCE concentrations in well LF05GW-2B, located near site LF07, had been below the cleanup level for four consecutive sampling events in 1996 and 1997, and the well was consequently removed from the OU1 groundwater monitoring program (USAF, 1997e). These data contributed to the removal of LF07 and other former OU1 sites from CERCLA (USAF, 2004c). Well LF05GW-2B was sampled again between 2006 and 2008 under the Compliance Program (USAF, 2007f, 2008i), and the TCE concentration in groundwater was once again above the cleanup level (up to 13 μg/L in 2007). It is possible that filling, covering, and capping activities conducted since the 1990s and the evapotranspiration caps installed in 2005 through 2007 at the former OU1 sites to the east of Vandenberg Avenue have changed site hydraulics such that concentrations have increased slightly. Compliance Program sampling in 2006 also detected TCE in new well OU1LF-19 and in direct push samples collected between wells LF05GW-2B, OU1LF-19, and LF59MW-03 (USAF, 2007f), as shown in Figure C-1. Therefore, the TCE contamination at LF59MW-03 may be originating, at least in part, from the vicinity of former CERCLA site LF07. However, LF07 may not be the only source of TCE contamination at LF59MW-03 since concentrations in this well have been relatively consistent since 1992 and did not mirror the decrease observed in LF05GW-2B in 1996 and 1997. There are insufficient data to determine if the upgradient source will impact long-term groundwater quality and the estimated cleanup date for LF59MW-03. Evaluation of future results from compliance program monitoring should help determine the impact on the LF59 end-date.

During the period from 2003 through 2007, 1,1,2,2-tetrachloroethane, a COPC in OU1 groundwater, was detected at concentrations up to 12 μg/L at sample location LF59MW-03 in 2005, and has been detected in this well since 1992. Since it is not a COC, there is no OU1 cleanup level for 1,1,2,2-tetrachloroethane. The 2003 Five-Year Review (USAF, 2003j) concluded that 1,1,2,2-tetrachloroethane concentrations at OU1 do not impact the effectiveness of the remedy. By 2007, the 1,1,2,2-tetrachloroethane concentration had decreased to 5 μg/L, probably due to natural attenuation processes.

Recommendations for changes in the OU1 monitoring program include:

- Incorporate data from upgradient wells LF05GW-2B and OU1LF-19 into evaluation of contaminant trends for LF59.

6.4.2 Operable Unit 2

The selected remedy at OU2 is source removal (completed), operation of a free product recovery system (completed), natural attenuation of contaminants in groundwater (ongoing), and LUCs (ongoing). The free product recovery system operated as designed and was shut down in April 1999, after no recoverable quantities of free product were observed for over a year (refer to Section 4.2.1). After 1999, hand-bailing methods were used to recover remaining small quantities of floating free product at wells with more than 0.1 foot thickness. Free product detected in OU2 wells has been less than 0.1 foot thick since 2003.

Groundwater and surface water data have verified that natural attenuation is occurring at ST41. Two petroleum hydrocarbon plumes exist in groundwater at ST41 and are separated by a groundwater divide (see Figure C-2, Attachment C). The ST41 North Plume is oriented northwest while the ST41 South Plume is oriented southwest. Groundwater and surface water data collected from 1996 through 2007 have verified that natural attenuation is occurring in both plumes at ST41. Groundwater from all wells sampled in 2007 met the cleanup levels for toluene, ethylbenzene, and xylenes. The only COC that exceeded cleanup levels was benzene in groundwater. Benzene exceeded the cleanup level at seep ST41SP-01. Due to confusion over its location, the surface water point of compliance for the wetland area to the north of ST41, identified as SW-13, was not sampled during the period 2003 through 2007. The location of SW-13 was recently re-established and surface water was sampled in 2008. All surface water COC concentrations, as well as SWQC TAH and TAqH, were below the detection limit in the 2008 SW-13 surface water sample. Sampling results for OU2 are presented in Attachment C, Figure C-2.

Sampling results show the natural attenuation remedy is working in groundwater, but that benzene concentrations are not decreasing quickly enough to meet cleanup levels by 2016 in all wells. Two sentry wells downgradient of the North Plume, ST41-20 and ST41-30, were sampled and only trace levels of benzene (below the cleanup level) were detected, indicating that natural attenuation was limiting plume size and mobility. Sentry wells downgradient of the South Plume included ST41-29 (sampled in 1991 and 1992), ST41MW-ES4B (sampled 1996 through 2000), and ST41MW-37A (sampled 1992 through 2001). All of these wells consistently showed benzene and other COC concentrations below the cleanup level and usually below the detection limit, indicating that natural attenuation limits plume size and mobility.

In the ST41 North Plume, benzene concentrations in well ST41-10R are on track to meet the cleanup level by 2016. Benzene concentration trends for well ST41-28 (not sampled since 2002 due to the presence of free product in the well) indicate that the cleanup level will be met by 2024. In the ST41 South Plume, benzene concentrations in well ST41-07 currently meet the cleanup level, but in wells ST41-25 and ST41-16, benzene concentrations are decreasing but are not predicted to reach the cleanup level until 2061 and 2098, respectively. These estimates may be overly conservative because 1) there is considerable variability in the data, making reliable prediction uncertain, and 2) well ST41-16 has not been sampled since 2002 due to the presence of free product in the well. Trend analyses are summarized in Table 6-1.

Table 6-1
Summary of Contaminants of Concern Trend Analysis in Operable Unit 2 Plume Wells

Plume	Number of OU2 plume wells sampled in 2007				
	COCs currently below cleanup level	COCs projected to reach cleanup level by 2016	COCs decreasing but projected to reach cleanup level after 2016	COCs not decreasing	Total Wells
ST41 North plume		1	1[a]		2
ST41 South plume	1		2[a]		3
All OU2 plumes	**1**	**1**	**3[a]**	**0**	**5**

[a]These totals include well ST41-28 in the North plume and well ST41-16 in the South plume that are not currently part of the OU2 sampling program and have not been sampled since 2002 due to the presence of free product.
COC = contaminant of concern; OU = operable unit

The seep and surface water data series are insufficient (too few measurements) to make a reliable prediction regarding the timeframe to meet cleanup levels for benzene. A longer sampling history is needed to discern the temporal trend and predict when cleanup levels will be met.

Although a surface water compliance point (SW-13) in the center of the wetland area was identified (USAF, 1998g, 1999b), it was not monitored during the past five years due to confusion about its location. Historical results for SW-13 are referenced in several documents. Reports indicate that SW-13 was sampled in 1995, 1997, 1998, 1999, 2000, and 2001 (USAF, 1997g, 1998g, 1999b, 2001a, 2003a,j). These references state that SW-13 met cleanup levels in the 1997, 1998, 1999 and 2001 sampling events, but only the results of the 1999 and 2000 sampling events could be located (USAF, 2001a) and are indicated in Attachment C, Figure C-2. The 1999 sample met the OU2 cleanup levels, but cleanup levels for benzene and ethylbenzene were slightly exceeded in the 2000 sample. The location of SW-13 was re-established and surface water was sampled in 2008. Concentrations of surface water COCs benzene, ethylbenzene and toluene, as well as SWQC TAH and TAqH, were below the detection limit in the 2008 SW-13 surface water sample. Surface water should continue to be sampled annually at the point of compliance to demonstrate protectiveness.

During the period since the last five-year review (2003 through 2007), there were several detections of contaminants at OU2 in addition to COCs. The fuel components acenaphthene (12 µg/L), fluorene (0.93 µg/L), n-butylbenzene (16 µg/L), and phenanthrene (0.36 µg/L) were all detected in 2005 in Well ST41-10R. These chemicals are common petroleum contaminants (i.e., they do not indicate a new source of contamination). No MCLs have been promulgated for these chemicals, and concentrations are below existing ADEC cleanup levels. Sampling of seep ST41SP-01 was conducted for the first time in 2003. All chemicals detected are typical for petroleum contamination (i.e., they do not indicate a new source of contamination).

The following changes to the OU2 monitoring program are recommended:

- Incorporate wells ST41-28 (North Plume) and ST41-16 (South Plume) back into the monitoring program for OU2 when free product is no longer present in these wells. These wells have historically produced samples with some of the highest COC concentrations at OU2, and monitoring results are important for trend analysis estimates for meeting cleanup levels. Small amounts of free product were still detected in these wells in 2007.

- The sampling frequency for well ST41-07 may be reduced or eliminated because cleanup levels appear to be met at this location.

- Permanently establish, in a memorandum to the site file, the location and annual monitoring requirement for the surface water point of compliance SW-13 in the wetland area to document that the natural attenuation remedy is working for OU2 surface water. Monitor seep ST41SP-01 once every five years.

6.4.3 Operable Unit 4

The selected remedy for soils at OU4 includes bioventing for deep soils and LUCs for shallow soils. Shallow soils meet cleanup levels at all OU4 sites (USAF, 1998b). DRO is the only COC that still remains above its cleanup level in deep soil at OU4 (FT23). One blower is currently operating at FT23. In 2005, the DRO concentration in one sample from 15 feet bgs exceeded the cleanup level (USAF, 2006g). Cleanup objectives for deep soils identified in the OU4 ROD have been achieved at sites SD25 and SS10 within the last five years (USAF, 2003b, 2006b).

The selected remedy for groundwater at OU4 includes natural attenuation and LUCs. Benzene, toluene, PCE, and TCE are the primary COCs that still remain above cleanup levels in groundwater at OU4, and results are provided in Attachment C, Figure C-3. A total of five wells at four OU4 sites were monitored in 2007. Results of trend analysis of COC concentrations are summarized in Table 6-2.

Table 6-2
Summary of Contaminants of Concern Trend Analysis in Operable Unit 4 Plume Wells

Plume	Number of OU4 plume wells sampled in 2007				
	COCs currently below cleanup level	COCs projected to reach cleanup level by 2008	COCs decreasing but projected to reach cleanup level after 2008	COCs not decreasing	Total Wells
FT23 plumes			2		2
SD24 plume			1		1
SD25 plume				1	1
SD29 plume			1		1
All OU4 plumes	**0**	**0**	**4**	**1**	**5**

COC = contaminant of concern; OU = operable unit

COC concentrations are decreasing in groundwater at FT23, SD24 and SD29, and trend analysis predicts that concentrations will reach cleanup levels by 2009 (USAF, 2008a). This is only one year beyond the ROD-estimated end date of 2008, and indicates that the natural attenuation remedies at these sites are operating successfully.

Evaluation of COC trends in SD25 groundwater is complicated by the fact that historical well OU4MW-08 was mistakenly abandoned in 2002 and was replaced by well OU4MW-08R in 2003. Concentrations of COCs in the replacement well are higher than in the original well, and the monitoring history of the replacement well is too short to discern temporal trends in concentrations of benzene and toluene. However, given that benzene and toluene concentrations were decreasing in the original well, and the general success of natural attenuation of petroleum contaminants at Elmendorf AFB, it is reasonable to expect that natural attenuation is working at SD15 and that decreasing trends will be apparent in the future at well OU4MW-08R.

No wells were monitored for SD28 during 2003 through 2007. As shown in Attachment C, Figure C-3, SD28 well IS5-01 was last sampled in 1993, and concentrations of the COCs TCE and PCE were below cleanup levels. COC concentrations in nearby wells OU4-E1 (upgradient of SD28) and OU4-E3 (downgradient of SD28 and SD29) were similarly below cleanup levels. Well OU4-E3 was last monitored in 2002. Based on the available data, groundwater at SD28 has met cleanup levels for all COCs and the site should be closed out.

During the period 2003 through 2007, there were several notable detections of contaminants at OU4 in addition to COCs:

- Bromomethane was detected in well FP-56 at 0.11 μg/L in 2005, but has never been detected prior to or after 2005. Bromomethane was not identified as a COPC for FT23. There is no MCL or ADEC cleanup level for bromomethane.

- In 2006, 1,1,2-trichloroethane, a COPC for OU4 groundwater, was detected in SD25 well OU4MW-08R at 39 μg/L and in FT23 well FP-56 at 19 μg/L. The MCL and ADEC cleanup level for 1,1,2-trichloroethane is 5 μg/L. 1,1,2-Trichloroethane had never been detected previously in OU4MW-08R, but was detected in well FP-56 in the 1990s. 1,1,2-Trichloroethane was not detected in any OU4 well in 2007.

Since the detections of bromomethane and 1,1,2-trichloroethane were isolated events that were not repeated, they are unlikely to represent new and continuing sources of contamination.

Recommendations for changes to the OU4 monitoring program include:

- Perform confirmation sampling to close out the soils remedy at FT23 in 2010 or sooner.

- Because groundwater at SD24 and SD29 is expected to meet cleanup levels by 2009, increase monitoring frequency from once every five years to annually in accordance with the monitoring frequency decision guide (Attachment F, Figure F-1). This will document attainment of cleanup levels and expedite closure of these sites.

- Prepare a memorandum to the site file documenting that groundwater meets cleanup levels at SD28 and recommend NFA for this site.

6.4.4 Operable Unit 5

The selected remedy at OU5 includes source removal (completed), seep water containment and treatment (ongoing), natural attenuation of groundwater and surface water (ongoing), and LUCs (ongoing). TCE is the primary COC that still remains above cleanup level in groundwater and surface water at OU5. Benzene and total fuel hydrocarbons meet cleanup levels at most locations across OU5. Concentrations of COCs at OU5 monitoring locations are presented in Figures C-4 through C-10 in Attachment C.

The point of compliance for OU5 is Ship Creek. To date, no COCs have been detected in any Ship Creek sample (Attachment C, Figure C-10). To provide additional protection to Ship Creek, the effluent of the WRS (Attachment C, Figure C-8) and Beaver Pond (Attachment C, Figure C-6) are also monitored. Also, two lines of monitoring wells, designated early warning wells and sentry wells, are located between the OU5 groundwater plumes and Ship Creek

(Attachment C, Figure C-7). The early warning and sentry wells are monitored to determine if significant concentrations of groundwater contaminants are migrating toward Ship Creek. All effluent monitoring results from the WRS and Beaver Pond and all early warning and sentry groundwater monitoring results for COCs have been below cleanup levels (USAF, 2004e, 2005i, 2006i, 2007e, 2008b, Weston Solutions, Inc., 2007d). Some early warning (OU5MW-05, 76WL-01, and OU5MW-11) and sentry (OU5MW-09, OU5MW-10, 401WL-04 and 401WL-03) wells are not downgradient of any plume. Geostatistical analysis performed in 2007 (USAF, 2008b) concluded that there is a low probability of TCE exceeding cleanup levels in this area. The early warning and sentry monitoring well network should be optimized.

The majority of sentry and early warning wells have had no TCE detections or minimal detections (less than 1 μg/L). However, measurements in sentry wells NS3-02 and OU5MW-31 have been close to the cleanup level of 5 μg/L. Statistical (Mann-Kendall) analysis was performed on TCE data from these wells through 2007 (USAF, 2008b). The analysis concluded that well NS-02 does not have a statistically significant trend, but concentrations are stable (i.e., the results have a coefficient of variation less than 1). A stable trend at NS-02 implies that TCE concentrations are expected to remain relatively constant over time and are therefore likely to remain below the TCE cleanup level for most future sampling events. OU5MW-31 showed a decreasing trend, which was accentuated by the recent sample less than 1 μg/L

There is some uncertainty regarding the downgradient extent of the Fairchild Avenue TCE plume in the deeper portions of the shallow aquifer (USAF, 2008b) (Attachment C, Figures C-5 and C-9). Wells in the Fairchild Avenue plume are screened at different elevations. Most of the wells are screened across the water table, however, wells OU3MW-11, OU5MW-34, and OU5MW-38 are screened deeper in the shallow aquifer. The extent of the TCE plume at the water table is clearly delineated and its migration does not extend to the base boundary. TCE concentrations in the deeper portions of the shallow aquifer decrease along the direction of groundwater flow, so the Fairchild Avenue plume was not expected to extend significantly beyond the limits indicated in reports. However, the downgradient extent of the deeper portion of the Fairchild Avenue plume is not delineated.

Results of a 2002 ARRC groundwater investigation (MWH Americas, Inc., 2002) also contributes to uncertainty about the downgradient extent of the Fairchild Avenue plume. The ARRC monitoring wells are not part of the OU5 monitoring program, but the results of the ARRC investigation were considered in this five-year review. TCE was detected in ARRC groundwater wells installed downgradient of the Fairchild Avenue plume at concentrations ranging up to 14.9 μg/L. The locations of and data from the ARRC monitoring wells are shown in Attachment C, Figure C-9. Well ARRC MW4 was completed in the shallow aquifer, and the elevation of the bottom of the well is about 82 feet amsl (the elevation of the top of Bootlegger Cove clay formation). The well contained TCE above the OU5 cleanup level during the only sampling event in 2002. OU5 early warning well OU5MW-01 is located about 600 feet north (upgradient) of the ARRC wells. It was also completed in the shallow aquifer, and the elevation of the bottom of the well is about 89 feet amsl (USAF, 2008h), which is approximately five feet above the top of the Bootlegger Cove formation. TCE concentrations in OU5MW-01 have been below detection limits in all 23 sampling events between 1992 and 2007. ARRC well results and OU5 early warning well results may appear contradictory, but only if it is assumed that the contamination in the ARRC well is coming from the Fairchild Avenue Plume. The current uncertainty illustrates the need for better delineation of the downgradient extent of the Fairchild Avenue TCE plume.

Seeps on the western and central bluffs (Attachment C, Figure C-8) that were known to be contaminated with TCE above the cleanup goal have been routed into the wetland treatment cell since 2004. However, in 2005 and 2006, the TCE concentration in Seep 7 increased to just above the cleanup level. Seep 7 is not captured by the WRS, and flow from this seep merges with the WRS effluent just downstream of the WRS discharge point. The TCE concentrations in Seep 7 are only slightly above the cleanup level, and based on concentrations in upgradient groundwater (Kenney Avenue plume), are unlikely to increase in the future. TCE is volatile, and concentrations likely decrease to below the cleanup level within a short distance from the seep. Therefore Seep 7 poses no significant risk to human health or the environment (i.e., Ship Creek). In accordance with the decision guide for restarting an existing seep collection area or adding a new seep collection area for treatment (Attachment F, Figure F-4) that was adopted by the 2005 OU5 memorandum to the site file (USAF, 2005b), the USAF should monitor Seep 7 quarterly.

Seeps on the western and central bluffs (Attachment C, Figure C-8) mark the downgradient extent of TCE contamination above the 5 μg/L cleanup level. This is confirmed by the consistent monitoring results from downgradient sentry wells OU5MW-12, OU5MW-13, and OU5MW-14 (Attachment C, Figure C-7). TCE concentrations in these sentry wells have usually been below detection limits and have never exceeded 0.35 μg/L during the period 2003 through 2007.

The success of the natural attenuation remedy for groundwater has been mixed. A total of 22 wells in the six OU5 TCE plumes were monitored in 2007 (Attachment C, Figures C-5 and C-6). Results of trend analysis of TCE concentrations (USAF, 2008b) in these wells are summarized in Table 6-3.

Table 6-3
Summary of Trichloroethene Trend Analysis in Operable Unit 5 Plume Wells

Plume	**Number of OU5 plume wells sampled in 2007**				
	TCE currently below cleanup level	**TCE projected to reach cleanup level by 2026**	**TCE decreasing but projected to reach cleanup level after 2026**	**TCE not decreasing**	**Total Wells**
Fairchild Avenue plume	1	1	1	3	6
Kenney Avenue plume	3		1		4
Slammer Avenue plumes	3	1		2	6
OU3MW-25 plume	1				1
OU5MW-02 plume			1	2	3
SP1-02 plume	1		1		2
All OU5 plumes	**9**	**2**	**4**	**7**	**22**

OU = operable unit; TCE = trichloroethene

Table 6-3 shows that TCE concentrations in 50 percent of these 22 wells are either currently below the cleanup level, or are predicted to reach the cleanup level by the ROD-specified end date of 2026. Another 18 percent of the wells also show decreasing TCE concentrations, but rates are too slow to meet the ROD-specified end date. In some wells, particularly in the Fairchild Avenue, OU5MW-02, and Slammer Avenue plumes, decreases in TCE concentrations coupled with detections of the intermediate degradation product *cis*-1,2-DCE show strong evidence of natural attenuation by reductive dechlorination. At other wells, such as OU5MW-06 in the Slammer Avenue plume, the decreasing TCE concentrations are probably primarily due to slow flushing of the contaminant source rather than reductive dechlorination.

TCE concentrations do not currently exhibit a decreasing trend in 32 percent of the OU5 plume wells. TCE concentrations in these wells are relatively low compared to the solubility of TCE. As such, there is no indication of a strong or growing source of contamination. Without a continuing source of contamination, TCE concentrations should eventually begin to decrease as the old sources are depleted through groundwater flushing. An increasing trend has transitioned to a decreasing trend in at least one OU5 well (49WL-01 in Fairchild Avenue plume) and the total monitoring history (varying from 3 to 13 years) of these wells is shorter than the 18 years that remain until the ROD-specified end date. However, current trends indicate that natural attenuation processes alone are unlikely to achieve TCE cleanup levels throughout OU5 groundwater by 2026. Because contaminants in seeps are fed by groundwater, it is unlikely that TCE will meet cleanup levels in seeps by 2026.

The USAF has begun to investigate alternative remedial strategies to meet cleanup levels by 2026, including a pilot test of enhanced bioremediation at the Kenney Avenue plume (Henry, 2007a). To accelerate the cleanup process, alternative treatment must focus on the contaminant sources, which are generally not defined for the OU5 plumes. Investigations to better understand the plumes have been ongoing; see Section 4.4.1 for a complete listing of actions taken over the past five years. Recent direct push/TRIAD investigations at the Kenney Avenue and Slammer Avenue plumes are improving the understanding of these plumes. Similar investigations are being planned for the other OU5 plumes, and improved characterization, if successful, will help define options for alternative remedies. The relatively dilute nature of the OU5 plumes will likely make it difficult to locate plume sources.

In 2007, benzene met the cleanup level in all OU5 groundwater samples and in all OU5 seep samples except for Seep 2. TAH and TAqH were below the cleanup levels in all OU5 seeps except Seep 2. In Seep 2, benzene concentrations are fluctuating just above the cleanup level and TAH concentrations are slowly decreasing. Seep 2 contamination is mitigated by capture and treatment in the WRS.

During the period 2003 through 2007, there were several notable detections of contaminants at OU5 in addition to COCs:

- PCE, carbon tetrachloride, and 1,1,2-trichloroethane were the only compounds other than COCs to be detected at concentrations above their MCLs (USEPA, 2006) and/or ADEC groundwater cleanup standards (ADEC, 2006d). None of these contaminants are COPCs for OU5. PCE was detected in well OU3MW-11 at concentrations up to 7.2 μg/L. PCE has been detected in this well above the 5-μg/L MCL since 1993. Its presence was noted in the 2003 Five-Year review, where it was concluded that PCE attenuates prior to discharge into Ship Creek. Carbon tetrachloride was detected in early warning well OU5MW-45 at 5.6 μg/L in January 2007, but by June 2007 its concentrations were once again below the 5 μg/L MCL. Carbon tetrachloride has been detected at a total of ten OU5 sample locations since 1993 (generally in the Fairchild Avenue and OU5MW-02 plume wells), but has exceeded the MCL in only one sample. 1,1,2-Trichloroethane was detected in Seep 2 at 38 μg/L in May 2006, but was not detected during the subsequent six sampling events. 1,1,2-Trichloroethane has been detected at ten OU5 sampling locations since 1995, but the Seep 2 detection was the only detection above the 5-μg/L MCL or ADEC groundwater cleanup standard. All three chemicals have consistently been low-level contaminants at OU5 (i.e., they do not represent a new source of contamination), and they occur at concentrations in excess of MCLs and ADEC cleanup standards only in isolated locations or as isolated events.

- Bromomethane was detected at 0.11 μg/L at Ship Creek sample location SC-8 in 2005, but was not detected during the next sampling round in 2006. Trace concentrations of bromomethane up to 0.24 μg/L were also detected in groundwater in nine wells in 2005. Bromomethane is a COPC for OU5 surface water, but not for groundwater. Because bromomethane was detected at very low concentrations in multiple samples in a single sampling round, and not in previous or subsequent sampling rounds, suggests that it did not originate from OU5 and may possibly be the result of outside or cross contamination. During the 2005 sampling round, the nine wells contained an average TCE concentration of 6.6 μg/L and an average bromomethane concentration of 0.17 μg/L. The Ship Creek sample contained 0.11 μg/L of bromomethane but TCE was not detected. If the bromomethane detection in the Ship Creek sample were the result of OU5 contamination, other OU5 contaminants such as TCE would probably have been also been present. The absence of other OU5 contaminants such as TCE suggests that the bromomethane detected in Ship Creek probably did not originate from OU5.

- Trace concentrations of bromomethane up to 0.24 μg/L were also detected in groundwater in nine wells in 2005. Bromomethane is a COPC for surface water, but not for groundwater.

- Vinyl chloride was detected at 0.31 μg/L in well OU5MW-14 in July 2006 only, and in surface water sample BPSW-03 in December 2007 only. Vinyl chloride is an anaerobic biodegradation product of TCE, but is not a COPC at OU5 groundwater.

- 1,2,3-Trichloropropane was detected in Seep 2 at 1 μg/L in September 2007 only, and its degradation product, 1,2-dichloropropane, was detected in Seep 2 at 2.8 μg/L in December 2007 only. 1,2,3-Trichloropropane was previously detected at OU5 in a single groundwater sample in 1993. 1,2,3-Trichloropropane and 1,2-dichloropropane are not COPCs for OU5 groundwater.

- 1-Methylnaphthalene was detected in several seeps at concentrations up to 12 μg/L, and 2-methylnaphthalene was detected in Seep 2 at concentrations up to 5.1 μg/L. These compounds are common components of fuels, but are generally not analyzed in groundwater samples and have only been included as analytes for seep samples since 2006. These compounds are not COPCs for OU5 surface water.

- Several compounds were detected in seeps or surface water samples for the first time during 2003 through 2007, but have all been previously detected in OU5 groundwater samples. Several are chlorinated solvents and decay products, including 1,1,2,2-tetrachloroethane (up to 2.8 μg/L), 1,1,2-trichloroethane (up to 38 μg/L), and 1,1-dichloroethene (1,1-DCE, up to 1.4 μg/L). Three halogenated methanes were detected at concentrations less than 1 μg/L: bromodichloromethane, chloromethane, and dichlorodifluoromethane. Methyl-ethyl-ketone (up to 16 μg/L) and methyl-isobutyl-ketone (0.45 μg/L) were detected; ketones can be produced by fermentation of petroleum compounds under low pH conditions, but are highly unstable and do not persist very long in the environment. The petroleum hydrocarbon analytes DRO (up to 1,200 μg/L) and GRO (up to 1,900 μg/L) were detected at several seeps, but analysis for these compounds in seeps only began in 2007. The fuel additive methyl-tert-butyl-ether was detected in Seep 4 at 0.57 μg/L in 2004 only. None of these compounds except GRO were COPCs for OU5 surface water.

Recommendations for changes to the OU5 monitoring program include:

- Attempt to identify sources of TCE contamination for Fairchild Avenue, OU5MW-02, SP1-02 Kenney Avenue, and Slammer Avenue plumes using direct push/TRIAD techniques, followed by installation of permanent wells where and if appropriate. If sources can be identified, evaluate alternative remedial strategies to accelerate attainment of the TCE cleanup level in OU5 groundwater.

- Delineate the downgradient extent of TCE contamination in the deeper portions of the shallow aquifer at the Fairchild Avenue plume.

- Increase the monitoring frequency for Seep 7 to quarterly in accordance with the decision guide for restarting an existing seep collection area or adding a new seep collection area for treatment (Attachment F, Figure F-4).

- Resample well OU3MW-25 (OU3MW-25 plume) to confirm that the TCE concentration remains below the cleanup level. If confirmed, prepare a memorandum to the site file to discontinue sampling of this plume.

- Optimize early warning and sentry monitoring well network to eliminate wells that are not downgradient of plumes and consider additional wells where there is a greater probability of contaminant migration.

6.4.5 Operable Unit 6

The selected remedy at areas within OU6 includes natural attenuation of contaminants in groundwater (ongoing), annual LF04 debris removal (ongoing), LF02 surface debris removal and cover application (complete), and SD15 groundwater and soil treatment via HVE (complete) and SD15 groundwater via MNA (on-going).

Groundwater, soil, and other monitoring data were reviewed for trends and expectations of meeting cleanup levels. The most recent data and trends are documented in the 2007 annual data and RPO reports (USAF, 2007h, 2008a,f).

6.4.5.1 Operable Unit 6 Groundwater

Overall, OU6 groundwater is on-track to meet cleanup goals. COC trends in OU6 wells are summarized in Table 6-4.

Table 6-4
Summary of Contaminants of Concern Trend Analysis in Operable Unit 6 Plume Wells

Site	Number of OU6 wells sampled in 2007				
	COCs currently below cleanup level	COCs projected to reach cleanup level by target date[1]	COCs decreasing but projected to reach cleanup level after target date[1]	COCs not decreasing	Total Wells
LF02	2				2
LF04 South[2]	1				1
WP14	4			1	5
SD15	1	1	1		3
All OU6 sites	**8**	**1**	**1**	**1**	**11**

[1] Target cleanup dates: WP14 and LF04 South: 2011, SD15: 2015, LF02: 2020
[2] LF04 South groundwater is monitored by WP14 and PL81 wells; WP14 wells are listed separately.
COC = contaminant of concern; OU = operable unit

All wells except two have met or are projected to meet cleanup levels within the target date discussed in the ROD or ROD update. Benzene in well OU6MW-91 at WP14 does not have a decreasing trend, but concentrations are low and fluctuating just above and below the cleanup level. Table 6-4 does not include trends from two wells at WP14/LF04 (wells OU6MW-61 and OU6MW-77); these wells were removed from the groundwater monitoring program after being sampled in 1994 and 2002 respectively, and COC concentrations in these wells may extend the estimated timeframe to meet groundwater cleanup goals for these sites. Groundwater monitoring data are discussed for each of the OU6 sites.

LF02 Groundwater: The only groundwater COC at LF02 was 1,1,2,2-tetrachloroethane, and monitoring results are presented in Attachment C, Figure C-13. The ADEC cleanup standard for 1,1,2,2-tetrachloroethane, 4 μg/L, was adopted as a cleanup level for LF02 groundwater in the 2007 OU6 ESD (USAF, 2007a). The concentration of 1,1,2,2-tetrachloroethane has been below the 4-μg/L cleanup level in well OU6MW-49R since 2003 (total of three sampling rounds) and has always been below the cleanup level in well 53WL-05 and seep LF02SP-01 (USAF, 2008f). Therefore groundwater cleanup levels for LF02 appear to be met.

LF04 South Groundwater: The OU6 ROD identified benzene, ethylbenzene, toluene, methylene chloride, and 1,2-dichloroethane as COCs, and monitoring results are presented in Attachment C, Figure C-11. At the time of the ROD, fuel contaminants were found in groundwater throughout the southern part of LF04 and in seep LF04SP-02. Also at the time of the ROD, chlorinated solvents were limited to just a few wells: OU6MW-61, OU6MW-67, and

OU6MW-77. Since the ROD, the conceptual site model for LF04 South has evolved. Fuel contamination is currently believed to originate from WP14 and PL81; groundwater monitoring is currently conducted in the context of these sites and there is no groundwater monitoring specifically designated for LF04 South. In the future, monitoring and evaluation should also be conducted in the context of LF04 South (i.e., include a specific section on LF04 South groundwater in annual monitoring reports) to ensure compliance with OU6 ROD requirements.

WP14 is part of OU6. Wells OU6MW-67 and OU6MW-77, formerly associated with LF04, are located along the downgradient portion of WP14, and well OU6MW-67 remains part of the groundwater monitoring program for WP14. Seeps LF04SP-03 and LF04SP-04 are downgradient of WP14 and are part of the WP14 monitoring program. Methylene chloride was detected in OU6MW-67 and OU6MW-77 in excess of the cleanup level at the time of the ROD, but concentrations have been below the cleanup level for these wells in all samples since October 1996. Groundwater in this portion of LF04 meets cleanup levels for chlorinated solvent COCs. Benzene still exceeds its cleanup level in downgradient seeps LF04SP-03 and LF04SP-04. Please refer to the discussion of WP14 groundwater monitoring presented later in this section for results and trends associated with fuel contaminants in these wells and seeps.

PL81 consists of fuel leaks associated with a valve pit along a fuel pipeline; this site is administered under a state program and is not part of OU6. PL81 source areas and monitoring wells are located upgradient of the LF04 site boundary. However, seep LF04SP-02 was specifically mentioned in the LF04 portion of the OU6 ROD, and the seep continues to be monitored as part of PL81 South. Concentrations of benzene in LF04SP-02 have been decreasing since 1994. The benzene concentration has been below the OU6 cleanup level since 2006 (two sampling rounds). Benzene concentrations in nearby seeps LF04SP-01 and LF04SP-02DG have also been consistently below the OU6 cleanup level. Monitoring well OU6MW-63, located just upgradient of LF04SP-02 and the LF04 boundary, has also exhibited decreasing benzene concentrations over time and has met the benzene cleanup level since 2006. Groundwater in this portion of LF04 appears to meet all OU6 cleanup levels for COCs.

The OU6 ROD indicated that the highest levels of benzene (up to 3,400 μg/L) and 1,2-dichloroethane (up to 38.7 μg/L) in LF04 groundwater were detected in well OU6MW-61. Both COCs exceeded their OU6 cleanup levels during the most recent sampling event conducted in September 1994 (during the RI/FS). Water levels are routinely measured in well OU6MW-61, but otherwise it was not incorporated into the post-ROD monitoring program, probably because it is screened in a perched aquifer. Well OU6MW-61 should be sampled to determine if it currently meets cleanup levels for 1,2-dichloroethane and methylene chloride. If the cleanup levels are met for these compounds in OU6MW-61, then cleanup of all LF04 South groundwater would be complete for chlorinated COCs.

<u>WP14 Groundwater</u>: The OU6 ROD identified benzene, ethylbenzene, and toluene as COCs for WP14 groundwater, and monitoring results are presented in Attachment C, Figure C-11. Groundwater quality meets or is close to cleanup levels for COCs at WP14 (USAF, 2007h, 2008f). Ethylbenzene and toluene concentrations met their cleanup levels at all sampling locations in 2007. Benzene met its cleanup level at all sampling locations in 2007 except for seeps LF04SP-03 and LF04SP-04 and well OU6MW-91. At these locations, benzene concentrations have fluctuated just above and below the cleanup level over the past five years. The fluctuations of benzene concentrations prevent reliable prediction of when cleanup levels

will be consistently met. The non-detection of benzene at seep LF04SP-03 in 2003 through 2006 was attributed to an incorrect identification of the sampling point. Samples during this time period were collected downstream of the seep, and the correct sampling location was identified again in 2007. These data indicate that seep LF04SP-03 contaminants rapidly degrade or volatilize as water flows down the slope away from the seep. The correct sampling point (including GPS coordinates) for seep LF04SP-03 was re-established in 2007, so data from 2007 can be directly compared to data before 2003.

In addition to the COCs identified in the ROD, the monitoring program for WP14 includes analyses for DRO and GRO in groundwater and TAH and TAqH in seeps. DRO and GRO are monitored at wells associated with fuel plumes as a result of an agreement between the USAF, USEPA and ADEC in January 2003 (USAF, 2003j), but were not added as CERCLA ARARs. TAH and TAqH are monitored at WP14 seeps as a result of a recommendation in the 2003 annual monitoring report (USAF, 2004b). DRO and GRO in groundwater and TAH and TAqH in seeps were not selected as COCs for WP14 or LF04 South in the OU6 ROD or ESD, nor were they selected as COCs for state site PL81. However, these parameters have been identified as WP14 COCs in annual monitoring reports since 2004 (USAF, 2004h). The USAF may continue to monitor for these parameters at WP14, but should not list them as COCs in annual reports. DRO and GRO concentrations have exceeded their ADEC groundwater cleanup standards but are consistently trending toward those standards at most wells. The trend in downgradient well OU6MW-67 predicts the DRO concentrations will meet the standard by 2023. Besides being downgradient of the source area, this well is infrequently monitored (only once in the past five years), so trends are heavily influenced by the most recent sampling event. TAH and TAqH concentrations in the seeps fluctuate above and below the ADEC standards in a pattern consistent with the benzene concentrations.

All active groundwater monitoring wells at WP14 and LF04 South, and four additional wells with a history of containing free product, were checked annually for free product. If more than 0.1 foot of product is detected in a well, the free product is removed. Free product in excess of 0.1 foot was discovered in only one well (OU6MW-77) at these sites during the past five years. In 2005, 1.16 feet was measured in OU6MW-77 (USAF, 2006c), but no product was measured in this well in 2006 or 2007. It is unlikely that any recoverable free product remains at existing well locations at these sites.

WP14 groundwater generally appears to be close to meeting its cleanup goals. Well OU6MW-77 had very high concentrations of benzene when it was last sampled in 2002. The well was removed from the groundwater monitoring program after that date due to the presence of free product. If free product continues to be absent from this well, it should be reincorporated into the groundwater monitoring program because its historically high contaminant concentrations make it important for trend analysis to establish the cleanup date for groundwater.

Methyl-isobutyl-ketone was the only new chemical detected in WP14 groundwater during the period 2003-2007. It was detected only once at well 14WM-120 at 4.2 μg/L in 2003, and has been non-detect in all subsequent samples. Ketones can be produced by fermentation of petroleum contaminants under low pH conditions, but are very unstable and degrade rapidly in the environment. There is no MCL or ADEC cleanup standard for methyl-isobutyl-ketone.

<u>SD15 Groundwater</u>: The HVE system was no longer effective at removing VOCs and was shut down in 2007. The remaining contaminants are addressed through natural attenuation

(USAF, 2007a). Benzene and TCE are the only SD15 COCs that still exceed their cleanup levels. Three wells are monitored at SD15, and monitoring data is presented in Attachment C, Figure C-12. Benzene and TCE concentrations meet cleanup levels in one well, and are decreasing at the other two wells. Trend analysis in 2007 showed that benzene in well OU6MW-17 is predicted to reach its cleanup level by 2023 (USAF, 2008a). The remaining COCs and wells are predicted to reach cleanup levels by 2015.

Several chemicals were detected in SD15 groundwater for the first time during the period 2003 through 2007. 1,2,4-Trimethylbenzene (up to 0.17 μg/L), n-propylbenzene (up to 0.24 μg/L), p-cymene (up to 0.34 μg/L) and sec-butylbenzene (up to 0.22 μg/L) were all detected at SD15 for the first time in 2006 or 2007. These chemicals are all fuel constituents (substituted benzenes) but were only added to VOC analytical protocols in 2001 or 2002. They are characteristic of the contaminants found at SD15. Dichlorodifluoromethane was also detected in only one well at 0.24 μg/L in 2003, but has not been detected since that time. Because these chemicals were detected only sporadically and at very low concentrations, they do not indicate a new or continuing source of contamination. There are no MCLs or ADEC cleanup levels for these compounds.

6.4.5.2 Operable Unit 6 Soil

Soil sampling data for OU6 sites LF04 and SD15 are discussed in the following paragraphs.

LF04 Soil: Debris removal was conducted annually at LF04. Since the previous five-year review in 2003, approximately 48 tons of debris were removed (USAF, 2008f), which was less than half of the 118 tons removed in the previous five-year period. Most of the waste material was non-hazardous solid waste. Other material recovered included approximately 1,240 lbs of asbestos-containing material (pipe and cementitious board), and lesser amounts of various waste materials including shell casings, a light ballast, soldering rods, a car battery, and asphalt. It is possible that erosion along the bluff is decreasing over time as the bluff stabilizes, resulting in an overall reduction in debris recovered. The Port of Anchorage expansion project along the shoreline of LF04 is expected to further reduce the erosional debris.

In 2007, surface soil samples were collected from 10 locations along the LF04 bluff to determine if contaminant concentrations had changed (USAF, 2008f). Soil samples were analyzed for polynuclear aromatic hydrocarbons (PAHs), metals, pesticides, polychlorinated biphenyls (PCBs), VOCs, semi-volatile organic compounds, dioxins/furans, GRO, DRO, and residual-range organics (RRO). Of these analytes, only six VOCs were present in any sample at concentrations greater than were detected at the time of the ROD. However, the overall low concentrations and isolated nature of the detections suggests that there has not been a new release of contaminants and that overall soil contamination levels have not increased. Results are summarized in Table 6-5.

Table 6-5
LF04 Surface Soil Sampling

Contaminant	Record of Decision		2007 Sampling Event	
	Max Concentration (mg/kg)	Frequency of Detection	Max Concentration (mg/kg)	Frequency of Detection
1,2-Dichloroethane	--	0/53	0.0864	1/10
cis-1,2-Dichloroethene	--	0/53	0.952	1/10
Methylene Chloride	0.0832	30/53	0.364	10/10
1,1,2,2-Tetrachloroethane	0.0198	1/53	0.0193	1/10
Tetrachloroethene	--	0/53	0.039	1/10
Trichloroethene	0.0113	1/53	0.923	4/10

mg/kg = milligram per kilogram

Four of the six VOCs were detected in only a single sample, and the highest concentration of five of the VOCs were all detected at the same sample location (LF04-05-SO). The isolated nature of soil contamination mirrors the results at the time of the ROD, when the TCE and 1,1,2,2-tetrachloroethane detections were limited to a single sample location (SS-17, located in the same general vicinity as sample location LF04-05-SO). Of the six VOCs, only methylene chloride and 1,2-dichlorethane have ever been detected in LF04 groundwater at concentrations above the groundwater cleanup levels. Concentrations of these six VOCs in groundwater at LF04 have not exceeded cleanup levels since 1996, including during annual sampling of nearby seep LF04SP-06 as recently as 2006. Because the groundwater monitoring program shows no evidence of significant contamination from these chemicals, the soil sample results most likely indicate an isolated pocket of contamination that does not threaten groundwater quality.

The most widely detected soil contaminant, methylene chloride, was also detected in blank samples both at the time of the ROD and during the 2007 sampling event. Methylene chloride is commonly used as a laboratory solvent, and may have been introduced into the samples in the laboratory and does not represent contamination at the site.

<u>SD15 Soil</u>: Soil sampling conducted on August 9, 2005 confirmed that shallow and deep soil meet cleanup levels for all soil COCs, including GRO, DRO and BTEX (USAF, 2006f). Cleanup for SD15 soil is complete.

6.4.5.3 Operable Unit 6 Monitoring Recommendations

Recommendations for changes to OU6 monitoring program include:

- Sample LF02 groundwater for all COPCs for one sample round to confirm that cleanup levels have been met.

- Conduct groundwater monitoring and evaluations in the context of LF04 South requirements of the OU6 ROD. Sample well OU6MW-61 to determine if LF04 South groundwater meets cleanup levels for chlorinated COCs.

- If free product continues to be absent from WP14 well OU6MW-77, reincorporate the well into the groundwater monitoring program.

6.4.6 Site DP98

The selected remedy at DP98 is source removal (completed), natural attenuation of contaminants in groundwater (ongoing), and LUCs. Groundwater and surface water data have verified that natural attenuation is occurring at DP98. A DRO plume and a chlorinated solvent plume partially overlap in groundwater at DP98. The DRO plume is presumed to be attenuating because the UST sources were removed in 1995, and there is no longer a visible sheen in the wetland (USAF, 2008g). Petroleum hydrocarbons, including DRO, were not included as COCs in the DP98 ROD, and their presence helps accelerate breakdown of chlorinated COCs by providing a carbon source to promote anaerobic biodegradation (USAF, 2004d). There are two chlorinated solvent plumes; the larger plume is defined by wells 41755WL-02, 41755WL-03, 41755WL-04 and 41755WL-05, and a smaller plume is defined by well 41755WL-08 (see Figure C-14 in Attachment C). The smaller plume is migrating slowly through well 41755WL-08, and may be discharging to the wetland or slowly flowing under the wetland but has not yet arrived at the downgradient sentry well (41755WL-16). Groundwater flow at DP98 is generally to the northwest.

Groundwater data collected from 1997 through 2007 have verified that COCs are naturally attenuating at DP98. Contaminant levels have generally been reduced; however, concentrations of all of the COCs were above the cleanup standards in 2007. The five groundwater COCs are TCE, PCE, *cis*-1,2-DCE, 1,1- DCE and vinyl chloride (USAF, 2004d). Two of the COCs, 1,1-DCE and vinyl chloride are present at much lower concentration than *cis*-1,2-DCE and TCE. The maximum detected concentrations of 1,1-DCE and vinyl chloride in 2007 were 15.7 µg/L at well 41755WL-04 (the cleanup level is 7 µg/L), and 13.8 µg/L at Well 41755WL-05 (the cleanup level is 2 µg/L), respectively. Sampling results for TCE, PCE, and *cis*-1,2-DCE are presented on Figure C-14, Attachment C.

The sampling histories of individual COCs in individual wells are too short, and data exhibit too much scatter, to get a clear picture of the impact of natural attenuation on contaminant concentrations. To facilitate evaluation of natural attenuation in 2007, data for individual COCs and individual wells were composited (USAF, 2008g). Because *cis*-1,2-DCE is the limiting step to anaerobic degradation of PCE and TCE, molar concentrations of PCE and TCE were added to those of *cis*-1,2-DCE (and 1,1-DCE) to obtain a total molar COC concentration. The total molar concentrations for wells 41755WL-03, 41755WL-04 and 41755WL-05 were normalized to the same mean molar concentration as well 41755WL-02 so data from all wells could be plotted and trended together. Trend analysis for normalized concentrations for all four wells predicts that cleanup levels will be reached by 2068 (USAF, 2008g). This analysis suggests that natural attenuation is occurring as anticipated by the ROD. As more monitoring data become available, cleanup timeframe estimates for individual wells and COCs should be possible.

TCE and *cis*-1,2-DCE concentrations have generally been increasing since 1997 in the smaller COC plume defined by well 41755WL-08. However, total COC concentrations in the smaller plume are an order of magnitude lower than in the larger plume. Since the ROD estimated that COC concentrations will meet cleanup goals by 2079, there is a lot of time for concentrations at this location to decrease. Results of trend analysis for both COC plumes are summarized in Table 6-6.

Table 6-6
Summary of Contaminants of Concern Trend Analysis for DP98 Plume Wells

Plume	Number of DP98 plume wells sampled in 2007				
	COCs currently below cleanup level	COCs projected to reach cleanup level by 2079	COCs decreasing but projected to reach cleanup level after 2079	COCs not decreasing	Total Wells
Larger COC plume		2	2		4
Smaller COC plume				1	1
DP98 Total	**0**	**2**	**2**	**1**	**5**

COC = contaminant of concern

Surface water samples from the former kettle pond has not contained detectable concentrations of groundwater COCs (there are no COCs specified for surface water in the ROD) since sampling began in 2005 (USAF, 2008g).

After the ROD was signed in June 2004, there were several notable detections of contaminants at DP98 in addition to COCs:

- DRO, GRO, and benzene were detected at concentrations above the ADEC groundwater cleanup levels (ADEC, 2006d) and/or MCL. All of these contaminants are COPCs for DP98 and their detection does not indicate a new source of contamination. Monitoring for DRO and GRO was conducted at DP98 in 2007 (for first time since the ROD) to help assess the impact of petroleum hydrocarbons on natural attenuation of the chlorinated solvent COCs. Benzene was detected above the MCL of 5 µg/L at well 41755WL-01 (30.1 µg/L in 2006); however, concentrations are declining and this is the only well where benzene has been above the MCL. Benzene has consistently been a low-level contaminant at DP98, but it occurs at concentrations in excess of the MCL only at one isolated location.

- A few compounds were detected in groundwater samples for the first time since the ROD. The chlorinated solvent decay product 1,2-dichloroethane was detected in only one sample (0.58 µg/L) in 2006 and was only slightly above the detection limit for that sample. Methyl-ethyl-ketone (up to 5.3 µg/L) and methyl-isobutyl-ketone (up to 2.3 µg/L) were also detected. Ketones can be produced by fermentation of petroleum contaminants under low pH conditions, and are unstable in the environment. The MCL and ADEC cleanup standard for 1,2-dichloroethane is 5 µg/L, but standards have not been established for the ketones.

Recommendations for changes to the DP98 monitoring program include:

- Increase the sampling frequency of well 41755WL-08, located in the smaller COC plume, to semi-annual. The DP98 ROD (USAF, 2004d) requires this frequency of monitoring if wells are upgradient of a receptor and COC concentrations are increasing (Attachment F, Figure F-2).

- Sample surface water in the vicinity of well 41755WL-08 concurrently with groundwater sampling.

6.5 SITE INSPECTION

The site inspection for this five-year review was conducted May 6 through 8, 2008. The site inspection team consisted of four environmental engineers from Parsons: Dr. Ross Miller, Ph.D., P.E., CIH (technical director), Dr. Edward Heyse, Ph.D., P.E. (principal investigator), Mr. Scott Anderson, P.E. and Ms. Carrie Ross, E.I.T. (team members). The Parsons team was guided on the site inspection by USAF RPMs and the site O&M contractors (see Section 6.6). The team visited every site, and discussed the sites and performance of the remedies with the USAF RPMs and their contractors. The team located all actively monitored wells and looked for signs of site disturbance (such as excavations) and changes in land use from those described in decision documents. The team documented the results of the site inspections on checklists that are located in Attachment D.

The site inspection results were supplemented with documentation of site inspection activities conducted by Elmendorf AFB environmental restoration contractors in annual reports. These inspections include periodic O&M inspections of active remediation systems as well as an annual inspection of each monitoring well in the monitoring program to identify and repair any damage, and an annual visual inspection of each OU to look for signs of any unauthorized digging or well installation.

LUCs were inspected by reviewing governing documents; interviewing Elmendorf AFB personnel associated with community planning, real estate, dig permitting, GeoBase, and the environmental restoration program; inspecting dig permit documentation; and inspecting the sites. The LUC process is detailed in Section 4.7, and interviews are summarized in Section 6.6.

Site conditions and inspection results as determined from the site inspection are summarized below:

<u>OU1 (LF59)</u>. All active monitoring wells were located and were in good condition. There was no evidence of unauthorized wells or site disturbance. Evapotranspiration covers have been installed on the other OU1 landfills (no longer part of the CERCLA program) between 2005 and 2007. Mr. Gary Fink, the USAF project manager for the OU1 landfills, estimates that plants on the evapotranspiration covers will be fully mature (i.e., evapotranspire potential recharge water at full capacity) after about seven years of growth.

<u>OU2 (ST41)</u>. All active monitoring wells were located. Four wells showed evidence of damage due to frost heaving. There was no evidence of unauthorized wells or site disturbance.

<u>OU4 (SD24, SD25, SD28 and SD29)</u>. All active monitoring wells were located and were in good condition. There are no active monitoring wells for SD28. There was no evidence of unauthorized wells or site disturbance.

<u>OU4 (FT23)</u>. The bioventing system was inspected and found to be operational. Mr. Marty Hannah, the system operator, reported O&M problems including failure of an electrical controller and blockage of one vent during the winter, probably due to ice. Land use changes included construction of new hangars on a portion of FT23. Vapor barriers have been

incorporated into the design of the hangars to control migration of VOCs into indoor air. All active monitoring wells were located, and one well needs a replacement cap. There was no evidence of unauthorized wells or any other site disturbance.

OU5 (ST37). The WRS system was inspected and found to be operational. Mr. Marty Hannah, the system operator, reported O&M problems with maintaining pumps and corrupted program control logic (resulting in false alarms). The pump stations and overland flow cell are individually fenced and locked. The WRS and pump stations are located on the property easement purchased from the ARRC. Seep 7 is not incorporated into the WRS; it flows into a ditch and mixes with effluent from the WRS just below the discharge point. All active monitoring wells, including early warning and sentry wells, were located. One had a broken cover (probably due to frost heaving), one had a cracked concrete pad, and two showed minor frost heaving. There was no evidence of unauthorized wells or any other site disturbance.

OU6 (LF02). The site is heavily wooded and is not recognizable as a landfill. The limited areas that received covers were not recognizable. There was no evidence of debris extruding to the surface, or of human traffic. All active monitoring wells were located, and both were damaged due to frost heaving. There was no evidence of unauthorized wells or any other site disturbance.

OU6 (LF03). The site is wooded and is recognizable as a landfill only due to topographic mounding. There was some evidence of littering but no evidence of debris extruding to the surface. There are partially overgrown recreational trails on the site. Given the limited amount of litter and overgrowth on the trails, human traffic appears to be light. There are no actively monitored wells at the site. There was no evidence of unauthorized wells or any other site disturbance.

OU6 (LF04). The landfill and most of the bluff are wooded. Only a small portion of the bluff was bare, indicating possible recent sliding. Debris was visible on the bluff in small ravines, but none was observed at the base of the bluff. Mr. Kelly McGovern, the site manager, believes that most of the bluff has stabilized (as evidenced by the mature trees) which accounts for the decreased amount of debris collected over time. In 2007 and 2008, the Port of Anchorage expanded their facilities which included filling the area along the shoreline at the base of LF04. The filled area covered over the former beach at the base of the bluff (location of former sediment samples). The filled area will protect the bluff from erosion previously caused by wave action during storms, reducing erosion in the future. A fence will be installed near the base of the bluff between the Port facilities and the Elmendorf AFB property, with enough room for the USAF to continue debris removal as necessary. Access to LF04 is controlled by fences and gates. The Port construction site (beyond the landfill at the base of the bluff, Figure A-3 of Attachment A) is fenced and secured by the Port of Anchorage. Traffic on the top of the landfill is controlled by a locked gate on the only road. The gate has a sign warning of landslides, landfill waste, and mudflats, and visitors are required to sign in and out of the site. Human traffic on the top of the landfill is generally limited to environmental contractors and staff conducting inspections or sampling activities, and volunteers for a whale-watching station at a single overlook point on the bluff. Whale-watching volunteers are instructed to stay at the whale-watching platform and not to roam the landfill or bluffs. Access controls were generally in good working order except for one vehicle barrier that was broken. Because the LF04 road is also secured with a locked gate, the broken vehicle barrier did not reduce the effectiveness of the access controls for this site. All active monitoring wells were located and appeared to be in good condition. There was no evidence of unauthorized wells or other disturbance on the landfill itself. The area to the south of the landfill (Cherry Hill borrow pit, Figure A-3 of Attachment A) has been extensively mined for fill material to support the Port expansion activities. The excavation was conducted outside of the LF04 and WP14 boundaries. There was no standing water in the floor of the excavation, indicating that excavations did not extend into the groundwater table. The Port expansion does not currently include any buildings for human occupancy.

OU6 (WP14). All active monitoring wells were located and were in good condition. There was no evidence of unauthorized wells or site disturbance. The area to the south of the site has been extensively mined for fill material to support the Port expansion activities, but the site area was untouched.

OU6 (SD15). The HVE system piping and equipment remains on site but operations have been shut down. The equipment and piping are scheduled for removal. All active monitoring wells were located and were in good condition. Two wells doubled as HVE and monitoring wells, and monitoring access will be simplified when HVE piping is removed. Access to the site is controlled by a locked gate, with a sign that contains contact information. There was no evidence of unauthorized wells or site disturbance. An area to the south of the site has been mined for fill material to support the Port expansion activities, but site area was untouched.

DP98. The site is located next to a secure military facility. Some wells are inside the secure area and were observed through the fence. Other wells are located in a wetlands area, and were not visited. Of the active monitoring wells that were inspected, one showed signs of damage due to frost heaving, and the site manager, Dr. Dave Ward, reported that one of the wells in the wetlands area showed similar damage. There was no evidence of unauthorized wells or site disturbance.

The five-year review site inspection team concluded that the CERCLA sites on Elmendorf AFB are being properly managed and maintained. LUCs appear to be properly implemented and enforced. Changes to land use were evident at sites FT23 and LF04, but site conditions are understood and precautions to prevent exposure are being incorporated into the design of the new facilities. Difficult environmental conditions as evidenced by frost heaving of wells are routinely addressed through maintenance. The cleanup program has generally been highly optimized, but some opportunities still exist for the WRS treatment system and the early warning and sentry monitoring locations at OU5.

6.6 INTERVIEWS

The five-year review team interviewed all key personnel involved in the Elmendorf AFB restoration program. Interviews were conducted with USAF RPMs and their contractors, representatives of USEPA Region 10 and ADEC, and Elmendorf AFB personnel involved in implementation and enforcement of LUCs. Many of these individuals, as well as members of the CEB, the ARRC, the Port of Anchorage, and members of the public at large were invited to provide input to the five-year review process by responding to an emailed questionnaire. Each of these interview processes are described below.

During the site inspection from May 6 through 8, 2008, the five-year review team interviewed Air Force RPMs and their contractors. The USAF RPMs are Ms. Melissa Markell (RPM for OU1 and OU5), Ms. Donna Baumler (RPM for OU2; OU6 sites LF02, LF03, LF04 and WP14; and DP98), and Mr. Claude Mayer (RPM for OU4 and OU6 site SD15). The O&M contractors interviewed were Mr. Marty Hannah (Oasis Environmental, system operator for the OU5 WRS, FT23 bioventing system, and SD15 HVE system), Mr. Kelly McGovern (Jacobs Engineering, site manager for LF04), and Dr. Dave Ward (sampling manager for OU2, OU6, and DP98). Mr. Gary Fink, the Air Force project manager for the OU1 landfills currently managed under Alaska Solid Waste regulations, provided information and answered questions about the evapotranspiration covers on those landfills. Input provided was documented on the site inspection checklists (Attachment D), and incorporated into Sections 4 and 6.5 of this report.

Regulatory agency representatives Mr. Jacques Gusmano (USEPA Region 10) and Mr. Louis Howard (ADEC) were interviewed on August 14, 2007. They indicated that issues of interest to their agencies included: (1) assessment of how natural attenuation is working, (2) implementation of LUCs, including on land that the USAF does not own, (3) and new toxicity information for TCE. They also stressed the importance of using approved language for protectiveness statements, and suggested that RPO results and initiatives be incorporated into the five-year review evaluation. Mr. Howard provided additional input in an email questionnaire (described below).

As part of the assessment of LUCs, the site inspection team interviewed Ms. Valerie Payne (Elmendorf AFB Community Planning), Ms. Laura Keiser and Ms. Stephanie Kendrick (Elmendorf AFB Real Property), Ms. Becci Anderson (contracted operator for Elmendorf AFB GeoBase system), and several utility personnel involved in the work clearance request (dig permit) process. The results of these interviews are documented in Section 4.7 of this report.

Twenty-one stakeholders were invited to provide input to the five-year review process by responding to an emailed questionnaire. These included CEB members, contractors, and impacted neighbors (the Port of Anchorage and the ARRC). Members of the public were also invited to request and respond to the questionnaire in the public notices published in area newspapers. Four people responded to the questionnaires, which are included in Attachment E. The responses are summarized below:

- Mr. Louis Howard, ADEC: Mr. Howard commented that Elmendorf AFB cleanup program has been successful at eliminating/reducing the source and preventing off-site migration of contaminants. He referenced annual and RPO reports for information about remedial action performance at individual sites.

- Port of Anchorage: The Port's response complimented the Elmendorf AFB restoration program for its effectiveness at managing risk and controlling contamination and risk to downstream neighbors. They expressed concerns over funding limitations, and stressed the need for continued communication and coordination to address environmental issues, particularly where the Port is directly downstream or downgradient of Elmendorf AFB.

- Ms. Gloria Beckman, Oasis Environmental (Air Force contractor for OU1, OU4 and OU5): Ms. Beckman commented that it would be timely to re-evaluate some of the remediation systems; some have outlived their original purpose. The expense for repair and maintenance on active systems such as the OU5 WRS and the FT23 bioventing system was noted, and life-cycle costs and benefits of maintaining these systems should be evaluated. Ms. Beckman commented that natural attenuation processes may need assistance in some locations, and that identification of sources for some plumes may be needed. Finally, Ms. Beckman commented that monitoring data from different environmental programs needs to be integrated, and that combining the monitoring programs could result in cost savings.

- Mr. Art Isham, CEB member: Mr. Isham commented that Elmendorf AFB was doing what it could to address environmental problems within funding constraints. He said that when people were aware of the Elmendorf AFB environmental cleanup efforts, it has generally created a positive impression, but many people were unaware of what is being done.

SECTION 7.0

TECHNICAL ASSESSMENT

The protectiveness of the remedy is analyzed in this technical assessment, which was completed by answering three questions for each OU, as described below.

- Question A: Is the remedy functioning as intended in the decision documents?

  This question was answered by considering the remedy's implementation status (Section 4), available information reviewed in Section 6, and comparing the remedy to the requirements in the ROD and remedial design/construction specifications. Remedial action performance, system O&M, monitoring, costs, LUCs, and indicators of potential problems were assessed.

- Question B: Are the exposure assumptions, toxicity data, cleanup levels and RAOs used at the time of the remedy selection still valid?

  Question B was answered by evaluating the effects of significant changes in standards and assumptions that were used at the time of remedy selection that may impact the protectiveness of the remedy. In addition, TBCs used in preparation of the ROD were evaluated to determine whether new toxicity data would cause additional compounds, not considered at the time of the ROD, to become a potential concern.

  This evaluation was done according to the following USEPA (2001) Guidance: "Generally you should only consider changes in standards that were identified as ARARs in the ROD, then identify any newly promulgated standards for COPCs, and TBCs identified in the ROD that bear on the protectiveness of the remedy. As such, you should review any newly promulgated standards, including revised chemical-specific requirements (such as MCLs, ambient water quality criteria), revised action and location-specific requirements, and State standards if they were considered ARARs in the ROD. In evaluating a change in a standard that was identified as an ARAR in the ROD, or a newly promulgated standard or TBC, you should establish whether the new requirement indicates that the remedy is no longer protective."

  The evaluation of new or changed standards was accomplished by first comparing historical and current state or federal cleanup levels to identify changes in standards, newly promulgated standards for COPCs, and other TBCs. Potential cleanup levels for COPCs presented in the ROD were compared to current applicable federal or state cleanup standards (e.g., USEPA, 2003; ADEC 2006d). Only a few new federal standards have been promulgated since 2003, but the State of Alaska promulgated a large number of new standards. Table B-1 in Attachment B illustrates this evaluation and identifies the COPCs for which a new standard or more stringent standard was found.

The COPCs with new or more stringent standards were further evaluated by comparing the current applicable standard with the most recent maximum detected levels, as shown in Table B-2 in Attachment B. In some cases, particularly if a COPC was not selected as a COC, the most recent sampling event was at the time of the ROD. These cases are noted in the text. Since the source areas are not new or continuing sources of contamination, concentrations of contaminants are generally expected to decrease over time. Therefore contaminant levels from the time of the ROD result in conservative estimates of risk. Risk calculations were performed for COPCs where current maximum detected levels exceed this standard.

The majority of the required risk calculations (all COPCs except arsenic in groundwater) were driven by a new or more stringent ADEC standard (ADEC, 2006d). Therefore cancer risks and non-cancer hazards for all COPCs, except for arsenic in groundwater, were estimated by comparison with ADEC's risk-based standards for soil and groundwater presented in Tables B-1 and B-2. The ADEC groundwater and direct contact soil standards are based on a cancer risk of 1 in 100,000 (i.e., 1×10^{-5} for carcinogens) or a hazard quotient of 1.0 for non-carcinogenic chemicals. Because the risk/hazard equations are linear, increasing the concentration by a given factor increases risks by the same amount (i.e., if a carcinogenic chemical's concentration is five times the ADEC standard, then it represents a risk of 5×10^{-5} if all exposure and toxicity assumptions remain the same). Therefore, chemical-specific risks and hazards were calculated by evaluating the magnitude of the exceedance of ADEC standards. This is equivalent to using Equations 1 and 2 from the ADEC Cleanup Levels Guidance (ADEC, 2004 and 2007a) for groundwater and Equations 3, 4, 6, and 7 from the ADEC Cleanup Levels Guidance (ADEC, 2004 and 2007a) for soils. Table B-3 includes these calculations.

Note that Equations 3 and 4 of ADEC's cleanup level guidance (for soils) represent the ingestion pathway, and Equations 6 and 7 represent the inhalation pathway. The migration to groundwater cleanup levels were not used to determine the risks or hazards because COPCs did not exceed the groundwater cleanup levels at any site. The direct contact pathway equation that resulted in the most conservative cleanup level is more appropriate than the migration-to-groundwater pathway at these sites and was used to estimate health risks in Table B-3.

The requirement for a new risk calculation for arsenic in groundwater at OU2 was driven by a new MCL, not a risk-based ADEC cleanup level. In this case, risk and hazard quotients were estimated using the same methodology from the RI/FS (similar to the ADEC equations described above), but with the latest available arsenic slope factor and reference dose, and most current estimate of the arsenic concentration in OU2 groundwater.

Finally, an evaluation was made as to whether the remedy remains protective. The USEPA's risk management decision range is 1×10^{-4} to 1×10^{-6} for carcinogens and a hazard quotient of 1 or less for non-carcinogens. For the COPCs shown in Table B-2 that require further evaluation, risk/hazard levels were calculated, as shown in Table B-3, to evaluate whether USEPA's target health goals were exceeded and results are discussed in the following subsections.

As part of this evaluation, the potential effect of significant changes in risk parameters that were used to support the remedy selection, such as reference doses, cancer potency factors, and exposure pathways of concern, were reviewed. This included searching through all available analytical data for newly detected contaminants (including new contaminant sources or unanticipated toxic byproducts of the remedy), as well as any chemical detected at concentrations above MCLs or ADEC cleanup levels. In addition, the validity of the original assumptions regarding current and future land/groundwater uses and COCs, and any changes in physical features were reviewed.

The evaluation of TBCs and new toxicity data that would cause additional compounds or requirements to become a potential protectiveness concern is summarized in Table B-4. Twelve compounds (associated with one or more of the OUs) with new toxicity criteria were identified. Table B-4 shows the evaluation of risks and hazards that were calculated for each of these compounds using the new reference doses and cancer slope factors. Using ADEC methodology and the new toxicity data, the calculated risks indicate that the current cleanup standards for 10 of the 12 compounds are still within USEPA's risk management decision range (i.e., 1×10^{-4} to 1×10^{-6} for carcinogens and a hazard quotient of 1 or less for non-carcinogens). The current cleanup levels for arsenic and beryllium appear to result in risk estimates that exceed the USEPA's risk management decision range. At OUs where arsenic and beryllium are COPCs, the cleanup levels of these compounds were evaluated to determine if they are sufficiently protective.

- Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

  This question was answered by considering data gaps that limit the assessment of remedy protectiveness (primarily identified during the data and document review in Section 6), issues raised by a public health assessment conducted by the Agency for Toxic Substance and Disease Registry (ATSDR) (ATSDR, 2006), any new or proposed rulings that could result in changes to ecological risk, and any plans for potential land use or land use changes.

During a meeting held with USEPA and ADEC on January 14, 2003, the USAF agreed to fund the inclusion of DRO and GRO in the groundwater monitoring program because they have been shown to be associated with non-carcinogenic human health risks since the signing of the RODs. This agreement applies to monitoring of wells associated with fuel plumes. It was also agreed that until a decision document is signed with ADEC, concentrations will be compared to the current cleanup levels of 1,500 μg/L and 1,300 μg/L for DRO and GRO, respectively (18 AAC 75) in annual reports and subsequent five-year reviews. The USAF will not be required to add DRO and GRO as a CERCLA ARAR.

7.1 OPERABLE UNIT 1

Question A: Is the remedy functioning as intended in the decision documents?

Answer: Yes.

Remedial Action Performance: At OU1 the selected remedy includes monitoring of COCs in groundwater until the groundwater no longer poses an unacceptable health risk and the implementation of LUCs to limit exposure to the COCs. Monitoring results document that TCE is the only remaining COC above its cleanup level, and its concentrations are decreasing such that the cleanup level should be met within the time frame predicted by the ROD.

Systems Operations/O&M: Operating procedures (in this case, monitoring), as implemented, will maintain the effectiveness of response actions. There are no large variances in O&M costs that would indicate potential remedy problems or remedy issues.

Opportunities for Optimization: None.

Early Indicators of Potential Issues: None.

Implementation of LUCs and Other Measures: OU1 LUCs are appropriate and properly implemented. They are effective at preventing exposure and are expected to remain effective in the future. Contaminant levels at LF59 that exceed cleanup goals based on an UU/UE scenario are within the LUC boundary. Potentially impacted personnel at Elmendorf AFB are made aware of LUC requirements through the 3 WGI 32-7003, the *Base General Plan*, the Work Clearance Request process, and GeoBase.

Question B: Are the exposure assumption, toxicity data, cleanup levels and RAOs used at the time of the remedy selection still valid?

Answer: Yes.

Changes in Standards and TBCs: Groundwater and surface water COPCs were compared to current federal and state standards. New standards (not addressed in the ROD or previous five-year reviews) were identified for lead in groundwater (ADEC, 2006d) and total petroleum hydrocarbons (now regulated as TAH) in surface water (USEPA, 2007) (see Attachment B, Table B-1). Lead exceeded the new groundwater standard at well LF05-W5 through June 1996. By 1998, the lead concentration in LF05-W5 was well below the new standard. Total petroleum hydrocarbons were detected in one surface water sample during the RI/FS (USAF, 1994a). TAH (the current regulatory standard) consists of the sum of the BTEX concentrations. These chemicals were all below detection limits in the RI/FS sample. Therefore, measurements collected from this sample did not exceed the TAH standard. Based on this information, the new standards for groundwater and surface water do not call into question the protectiveness of the remedy at OU1.

Soil COPCs were compared to current federal and state standards. New Alaska soil cleanup standards (ADEC, 2006d) have been promulgated for four soil COPCs identified in the ROD, including benzo(a)anthracene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate and lead (see Attachment B, Table B-1). All COPC concentrations, last measured at the time of the ROD, were below the most stringent state standard (see Attachment B, Table B-2). Therefore the new Alaska soil cleanup standards do not call into question the protectiveness of the remedy.

Changes in Exposure Pathways: There has been no change to the current or expected land use at and near OU1. The 50-year vision for Elmendorf AFB anticipates no future development or changes to land use in the OU1 area. No new or changed human health or ecological routes of exposure or receptors have been identified. Physical site conditions have not changed at LF59. Filling, covering and capping activities conducted in the upgradient portions of OU1 (LF05, LF07, LF13 and OT56) since the 1990s have probably impacted the hydraulics of these areas and may be responsible for the slight increases in TCE concentrations detected upgradient of LF59 in 2006. However, the current sampling history is too short to make a definite determination.

There are no newly identified contaminants or contaminant sources. 1,1,2,2-Tetrachloroethane, a COPC for OU1, was detected in well LF59MW-03 at concentrations slightly above the ADEC cleanup standard (there is no MCL established for 1,1,2,2-tetrachloroethane). The 1,1,2,2-tetrachloroethane detection is collocated with TCE contamination at LF59. The 2003 Five-Year Review (USAF, 2003j) concluded that 1,1,2,2-tetrachloroethane concentrations at OU1 do not impact the effectiveness of the remedy. Data from 2003 through 2007 confirm that the contaminant is naturally attenuating and its detection does not impact the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: Toxicity factors changed for OU1 COC arsenic, as well as for three COPCs at OU1 (PCE, toluene, and barium). The established cleanup standards for these compounds are still protective for all contaminants except arsenic (see Attachment B, Table B-4). The arsenic MCL of 10 μg/L results in risk above the USEPA's risk management decision range of 10^{-4} to 10^{-6}. Groundwater at most OU1 sites has contained concentrations of arsenic greater than the 10 μg/L MCL (up to 130 μg/L). However, statistical analyses performed during the RI/FS (USAF, 1994a) determined that arsenic in groundwater at OU1 sites was not significantly different from background. For this reason, no cleanup level was established for arsenic in the OU1 ROD. Because arsenic concentrations in groundwater at OU1 sites are representative of natural background levels, more stringent cleanup levels are not practical. Therefore the protectiveness of the OU1 remedy is not affected by the change in the arsenic toxicity factor.

Changes in Risk Assessment Methods: None.

Expected Progress Towards Meeting RAOs: The remedy is progressing at the rate originally expected in the ROD.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Answer: No.

Additional investigation activities conducted near LF59 in 2006 under the environmental compliance program indicate that the TCE plume at LF59MW-03 originates, at least in part, farther upgradient than originally conceived. The source is still within OU1 and probably does not indicate a new contaminant source. The plume appears to be originating near LF07. Well LF05GW-2B had met the TCE cleanup level in 1996 and1997 and monitoring was discontinued after 1997. However, new monitoring in 2006 indicated that TCE concentrations were once again just above the cleanup level. LF07 may not be the only source of TCE contamination at LF59MW-03 because concentrations in this well have been relatively consistent since 1992 and did not mirror the decrease observed in LF05GW-2B in 1996 and 1997. Because monitoring was not performed at well LF05GW-2B between 1997 and 2006, it is not possible to determine how long-term groundwater quality and the estimated cleanup date for LF59 will be impacted. Future evaluations of the TCE plume at LF59 should incorporate data from upgradient wells OU1LF-19 and LF05GW-2B.

7.2 OPERABLE UNIT 2

Question A: Is the remedy functioning as intended in the decision documents?

Answer: Yes.

Remedial Action Performance: At OU2, the ROD-selected remedy included a free product and dissolved phase recovery and treatment system; source removal (tanks, piping, and contaminated soil); monitoring of groundwater, seeps, and surface water to track natural attenuation progress; and the implementation of LUCs. The source removal and free-product recovery portions of the remedy were completed in 1996 and 1999 respectively; monitoring and LUCs are the only remaining active remedies at OU2. Benzene exceeds its cleanup level in groundwater and seep water. All other COCs met cleanup levels at locations sampled in 2007. Concentrations of benzene are decreasing in all groundwater wells, although at somewhat slower rates than anticipated in the ROD. Monitoring of downgradient wells indicate that natural attenuation has contained migration of the ST41 plumes. The surface water point-of-compliance location was not monitored during the period 2003 through 2007 due to confusion over its location, but was re-established and sampled in 2008. The 2008 sample results (Attachment C, Figure C-2) show that seep and surface water contaminants are biodegraded or otherwise attenuated upstream of the point of compliance. Monitoring at the surface water point of compliance is necessary to determine if natural attenuation is successfully occurring in the wetland area. Despite the data gap and somewhat slower contaminant attenuation rate, the natural attenuation remedy appears to be working as intended when the ROD was finalized.

Systems Operations/O&M: Operating procedures (in this case, monitoring), as implemented, will maintain the effectiveness of response actions. There are no large variances in O&M costs that would indicate potential remedy problems or remedy issues.

Opportunities for Optimization: None.

Early Indicators of Potential Issues: None.

Implementation of LUCs and Other Measures: OU2 LUCs are appropriate and properly implemented. They are effective at preventing exposure and are expected to remain effective in the future. Contaminant levels at ST41 that exceed cleanup goals based on a UU/UE scenario are within the LUC boundary. Potentially impacted personnel at Elmendorf AFB are made aware of LUC requirements through the 3 WGI 32-7003, the *Base General Plan*, the Work Clearance Request process, and GeoBase.

Question B: Are the exposure assumption, toxicity data, cleanup levels and RAOs used at the time of the remedy selection still valid?

Answer: Yes.

Changes in Standards and TBCs: A comparison of historical and current state and federal cleanup levels found a newly promulgated standard for 15 contaminants in groundwater and four contaminants in surface water (see Table B-1, Attachment B). There were no newly promulgated standards for soil.

Of the 15 groundwater contaminants, five had analytical results (the most recent inorganics analyses were generally 2001) that exceeded the current standard (see Table B-2, Attachment B). Risk or hazard index, as appropriate, was calculated based on the highest, most recent concentration of each contaminant. On this basis, arsenic, lead, nickel, and vanadium exceeded the hazard quotient of 1 (see Table B-3, Attachment B). Arsenic was identified as a COC in the ROD, but a cleanup level was not established because arsenic concentrations at OU2 were not statistically different from background concentrations in the Anchorage Bowl area (USAF, 1994b). Although the highest concentrations of lead, nickel, and vanadium exceeded the new cleanup standards, most of the detections of these elements in OU2 groundwater were less than the cleanup standards.

During the period of 1999 through 2001 (the most recent three-year period that inorganics were analyzed in groundwater samples from OU2), lead and vanadium exceeded their new cleanup standards in 2 of 66 samples, and nickel exceeded its new cleanup standard in 5 of 66 samples. Assuming a lognormal distribution and treating non-detects as being equal to one-half the detection limit, the 95% upper confidence limit of the means of the groundwater concentrations during this time period are 2.0 μg/L for lead, 11.2 μg/L for nickel, and 10.7 μg/L for vanadium. All of these mean values are below the new cleanup standards, and concentrations of lead and nickel are below the 95% upper confidence limits of the mean of their background concentrations in groundwater (USAF, 1994b). Therefore these new cleanup standards do not call into question the protectiveness of the remedy.

Three of the four surface water contaminants were present at levels that exceed the current standards (maximum detected levels from the ROD were used if no recent data were available). These contaminants are benzene, arsenic, and thallium (Tables B-2 and B-3, Attachment B). All three of these chemicals were identified as COCs for OU2 surface water, but cleanup levels were not specified for arsenic or thallium. The OU2 cleanup level for benzene is based on the Alaska SWQC for TAH which is sufficiently protective. Arsenic concentrations were not statistically different from background concentrations in the Anchorage Bowl area (USAF, 1994b). Thallium was detected in one out of 11 samples analyzed (USAF, 1995a). Arsenic and thallium are already COCs for OU2 surface water, and the new cleanup standards do not call into question the protectiveness of the remedy.

The original risk assessment for the site found potentially unacceptable risks/hazards (primarily due to benzene) if groundwater was used as a source of drinking water based on either residential or commercial/industria1 land use (USAF, 1994b). LUCs prevent groundwater use as a source of drinking water and no significant land use changes have occurred at the site. Land use restrictions remain in place to limit the site to industrial use, and actual use continues to be minimal. All exposure assumptions, cleanup levels, or RAOs used at the time of the remedy selection remain valid at this time.

<u>Changes in Exposure Pathways</u>: There has been no change to the current or expected land use at and near OU2. The 50-year vision for Elmendorf AFB anticipates no future development in the OU2 area. No new or changed human health or ecological routes of exposure or receptors have been identified. Physical site conditions have not changed at OU2. There are no newly identified contaminants or contaminant sources, and no unanticipated toxic by-products of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: Toxicity information has changed for several contaminants as shown in Table B-4 of Appendix B. The standards for two contaminants, arsenic and beryllium, detected in OU2 groundwater exceed the USEPA's risk management range. The cancer risk associated with the current standard for these chemicals is 2 x 10^{-4}. However, arsenic concentrations are not statistically different from background concentrations in the Anchorage Bowl area (USAF, 1994b). Beryllium was detected in 3 out of 93 samples analyzed (USAF, 1995a), and its mean concentration at the site is well below the current standard. Therefore the new toxicity factors for arsenic and beryllium do not change protectiveness conclusions about OU2 groundwater. All other exposure assumptions, toxicity data, and RAOs used at the time of the remedy selection remain valid at this time.

Changes in Risk Assessment Methods: None.

Expected Progress Towards Meeting RAOs: The remedy is generally progressing as expected. Concentrations of fuel contaminants are decreasing, although at a slower rate than originally anticipated.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Answer: No.

A memorandum to the site file should be prepared to detail the requirements for surface water and seep monitoring. Surface water monitoring should be conducted annually at the surface water point-of-compliance SW-13 to confirm that the natural attenuation processes are occurring. Monitoring recommendations are described in Section 6.4.2.

7.3 OPERABLE UNIT 4

Question A: Is the remedy functioning as intended by the decision documents?

Answer: Yes.

Remedial Action Performance: Shallow soils meet cleanup levels at all OU4 sites (USAF, 1998b). Site closure deep soil sampling at SS10 and SD25 demonstrated that COC concentrations were consistently below remediation goals outlined in the ROD (USAF, 2003b, 2006b). Therefore, the bioventing systems successfully remediated contaminants at these sites as intended. The bioventing systems have been shut down and site closure reports were completed (USAF, 2003b, 2006b).

The bioventing system at FT23 continues to operate and function as designed. Deep soil sampling performed in 2005 indicated that DRO remains above the cleanup level at 15 feet bgs (USAF, 2006g). Consequently, this system is being operated to address remaining deep soil contamination. Bioventing system O&M procedures and LUCs continue to ensure protectiveness of the remedy.

For groundwater at OU4, the major components of the selected remedy are: (1) monitoring to evaluate contaminant migration and timely reduction of contaminant concentrations by natural attenuation, and (2) implementation of LUCs that limit exposure to water in the shallow aquifer.

Each of these components has been implemented and is functional. COCs in groundwater have been below cleanup levels at SD28 since 1993. COCs in groundwater at FT23, SD24 and SD29 are decreasing through natural attenuation at a rate very close to that anticipated by the ROD. Natural attenuation is also occurring at SD25, but at a slower rate than anticipated in the ROD. Data interpretation at SD25 was also complicated by the mistaken abandonment and replacement of a monitoring well.

Systems Operations/O&M: Operating procedures, as implemented, will maintain the effectiveness of response actions. There are no large variances in O&M costs that would indicate potential remedy problems or remedy issues.

Opportunities for Optimization: Shut down FT23 bioventing system after soil cleanup levels are met.

Early Indicators of Potential Issues: There were several minor mechanical and electrical problems with the FT23 bioventing systems which were repaired. The FT23 bioventing system is expected to be able to complete soil cleanup within the next two years.

Implementation of LUCs and Other Measures: OU4 LUCs are appropriate and properly implemented. They are effective at preventing exposure and are expected to remain effective in the future. LUCs are no longer necessary for shallow soils because cleanup levels have been attained at all OU4 sites (USAF, 1998b). Contaminant levels in groundwater at FT23, SD24, SD25, and SD29 that exceed cleanup goals based on a UU/UE scenario are within the LUC boundary. Potentially impacted personnel at Elmendorf AFB are made aware of LUC requirements through the 3 WGI 32-7003, the *Base General Plan*, the Work Clearance Request process, and GeoBase.

Question B: Are the exposure assumption, toxicity data, cleanup levels and RAOs used at the time of the remedy selection still valid?

Answer: Yes.

Changes in Standards and TBCs: Groundwater and surface water COPCs were compared to current federal and state standards. New ADEC cleanup standards and/or MCLs (not addressed in the ROD or previous five-year reviews) for DRO, 2-methylphenol (o-cresol), acenaphthene, acetone, benzoic acid, chloroform, fluorene, naphthalene, and phenol in groundwater (ADEC, 2006d) were identified (see Attachment B, Table B-1). Concentrations for all of these contaminants at the time of the ROD were below the new cleanup standards (see Attachment B, Table B-2). Therefore these new cleanup standards do not call into question the protectiveness of the remedy.

Soil COPCs were compared to current federal and state standards. New Alaska soil cleanup standards (ADEC, 2006d) have been promulgated for 13 soil COCs and 38 soil COPCs identified in the ROD, including those for various VOCs, PAHs, inorganics, and petroleum hydrocarbons (see Attachment B, Table B-1). Only one of the COPCs, TCE, exceeded the most stringent state cleanup standard in at least one soil sample at the time of the ROD (see Attachment B, Table B-2). At the time of the ROD, TCE was detected in subsurface soil at FT23 at concentrations above its current ADEC soil cleanup standard to be protective for migration to groundwater, but below the ADEC soil cleanup standard to be protective for inhalation or ingestion. The FT23 bioventing system continues to operate and address remaining soil contamination. Although soil samples have not been analyzed for TCE since the RI/FS because it was not identified as a soil COC, it is unlikely that TCE still exists on site at the pre-ROD levels. Given the extensive soil treatment and the decreasing concentration of TCE in groundwater, the new soil cleanup standard does not call into question the protectiveness of the remedy.

The cleanup levels for 1,2-dichloroethane, PCE, and TCE for FT23 groundwater, and DRO and GRO for SD24 and SD25 soil, as presented in OU4 ROD, are inconsistent with their referenced standards. The cleanup levels for 1,2-dichloroethane, PCE and TCE at FT23 are listed as 6 μg/L instead of the MCL standard of 5 μg/L. The cleanup levels identified for DRO and GRO at SD24 and SD25 are 1,000 and 2,000 mg/kg respectively, which is the reverse of their referenced ACM Level D standard. These inconsistencies appear to be typographical errors because there is no discussion in the ROD about deviation from the referenced standards. The cleanup levels for these COCs should be adjusted in a memorandum to the site file so they are consistent with the standards referenced in the ROD.

Changes in Exposure Pathways: There has been no change to the current or expected land use at and near OU4. The 50-year vision for Elmendorf AFB anticipates future land use in the OU4 area to include aircraft operations and maintenance which include active and inactive runways, taxiways, and parking aprons for aircraft, similar to current land uses. The base is currently constructing several new buildings at FT23 in the vicinity of existing wells W-15 and GW-5A. Benzene, TCE, and PCE were detected in these wells in 1993 (the most recent monitoring event). The design of the new hangars incorporated vapor barriers to prevent vapor intrusion to indoor air. Because the vapor intrusion pathway was mitigated at the design stage, no new or changed human health or ecological routes of exposure or receptors have been identified.

During the period between 2003 and 2007, there were two notable detections of contaminants in OU4 groundwater in addition to COCs. Bromomethane was detected at a very low concentration in one well at FT23 in 2005, but was not in any previous or subsequent samples. 1,1,2-Trichloroethane, an OU4 COPC, was detected at concentrations above the ADEC cleanup standard (there is no MCL for 1,1,2,2-tetrachloroethane) in one well each at FT23 and SD25 in 2006, but was not detected in 2007. The isolated detections are unlikely to represent new sources contamination at OU4.

Changes in Toxicity and Other Contaminant Characteristics: Toxicity factors have not changed for any of the OU4 COCs. Toxicity factors have changed for two OU4 COPCs; naphthalene and phenol. The current cleanup standards for these compounds are still protective (see Attachment B, Table B-4), and concentrations of these chemicals in OU4 groundwater are below the ADEC cleanup standards (there is no MCL for either chemical). Therefore the protectiveness of the OU4 remedy is not affected by these changes.

Changes in Risk Assessment Methods: None.

Expected Progress Towards Meeting RAOs: The natural attenuation remedy is generally progressing as anticipated by the ROD, except at SD25. Natural attenuation is also occurring at SD25, but at a rate that is slower than originally anticipated in the ROD.

<u>Question C: Has any other information come to light that could call into question the protectiveness of the remedy?</u>

<u>Answer: No</u>.

7.4 OPERABLE UNIT 5

<u>Question A: Is the remedy functioning as intended by the decision documents?</u>

<u>Answer: Yes</u>.

<u>Remedial Action Performance</u>: The remedy at OU5 continues to operate and function as designed. Contaminant concentrations in the effluent of the WRS and from the Beaver Pond wetland consistently meet effluent requirements. The monitoring program indicates that OU5 contaminants naturally attenuate or are contained and treated before they reach Ship Creek. However, the rate that TCE naturally attenuates in some on-site wells is slower than predicted, and it is unlikely that groundwater cleanup levels will be met across the entire site by 2026.

<u>Systems Operations/O&M</u>: Operating procedures, as implemented, are expected to maintain the effectiveness of the response actions. The WRS O&M contractor noted maintenance issues, particularly with the cost to rebuild pumps, but these issues have been successfully resolved in the past and do not threaten remedy effectiveness. O&M costs, though relatively high due to operation of the WRS and the large monitoring program, are relatively stable and do not indicate potential remedy problems.

<u>Opportunities for Optimization</u>: There are several optimization opportunities at OU5.

- The operating costs of the WRS are higher than were originally estimated at the time of the ROD, driven at least partially by high maintenance requirements for the pumps. Further, the WRS was originally designed to address petroleum contaminants, but the primary remaining COC for OU5 is TCE. Although the WRS effectively treats the remaining TCE contamination, the feasibility of optimization alternatives should be evaluated to reduce operating costs.

    - Costs can be reduced by eliminating the moving parts (the pump stations) from the WRS once they are no longer necessary. Pump Station 2 can be mothballed because Seep 3 has met cleanup levels for the past five years. The decision guide for shutting down pump stations (Attachment F, Figure F-3) that was adopted in the 2005 OU5 memorandum to the site file (USAF, 2005b) supports this action.

    - Evaluate the feasibility of diverting Seep 1 from Pump Station 1 because Seep 1 has met cleanup levels for the past five years. Because this action would require redirecting seep flow instead of simply mothballing a pump station, implementation of this action would require a memorandum to the site file. If implemented, Seep 2 would be the only seep discharging to Pump Station 1, which would then only have to operate at a fraction of its current flow rate.

    - Evaluate the feasibility of alternative treatment technology to the WRS for treating contaminated seeps. The WRS was constructed to treat petroleum contaminants.

Although it is effective at treating the current TCE contamination, it is not very efficient. Seep 2 is collected in a lined, gravel-filled drain, and most of the contaminants at the seep appear to volatilize or biodegrade as water flows from the seep to Pump Station 1. The magnitude of the dilution effect of mixing clean water from Seep 1 with contaminated water from Seep 2 is unknown. If contaminant treatment in the lined drain can be confirmed, similarly constructed lined drains may be able to treat contaminants in other seeps (Seeps 7, 9, 10, and 11) in a passive (i.e., no pumping) treatment system with a much smaller footprint than the current WRS. A feasibility study would be required to determine whether this treatment alternative would meet cleanup goals and if it is compatible with ARRC land use plans along the bluff. If feasible, implementation would likely require an ESD or ROD amendment.

- The natural attenuation remedy is not reducing TCE concentrations in groundwater as quickly as anticipated at the time of the ROD. It may be possible to significantly decrease the time to reach cleanup levels if TCE source areas can be identified and treated. The dilute concentrations of TCE (relative to solubility) in OU5 plumes suggest relatively small source areas. Low concentrations spread over the large OU5 area may make it difficult to identify source areas. More detailed characterization, such as the TRIAD investigation conducted at the Slammer Avenue and Kenney Avenue plumes in 2007 (USAF, 2008b), would be needed before it can be determined if more aggressive treatment options will be successful and can be designed or implemented.

- Early warning and sentry wells are monitored to indicate if contaminants are migrating off site toward Ship Creek. Monitoring of early warning wells was initiated to provide sufficiently early indication of contaminant migration so that contingency actions, if necessary, could be programmed and implemented prior to contaminants reaching Ship Creek. Some of these wells are not downgradient of any known plumes and data have been consistently non-detect. Because these wells are not downgradient of a plume, they do not serve their intended purpose. Optimization of the early warning and sentry monitoring well system to eliminate unnecessary wells would reduce monitoring costs.

<u>Early Indicators of Potential Issues</u>: Maintenance issues with pumps and control/alarm systems contributes to the relatively high O&M costs. However, these issues are not expected to place protectiveness of the remedy at risk.

<u>Implementation of LUCs and Other Measures</u>: OU5 LUCs are appropriate and properly implemented. They are effective at preventing exposure and are expected to remain effective in the future. Contaminant levels at ST37 that exceed cleanup goals based on a UU/UE scenario are within the LUC boundary. Potentially impacted personnel at Elmendorf AFB are made aware of LUC requirements through the 3 WGI 32-7003, the *Base General Plan*, the Work Clearance Request process, and GeoBase.

<u>Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?</u>

<u>Answer: Yes</u>.

<u>Changes in Standards and TBCs</u>: Groundwater and surface water COPCs were compared to current federal and state standards. New cleanup standards (not addressed in the ROD or

previous five-year reviews) for naphthalene, n-nitrosodiphenylamine and vanadium in groundwater (ADEC, 2006d) and 1,1,2,2-tetrachloroethane in surface water (USEPA, 2007) were identified (see Attachment B, Table B-1). In addition, Grade 4 Jet Fuel (JP-4) in groundwater had been compared to the Alaska RRO cleanup level (ADEC, 2006d) at other Elmendorf AFB OUs, and this standard was also considered for JP-4 at OU5. Concentrations for all of these contaminants at the time of the ROD were below the new standards (see Attachment B, Table B-2). Therefore these new standards do not call into question the protectiveness of the remedy.

Soil COPCs were compared to current federal and state standards. New Alaska soil cleanup standards (ADEC, 2006d) have been promulgated for 29 soil COPCs identified in the ROD, including those for various VOCs, PAHs, inorganics and petroleum hydrocarbons (see Attachment B, Table B-1). Only four of the COPCs (arsenic, barium, chromium, and silver) exceeded the most stringent state cleanup level in at least one soil sample at the time of the ROD (see Attachment B, Table B-2). Alaska soil cleanup standards are established for up to three types of exposure; inhalation, ingestion, and migration to groundwater. At the time of the ROD, only a few isolated soil samples (1 of 38 for arsenic, chromium and silver, and 3 of 38 for barium) exceeded the current Alaska soil cleanup standard for migration to groundwater. However, arsenic, chromium and silver concentrations in OU5 groundwater do not exceed background levels (and are not OU5 groundwater COPCs), and barium concentrations in OU5 groundwater are below the groundwater cleanup standard in all samples. The isolated detection of these chemicals in OU5 soil has not impacted OU5 groundwater quality. Because contaminant concentrations in all soil samples were below the Alaska soil cleanup standards for inhalation and ingestion (see Attachment B, Table B-3), the new Alaska soil cleanup standards do not call into question the protectiveness of the remedy.

<u>Changes in Exposure Pathways</u>: There has been no change to the current or expected land use at and near OU5. The 50-year vision for Elmendorf AFB anticipates future land use in the OU5 area to include residential, office/administrative, industrial warehouse, and Air National Guard uses, similar to current land uses. No new or changed human health or ecological routes of exposure or receptors have been identified.

There are no newly identified contaminants or contaminant sources. There were some unusual detections (described in section 6.4.4) that are discussed below:

- Three chemicals, not identified as COPCs for OU5, were detected in groundwater in excess of ADEC cleanup standards and MCLs. PCE, as mentioned in the previous five-year review, is still detected at concentrations slightly above the MCL at well OU3MW-11, but naturally attenuates before it is transported very far from this well. Carbon tetrachloride exceeded its MCL level in one groundwater sample, and 1,1,2-trichloroethane exceeded is MCL in one seep sample. Carbon tetrachloride and 1,1,2-trichloroethane have been detected previously at OU5, and the samples that exceeded the MCLs appear to be isolated events. None of these chemicals represent new contaminants or contaminant sources, and the detections do not impact the protectiveness of the remedy.

- Bromomethane was detected in one Ship Creek sample, and several groundwater samples at very low concentrations. The detection in Ship Creek is probably not attributable to OU5 contamination because the other contaminants (present in OU5 groundwater at much greater concentrations than bromomethane) were not detected in the Ship Creek sample. Therefore the detections do not impact the protectiveness of the remedy.

- 1,2,3-Trichloropropane, and its decay product, 1,2-dichloropropane, were detected in one sample each in Seep 2 in 2007. 1,2,3-Trichloropropane was detected at OU5 only once previously, in 1993. The MCL for 1,2-dichloropropane is 5 μg/L. Because the concentrations of these chemicals are low and the detections so infrequent, it is unlikely that these recent detections represent a new contaminant or contaminant source. Future monitoring results should be evaluated for any trends for these chemicals to determine if they continue to be detected. Because Seep 2 is captured and treated in the WRS, it is unlikely that there will be any impact to protectiveness of the remedy.

- Several other contaminants were detected for the first time in seeps, but most have previously been detected in wells. These detections do not represent new contaminants or sources of contamination, or even necessarily spreading of contamination. The detections can be attributed to very low concentrations detected very close to the detection limit, or to changes in analytical protocols. The contaminants detected are consistent with known OU5 contamination. These detections do not impact the protectiveness of the remedy.

By-products of reductive dechlorination of TCE (and other chlorinated solvents) are routinely monitored. Vinyl chloride was detected for the first time at OU5 during the period 2003 through 2007. However, no by-products have exceeded MCLs or cleanup standards. Physical site conditions have not changed.

<u>Changes in Toxicity and Other Contaminant Characteristics</u>: Toxicity factors have not changed for any of the OU5 COCs. Toxicity factors have changed for three OU5 COPCs; naphthalene, toluene, and barium. The current state cleanup standards and/or MCLs for these compounds are still protective (see Attachment B, Table B-4), and concentrations of these chemicals in OU5 groundwater are below the ADEC cleanup standards and MCLs. Therefore the protectiveness of the OU5 remedy is not affected by these changes.

<u>Changes in Risk Assessment Methods</u>: The original OU5 risk assessment did not evaluate human health risk associated with the vapor intrusion to indoor air pathway. USEPA published guidance for evaluating this pathway in 2002 (USEPA, 2002), after completion of the OU5 ROD. In 2006, the Air Force evaluated the risk of TCE vapor intrusion to indoor air for the base housing area over the Fairchild Avenue plume at OU5 (AFIOH, 2006). The modeling evaluation estimated that the incremental increase in cancer risk to the base housing residents was 7.5×10^{-7} to 4.1×10^{-5}. These risks are lower than or within the USEPA's risk management decision range. Therefore the risk of vapor intrusion to indoor air for base housing does not call into question the protectiveness of the remedy.

<u>Expected Progress Towards Meeting RAOs</u>: The natural attenuation remedy is not progressing at the rate originally expected in the ROD. Natural attenuation is occurring, and does prevent contamination from reaching Ship Creek. However, TCE concentrations in groundwater at about half of the OU5 plume wells are decreasing slower than expected.

<u>Question C: Has any other information come to light that could call into question the protectiveness of the remedy?</u>

<u>Answer: No</u>.

The overall data from OU5 confirms that contaminants are either attenuated or captured/treated before they can reach Ship Creek. These data include the early warning and sentry wells between the plumes and Ship Creek, effluent samples from the WRS and Beaver Pond wetland, and monitoring in Ship Creek itself. However, there are two items of uncertainty that should be addressed.

- TCE concentrations are confirmed to attenuate to non-detect at the water table in the Fairchild Avenue plume. For wells screened deeper in the shallow aquifer, concentrations decrease along the axis of flow. However, the most downgradient in-plume well that is screened in the deeper portion of the shallow aquifer (OU5MW-38) contains TCE above the cleanup level. TCE has not been detected in downgradient seeps, downgradient early warning/sentinel wells, or in Ship Creek, but was detected in a downgradient ARRC well in 2002 (MWH Americas, Inc., 2002). Monitoring results are illustrated in Attachment C, Figure C-9. Recommend that the downgradient extent of the Fairchild Avenue plume be determined for the deeper portions of the shallow aquifer.

- Seeps on the western and central bluffs that were known to be contaminated with TCE above the cleanup goal have been routed into the wetland treatment cell since 2004, where they are remediated. However, in 2006, the TCE concentration in Seep 7 increased to just above the cleanup level. The TCE concentrations in Seep 7 are only slightly above the cleanup level, and based on concentrations in upgradient groundwater (Kenney Avenue plume), are unlikely to significantly increase in the future. TCE is volatile, and concentrations likely decrease to below the cleanup level within a short distance from the seep. Therefore Seep 7 poses no significant risk to people or the environment (i.e., Ship Creek). According to the decision guide for restarting an existing seep collection area or adding a new seep collection area (Attachment F, Figure F-4) that was adopted in the 2005 OU5 memorandum to the site file (USAF, 2005b), Seep 7 should be sampled quarterly.

7.5 OPERABLE UNIT 6

<u>Question A: Is the remedy functioning as intended by the decision documents?</u>

<u>Answer: Yes</u>.

<u>Remedial Action Performance</u>: All remedial actions are operating and functioning as envisioned by the ROD and ROD updates. Since the last five-year review, groundwater at LF02 and soils at SD15 have met their cleanup goals. Free product recovery at WP14 and LF04 South also appears to be complete. Debris removal is conducted annually at LF04; the quantity of debris has decreased over time. The Port of Anchorage expansion project may further reduce the amount of debris exposed through erosion. The SD15 HVE system reached the end of its effectiveness and was shut down in 2007. The HVE system achieved cleanup levels for SD15 soil but not for groundwater. Groundwater cleanup continues at LF04 South, WP14, and SD15 through natural attenuation. The natural attenuation process is generally working as intended, though somewhat slower than originally expected at a few of the wells and seeps.

<u>Systems Operations/O&M</u>: Operating procedures, as implemented, maintain the effectiveness of the remedial actions. Operating costs are expected to decrease in the future due to the

shutdown of the HVE system, closeout of LF02 monitoring, and probable reductions in LF04 erosional debris. There are no indications of problems that could place protectiveness at risk.

Opportunities for Optimization: LF02 groundwater currently meets cleanup levels. Closeout monitoring should be conducted so that groundwater monitoring can be discontinued.

Implementation of LUCs and Other Measures: OU6 LUCs are appropriate and properly implemented. They are effective at preventing exposure and are expected to remain effective in the future. Contaminant levels at LF02, LF03, LF04, WP14 and SD15 that exceed cleanup goals based on a UU/UE scenario are within the LUC boundary. Potentially impacted personnel at Elmendorf AFB are made aware of LUC requirements through the 3 WGI 32-7003, the *Base General Plan*, the Work Clearance Request process, and GeoBase. Access controls are in place at LF04. The extensive quarry operations for fill material conducted at Cherry Hill borrow pit to support the Port of Anchorage expansion avoided all OU6 sites, which indicates that LUCs were successfully implemented. Quarry operations were designed to avoid contact with groundwater by including a five-foot buffer between the bottom of the excavation and the groundwater table. There was no standing water in any of the excavations, indicating that excavations stopped short of the water table. The Port of Anchorage expansion is west of LF04 and Port employees will not be working within the LF04 boundary, so no additional LUCs are required.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

Answer: Yes.

Changes in Standards and TBCs: Although the OU6 RI/FS identified COPCs, none were specified in the OU6 ROD. Instead, the OU6 ROD listed all contaminants detected and the COCs for each site. Groundwater, surface water and soil contaminant detections as listed in the ROD were compared to current federal and state standards.

New cleanup standards (not addressed in the ROD or previous five-year reviews) were identified for 28 individual contaminants and GRO in groundwater (USEPA, 2003, ADEC, 2006d) (see Attachment B, Table B-1). In addition, JP-4 in groundwater had been compared to the Alaska RRO cleanup standard (ADEC, 2006d) at other Elmendorf AFB OUs, and this standard was also considered for JP-4 at OU6. Concentrations for all of these contaminants were below the new standards at the time of the ROD except for GRO, RRO, and vanadium (see Attachment B, Table B-2). Groundwater at WP14 and SD15 are routinely analyzed for GRO and DRO (even though they were not identified as COCs in the ROD) and progress toward meeting the ADEC cleanup standards is routinely evaluated through trend analysis. Vanadium was detected above the new standard only at LF04 (highest concentration in well K-302). Statistical analysis eliminated vanadium as a COPC at LF04 groundwater because the average concentration on-site was not significantly greater than the average background concentration (USAF, 1996a). Therefore the vanadium detection above the ADEC cleanup standard (there is no MCL for vanadium) is an isolated occurrence at OU6 and does not call into question the protectiveness of the remedy.

New cleanup standards (not addressed in the ROD or previous five-year reviews) were identified for TAH, TAqH, phenol and selenium in surface water (USEPA, 2003, ADEC, 2006c) (see Attachment B, Table B-1). Seep water at LF04 is routinely analyzed for TAH and TAqH (even though they were not identified as COCs in the ROD) and progress toward meeting ADEC SWQC is routinely evaluated through trend analysis. Phenol concentrations in seep water are well below the new cleanup standard. Selenium exceeded its new standard only once, in LF04SP-01 in an August 1994 sampling event. By 2002, the selenium concentration in LF04SP-01 was well below the new standard. Therefore the new cleanup standards for surface water do not call into question the protectiveness of the remedy.

New cleanup standards (not addressed in the ROD or previous five-year reviews) were identified for 34 individual chemicals in soil (ADEC, 2006d) (see Attachment B, Table B-1). In addition, JP-4 in soil had been compared to the Alaska RRO cleanup standard (ADEC, 2006d) at other Elmendorf AFB OUs, and this standard was also considered for JP-4 at OU6. Concentrations were below the new cleanup standards either at the time of the ROD or during the 2007 LF04 soil sampling event for all contaminants except jet fuel (RRO), chlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, PCE, TCE, antimony and cadmium (see Attachment B, Table B-2). Only 1,2-dichlorobenzene, TCE and antimony had the potential to result in hazard/risk levels greater than the USEPA risk management decision range (see Attachment B, Table B-3), but in all three cases, the existing remedy is protective for the soil contamination. Each of the contaminants and their new soil cleanup standards are discussed below:

- Jet fuel was detected in soil at 2050 mg/kg at WP14 at the time of the ROD. The RRO cleanup standard is 2000 mg/kg. The natural attenuation remedy for WP14 is generally working and petroleum hydrocarbon concentrations are decreasing in groundwater. Groundwater is routinely monitored for VOCs (including BTEX), GRO and DRO. The natural attenuation remedy should be effective for the jet fuel contamination in soil, and the current groundwater monitoring program provides adequate data to evaluate the effectiveness of the remedy.

- At the time of the ROD, chlorobenzene, 1,2-dichlorobenzene, and 1,4-dichlorobenzene were detected in surface and subsurface soil at SD15 at concentrations above their current ADEC soil cleanup standards to be protective for migration to groundwater. 1,2-Dichlorobenzene was also detected in surface soil above the ADEC soil cleanup standard protective for ingestion. These chemicals were not detected in SD15 groundwater in 2007. Contaminated surface soil at SD15 was excavated and treated in June 1996. Any remaining contamination in surface and subsurface soil was treated by an HVE system for 10 years and an SVE system for 2 years. Although soil samples have not been analyzed for these chemicals since the RI/FS because they were not identified as soil COCs, it is unlikely that they still exist on site at the pre-ROD levels. Given the extensive soil treatment and the absence of these chemicals in groundwater, the new soil cleanup standards do not call into question the protectiveness of the remedy.

- At the time of the ROD, PCE was detected in subsurface soil at SD15 at concentrations above its current ADEC soil cleanup standard to be protective for migration to groundwater, but below the cleanup standards protective for ingestion and inhalation. Contamination in subsurface soil was treated by an HVE system for 10 years and an SVE system for 2 years, and the PCE concentration in SD15 groundwater was below the groundwater cleanup level in 2007. Although soil samples have not been analyzed for PCE since the RI/FS because it was not identified as a soil COC, it is unlikely that PCE still exists on site at the pre-ROD levels. Given the extensive soil treatment and the low concentration of PCE in groundwater, the new soil cleanup standard does not call into question the protectiveness of the remedy.

- At the time of the ROD, TCE was detected in surface and subsurface soils at SD15 at concentrations above its current ADEC soil cleanup standard to be protective for migration to groundwater and inhalation. Contaminated surface soil at SD15 was excavated and treated in June 1996, and the remaining TCE contamination in surface and subsurface soil was treated by an HVE system for 10 years and an SVE system for 2 years. TCE concentrations in SD15 groundwater were still above the groundwater cleanup level in 2007, but show decreasing trends. Although soil samples have not been analyzed for TCE since the RI/FS because it was not identified as a soil COC, it is unlikely that TCE still exists on site at the pre-ROD levels. The new soil cleanup standard does not call into question the protectiveness of the remedy because the natural attenuation remedy is successfully addressing TCE contamination and the current groundwater monitoring program provides adequate data to evaluate the effectiveness of the remedy. Further, the TCE concentrations in soil at the time of the ROD do not exceed the USEPA's risk management decision range of 10^{-4} to 10^{-6}.

- At the time of the ROD, antimony was detected in surface soils at WP14, LF04, SD15, and LF02, and subsurface soils at WP14, SD15, and LF02 at concentrations above the current ADEC soil cleanup standard for the migration to groundwater exposure pathway. Concentrations of antimony in surface and subsurface soils at LF02 also exceeded the current ADEC soil cleanup standard for the ingestion exposure pathway. However, antimony was eliminated as a COPC for groundwater at all of these OU6 sites due to its infrequent detections (USAF, 1996a). Therefore, despite the detection of antimony in soil above the ADEC cleanup standard to be protective for migration to groundwater, groundwater has not been adversely impacted by antimony at these sites. The remedy for LF02 included a limited soil cover and LUCs to limit access to the area, and is protective for the antimony concentrations in LF02 soils.

- At the time of the ROD, cadmium was detected in surface soils at LF04 and LF02 at concentrations above its current ADEC soil cleanup standard for the migration to groundwater exposure pathway. However, cadmium was eliminated as a COPC for groundwater at these OU6 sites due to its infrequent detections and because its average concentration on-site was not significantly greater than the average background concentration (USAF, 1996a). The ADEC cleanup standard for cadmium for the ingestion exposure pathway was not exceeded in any soil sample. Despite the detection of cadmium in soil above the ADEC cleanup standard to be protective for migration to groundwater, groundwater has not been adversely impacted by cadmium at these sites. Therefore the new soil cleanup standard for cadmium does not call into question the protectiveness of the remedy.

Changes in Exposure Pathways: The land use at OU6 sites has not changed and is not expected to change in the future. The 50 year vision for Elmendorf AFB capital improvements does not anticipate development at any of the OU6 sites. No new or changed human health or ecological routes of exposure or receptors have been identified.

Port of Anchorage facilities are being expanded to the west of LF04. The port expansion project filled in the beach below LF04. Port employees will not be working within the LF04 boundary, so there is no change in exposure pathways expected as a result of the Port of Anchorage expansion. Quarry operations to support the port expansion project at the Cherry Hill borrow pit on Elmendorf AFB were conducted outside of all OU6 sites and avoided contact with groundwater. There was no change in exposure pathways as a result of the quarry operations that supported the Port of Anchorage expansion.

A few new contaminants were identified during the period between 2003 and 2007. Several new fuel components were identified in SD15 groundwater, but they are characteristic of other contaminants at SD15 (i.e., not a new contaminant source), the levels were very low and their detection is probably due to changes to the VOC analytical protocols. Dichlorodifluoromethane and methyl-isobutyl-ketone were detected in SD15 and WP14 groundwater respectively, but only once each at low concentrations and were non-detect in subsequent samples. These isolated detections do not call into question the protectiveness of the remedy for OU6.

Surface soil sampling along the LF04 bluff in 2007 detected low concentrations of six VOCs (see Table 6-5). Most of the detections are in the same general area where VOCs were detected in surface soils at the time of the ROD. TCE and methylene chloride were detected at concentrations above those detected at the time of the ROD. 1,2-Dichlorethane, *cis*-1,2-DCE, and PCE were detected for the first time in LF04 soil. All 2007 soil contaminant concentrations are more than an order of magnitude below ADEC soil cleanup standards that are designed to be protective for exposure by inhalation and ingestion. Therefore, the detections of soil contaminants in the 2007 sampling event do not indicate concern about the protectiveness of the remedy.

By-products of TCE reductive dechlorination are routinely monitored, and none of these compounds has exceeded its ADEC cleanup standard or MCL. Physical site conditions have not changed.

<u>Changes in Toxicity and Other Contaminant Characteristics</u>: Toxicity factors changed for OU6 COC toluene, as well as for other groundwater contaminants detected at OU6 including 1,1-DCE, naphthalene, phenol, PCE, arsenic, barium, beryllium, chromium, and zinc. The cleanup standards for these compounds are still protective for all contaminants except arsenic and beryllium (see Attachment B, Table B-4). The impact of the changes in toxicity factors are discussed below for each chemical.

- The arsenic MCL of 10 μg/L results in risk above the USEPA's risk management decision range of 10^{-4} to 10^{-6}. Groundwater at most OU6 sites has contained concentrations of arsenic greater than the 10 μg/L MCL (up to 96.3 μg/L). However, statistical analyses performed during the RI/FS (USAF, 1996a) determined that arsenic in groundwater at OU6 sites was not significantly different from background. For this reason, arsenic was eliminated as a groundwater COPC at OU6 sites. Because toxicity due to arsenic concentrations in groundwater at OU6 sites is due to natural background, more stringent cleanup levels are not practical. Therefore the protectiveness of the OU6 remedy is not affected by the change in the arsenic toxicity factor.

- The beryllium MCL of 4 μg/L results in risk above the USEPA's risk management decision range of 10^{-4} to 10^{-6}. Groundwater at OU6 contained concentrations of beryllium less than the 4 μg/L cleanup level (up to 1.7 μg/L). Increased cancer risk based on the maximum beryllium concentration at any OU6 site is within the USEPA's risk management decision range. Therefore the protectiveness of the OU6 remedy is not affected by the change in the beryllium toxicity factor.

Changes in Risk Assessment Methods: None.

Expected Progress Towards Meeting RAOs: The remedies at OU6 are generally progressing as intended, though at a slower rate than anticipated at the time of the ROD for a few COCs. The HVE/SVE system at SD15 succeeded in meeting soil cleanup levels but not groundwater. Benzene concentrations at few groundwater sampling locations at LF04 South and WP14, and at one well at SD15, will take longer than expected to reach cleanup goals (current estimates are 2013 at WP14 and 2023 at SD15).

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Answer: No.

There are several additional issues that were evaluated, but none of them call into question the protectiveness of the remedy.

A potential newly identified ecological risk/location-specific ARAR involves the Cook Inlet beluga whale. The whale was listed as endangered under the Endangered Species Act as of October 22, 2008 (73 FR 62919). In the rule, the National Marine Fisheries Service concluded that the Cook Inlet beluga whale was in danger of extinction throughout all of its range because of (among other things) present or threatened destruction, modification or curtailment of habitat or range. Several planned developments (i.e., new construction) and ongoing activities (including industrial activities that discharge or accidentally spill pollutants) were identified that could impact the habitat. Because LF04 is located on the Knik Arm of Cook Inlet (i.e., Cook Inlet beluga whale habitat), the potential impact of the proposed rule on the selected LF04 remedy was evaluated. Because the remedy for LF04 does not include any construction in Cook Inlet waters, the only potential concern would be if the current remedy impacts critical habitat through discharge of pollutants from LF04 into Cook Inlet through discharge of contaminated groundwater or erosion of contaminated soil/sediments. Contaminants or debris from LF04 are unlikely to reach Cook Inlet, particularly since the Port of Anchorage expansion project will limit erosion from the bluff at LF04. Further, in order for LF04 to be impacted by the proposed ruling, several things need to happen; critical habitat for the Cook Inlet beluga whale must be identified (this is being considered in a separate rulemaking), and primary constituent elements of the critical habitat need to include water quality concerns for the type of contaminants found at LF04. This second requirement may be unlikely to occur because research has provided no evidence that water quality concerns involving LF04 contaminants have impacted Cook Inlet beluga whales. Tissue samples collected from beluga whales that died during subsistence hunts or after stranding have been analyzed for PCBs, chlorinated pesticides, and heavy metals. Thus far, contaminant loads, in general, for belugas in Cook Inlet have been lower than observed in other beluga whale populations with the exception of hepatic copper levels (Becker, et al. 2000, Hobbs, et al. 2006). Further, US Geological Survey sampling to support dredging activities for the Port of Anchorage have not reported or identified elevated levels of contamination or debris in dredged sediments (ATSDR, 2006). The Port of Anchorage expansion project and LF04 debris removal efforts should eliminate any possibility of LF04 contaminants or debris reaching Cook Inlet. Therefore the LF04 selected remedy is anticipated to remain protective, but development of rulings involving the protection of the Cook Inlet beluga whale should be monitored in future five-year reviews.

ATSDR published a public health assessment for Elmendorf AFB in 2006 (ATSDR, 2006). The public health assessment identified a few concerns and recommendations for OU6 sites. The ATSDR findings and recommendations generally do not call into question the protectiveness of the remedies, but rather provide recommendations to help ensure and confirm that the existing remedies remain protective.

- ATSDR was concerned about safety for anyone visiting LF04 due to landslides because of the instability of the bluff. ATSDR recommended that access to the bluff be further restricted (suggesting that all monitoring of the landfill be conducted remotely by airplane or boat), and additional warning regarding the instability of the bluff at LF04 be added to signs at the access control point. The USAF has already limited access to and posted warning signs about LF04 (as acknowledged by ATSDR), but total elimination of human access is not practical as some access is required to monitor conditions and implement the remedy (i.e., remove debris). The existence of mature trees suggests that most of the bluff is stable. Continuing current access control procedures with warnings of slope stability and prudent safety precautions should be sufficient.

- ATSDR also recommended providing information about LF04 contamination to groups involved with trawling, dredging, and port expansion activities near LF04. Exchange of information of this sort is prudent, and also may result in obtaining information about any off-shore sediment sampling results (e.g., conducted as part of the port expansion project) which could in turn be used to help confirm the protectiveness of the LF04 remedy.

- For LF02 and LF03, ATSDR was concerned about landfill gas (methane) migrating from the landfills to nearby residences and causing fires or explosions, and recommended soil gas sampling for methane. LF02 and LF03 were closed 66 and 51 years ago respectively. Both are overgrown with mature trees and therefore have not been disturbed in years. If methane generation and migration into residences at these sites were a problem, it would have already occurred. Because methane generation decreases with time, it is unlikely to be an issue now or in the future.

- ATSDR was also concerned about the potential for people to be exposed to contaminants exposed by freeze/thaw, frost heaving, and erosion at LF02 and LF03. ATSDR recommended inspections/sampling for contaminants (particularly lead, antimony and thallium at LF02) in surface soil to correspond with five-year reviews. Periodic inspections to look for signs of erosion or exposed debris are prudent; no exposed landfill debris was evident during the five-year review site inspection. Limited surface soil sampling for metals at LF02 every five years is not necessary to ensure protectiveness of the remedy. Although frost heaving does occur for wells, it is unclear how it would cause the type of soil mixing necessary to bring contaminated soils to the surface. Further, LF02 is heavily overgrown and showed no signs of recreation trails or human traffic, and consequently no opportunity for exposure.

Port of Anchorage facilities are being expanded to the west of LF04. The port expansion project filled in the beach below LF04. The design of the new facilities allows all annual debris removal to be conducted unimpeded. Port of Anchorage employees will be working outside of the LF04 boundary. Therefore the Port of Anchorage expansion project does not call into question the protectiveness of the LF04 remedy.

7.6 SITE DP98

Question A: Is the remedy functioning as intended by the decision documents?

Answer: Yes.

Remedial Action Performance: The remedy at DP98 has been implemented and continues to operate and function as designed. Contaminant concentrations at the former kettle pond, the ROD-specified point of compliance, consistently meet effluent requirements. In general, the monitoring program indicates that DP98 contaminants are naturally attenuating and it is likely that groundwater cleanup levels will be met by 2079. However, the rate that the COCs are naturally attenuating at each well is variable and with short monitoring history, it is difficult to predict an accurate cleanup date. Groundwater data were compiled and evaluated in 2008 to assist in the evaluation of the natural attenuation remedy. Modeling confirmed that the MNA remedy is working as envisioned in the ROD. Most of the COC plume appears to be contracting and is not likely to expand beyond the LUC boundary. All components of the ROD-specified remedy have been implemented, and a Remedial Action report should be prepared.

Systems Operations/O&M: Operating procedures, as implemented, are expected to maintain the effectiveness of the response actions. O&M costs are relatively stable and do not indicate potential remedy problems. If the enhanced bioremediation pilot test is extended, bioaugmentation should be considered if reductive dechlorination appears to be stalled at *cis*-1,2-DCE.

Opportunities for Optimization: None.

Implementation of LUCs and Other Measures: DP98 LUCs are appropriate and properly implemented. They are effective at preventing exposure and are expected to remain effective in the future. Contaminant levels at DP98 that exceed cleanup goals based on a UU/UE scenario are within the LUC boundary. Potentially impacted personnel at Elmendorf AFB are made aware of LUC requirements through the 3 WGI 32-7003, the *Base General Plan*, the Work Clearance Request process, and GeoBase.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

Answer: Yes.

Changes in Standards and TBCs: Groundwater and surface water COPCs were compared to current federal and state standards. No new cleanup standards for groundwater contaminants were identified. A new cleanup standard (not addressed in the ROD) for indeno(1,2,3-cd)pyrene in surface water (USEPA, 2007) was identified (see Attachment B, Table B-1). Indeno(1,2,3-cd)pyrene concentrations were below the new standard at the time of the ROD (see Attachment B, Table B-2). Therefore the new cleanup standard does not call into question the protectiveness of the remedy.

Soil COPCs were compared to current state standards. A new Alaska soil cleanup standard (ADEC, 2006a) has been promulgated for TCE by an ADEC technical memorandum (see Attachment B, Table B-1). TCE exceeded the ADEC cleanup standard designed to be protective for inhalation in at least one soil sample after excavation of the most contaminated soils at DP98 in 2005 (see Attachment B, Table B-2). However, the TCE concentration does not exceed the USEPA's risk management decision range of 10^{-4} to 10^{-6} (see Attachment B, Table B-4). Therefore the new cleanup standard does not call into question the protectiveness of the remedy.

Changes in Exposure Pathways: There has been no change to the current or expected land use at and near DP98, and no new development was anticipated in the 50-year vision for Elmendorf AFB. No new or changed human health or ecological routes of exposure or receptors have been identified.

There were some notable contaminant detections (described in section 6.4.6) that are discussed below:

- DRO, GRO, and benzene were detected at concentrations above the ADEC groundwater cleanup standards (ADEC, 2006d) and/or MCL. All of these contaminants are COPCs for DP98. DRO and GRO analyses were performed in 2007 to help assess the impact of petroleum hydrocarbons on natural attenuation of chlorinated COCs at DP98. Benzene has been detected above the current standard, however concentrations are declining and there is only one well where benzene has been above the cleanup standard. Benzene has consistently been a low-level contaminant at DP98 (i.e., it does not represent a new source of contamination), and benzene occurs at concentrations in excess of cleanup standards only in isolated locations or as isolated events. None of these chemicals represent new contaminants, and the detections do not impact the protectiveness of the remedy.

- A few compounds were detected in groundwater samples for the first time since the ROD. The chlorinated solvent decay product 1,2-dichloroethane was detected in only one sample in 2006 and only slightly above the detection level in that sample. Methyl-ethyl-ketone and methyl-isobutyl-ketone were also detected. Ketones can be produced by fermentation of petroleum contaminants under low pH conditions, but are unstable in the environment. These detections are below the current cleanup standards, if any, and do not impact the protectiveness of the remedy.

By-products of reductive dechlorination of TCE (and other chlorinated solvents) are routinely monitored. Physical site conditions have not changed.

Changes in Toxicity and Other Contaminant Characteristics: Toxicity factors have changed for two DP98 COPCs: 1,1-DCE and PCE. The current MCLs and state cleanup standards for these compounds are still sufficiently protective (see Attachment B, Table B-4). Therefore, the protectiveness of the DP98 remedy is not affected by these changes.

Changes in Risk Assessment Methods: None.

Expected Progress Towards Meeting RAOs: The natural attenuation remedy is progressing at the rate originally expected in the ROD, based on composite data for the in-plume wells. More data is needed to better estimate a cleanup date for individual wells due to significant scatter in the data and a relatively short monitoring history.

<u>Question C: Has any other information come to light that could call into question the protectiveness of the remedy?</u>

<u>Answer: No</u>.

7.7 TECHNICAL ASSESSMENT SUMMARY

Past and current data from system monitoring indicate that the remedies are generally performing as intended by the decision documents for OUs 1, 2, 4, 5, and 6 and DP98. Groundwater cleanup levels appear to be met at SD28 in OU4 and LF02 in OU6. Shallow soils meet cleanup levels at all OU4 sites. The natural attenuation remedy is working somewhat slower than originally intended at certain sites, particularly OU5. Operating and monitoring procedures, as implemented, are expected to maintain the effectiveness of response actions. As a whole, the Elmendorf AFB remediation program has been highly optimized, but remaining optimization opportunities are the WRS and monitoring program at OU5. LUCs are in place and are preventing exposure.

A review of changes in exposure assumptions, toxicity data, and cleanup levels since the time of the remedy selection has not revealed any issues that affect remedy protectiveness. All of the cleanup levels for the final COCs are still protective according to the current regulatory cleanup levels and associated risk evaluations. There have been no changes to the physical conditions of the sites that could affect the protectiveness of the remedies. Development on or near sites, including new hangars near FT23 and Port of Anchorage expansion below LF04, have been conducted in close coordination with Elmendorf AFB environmental restoration personnel to eliminate the possibility of exposure and to ensure remedial actions continue unimpeded. Data were carefully searched for any newly detected contaminants, contaminants that exceed cleanup standards (including contaminants not identified as COCs), and toxic by-products of remediation. Several detections are noted, but all were relatively low concentrations and tended to be at isolated locations and events, and none were judged to impact the protectiveness of the remedy.

Two data gaps were identified. At OU2, the surface water point-of-compliance SW-13 was not monitored between 2003 and 2007 due to confusion over its location. The point of compliance has been re-established and was monitored in 2008 to demonstrate that natural attenuation is occurring. At OU5, the downgradient extent of the Fairchild Avenue plume is not defined in the deeper portion of the shallow aquifer.

SECTION 8.0

ISSUES

This section details issues related to current site operations, conditions, or activities and evaluates whether the issues affect current or future protectiveness of the associated remedy. Table 8-1 summarizes the issues at each OU.

Table 8-1
Issues

Issue No.	OU	Site	Issue	Affects Current Protectiveness? (Y/N)	Affects Future Protectiveness? (Y/N)
1	1	LF59	Upgradient Plume: The TCE plume at LF59 appears to be originating, at least in part, from the upgradient OU1 landfills. There are insufficient data to determine the impact to long-term groundwater quality and the estimated cleanup date at LF59.	N	N
2	2	ST41	Surface Water: The surface water point of compliance (SW-13) in the center of the wetland area was not monitored between 2003 and 2007 due to confusion over its location. The location of point of compliance was re-established and surface water was sampled in 2008. The 2008 results demonstrate that surface water contaminants attenuate between contaminated seep ST41-SP01 and the surface water point of compliance. Annual sampling is needed to demonstrate protectiveness.	N	N
3	4	FT23, SD24, SD25	Inconsistent Cleanup Levels: The cleanup levels for 1,2-dichloroethane, PCE, and TCE for FT23 groundwater, and DRO and GRO for SD24 and SD25 soil, as presented in OU4 ROD, are inconsistent with their referenced standards. The cleanup levels for 1,2-dichloroethane, PCE and TCE at FT23 are listed as 6 μg/L instead of the MCL standard of 5 μg/L. The cleanup levels identified for DRO and GRO at SD24 and SD25 are 1,000 and 2,000 mg/kg respectively, which is the reverse of their referenced Alaska Cleanup Matrix Level D standard. These inconsistencies appear to be typographical errors because there is no discussion in the ROD about deviation from the referenced standards.	N	N

Table 8-1 (Continued)
Issues

Issue No.	OU	Site	Issue	Affects Current Protectiveness? (Y/N)	Affects Future Protectiveness? (Y/N)
4	5	ST37	Fairchild Avenue Plume Downgradient Boundary: The down-gradient extent of the Fairchild Avenue plume is delineated at the water table but not in wells screened deeper in the shallow aquifer. TCE has not been detected in downgradient seeps, downgradient early warning/sentry wells, or in Ship Creek, but was detected in a downgradient ARRC well in 2002.	N	N
5	5	ST37	Contaminated Seep: In 2005 and 2006, the TCE concentration in Seep 7 increased to just above the cleanup level. The decision guide for restarting an existing seep collection area or adding a new seep collection area for treatment (Attachment F, Figure F-4) indicates that the response for this seep should be quarterly monitoring.	N	N
6	2, 4, 5, 6	ST41, SD25, ST37, WP14, LF04, SD15	Cleanup Schedules: Monitoring shows that the natural attenuation remedies are generally decreasing COC concentrations. At several sites, the process is slower than anticipated in the ROD. For most of the affected sites, the slower attenuation rates are limited to a few individual wells or just a few additional years until cleanup goals are met. The slower rates of natural attenuation have the largest impact at OU5, where natural attenuation may take several additional decades to reach cleanup levels. OU5 has a large monitoring program and a relatively expensive treatment system for contaminants discharging at seeps, so the impact on cleanup costs could be significant. In the interim, LUCs are in place to ensure protectiveness.	N	N

ARRC = Alaska Railroad Corporation; COC = contaminant of concern; DRO = diesel-range organics; GRO = gasoline-range organics; LUC = land use control; MCL = maximum contaminant level; mg/kg = milligram per kilogram; OU = operable unit; PCE = tetrachloroethene; ROD = record of decision; TCE = trichloroethene

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SECTION 9.0

RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Recommendations and follow-up actions have been identified, as shown in Table 9-1, to address the issues presented in Section 8. The USAF will prepare separate closure documents for those treatment systems and sites that are targeted for closure. In addition to the recommendations that respond to issues cited in Section 8, several recommendations are included to optimize the remedy and/or minimize unnecessary costs. These recommendations are also included in Table 9-1.

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Table 9-1
Recommendations and Follow-up Actions

Item No.	Issue No.	OU	Site	Recommendations/Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Current Protectiveness (Y/N)	Follow-up Actions: Affects Future Protectiveness (Y/N)
1	1	1	LF59	Upgradient Plume: Incorporate data from upgradient wells LF05GW-2B and OU1LF-19 into evaluation of natural attenuation and analysis of contaminant trends, and update the conceptual site model for the TCE plume at LF59.	USAF	ADEC, USEPA	2010	N	N
2	2	2	ST41	Surface Water: Monitor the surface water point of compliance (SW-13) annually and seep ST41-SP01 every five years to assess the natural attenuation remedy for OU2 surface water. Document these updates to the OU2 monitoring program in a memorandum to the site file.	USAF	ADEC, USEPA	2009	N	N
3	3	4	FT23, SD24, SD25	Update the ROD-specified cleanup levels for 1,2-dichloroethane, PCE, and TCE for FT23 groundwater, and DRO and GRO for SD24 and SD25 groundwater, so that they are consistent with their referenced standards. Document the updated cleanup levels in a memorandum to the site file.	USAF	ADEC, USEPA	2009	N	N
4	4	5	ST37	Fairchild Avenue Plume Downgradient Boundary: Define the downgradient limit of the Fairchild Avenue plume in the deeper portions of the shallow aquifer.	USAF	ADEC, USEPA	2010	N	N
5	5	5	ST37	Contaminated Seep: Increase the monitoring frequency for Seep 7 to quarterly in accordance with the decision guide in the 2005 OU5 memorandum to the site file.	USAF	ADEC, USEPA	2009	N	N
6	6	2, 4, 5, 6	ST41, SD25, ST37, WP14, LF04, SD15	Cleanup Schedules: Continue monitoring until cleanup levels are met. Continue to use trend analysis to evaluate the natural attenuation remedies. Adjust estimated dates for achieving groundwater cleanup in accordance with trend projections. For OU5, attempt to identify sources of TCE contamination for Fairchild Avenue, OU5MW-02, SP1-02, Kenney Avenue, and Slammer Avenue plumes. If sources can be identified, evaluate alternative remedial strategies to accelerate attainment of the TCE cleanup level in OU5 groundwater. LUCs shall remain in place to ensure protectiveness until cleanup goals are met.	USAF	ADEC, USEPA	2013	N	N
7	NA	2	ST41	Incorporate wells ST41-28 (North Plume) and ST41-16 (South Plume) back into the monitoring program for OU2 when free product is no longer present in these wells. These wells have historically had some of the highest COC concentrations and are important for trend analysis estimates for meeting cleanup levels. Reduce sampling frequency or eliminate well ST41-07 because cleanup levels appear to be met at this location. Document sampling frequency of seeps (every 5-years) versus surface water point of compliance (annually) in a memo to site file.	USAF	ADEC, USEPA	When free product is absent, 2009	N	N
8	NA	4	FT23	Conduct soil sampling in 2010 or earlier. If soil meets cleanup levels, prepare a memorandum to the site file, shut down the bioventing system and remove bioventing components.	USAF	ADEC, USEPA	2010	N	N
9	NA	4	SD24, SD29	Increase monitoring frequency of wells OU4MW-04 and IS6-01 to annually to document attainment of cleanup levels and expedite closure of these sites.	USAF	ADEC, USEPA	2009	N	N
10	NA	4	SD28	Prepare a Site Closure report documenting that groundwater meets cleanup levels at SD28 and recommend NFA for this site.	USAF	ADEC, USEPA	2009	N	N
11	NA	5	ST37	Resample well OU3MW-25 (OU3MW-25 plume) to confirm that TCE concentration remains below the cleanup level. If confirmed, prepare memorandum to site file to document that sampling for this plume should be discontinued.	USAF	ADEC, USEPA	2009	N	N

Table 9-1 (Continued)
Recommendations and Follow-up Actions

Item No.	Issue No.	OU	Site	Recommendations/Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Current Protectiveness (Y/N)	Follow-up Actions: Affects Future Protectiveness (Y/N)
12	NA	5	ST37	Optimize early warning and sentry monitoring well networks to eliminate wells that are not downgradient of plumes and consider additional wells where there is a greater probability of contaminant migration.	USAF	ADEC, USEPA	2010	N	N
13	NA	5	ST37	High O&M costs for the WRS are attributed primarily to the moving parts (pumping systems). Evaluate the feasibility of shutting down pump stations. Pump station 2 can be mothballed in accordance with the decision guide for shutting down pumping stations because Seep 3 has met cleanup levels for the past five years. Seep 1 may be diverted from Pump Station 1 since it has also met cleanup levels for the past five years. This would leave only Seep 2 discharging to Pump Station 1, which would then only have to operate at a fraction of its current flow rate. These alternatives, if determined to be feasible, could be implemented through a memorandum to the site file.	USAF	ADEC, USEPA	2011	N	N
14	NA	5	ST37	Evaluate the feasibility of alternatives to the WRS for treating contaminated seeps. The WRS was designed to treat petroleum contaminants. Although it is also effective at treating the current TCE contamination, it is not very efficient. Seep 2 is collected in a lined, gravel-filled drain, and most of the contaminants at the seep appear to volatilize or biodegrade as water flows from the seep to Pump Station 1. The magnitude of the dilution effect of mixing clean water from Seep 1 with contaminated water from Seep 2 is unknown. If contaminant treatment in the lined drain can be confirmed, similarly constructed lined drains may be able to treat contaminants in other seeps (Seeps 7, 9, 10, and 11) in a passive (i.e., no pumping) treatment system with a much smaller footprint than the current WRS. This alternative, if feasible, would likely require an ESD or ROD amendment to be implemented.	USAF	ADEC, USEPA	2011	N	N
15	NA	6	LF02	Sample LF02 groundwater for all COPCs for one sample round. If LF02 groundwater meets all cleanup levels, prepare a site closure report to document response complete for LF02.	USAF	ADEC, USEPA	2010	N	N
16	NA	6	LF04	Conduct groundwater monitoring and evaluations in the context of LF04 South requirements of the OU6 ROD. Sample well OU6MW-61 to determine if LF04 South groundwater meets cleanup levels for chlorinated solvent COCs.	USAF	ADEC, USEPA	2010	N	N
17	NA	6	WP14	Incorporate well OU6MW-77 back into the monitoring program for WP14 once free product is no longer present in the well. This well has historically had some of the highest COC concentrations and is important for trend analysis estimates for meeting cleanup levels.	USAF	ADEC, USEPA	When free product is absent.	N	N
18	NA		DP98	Increase the sampling frequency of well 41755WL-08, located in the smaller COC plume, to twice annually. The DP98 ROD requires this frequency of monitoring if wells are upgradient of a receptor and COC concentrations are increasing. Sample surface water in the vicinity of Well 41755WL-08 concurrently with groundwater samples.	USAF	ADEC, USEPA	2010	N	N
19	NA		DP98	Prepare a Remedial Action report now that all components of the remedy are implemented.	USAF	ADEC, USEPA	2009	N	N

Table 9-1 (Continued)
Recommendations and Follow-up Actions

Item No.	Issue No.	OU	Site	Recommendations/Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Current Protectiveness (Y/N)	Follow-up Actions: Affects Future Protectiveness (Y/N)
20	NA	1, 2, 4, 5		Update the documentation of LUC implementation in a memorandum to the site file to comply with Air Force policy.	USAF	ADEC, USEPA	2009	N	N

ADEC = Alaska Department of Environmental Conservation; COC = contaminant of concern; COPC = contaminant of potential concern; DRO = diesel-range organics; ESD = explanation of significant differences; GRO = gasoline-range organics; LUC = land use control; NFA = No Further Action; O&M = operations and maintenance; OU = operable unit; PCE= tetrachloroethene; ROD = record of decision; TCE = trichloroethene; USAF = United States Air Force; USEPA = United States Environmental Protection Agency; WRS = wetland remediation system.

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SECTION 10.0

PROTECTIVENESS STATEMENTS

Protectiveness statements for each OU at which a remedial action has been initiated were developed in accordance with USEPA guidance (USEPA, 2001) and are included in this section.

10.1 OPERABLE UNIT 1

The remedy at OU1 is expected to be protective of human health and the environment upon attainment of groundwater cleanup levels at one remaining site (LF59). In the interim, exposure pathways that could result in unacceptable risks are being controlled.

10.2 OPERABLE UNIT 2

The remedy at OU2 is expected to be protective of human health and the environment upon attainment of groundwater cleanup levels, through natural attenuation at ST41. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

10.3 OPERABLE UNIT 4

The remedy at OU4 is expected to be protective of human health and the environment upon attainment of deep soil cleanup levels through bioventing at one remaining site (FT23) and attainment of groundwater cleanup levels through natural attenuation at sites FT23, SD24, SD25 and SD29. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

The remedy at site SD28 is protective of human health and the environment. Groundwater samples from the time of the ROD show that no contamination above background levels/regulatory cleanup levels remains and the site is acceptable for UU/UE.

10.4 OPERABLE UNIT 5

The remedy at OU5 is expected to be protective of human health and the environment upon attainment of groundwater and seep cleanup levels through natural attenuation, capture and treatment of contaminated seeps, and confirmation through sentry and early warning well monitoring networks that the point of compliance at Ship Creek is not impacted by OU5 contaminants. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

10.5 OPERABLE UNIT 6

The remedy at OU6 is expected to be protective of human heath and the environment for all sites. The remedy at LF04 North is expected to be protective of human health and the environment through the annual removal of exposed landfill debris. The remedies at LF04 South, WP14 and SD15 are expected to be protective of human health and the environment upon attainment of groundwater cleanup goals through natural attenuation. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

10.6 SITE DP98

The remedy at DP98 is expected to be protective of human health and the environment upon completion. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

SECTION 11.0

NEXT REVIEW

Future five-year reviews for OUs 1, 2, 4, 5 and 6 and DP98 are necessary because contamination remains above levels that allow for UU/UE in these areas. The next five-year review will be completed in 2013 and no later than five years from the signature date on this document.

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SECTION 12.0

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ATTACHMENT A

LOCATION MAPS

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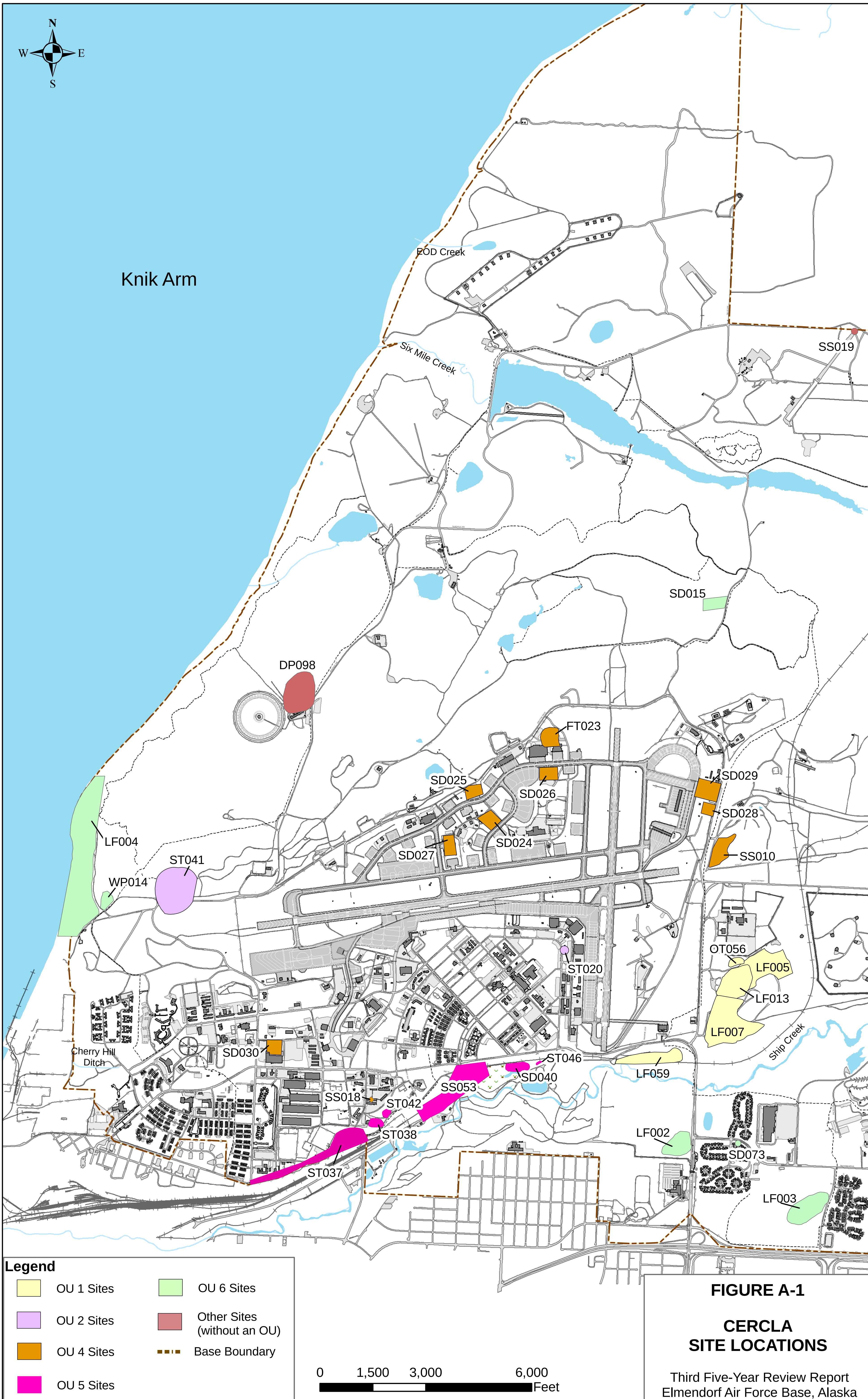

FIGURE A-1

CERCLA SITE LOCATIONS

Third Five-Year Review Report
Elmendorf Air Force Base, Alaska

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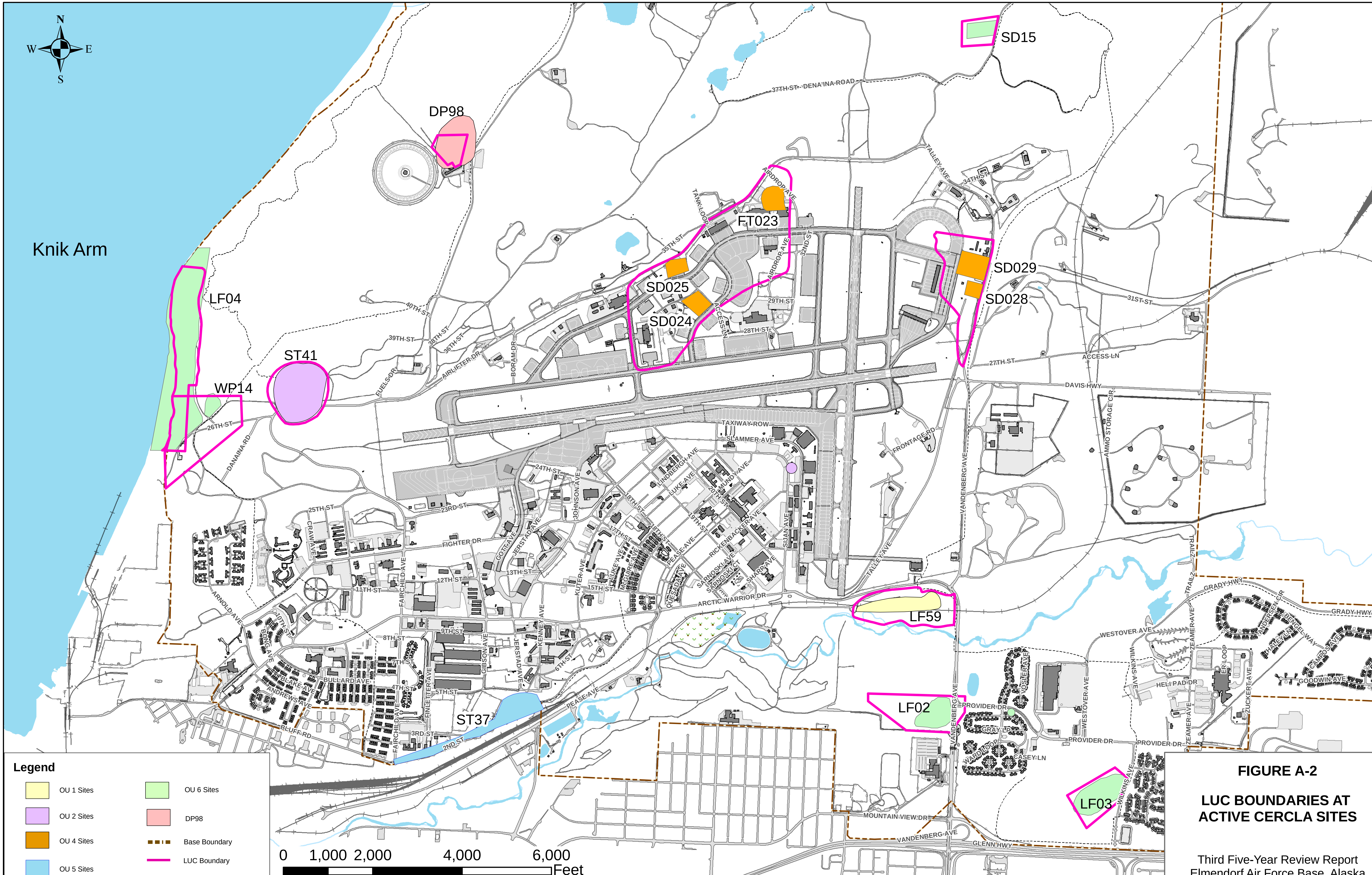

FIGURE A-2

LUC BOUNDARIES AT ACTIVE CERCLA SITES

Third Five-Year Review Report
Elmendorf Air Force Base, Alaska

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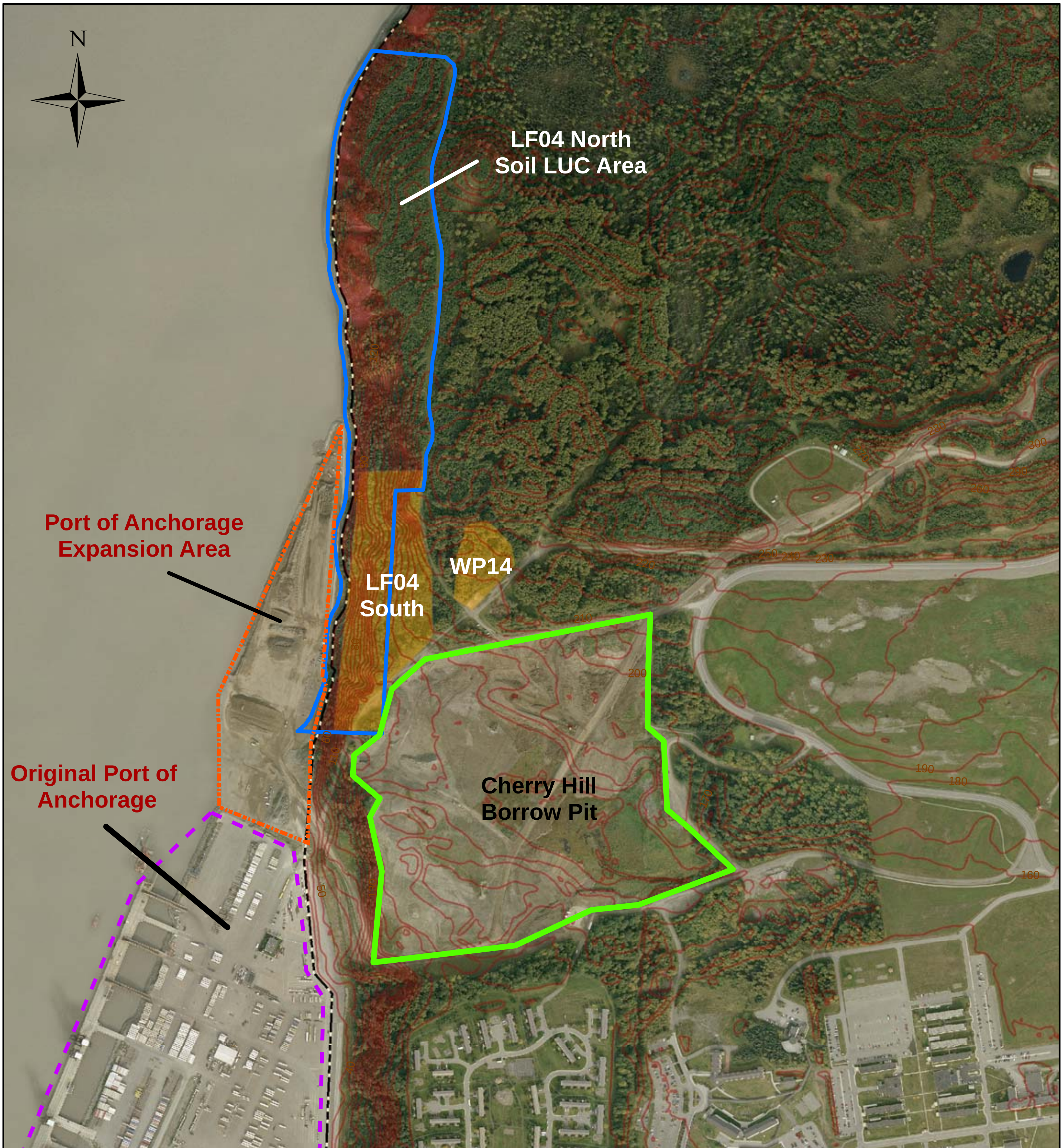

Legend

(green outline)	Cherry Hill Borrow Pit	(blue outline)	LFO4 North Soil LUC Boundary
(red dotted outline)	Port of Anchorage Expansion Area	(orange fill)	CERCLA Site
(purple dotted outline)	Original Port of Anchorage	(dash-dot line)	Base Boundary

FIGURE A-3

OPERABLE UNIT 6
PORT OF ANCHORAGE EXPANSION

Third Five-Year Review Report
Elmendorf Air Force Base, Alaska

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ATTACHMENT B

CLEANUP LEVELS, TOXICITY, AND RISK EVALUATION

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ATTACHMENT B
CLEANUP LEVELS, TOXICITY, AND RISK EVALUATION

The effects of significant changes in standards that were used at the time of remedy selection that may impact the protectiveness of the remedy were evaluated as part of the technical assessment of the five-year review at Elmendorf AFB. This was done according to USEPA (2001) Guidance as explained in Section 7.0 of this five-year review report.

The first step in this process is determining which COPCs have new or changed standards since the time of the ROD. Cleanup levels for COPCs presented in the ROD were compared to the current potentially applicable federal or state standards. For soils, 18 AAC 75, Table B1-Method 2, Under-40-Inch Zone applies for all compounds except DRO, GRO, and RRO. For these petroleum hydrocarbons, Table A1-Method 1 applies. For groundwater and surface water, federal MCLs (40 CFR § 141) and water quality standards (40 CFR § 131) were applied unless a more stringent state standard was promulgated under 18 AAC 75, 18 AAC 70, or 18 AAC 80.

Table B-1 illustrates this evaluation and identifies the COPCs for which a new or more stringent standard was found. The COPCs with new or more stringent standards were further evaluated by comparing the current applicable standard with maximum detected levels, as shown in Table B-2. A new risk evaluation was determined necessary if the most recent recorded concentrations exceeded the new/changed standards.

Most of the new standards were ADEC standards. For COPCs with a new ADEC standard, cancer risks and non-cancer hazards were estimated by comparing them with ADEC's risk-based cleanup standards for soil and groundwater in Table B-3. The ADEC groundwater and direct contact soil standards are based on a one in a hundred thousand risk (1×10^{-5}) for carcinogens or a hazard quotient of 1.0 for non-cancer chemicals. The method used to calculate risk is equivalent to using Equations 1 and 2 from the ADEC Cleanup Levels Guidance (ADEC, 2004, 2007a) for groundwater and surface water and Equations 4, 5, 7 and 8 for soils. In order to evaluate whether the remedy remains protective, the risk/hazard calculations were compared to the USEPA's management decision risk range of $1 \times l0^{-4}$ to $1 \times l0^{-6}$ for carcinogens and a hazard quotient of 1 for non-carcinogens. Section 7.0 of this report provides more detail regarding the risk calculation methodologies used. In the case of arsenic, a new MCL had been promulgated, prompting a risk evaluation. Since the new standard is not an ADEC risk-based standard, the above method could not be used to estimate risk. Instead, risk and hazard quotient was estimated based on the original risk assessment using updated toxicity information.

COPCs that did not have a MCL/State criteria at the time of the ROD and also do not have a current MCL/State criteria were not included in this first part of the review. Instead, compounds in the Drinking Water Standards and Health Advisories (USEPA, 2006) with updated health advisories since the time of the ROD were evaluated separately in Table B-4. This table summarizes the evaluation of new toxicity data that would cause additional compounds or requirements to become a potential protectiveness concern. Table B-4 shows the evaluation of risks and hazards that were calculated for each of these compounds using the new reference doses and cancer slope factors. A more detailed discussion of the results of this evaluation is included in Section 7.

Table B-1
Evaluation of Changes in Chemical-Specific Standards

Operable Unit (matrix and units)	COPCs* (Final ROD COCs in bold)	Former Standard/ Cleanup Level (in ROD)	Current Federal Cleanup Level[†]	Current Alaska Cleanup Level[†]	Is there a newly promulgated cleanup level or, is the new level more stringent? (Y/N)[‡]
OU1 (Ground water) µg/L	1,1,2,2-Tetrachloroethane	--	--	4 (A)	N[1]
	1,2-Dibromoethane (Ethylene dibromide)	0.05	0.05	**--**	N
	Arsenic	76[e]	10	50(A)	N[1e]
	Barium	2,000	2,000	2,000 (A)	N
	Benzene	5	5	5 (A)	N
	bis(2-ethylhexyl)phthalate	6	6	6 (A)	N
	cis 1,2-Dichloroethene	70	70	70(A)	N
	Lead[2]	--	**15**	**15**	**Y**
	Manganese	9,100[e]	**--**	50[d]	N[1e]
	Polychlorinated biphenyls (PCB)[2]	--	0.5	0.5 (A)	N[1]
	Tetrachloroethene	5	5	5 (A)	N
	Toluene	1,000	1,000	1,000 (A)	N
	Trichloroethene (TCE)	5	5	5(A)	N
	Vinyl chloride	2	2	2 (A)	N
OU1 (Surface water) µg/L	TPH (TAH)	--	**--**	**10[b] (B)**	**Y**
OU1 (Soil) mg/kg	Benzo(a) anthracene	--	--	**6**	**Y**
	Benzo(k) fluoranthene	--	--	**110**	**Y**
	bis(2-ethylhexyl)phthalate	--	--	**590**	**Y**
	Lead	--	--	**400**	**Y**
OU2 (Ground water) µg/L	**Benzene**	5	5	5 (A)	N
	Ethylbenzene	700	700	700(A)	N
	Toluene	1,000	1,000	1,000 (A)	N
	Xylenes, total	10,000	10,000	10,000(A)	N
	Antimony	--	**6**	**6 (A)**	**Y**
	Arsenic[2]	--	**10**	**50 (A)**	**Y**
	Barium	--	**2,000**	**2,000 (A)**	**Y**
	Beryllium[2]	--	**4**	**4 (A)**	**Y**
	bis(2-ethylhexyl)phthalate	6[e]	6	6 (A)	N
	Cadmium	--	**5**	**5 (A)**	**Y**
	Chloroform (THM)	100	**80[i]**	100 (A)	**Y**
	Chromium	--	**100**	**100 (A)**	**Y**
	Ethylene dibromide (1,2-Dibromoethane)	--	**0.05**	--	**Y**
	Lead	--	**15**	15 (A)	**Y**
	Methylene chloride	--	**--**	5 (A)	**Y**
	Naphthalene	--	--	**700 (A)**	**Y**

Table B-1 (Continued)
Evaluation of Changes in Chemical-Specific Standards

Operable Unit (matrix and units)	COPCs* (Final ROD COCs in bold)	Former Standard/ Cleanup Level (in ROD)	Current Federal Cleanup Level†	Current Alaska Cleanup Level†	Is there a newly promulgated cleanup level or, is the new level more stringent? (Y/N)‡
OU2 (Ground water) µg/L (Cont)	Nickel	--	--	**100 (A)**	**Y**
	Nitrate (as N)	--	**10,000**	--	**Y**
	1,1,2,2-Tetrachloroethane	--	--	4 (A)	N[1]
	Thallium[2]	--	**2**	**2 (A)**	**Y**
	Vanadium	--	--	**260 (A)**	**Y**
OU2 (Surface Water) µg/L	**Benzene**	10[a]	**710**	**5[b] (B)**	**Y**
	Ethylbenzene	10[a]	3,100	**700[b] (B)**	N
	Toluene	10[a]	6,800	**1,000[b](B)**	N
	Xylenes, total	10[a]	--	**10,000[b](B)**	N
	1,1,2,2-Tetrachloroethane	--	**110**	**--**	**Y**
	1,2-Dichloroethane	10[a]	**990**	5 (B)	N[1]
	Arsenic[2]	--	--	**50 (A)**	**Y**
	Thallium[2]	--	--	**2 (A)**	**Y**
	Diesel (TAqH)	15[f]	--	**15[b] (B)**	N
	Gasoline (TAqH)	15[f]	--	**15[b] (B)**	N
OU4 (Ground water) µg/L	Diesel (DRO)	--	--	**1,500 (A)**	**Y**
	Benzene	5	5	5(A)	N
	Ethylbenzene	700	700	700(A)	N
	Toluene	1,000	1,000	1,000(A)	N
	Xylenes, total	10,000	10,000	10,000(A)	N
	1,1,1-Trichloroethane	200	200	200 (A)	N
	1,1,2-Trichloroethane	5	5	5	N
	1,1-Dichloroethane	--	--	3,650(A)	N[1]
	1,1-Dichloroethene	7	7	7 (A)	N
	1,2-Dichlorobenzene	600	600	**600 (A)**	N
	1,2-Dichloroethane	5	5	5(A)	N
	1,3-Dichlorobenzene	600	600[j]	**600[j] (A)**	N
	1,4-Dichlorobenzene	75	75	75 (A)	N
	2-Methylphenol (o-cresol)	--	--	**1,800 (A)**	**Y**
	Acenaphthene	--	--	**2,200 (A)**	**Y**
	Acetone	--	--	**3,650 (A)**	**Y**
	Benzoic acid	--	--	**146,000(A)**	**Y**
	Carbon tetrachloride	5	5	5 (A)	N
	Chloroform (THM)	100	**80[i]**	100 (A)	**Y**
	cis-1,2-Dichloroethene	70	70	70(A)	N
	Fluorene	--	--	**1,460 (A)**	**Y**
	Heptachlor epoxide	0.2	0.2	0.2 (A)	N
	Naphthalene	--	--	**700 (A)**	**Y**
	Nitrate-Nitrite (as N)	10,000	10,000	**--**	N
	Phenol	--	--	**22,000(A)**	**Y**

Table B-1 (Continued)
Evaluation of Changes in Chemical-Specific Standards

Operable Unit (matrix and units)	COPCs* (Final ROD COCs in bold)	Former Standard/ Cleanup Level (in ROD)	Current Federal Cleanup Level[†]	Current Alaska Cleanup Level[†]	Is there a newly promulgated cleanup level or, is the new level more stringent? (Y/N)[‡]
OU4 (Ground water) µg/L (Cont)	**Tetrachloroethene**	5	5	5 (A)	N
	trans-l,2-Dichloroethene	100	100	100 (A)	N
	Trichloroethene (TCE)	5	5	5(A)	N
	Vinyl chloride	2	2	2(A)	N
OU4 (Soil) mg/kg	**Diesel (DRO)**	2,000	--	2,000[g]	N
	Gasoline (GRO)	1,000	--	1,000[g]	N
	Jet fuel (RRO)	2,000	--	2,000[g]	N
	Kerosene (RRO)	2,000	--	2,000[g]	N
	BTEX	100	--	--[k]	N
	Benzene	0.5	--	0.02	N[1]
	Ethylbenzene	--	--	5.5	N[1]
	Toluene	1,000	--	5.4	N[1]
	Xylenes, total	--	--	78	N[1]
	1,1,1-Trichloroethane	--	--	1.0	N[1]
	4,4-DDD	--	--	35	N[1]
	4,4-DDE	--	--	**24**	**Y**
	4,4-DDT	--	--	24	N[1]
	Acenaphthene	--	--	210	N[1]
	Aldrin	--	--	0.5	N[1]
	alpha-BHC	--	--	**0.0026**	**Y**
	Anthracene	--	--	4,300	N[1]
	Benzo(a)anthracene[2]	--	--	6	N[1]
	Benzo(a)pyrene[2]	--	--	1	N[1]
	Benzo(b)fluoranthene[2]	--	--	11	N[1]
	Benzo(k)fluoranthene[2]	--	--	110	N[1]
	beta-BHC	--	--	**0.009**	**Y**
	bis(2-ethylhexyl)phthalate	--	--	**590**	**Y**
	Butylbenzylphthalate	--	--	**5,600**	**Y**
	Chromium	48.44[e]	--	26	N[e]
	Chrysene	--	--	620	N[1]
	cis-l,2-Dichloroethene (1,2-DCE)	--	--	0.2	N[1]
	Cobalt	19.52[e]		--	N
	Cyanide	--	--	27	N[1]
	Dibenz(ah)anthracene[2]	--	--	1	N[1]
	Dibutylphthalate	--	--	**1,700**	**Y**
	Endrin	--	--	0.3	N[1]
	Fluoranthene	--	--	2,100	N[1]
	Fluorene	--	--	270	N[1]
	gamma-BHC (Lindane)	--	--	**0.003**	**Y**

Table B-1 (Continued)
Evaluation of Changes in Chemical-Specific Standards

Operable Unit (matrix and units)	**COPCs* (Final ROD COCs in bold)**	**Former Standard/ Cleanup Level (in ROD)**	**Current Federal Cleanup Level†**	**Current Alaska Cleanup Level†**	**Is there a newly promulgated cleanup level or, is the new level more stringent? (Y/N)‡**
OU4 (Soil) mg/kg (Cont)	Heptachlor	--	--	**0.8**	**Y**
	Ideno(123-cd)pyrene[2]	--	--	11	N[1]
	Isophorone	--	--	**3**	**Y**
	Lead	--	--	400	N[1]
	Meta-&para-xylenes	1,000	--	--	N
	Methylene chloride	--	--	0.015	N[1]
	Naphthalene	--	--	21	N[1]
	Nickel	51[e]	--	87	N
	Ortho-xylenes	1,000	--	--	N
	PCB-1260[2]	--	--	1	N[1]
	Pyrene	--	--	1,500	N[1]
	Selenium	0.54[e]	--	3.5	N
	Tetrachloroethene	--	--	0.3	N[1]
	Trichloroethene (TCE)	--	--	**0.020**	**Y**
	Vanadium	--	--	**710**	**Y**
	Zinc	--	--	9,100	N[1]
OU5 (Ground water) µg/L	JP-4 (RRO)	--	--	**1,100 (A)**	**Y**
	TFH-Diesel (TAH)[c]	10	--	10 (B)	N[c]
	TFH-Gas(TAqH)[c]	10	--	15 (B)	N[c]
	Benzene	5	5	5 (A)	N
	Ethylbenzene	700	700	700(A)	N
	Toluene	1,000	1,000	1,000(A)	N
	Xylenes, total	10,000	10,000	10,000(A)	N
	1,1,1-Trichloroethane	200	200	200 (A)	N
	1,1,2,2-Tetrachloroethane	--	--	4 (A)	N[1]
	1,1-Dichloroethane	--	--	3,650 (A)	N[1]
	Aluminum	50-200	--	**50-200**[d]	N
	Barium	2,000	2,000	2,000 (A)	N
	bis(2-ethylhexyl)phthalate	6	6	6 (A)	N
	Diethyl phthalate	--	--	**29,000(A)**	N
	Di-n-butyl phthalate	--	--	**3,650 (A)**	N
	Manganese	50	**--**	50[d]	N
	Naphthalene	--	--	**700 (A)**	**Y**
	N-nitrosodiphenylamine	--	--	**170 (A)**	**Y**
	Selenium	50	50	**50 (A)**	N
	Trichloroethene (TCE)	5	5	5(A)	N
	Vanadium	--	--	**260 (A)**	**Y**

Table B-1 (Continued)
Evaluation of Changes in Chemical-Specific Standards

Operable Unit (matrix and units)	COPCs* (Final ROD COCs in bold)	Former Standard/ Cleanup Level (in ROD)	Current Federal Cleanup Level[†]	Current Alaska Cleanup Level[†]	Is there a newly promulgated cleanup level or, is the new level more stringent? (Y/N)[‡]
OU5 (Surface Water) µg/L	l,l,l-Trichloroethane	200	--	200 (B)	N
	1,2-Dichloroethane	5	3.8	5 (B)	N[1]
	1,1,2,2-Tetrachloroethane	--	**110**	--	**Y**
	Benzene	5	12	5[b] (B)	N
	Ethylbenzene	700	3,100	700[b] (B)	N
	Toluene	1,000	6,800	1,000[b](B)	N
	Xylenes, total	10,000	--	10,000[b](B)	N
	Naphthalene (TAqH)	--	--	**700[b] (B)**	N[1]
	Trichloroethene (TCE)	5	**810**	5 (B)	N
	trans-1,2-Dichloroethene	100	--	100 (B)	N
	Sheen	No Sheen	--	No Sheen (B)	N
	TFH-Gas (TAH/TAqH)[c]	10	--	10/15[b] (B)	N[c]
	JP-4 (TAH)	10	--	**10[b] (B)**	N
OU5 (Soil) mg/kg	JP-4 (RRO)	--	--	**2,000[g]**	**Y**
	TFH-Gas (GRO)	--	--	**500[g]**	**Y**
	TFH-Diesel (DRO)	1,000	--	**1,000[g]**	N
	Benzene	--	--	**0.02**	**Y**
	Ethylbenzene	--	--	**5.5**	**Y**
	Toluene	--	--	**5.4**	**Y**
	Xylenes, total	--	--	**78**	**Y**
	Anthracene	--	--	**4,300**	**Y**
	Arsenic	--	--	**2**	**Y**
	Barium	--	--	**1,100**	**Y**
	Benzo(a)anthracene	--	--	**6**	**Y**
	Benzo(a)pyrene	--	--	**1**	**Y**
	Benzo(b) fluoranthene	--	--	**11**	**Y**
	Benzo(k)fluoranthene	--	--	**110**	**Y**
	Beryllium	--	--	**42**	**Y**
	bis(2-ethylhexyl)phthalate	--	--	**590**	**Y**
	Cadmium	--	--	**5**	**Y**
	Chromium	--	--	**26**	**Y**
	Chrysene	--	--	**620**	**Y**
	Diethyl phthalate	--	--	**190**	**Y**
	Di-n-butyl phthalate	--	--	**1,700**	**Y**
	Fluoranthene	--	--	**2,100**	**Y**
	Indeno(1,2,3,-cd)pyrene	--	--	**11**	**Y**
	Lead	--	--	**400**	**Y**
	Mercury	--	--	**1.4**	**Y**
	Naphthalene	--	--	**21**	**Y**

Table B-1 (Continued)
Evaluation of Changes in Chemical-Specific Standards

Operable Unit (matrix and units)	COPCs* (Final ROD COCs in bold)	Former Standard/ Cleanup Level (in ROD)	Current Federal Cleanup Level†	Current Alaska Cleanup Level†	Is there a newly promulgated cleanup level or, is the new level more stringent? (Y/N)‡
OU5 (Soil) mg/kg (Cont)	Pyrene	--	--	**1,500**	**Y**
	Selenium	--	--	**3.5**	**Y**
	Silver	--	--	**21**	**Y**
	Zinc	--	--	**9,100**	**Y**
OU6 (Ground water) μg/L	Jet fuel (JP-4; RRO)	--	--	**1,100 (A)**	**Y**
	Gasoline (GRO)	--	--	**1,300 (A)**	**Y**
	Benzene	5	5	5 (A)	N
	Ethylbenzene	700	700	700(A)	N
	Toluene	1,000	1,000	1,000 (A)	N
	Xylenes, total	10,000	10,000	10,000(A)	N
	1,1,1-Trichloroethane	200	200	200 (A)	N
	1,1,2,2-Tetrachloroethane	4[h]	--	4 (A)	N[1]
	1,1,2-Trichloroethane	5	5	5 (A)	N
	1,1-Dichloroethane	--	--	**3,650 (A)**	**Y**
	1,1-Dichloroethene	7	7	7 (A)	N
	1,2-Dichlorobenzene	600	600	600 (A)	N
	1,2-Dichloroethane	5	5	5 (A)	N
	1,2-Dichloropropane	5	5	5 (A)	N
	2,4-Dimethylphenol	--	--	**700 (A)**	**Y**
	2-Methylphenol (o-cresol)	--	--	**1,800 (A)**	**Y**
	4,4-DDD	--	**--**	**3.6 (A)**	**Y**
	4,4-DDE	--	**--**	**2.5 (A)**	**Y**
	4,4-DDT	--	**--**	**2.5 (A)**	**Y**
	Acenaphthene	--	--	**2,200 (A)**	**Y**
	Acetone	--	--	**3,650 (A)**	**Y**
	Aldrin	--	--	**0.05 (A)**	**Y**
	alpha-BHC	--	--	**0.1 (A)**	**Y**
	Anthracene	--	--	**11,000(A)**	**Y**
	Antimony	6	6	6 (A)	N
	Arsenic	50	10	50 (A)	N
	Barium	2,000	2,000	2,000 (A)	N
	Benzo(b)fluoranthene	0.2	--	**1 (A)**	N
	Benzoic acid	--	--	**146,000(A)**	**Y**
	Beryllium	4	4	4 (A)	N
	beta-BHC	--	--	**0.47 (A)**	**Y**
	bis(2-ethylhexyl)phthalate	6	6	6 (A)	N
	Cadmium	5	5	5 (A)	N
	Carbon disulfide	--	--	**3,650 (A)**	**Y**
	Carbon tetrachloride	5	5	5 (A)	N
	Chlorobenzene	--	--	**100 (A)**	**Y**

Table B-1 (Continued)
Evaluation of Changes in Chemical-Specific Standards

Operable Unit (matrix and units)	COPCs* (Final ROD COCs in bold)	Former Standard/ Cleanup Level (in ROD)	Current Federal Cleanup Level†	Current Alaska Cleanup Level†	Is there a newly promulgated cleanup level or, is the new level more stringent? (Y/N)‡
OU6 (Ground water) µg/L (Cont)	Chloroform (THM)	100	**80[i]**	100 (A)	**Y**
	Chromium	100	100	100 (A)	N
	Chrysene	0.2	**--**	**100 (A)**	N
	cis-1,2-Dichloroethene	70	70	70 (A)	N
	Copper	1,300	1,300	1,300 (A)	N
	Dieldrin	--	--	**0.05 (A)**	**Y**
	Diethylphthalate	6	--	**29,000(A)**	N
	Di-n-octylphthalate	--	--	**700 (A)**	**Y**
	Endrin	--	**2**	**2 (A)**	**Y**
	Fluoranthene	--	--	**1,460 (A)**	**Y**
	Fluorene	--	--	**1,460 (A)**	**Y**
	gamma-BHC (Lindane)	0.2	0.2	0.2 (A)	N
	Heptachlor	--	**0.4**	**0.4 (A)**	**Y**
	Heptachlor epoxide	--	**0.2**	**0.2 (A)**	**Y**
	Lead	15	15	15 (A)	N
	Methylene chloride	5	5	5(A)	N
	Naphthalene	--	--	**700 (A)**	**Y**
	Nickel	100	--	100 (A)	N
	Phenol	--	--	**22,000(A)**	**Y**
	Pyrene	--	--	**1,100 (A)**	**Y**
	Selenium	50	50	50 (A)	N
	Tetrachloroethene	5	5	5 (A)	N
	trans-1,2-Dichloroethene	100	100	100 (A)	N
	Trichloroethene (TCE)	5	5	5(A)	N
	Vanadium	--	--	**260 (A)**	**Y**
	Vinyl chloride	2	2	2 (A)	N
	Zinc	--	--	**11,000(A)**	**Y**
OU6 (Surface Water) µg/L	TAqH	--	--	**15[b] (B)**	**Y**
	TAH	--	--	**10[b] (B)**	**Y**
	Benzene	5	710	5[b] (B)	N
	Ethylbenzene	700	3,100	700[b] (B)	N
	Toluene	1,000	6,800	1,000[b](B)	N
	Xylenes, total	10,000	--	10,000[b](B)	N
	1,2-Dichloroethane	5	990	5 (B)	N[1]
	Arsenic	50	--	50 (B)	N
	Barium	2,000	--	2,000 (B)	N
	Benzo(b)fluoranthene	0.2	**0.31**	--	N
	Benzo(k)fluoranthene	0.2	**0.31**	--	N
	Beryllium	4	**--**	4 (B)	N
	Chromium	5	**--**	**100 (B)**	N

Table B-1 (Continued)
Evaluation of Changes in Chemical-Specific Standards

Operable Unit (matrix and units)	COPCs* (Final ROD COCs in bold)	Former Standard/ Cleanup Level (in ROD)	Current Federal Cleanup Level[†]	Current Alaska Cleanup Level[†]	Is there a newly promulgated cleanup level or, is the new level more stringent? (Y/N)[‡]
OU6 (Surface Water) µg/L (Cont)	Chrysene	0.2	**0.31**	--	N
	Nickel	100	--	100 (B)	N
	Phenol	--	**4,600,000**	--	**Y**
	Selenium	--	--	**50 (B)**	**Y**
	Styrene	100	--	100 (B)	N
OU6 (Soil[3]) mg/kg	**Diesel (DRO; Site SD15)**	2,000	--	2,000[g]	N
	Gasoline (GRO; Site SD15)	1,000	--	1,000[g]	N
	Diesel (DRO; Other Sites)	1,000	--	1,000[g]	N
	Gasoline(GRO;Other Sites)	500	--	500[g]	N
	Jet fuel (RRO)	--	--	**2,000[g]**	**Y**
	Kerosene (RRO)	2,000	--	2,000[g]	N
	BTEX	100	--	See	N
	Benzene	0.5	--	0.02	N[1]
	Ethylbenzene	--	--	5.5	N[1]
	Toluene	--	--	5.4	N[1]
	Xylenes, total	10	--	78	N
	1,1,1-Trichloroethane	--	--	1.0	N[1]
	1,1,2,2-Tetrachloroethane	--	--	0.017	N[1]
	1,1-Dichloroethane	--	--	12	N[1]
	1,2,4-Trichlorobenzene	--	--	**2**	**Y**
	1,2-Dichlorobenzene	--	--	**7**	**Y**
	1,4-Dichlorobenzene	--	--	**0.8**	**Y**
	2-Methylphenol (o-cresol)	--	--	7	N[1]
	4,4-DDD	--	--	**35**	**Y**
	4,4-DDE	--	--	**24**	**Y**
	4,4-DDT	--	--	**24**	**Y**
	Acenaphthalene	--	--	**210**	**Y**
	Acetone	--	--	10	N[1]
	Aldrin	--	--	**0.5**	**Y**
	alpha-BHC	--	--	**0.0026**	**Y**
	Anthracene	--	--	**4,300**	**Y**
	Antimony	--	--	**3.6**	**Y**
	Arsenic	9.31[e]	--	2	N[1e]
	Barium	196.45[e]	--	1,100	N
	Benzo(a)anthracene	--	--	6	N[1]
	Benzo(a)pyrene	--	--	1	N[1]
	Benzo(b)fluoranthene	--	--	**11**	**Y**
	Benzo(k)fluoranthene	--	--	**110**	**Y**
	Benzoic acid	--	--	**390**	**Y**
	Beryllium	0.76[e]	--	42	N

Table B-1 (Continued)
Evaluation of Changes in Chemical-Specific Standards

Operable Unit (matrix and units)	COPCs* (Final ROD COCs in bold)	Former Standard/ Cleanup Level (in ROD)	Current Federal Cleanup Level†	Current Alaska Cleanup Level†	Is there a newly promulgated cleanup level or, is the new level more stringent? (Y/N)‡
OU6 (Soil[3]) mg/kg (Cont)	beta-BHC	--	--	**0.009**	**Y**
	bis(2-ethylhexyl)phthalate	--	--	590	N[1]
	Butylbenzylphthalate	--	--	**5,600**	**Y**
	Cadmium	--	--	**5**	**Y**
	Chlorobenzene	--	--	**0.6**	**Y**
	Chloroform	--	--	0.34	N[1]
	Chromium	48.44[e]	--	26	N[1e]
	Chrysene	--	--	**620**	**Y**
	cis-1,2-Dichloroethene	--	--	**0.2**	**Y**
	Dibenz(a,h)anthracene	--	--	**1**	**Y**
	Dieldrin	--	--	**0.015**	**Y**
	Diethylphthalate	--	--	**190**	**Y**
	Dimethylphthalate	--	--	**1,400**	**Y**
	Di-n-octylphthalate	--	--	**2,000**	**Y**
	Endrin	--	--	**0.3**	**Y**
	Fluoranthene	--	--	2,100	N[1]
	Fluorene	--	--	270	N[1]
	gamma-BHC (Lindane)	--	--	**0.003**	**Y**
	Heptachlor	--	--	**0.8**	**Y**
	Heptachlor epoxide	--	--	**0.2**	**Y**
	Indeno(1,2,3,-cd)pyrene	--	--	11	N[1]
	l,1-Dichloroethene	--	--	0.03	N[1]
	Lead	10.13[e]	--	400	N
	Methoxychlor	--	--	**52**	**Y**
	Methylene chloride	--	--	0.015	N[1]
	Naphthalene	--	--	21	N[1]
	Nickel	71.79[e]	--	87	N
	Phenol	--	--	**67**	**Y**
	Pyrene	--	--	1,500	N[1]
	Selenium	0.54[e]	--	3.5	N
	Silver	1.68[e]	--	21	N
	Styrene	--	--	**1.3**	**Y**
	Tetrachloroethene (PCE)	--	--	**0.03**	**Y**
	Trichloroethene (TCE)	--	--	**0.020**	**Y**
	Vanadium	101.64[e]	--	710	N
	Zinc	90.01[e]	--	9,100	N

Table B-1 (Continued)
Evaluation of Changes in Chemical-Specific Standards

Operable Unit (matrix and units)	COPCs* (Final ROD COCs in bold)	Former Standard/ Cleanup Level (in ROD)	Current Federal Cleanup Level†	Current Alaska Cleanup Level†	Is there a newly promulgated cleanup level or, is the new level more stringent? (Y/N)‡
DP98 (Ground water) µg/L	DRO	1,500	--	1,500 (A)	N
	GRO	1,300	--	1,300 (A)	N
	RRO	1,100	--	1,100 (A)	N
	1,1-Dichloroethene	7	7	7 (A)	N
	Benzene	5	5	5 (A)	N
	Chloroform (THM)	80	80[i]	100 (A)	N
	cis-1,2-Dichloroethene	70	70	70 (A)	N
	gamma-BHC (Lindane)	0.2	0.2	0.2 (A)	N
	Methylene chloride	5	--	5 (A)	N
	Tetrachloroethene (PCE)	5	5	5 (A)	N
	trans-1,2-Dichloroethene	100	100	100 (A)	N
	Trichloroethene (TCE)	5	5	5 (A)	N
	Vinyl Chloride	2	2	2 (A)	N
	Xylenes, total	10,000	10,000	10,000(A)	N
DP98 (Surface water) µg/L	Benzo(a)pyrene	0.2	0.31	0.2 (A)	N
	cis-1,2-Dichloroethene	5	--	70 (A)	N
	Dibenz(a,h)anthracene	0.1	**0.31**	--	N
	Indeno(1,2,3-cd)pyrene	1	**0.31**	--	**Y**
	TAH	10	--	10 (B)	N
	TAqH	15	--	15 (B)	N
	Trichloroethene (TCE)	5	810	5 (A)	N
DP98 (Soil) mg/kg	DRO	250	--	250	N
	GRO	300	--	300	N
	RRO	10,000	--	10,000	N
	1,1-Dichloroethene	0.03	--	0.03	N
	Benzene	0.02	--	0.02	N
	cis-1,2-Dichloroethene	0.2	--	0.2	N
	Tetrachloroethene (PCE)	0.03	--	0.03	N
	Trichloroethene (TCE)	0.027	--	**0.020**	**Y**

* All contaminants that currently have a cleanup standard and are listed as detected in the OU6 ROD are included in this table, since there are no COPCs listed in the OU6 ROD. COPCs listed in the OU2 and OU6 RI/FS reports are also included.

† For water, the strictest of 18 AAC 70 and 18 AAC 75 used for State cleanup levels (origin of State criteria clarified by alpha notation following the criteria, as indicated below) and Federal cleanup levels are from 40 CFR 141 for groundwater and 40 CFR 131 for surface water. For soils, 18 AAC 75, Table B1 Method 2, under-40-inch zone applies for all compounds except DRO, GRO, and RRO (see note g). Changes to cleanup levels since previous 5-year Review shown in bold.

(A) 18 AAC 75, Table C, Alaska Oil and Hazardous Substances Pollution Control Cleanup Regulations

(B) 18 AAC 70, Alaska Water Quality Standards

Table B-1 (Continued)
Evaluation of Changes in Chemical-Specific Standards

Operable Unit (matrix and units)	COPCs* (Final ROD COCs in bold)	Former Standard/ Cleanup Level (in ROD)	Current Federal Cleanup Level†	Current Alaska Cleanup Level†	Is there a newly promulgated cleanup level or, is the new level more stringent? (Y/N)‡

‡ If the current MCL or criterion is new (i.e. there was no standard at the time of the ROD), or if the current MCL or criterion is more stringent than the standard at the time of the ROD, then go to Table B-2 to determine whether a risk evaluation is required. However, if the new or more stringent cleanup level has already been addressed in a previous five-year review, it was not reassessed in this five-year review.

[1]The new or more stringent cleanup level was already assessed in a previous five-year review.

[2]Identified in ROD as a final COC, but no cleanup level was assigned to this chemical.

[3]Updated soil cleanup levels have been evaluated for all soil contaminant detections for all OU6 sites. However, soil COC cleanup levels in the ROD are applicable to SD15 only, except for lead at LF02. The ROD did not specify soil COCs for the other OU6 sites.

[a] Surface water criteria established under 18 AAC 70, based on Total Aromatic Hydrocarbons.

[b] Total Aromatic Hydrocarbons (TAH) in surface water may not exceed 10 µg/L. TAH consists of benzene, toluene, ethylbenzene, and xylenes. Total Aqueous Hydrocarbons (TAqH) in surface water may not exceed 15 µg/L. TAqH consists of TAH and polyaromatic hydrocarbons, including Naphthalene (700 µg/L is a groundwater standard).

[c] The ROD identified TFH-gas and/or TFH-diesel from 18 AAC 70, which have since become outdated. In 1998, an agreement with ADEC and USEPA was made to replace the outdated TFH analyses with TAH and TAqH. Because TFH is no longer used, the current criteria shown are for TAH and TAqH and are consistent with current RAOs for OU5.

[d] Secondary Drinking Water MCL, (18 AAC 80). Secondary criteria mainly affect the aesthetic quality of drinking water.

[e] ROD-specified limit based on elevated background levels; therefore, cleanup level is still protective and no further evaluation is needed.

[f] ROD cleanup levels are based on total hydrocarbons.

[g] This Criteria is from 18 AAC 75, Table C for groundwater and Table A1-Method 1 for soils (See agreements in the ROD to use Category D for OU4 sites and OU6 site SD15, and Category C for the other OU6 sites and OU5). Kerosene and jet fuel (including JP-4) are compared to RRO in current State criteria.

[h] The cleanup level for 1,1,2,2-tetrachloroethane was changed in the January 2007 ESD for OU6. The cleanup level is now 4 µg/L.

[i] The total for trihalomethanes (THM) is 80 ug/L.

[j] The cleanup levels for 1,3-Dichlorobenzene (m-) are based on the cleanup levels for 1,2-Dichlorobenzene (o-) as per the Federal 2006 Drinking Water Standards.

[k] Cleanup standards for BTEX no longer apply, instead cleanup standards are listed for the individual contaminants.

"--" Indicates no criterion/MCL or not applicable
µg/L — micrograms per liter
mg/kg — milligrams per kilogram
BHC — Hexachlorocyclohexane
CFR — Code of Federal Regulations
COC — Contaminant of Concern
COPC — Contaminant of Potential Concern
DDT — dichloro-diphenyl-trichloroethane
MCL — Maximum Contaminant Level
OU — Operable Unit
PCB — polychlorinated biphenyl
ROD — Record of Decision
RRO — Residual Range Organics
TFH — Total Fuel Hydrocarbons
TAH — Total Aromatic Hydrocarbons
TAqH — Total Aqueous Hydrocarbons

Table B-2
Evaluation of Changes for New, More Stringent, Standards

Operable Unit (matrix and units)	COPCs[1] (Final ROD COCs in bold)	Former Standard/ Cleanup Level (in ROD)	Current Applicable Standard	Max. Detected Level at ROD[2]	2007 Max. Detected Level[3]	New Risk Evaluation Needed?[4] (Y/N)
OU1 (Groundwater) µg/L	Lead[6]	--	15	130	1.19	N
OU1 (Surface water) µg/L	TPH (TAH)	--	10[b]	1600	--	**Y**
OU1 (Soil) mg/kg	Benzo(a) anthracene	--	6	0.58	--	N
	Benzo(k) fluoranthene	--	110	0.43	--	N
	bis(2-ethylhexyl)phthalate	--	590	13	--	N
	Lead	--	400	21.7	--	N
OU2 (Groundwater) µg/L	Antimony	--	6	20	0.67	N
	Arsenic[6]	--	10	76	72.2	**Y**
	Barium	--	2,000	1,900	118	N
	Beryllium[6]	--	4	4.0	1.5	N
	Cadmium	--	5	9.0	3	N
	Chloroform (THM)	100	80[d]	3.0	ND	N
	Chromium	--	100	350	226	**Y**
	Ethylene dibromide (1,2-Dibromoethane)	--	0.05	180	ND	N
	Lead	--	15	65	97.3	**Y**
	Methylene chloride	--	5	3800	ND	N
	Naphthalene	--	700	23	26	N
	Nickel	--	100	440	318	**Y**
	Nitrate (as N)	--	10,000	90,400	ND (31)	N
	Thallium[6]	--	2	180	0.356	N
	Vanadium	--	260	660	370	**Y**
OU2 (Surface Water) µg/L	**Benzene**	10[a]	5[b]	1,500	100	**Y**
	1,1,2,2-Tetrachloroethane	--	110	--	ND (0.15)	N
	Arsenic[6]	--	50	63	--	**Y**
	Thallium[6]	--	2	440	--	**Y**
OU4 (Groundwater) µg/L	Diesel (DRO)	--	1,500	330	--	N
	2-Methylphenol (o-cresol)	--	1,800	5.13	--	N
	Acenaphthene	--	2,200	0.362	--	N
	Acetone	--	3,650	112	ND (0.75)	N
	Benzoic acid	--	146,000	7.98	--	N
	Chloroform (THM)	100	80[d]	2.72	ND (0.15)	N
	Fluorene	--	1,460	0.386	--	N
	Naphthalene	--	700	72.6	130	N
	Phenol	--	22,000	5.12	--	N
OU4 (Soil) mg/kg	4,4-DDE	--	24	0.00292	--	N
	alpha-BHC	--	0.0026	0.000836	--	N
	beta-BHC	--	0.009	0.00702	--	N
	bis(2-ethylhexyl)phthalate	--	590	0.00117	--	N
	Butylbenzylphthalate	--	5,600	0.0425	--	N
	Dibutylphthalate	--	1,700	0.0327	--	N
	gamma-BHC (Lindane)	--	0.003	0.000724	--	N
	Heptachlor	--	0.8	0.00284	--	N
	Isophorone	--	3	0.0274	--	N
	Trichloroethene (TCE)	--	0.020	0.0364	--	**Y**
	Vanadium	--	710	67.8	--	N

Table B-2 (Continued)
Evaluation of Changes for New, More Stringent, Standards

Operable Unit (matrix and units)	COPCs[1] (Final ROD COCs in bold)	Former Standard/ Cleanup Level (in ROD)	Current Applicable Standard	Max. Detected Level at ROD[2]	2007 Max. Detected Level[3]	New Risk Evaluation Needed?[4] (Y/N)
OU5 (Groundwater) µg/L	JP-4 (RRO)	--	1,100	760	--	N
	Naphthalene	--	700	13	3.5	N
	N-nitrosodiphenylamine	--	170	5	--	N
	Vanadium	--	260	5	--	N
OU5 (Surface Water) µg/L	1,1,2,2-Tetrachloroethane	--	110	4.3	ND (0.22)	N
OU5 (Soil) mg/kg	JP-4 (RRO)	--	2,000[c]	100	--	N
	TFH-Gas (GRO)	--	500[c]	310	--	N
	Benzene	--	0.02	0.0149	ND(0.0006)	N
	Ethylbenzene	--	5.5	0.93	ND(0.0005)	N
	Toluene	--	5.4	0.064	ND(0.0004)	N
	Xylenes, total	--	78	6.2	ND	N
	Anthracene	--	4,300	0.23	--	N
	Arsenic	--	2	28.2	--	**Y**
	Barium	--	1,100	3,650	--	**Y**
	Benzo(a)anthracene	--	6	0.2	--	N
	Benzo(a)pyrene	--	1	0.33	--	N
	Benzo(b)fluoranthene	--	11	0.16	--	N
	Benzo(k)fluoranthene	--	110	0.18	--	N
	Beryllium	--	42	1.3	--	N
	bis(2-ethylhexyl)phthalate	--	590	0.24	--	N
	Cadmium	--	5	3.1	--	N
	Chromium	--	26	64	--	**Y**
	Chrysene	--	620	0.24	--	N
	Diethyl phthalate	--	190	0.049	--	N
	Di-n-butyl phthalate	--	1,700	0.039	--	N
	Fluoranthene	--	2,100	0.3	--	N
	Indeno(1,2,3,-cd)pyrene	--	11	0.098	--	N
	Lead	--	400	206	--	N
	Mercury	--	1.4	0.31	--	N
	Naphthalene	--	21	0.069	ND(0.0017)	N
	Pyrene	--	1,500	0.28	--	N
	Selenium	--	3.5	3.1	--	N
	Silver	--	21	22	--	**Y**
	Zinc	--	9,100	159	--	N
OU6 (Groundwater) µg/L	Jet fuel (JP-4; RRO)	--	1,100	554,000	--	**Y**
	Gasoline (GRO)	--	1,300	31,700	3,810	**Y**
	1,1-Dichloroethane	--	3,650	185	20	N
	2,4-Dimethylphenol	--	700	1.89	--	N
	2-Methylphenol (o-cresol)	--	1,800	5.64	--	N
	4,4-DDD	--	3.6	0.0908	--	N
	4,4-DDE	--	2.5	0.0875	--	N
	4,4-DDT	--	2.5	0.0382	--	N
	Acenaphthene	--	2,200	20.3	--	N
	Acetone	--	3,650	129	1.1	N
	Aldrin	--	0.05	0.0243	--	N
	alpha-BHC	--	0.1	0.0197	--	N
	Anthracene	--	11,000	0.34	--	N

Table B-2 (Continued)
Evaluation of Changes for New, More Stringent, Standards

Operable Unit (matrix and units)	COPCs[1] (Final ROD COCs in bold)	Former Standard/ Cleanup Level (in ROD)	Current Applicable Standard	Max. Detected Level at ROD[2]	2007 Max. Detected Level[3]	New Risk Evaluation Needed?[4] (Y/N)
OU6 (Groundwater) µg/L (Cont)	Benzoic acid	--	146,000	37.2	--	N
	beta-BHC	--	0.47	0.068	--	N
	Carbon disulfide	--	3,650	0.58	--	N
	Chlorobenzene	--	100	0.16	ND (0.12)	N
	Chloroform (THM)	100	80[d]	6.28	2.6	N
	Dieldrin	--	0.05	0.0324	--	N
	Di-n-octylphthalate	--	700	49.6	--	N
	Endrin	--	2	0.008	--	N
	Fluoranthene	--	1,460	0.241	--	N
	Fluorene	--	1,460	1.49	--	N
	Heptachlor	--	0.4	0.0177	--	N
	Heptachlor epoxide	--	0.2	0.0603	--	N
	Naphthalene	--	700	384	ND (0.1)	N
	Phenol	--	22,000	88.3	--	N
	Pyrene	--	1,100	0.162	--	N
	Vanadium	--	260	287	--	**Y**
	Zinc	--	11,000	5,270	--	N
OU6 (Surface Water) µg/L	TAqH	--	15[a]	2,762	79.6	**Y**
	TAH	--	10[a]	2,734	125.4	**Y**
	Phenol	--	4,600,000	4.36	ND (11)	N
	Selenium	--	50	59.2	3.36	N
OU6 (Soil[5]) mg/kg	Jet fuel (RRO)	--	2,000[c]	2,050	--	**Y**
	1,2,4-Trichlorobenzene	--	2	0.108	--	N
	1,2-Dichlorobenzene	--	7	307	--	**Y**
	1,4-Dichlorobenzene	--	0.8	147	--	**Y**
	4,4-DDD	--	35	8.41	0.207	N
	4,4-DDE	--	24	1.69	0.361	N
	4,4-DDT	--	24	47.3	0.331	N
	Acenaphthalene	--	210	0.0249	--	N
	Aldrin	--	0.5	0.0222	ND (0.00909)	N
	alpha-BHC	--	0.0026	0.00122	ND (0.00909)	N
	Anthracene	--	4,300	0.012	--	N
	Antimony	--	3.6	184	--	**Y**
	Benzo(b)fluoranthene	--	11	0.466	0.0152	N
	Benzo(k)fluoranthene	--	110	0.466	0.0236	N
	Benzoic acid	--	390	2.14	--	N
	beta-BHC	--	0.009	0.00944	ND (0.00166)	N
	Butylbenzylphthalate	--	5,600	0.403	--	N
	Cadmium	--	5	20.4	--	**Y**
	Chlorobenzene	--	0.6	22.0	--	**Y**
	Chrysene	--	620	0.391	0.0207	N
	cis 1,2-Dichloroethene	--	0.2	0.105	--	N
	Dibenz(a,h)anthracene	--	1	0.0105	--	N
	Dieldrin	--	0.015	0.143	ND (0.0121)	N
	Diethylphthalate	--	190	0.183	--	N
	Dimethylphthalate	--	1,400	0.0655	--	N
	Di-n-octylphthalate	--	2,000	0.285	--	N
	Endrin	--	0.3	0.0226	ND (0.0121)	N

Table B-2 (Continued)
Evaluation of Changes for New, More Stringent, Standards

Operable Unit (matrix and units)	COPCs[1] (Final ROD COCs in bold)	Former Standard/ Cleanup Level (in ROD)	Current Applicable Standard	Max. Detected Level at ROD[2]	2007 Max. Detected Level[3]	New Risk Evaluation Needed?[4] (Y/N)
OU6 (Soil5) mg/kg (Cont)	gamma-BHC (Lindane)	--	0.003	0.0313	ND (0.00166)	N
	Heptachlor	--	0.8	0.00844	ND (0.0121)	N
	Heptachlor epoxide	--	0.2	0.023	ND (0.0121)	N
	Methoxychlor	--	52	0.007	--	N
	Phenol	--	67	0.0448	--	N
	Styrene	--	1.3	0.0146	--	N
	Tetrachloroethene (PCE)	--	0.03	0.0666	--	**Y**
	Trichloroethene (TCE)	--	0.020	1.74	--	**Y**
DP98 (Surface water) µg/L	Indeno(1,2,3-cd)pyrene	1	0.31	0.118	--	N
DP98 (Soil) mg/kg	**Trichloroethene (TCE)**	0.027	0.020	59.63	3.1	**Y**

[1]All contaminants that currently have a cleanup standard and are listed as detected in the OU6 ROD are included in this table, since there are no COPCs listed in the OU6 ROD. COPCs listed in the OU2 and OU6 RI/FS reports are also included.

[2]Maximum detected levels are from the original risk assessment performed in conjunction with the ROD for each OU.

[3]2007 Analytical data were reviewed for current maximum detected levels (2006 data was used in the absence of 2007 data). Soils data were evaluated from the time of the RODs through 2007 due to the limited soil sample data available. Data are not available for all of the COPCs.

[4]A new risk evaluation/calculation is considered necessary if the most recent recorded levels exceed the new/ changed current standards, unless otherwise stated.

[5]Updated soil cleanup levels have been evaluated for all soil contaminant detections for all OU6 sites. However, soil COC cleanup levels in the ROD are applicable to SD15 only, except for lead at LF02. The ROD did not specify soil COCs for the other OU6 sites.

[6]Identified in ROD as a final COC, but no cleanup level was assigned to this chemical.

[a] Surface water criteria established under 18 AAC 70, based on Total Aromatic Hydrocarbons.

[b] Total Aromatic Hydrocarbons (TAH) in surface water may not exceed 10 µg/L. TAH consists of benzene, toluene, ethylbenzene, and xylenes. Total Aqueous Hydrocarbons (TAqH) in surface water may not exceed 15 µg/L. TAqH consists of TAH and polyaromatic hydrocarbons.

[c] Criteria are from 18 AAC 75, Table C for groundwater and Table A1-Method 1 for soils (See agreements in the ROD to use Category D for OU4 sites and OU6 site SD15, and Category C for the other OU6 sites and OU5). Kerosene and jet fuel (including JP-4) are compared to RRO in current State criteria.

[d] The total for trihalomethanes (THM) is 80 ug/L.

"--" Indicates no criterion/MCL or not applicable
µg/L — micrograms per liter
mg/kg — milligrams per kilogram
BHC — Hexachlorocyclohexane
COC — Contaminant of Concern
COPC — Contaminant of Potential Concern
DDD — dichlorodiphenyldichloroethane
DDE — dichlorodiphenyldichloroethene
DDT — dichlorodiphenyltrichloroethane
DRO — Diesel Range Organics
GRO — Gasoline Range Organics
MCL — Maximum Contaminant Level
ND — non-detect
OU — Operable Unit
ROD — Record of Decision
RRO — Residual Range Organics
TAH — Total Aromatic Hydrocarbons
TAqH — Total Aqueous Hydrocarbons
THM — trihalomethane
TPH — Total Petroleum Hydrocarbons

Table B-3
Risk/Hazard Estimates for Chemicals above New Standards

Operable Unit	**COPCs**[†] **(Final ROD COCs in bold)**	**Site Concentration**	**Current Standard**	**Hazard**[1]	**Risk**[2]
Groundwater (µg/L)[3]					
OU2	**Arsenic**[6]	72.2	10	**6.59**	1E-03
	Chromium	226	100	--	2E-05
	Lead	97.3	15	**6.49**	--
	Nickel	318	100	**3.18**	--
	Vanadium	370	260	1.42	--
OU6	Jet fuel (JP-4; RRO)[9]	554,000	1,100	--	--
	Gasoline (GRO)[9]	3,810	1,300	--	--
	Vanadium	287	260	1.10	--
Surface Water (µg/L)[4]					
OU1	TPH (TAH)[8]	1600	10	--	--
OU2	**Benzene**[8]	100	5	--	**2E-04**
	Arsenic[6]	63	50	1.26	--
	Thallium[6]	440	2	**220**	--
Soils (mg/kg)[5]					
OU4	Trichloroethene (TCE)**	0.0364	0.57	--	6E-07
OU5	Arsenic*	28.2	5.5	--	5E-05
	Barium*	3,650	7,100	0.51	--
	Chromium*	64	300	0.21	--
	Silver*	22	510	0.04	--
OU6 [7]	Jet fuel (RRO)[9]	2,050	2,000	--	--
	1,2-Dichlorobenzene*	307	110	**2.79**	--
	1,4-Dichlorobenzene*	147	350	--	4E-06
	Antimony*	184	41	**4.49**	--
	Cadmium*	20.4	100	0.20	--
	Chlorobenzene*	22.0	110	0.20	--
	Tetrachloroethene (PCE)*	0.0666	80	--	8E-09
	Trichloroethene (TCE)**	1.74	0.57	--	3E-05
DP98	**Trichloroethene (TCE)****	3.1	0.57	--	5E-05

NOTES:

Calculations were performed based on equations from ADEC Cleanup Levels Guidance (January 2004). Groundwater calculations are based on Equations 1 and 2 for non-carcinogens and carcinogens, respectively. Soil calculations are based on Equations 6 and 7 for carcinogenic and non-carcinogenic volatile contaminants, respectively.

* Chemical does not exceed groundwater cleanup level at the site, therefore the migration to groundwater cleanup level was not used to determine the risk/hazard. See note 5.

** TCE groundwater risk is estimated from groundwater concentrations. Therefore soil cleanup level for inhalation was used to determine the risk/hazard. See note 5.

[†]All contaminants that currently have a cleanup standard and are listed as detected in the OU6 ROD are included in this table, since there are no COPCs listed in the OU6 ROD. COPCs listed in the OU2 and OU6 RI/FS reports are also included.

[1] Chemicals with values in this column are non-carcinogens; therefore, the hazard, rather than the risk, is estimated: (site concentration/standard) x 1 = hazard. Standard is based on a hazard of 1. Hazards greater than 1 in bold.

[2]Chemicals with values in this column are carcinogens; therefore, the risk is estimated: (site concentration/standard) x $1x10^{-5}$ = risk. Standard is based on a risk of $1x10^{-5}$. Risk greater than $1x10^{-4}$ in bold.

[3] 18 AAC 75, Table C. Groundwater standard is based on drinking the water, no bathing (inhalation, dermal) risks/hazards are included. The state only considers ingestion hazards/risks when establishing their risk-based groundwater standards.

[4] ADEC Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances, Table I.

[5] 18 AAC 75, Table B1, Under 40-Inch Zone. The State of Alaska soil standards here are the lowest of ingestion, inhalation, and migration to groundwater cleanup levels.

[6] Identified in ROD as a final contaminant of concern, but no cleanup level was assigned to this chemical. The risk and hazard were calculated from the most recent slope factor and reference dose, since the arsenic standard is derived from the USEPA MCL and not from the risk-based ADEC cleanup standard (see Table B-4).

[7]Updated soil cleanup levels have been evaluated for all soil contaminant detections for all OU6 sites. However, soil COC cleanup levels in the ROD are applicable to SD15 only, except for lead at LF02. The ROD did not specify soil COCs for the other OU6 sites.

[8] Total Aromatic Hydrocarbons (TAH) in surface water may not exceed 10 µg/L. TAH consists of benzene, toluene, ethylbenzene, and xylenes. TAH cleanup levels are not directly based on Hazard Index or Cancer Risk.

[9] Criteria are from 18 AAC 75, Table C for groundwater and Table A1-Method 1 for soil (See agreements in the ROD to use Category D for OU4 sites and OU6 site SD15, and Category C for the other OU6 sites and OU5). Kerosene and jet fuel (including JP-4) are compared to RRO in current State criteria. GRO, DRO, and RRO cleanup levels are not directly based on Hazard Index or Cancer Risk.

[10] Ethylene dibromide risk values are taken from the Public Review Draft Cleanup Levels Guidance (August 2007). Ethylene dibromide is not listed in the final (January 2004) version.

"--" Indicates no criteria/MCL or not applicable

µg/L — micrograms per liter

mg/kg — milligrams per kilogram

COC — Contaminant of Concern

COPC — Contaminant of Potential Concern

DRO — Diesel Range Organics

GRO — Gasoline Range Organics

MCL — Maximum Contaminant Level

OU — Operable Unit

ROD — Record of Decision

RRO — Residual Range Organics

TAH — Total Aromatic Hydrocarbons

TAqH — Total Aqueous Hydrocarbons

TPH — Total Petroleum Hydrocarbons

Table B-4
Risks and Hazards for COPCs with Toxicity Changes

Chemical[1]	Cleanup Level (μg/L)	Intake Noncancer (mg/kg-d)	Intake Cancer (mg/kg-d)	Oral Reference Dose (RfD_o) (mg/kg-d)	Oral Slope Factor (Sf_o) $(mg/kg\text{-}d)^{-1}$	Hazard Quotient (HQ)	Cancer Risk (CR)	Is Cleanup Level Sufficiently Protective?
Organics:								
1,1-Dichloroethene	7	1.92E-04	8.22E-05	9.0E-03	6.0E-01	0.02	5E-05	Y
Endrin[1]	2	5.48E-05	2.35E-05	3.0E-04	--	0.18	--	Y
Ethylene dibromide (1,2-Dibromoethane)	0.05	1.37E-06	5.87E-07	9.0E-03	2.0E+00	0.00	1E-06	Y[2]
Naphthalene	700	1.92E-02	8.22E-03	2.0E-02	--	0.96	--	Y
Phenol	22,000	6.03E-01	2.58E-01	6.0E-01	--	1.00	--	Y
Tetrachloroethene	5	1.37E-04	5.87E-05	1.0E-02	5.2E-02	0.01	3E-06	Y
Toluene	1,000	2.74E-02	1.17E-02	2.0E-01	--	0.14	--	Y
Inorganics:								
Arsenic	10	2.74E-04	1.17E-04	3.0E-04	1.5E+00	0.91	**2E-04**	**N**
Barium	2,000	5.48E-02	2.35E-02	7.0E-02	--	0.78	--	Y
Beryllium	4	1.10E-04	4.70E-05	2.0E-03	4.3E+00	0.05	**2E-04**	**N[2]**
Chromium	100	2.74E-03	1.17E-03	3.0E-03	--	0.91	--	Y
Zinc[1]	11,000	3.01E-01	1.29E-01	3.0E-01	--	1.00	--	Y

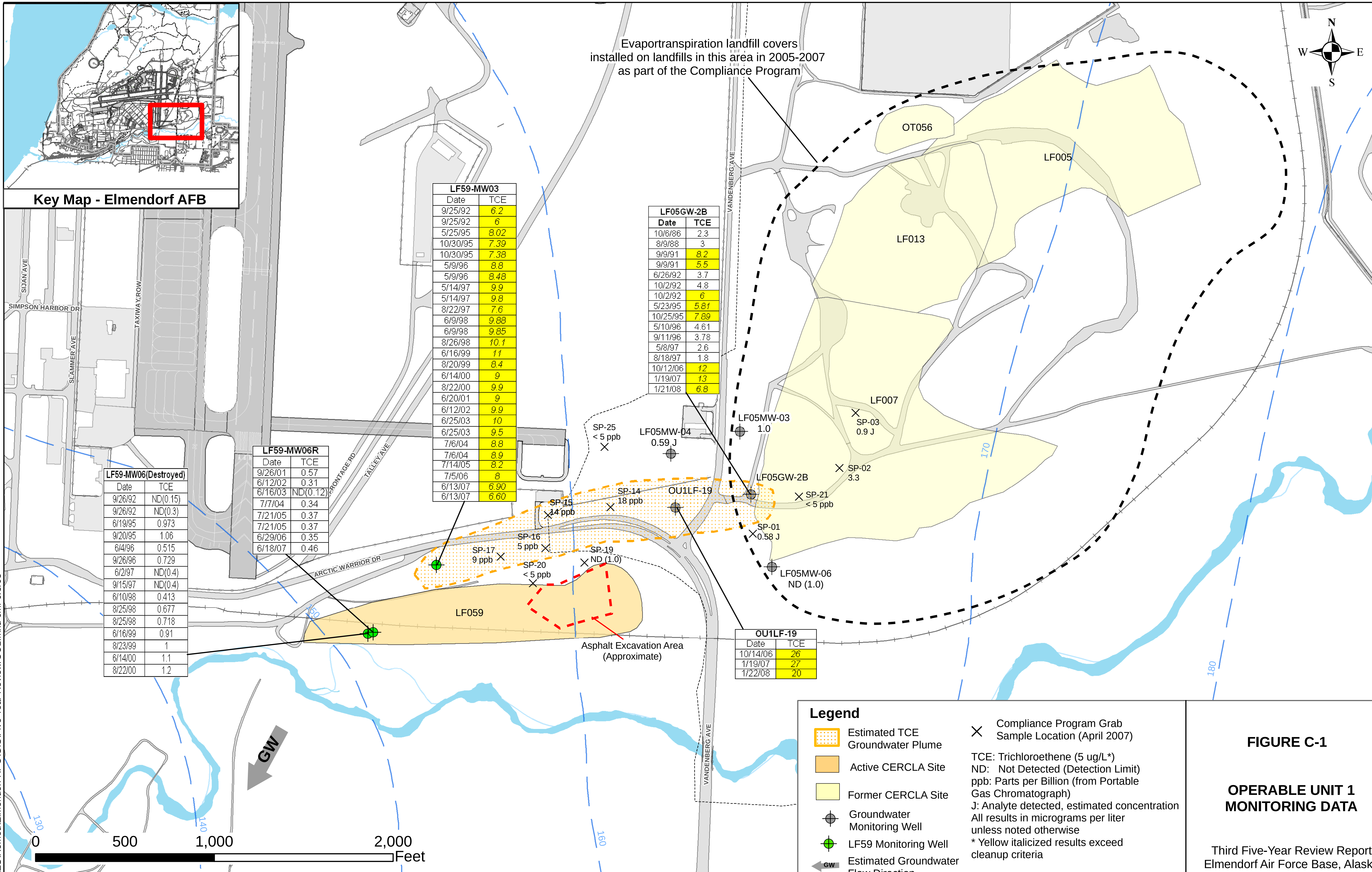
Parameter	Unit	Value
Ingestion Rate of Water (IR)	L/day	2
Exposure frequency (EF)	days/yr	350
Exposure duration (ED)	yrs	30
Absorption factor (A)	()	1
Body weight (BW)	kg	70
Conversion Factor (CF_1)	μg/mg	1000
Conversion Factor (CF_2)	days/yr	365
Averaging time (noncancer) (AT_{nc})	yrs	30
Averaging time (cancer) (AT_c)	yrs	70
$SIF_{nc} = (IR*EF*ED*A)/(BW*CF_1*CF_2*AT_{nc})$	(L*mg)/(kg*μg*d)	2.74E-05
$SIF_c = (IR*EF*ED*A)/(BW*CF_1*CF_2*AT_c)$	(L*mg)/(kg*μg*d)	1.17E-05

Notes

SIF_{nc}: Summary Intake Factor, non-cancer
SIF_c: Summary Intake Factor, cancer
Intake: Standard x SIF
Hazard Quotient = Standard x SIF_{nc} / RfD_o
Cancer Risk = Standard x SIF_c x Sf_o
[1] Contaminants listed as detected in the OU6 ROD are included, because there are no COPCs listed in the ROD.
[2] Ethylene dibromide RfD_o and Sf_o values and beryllium Sf_o values are taken from the Public Review Draft Cleanup Levels Guidance (August 2007).

ATTACHMENT C

MONITORING FIGURES



LF59-MW03

Date	TCE
9/25/92	*6.2*
9/25/92	*6*
5/25/95	*8.02*
10/30/95	*7.39*
10/30/95	*7.38*
5/9/96	*8.8*
5/9/96	*8.48*
5/14/97	*9.9*
5/14/97	*9.8*
8/22/97	*7.6*
6/9/98	*9.88*
6/9/98	*9.85*
8/26/98	*10.1*
6/16/99	*11*
8/20/99	*8.4*
6/14/00	*9*
8/22/00	*9.9*
6/20/01	*9*
6/12/02	*9.9*
6/25/03	*10*
6/25/03	*9.5*
7/6/04	*8.8*
7/6/04	*8.9*
7/14/05	*8.2*
7/5/06	*8*
6/13/07	*6.90*
6/13/07	*6.60*

LF05GW-2B

Date	TCE
10/6/86	2.3
8/9/88	3
9/9/91	*8.2*
9/9/91	*5.5*
6/26/92	3.7
10/2/92	4.8
10/2/92	*6*
5/23/95	*5.81*
10/25/95	*7.89*
5/10/96	4.61
9/11/96	3.78
5/8/97	2.6
8/18/97	1.8
10/12/06	*12*
1/19/07	*13*
1/21/08	*6.8*

LF59-MW06R

Date	TCE
9/26/01	0.57
6/12/02	0.31
6/16/03	ND(0.12)
7/7/04	0.34
7/21/05	0.37
7/21/05	0.37
6/29/06	0.35
6/18/07	0.46

LF59-MW06(Destroyed)

Date	TCE
9/26/92	ND(0.15)
9/26/92	ND(0.3)
6/19/95	0.973
9/20/95	1.06
6/4/96	0.515
9/26/96	0.729
6/2/97	ND(0.4)
9/15/97	ND(0.4)
6/10/98	0.413
8/25/98	0.677
8/25/98	0.718
6/16/99	0.91
8/23/99	1
6/14/00	1.1
8/22/00	1.2

OU1LF-19

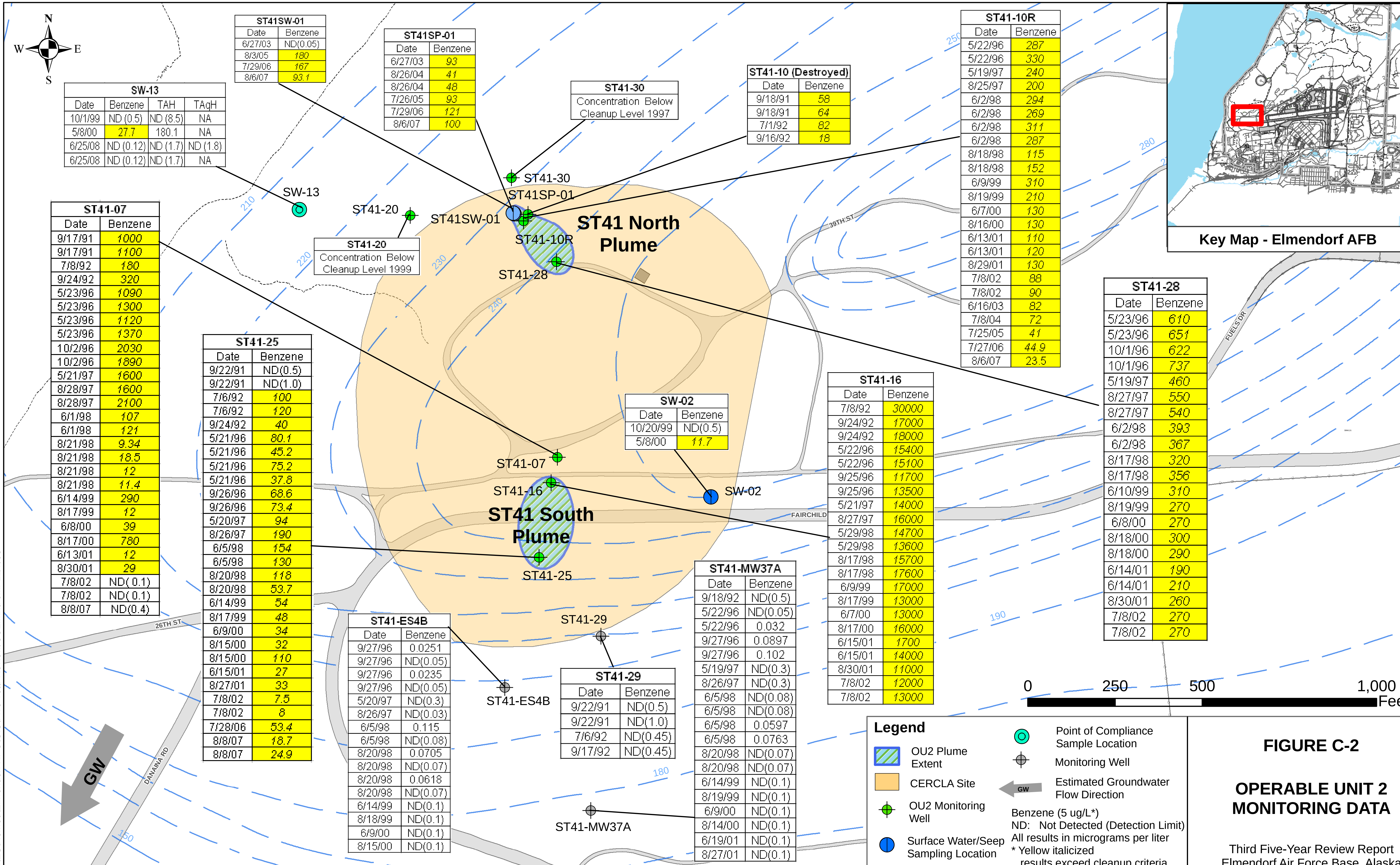
Date	TCE
10/14/06	*26*
1/19/07	*27*
1/22/08	*20*

FIGURE C-1

OPERABLE UNIT 1 MONITORING DATA

Third Five-Year Review Report
Elmendorf Air Force Base, Alaska

S:\ES\Remed\Elmendorf RPO\GIS\Five Year Review\OU1.mxd cmr 9/8/08



ST41SW-01

Date	Benzene
6/27/03	ND(0.05)
8/3/05	180
7/29/06	167
8/6/07	93.1

ST41SP-01

Date	Benzene
6/27/03	93
8/26/04	41
8/26/04	48
7/26/05	93
7/29/06	121
8/6/07	100

SW-13

Date	Benzene	TAH	TAqH
10/1/99	ND (0.5)	ND (8.5)	NA
5/8/00	27.7	180.1	NA
6/25/08	ND (0.12)	ND (1.7)	ND (1.8)
6/25/08	ND (0.12)	ND (1.7)	NA

ST41-30
Concentration Below Cleanup Level 1997

ST41-10 (Destroyed)

Date	Benzene
9/18/91	58
9/18/91	64
7/1/92	82
9/16/92	18

ST41-10R

Date	Benzene
5/22/96	287
5/22/96	330
5/19/97	240
8/25/97	200
6/2/98	294
6/2/98	269
6/2/98	311
6/2/98	287
8/18/98	115
8/18/98	152
6/9/99	310
8/19/99	210
6/7/00	130
8/16/00	130
6/13/01	110
6/13/01	120
8/29/01	130
7/8/02	88
7/8/02	90
6/16/03	82
7/8/04	72
7/25/05	41
7/27/06	44.9
8/6/07	23.5

ST41-07

Date	Benzene
9/17/91	1000
9/17/91	1100
7/8/92	180
9/24/92	320
5/23/96	1090
5/23/96	1300
5/23/96	1120
5/23/96	1370
10/2/96	2030
10/2/96	1890
5/21/97	1600
8/28/97	1600
8/28/97	2100
6/1/98	107
6/1/98	121
8/21/98	9.34
8/21/98	18.5
8/21/98	12
8/21/98	11.4
6/14/99	290
8/17/99	12
6/8/00	39
8/17/00	780
6/13/01	12
8/30/01	29
7/8/02	ND(0.1)
7/8/02	ND(0.1)
8/8/07	ND(0.4)

ST41-20
Concentration Below Cleanup Level 1999

ST41-25

Date	Benzene
9/22/91	ND(0.5)
9/22/91	ND(1.0)
7/6/92	100
7/6/92	120
9/24/92	40
5/21/96	80.1
5/21/96	45.2
5/21/96	75.2
5/21/96	37.8
9/26/96	68.6
9/26/96	73.4
5/20/97	94
8/26/97	190
6/5/98	154
6/5/98	130
8/20/98	118
8/20/98	53.7
6/14/99	54
8/17/99	48
6/9/00	34
8/15/00	32
8/15/00	110
6/15/01	27
8/27/01	33
7/8/02	7.5
7/8/02	8
7/28/06	53.4
8/8/07	18.7
8/8/07	24.9

SW-02

Date	Benzene
10/20/99	ND(0.5)
5/8/00	11.7

ST41-16

Date	Benzene
7/8/92	30000
9/24/92	17000
9/24/92	18000
5/22/96	15400
5/22/96	15100
9/25/96	11700
9/25/96	13500
5/21/97	14000
8/27/97	16000
5/29/98	14700
5/29/98	13600
8/17/98	15700
8/17/98	17600
6/9/99	17000
8/17/99	13000
6/7/00	13000
8/17/00	16000
6/15/01	1700
6/15/01	14000
8/30/01	11000
7/8/02	12000
7/8/02	13000

ST41-28

Date	Benzene
5/23/96	610
5/23/96	651
10/1/96	622
10/1/96	737
5/19/97	460
8/27/97	550
8/27/97	540
6/2/98	393
6/2/98	367
8/17/98	320
8/17/98	356
6/10/99	310
8/19/99	270
6/8/00	270
8/18/00	300
8/18/00	290
6/14/01	190
6/14/01	210
8/30/01	260
7/8/02	270
7/8/02	270

ST41-ES4B

Date	Benzene
9/27/96	0.0251
9/27/96	ND(0.05)
9/27/96	0.0235
9/27/96	ND(0.05)
5/20/97	ND(0.3)
8/26/97	ND(0.03)
6/5/98	0.115
6/5/98	ND(0.08)
8/20/98	0.0705
8/20/98	ND(0.07)
8/20/98	0.0618
8/20/98	ND(0.07)
6/14/99	ND(0.1)
8/18/99	ND(0.1)
6/9/00	ND(0.1)
8/15/00	ND(0.1)

ST41-29

Date	Benzene
9/22/91	ND(0.5)
9/22/91	ND(1.0)
7/6/92	ND(0.45)
9/17/92	ND(0.45)

ST41-MW37A

Date	Benzene
9/18/92	ND(0.5)
5/22/96	ND(0.05)
5/22/96	0.032
9/27/96	0.0897
9/27/96	0.102
5/19/97	ND(0.3)
8/26/97	ND(0.3)
6/5/98	ND(0.08)
6/5/98	ND(0.08)
6/5/98	0.0597
6/5/98	0.0763
8/20/98	ND(0.07)
8/20/98	ND(0.07)
6/14/99	ND(0.1)
8/19/99	ND(0.1)
6/9/00	ND(0.1)
8/14/00	ND(0.1)
6/19/01	ND(0.1)
8/27/01	ND(0.1)

Legend

OU2 Plume Extent

CERCLA Site

OU2 Monitoring Well

Surface Water/Seep Sampling Location

Point of Compliance Sample Location

Monitoring Well

GW Estimated Groundwater Flow Direction

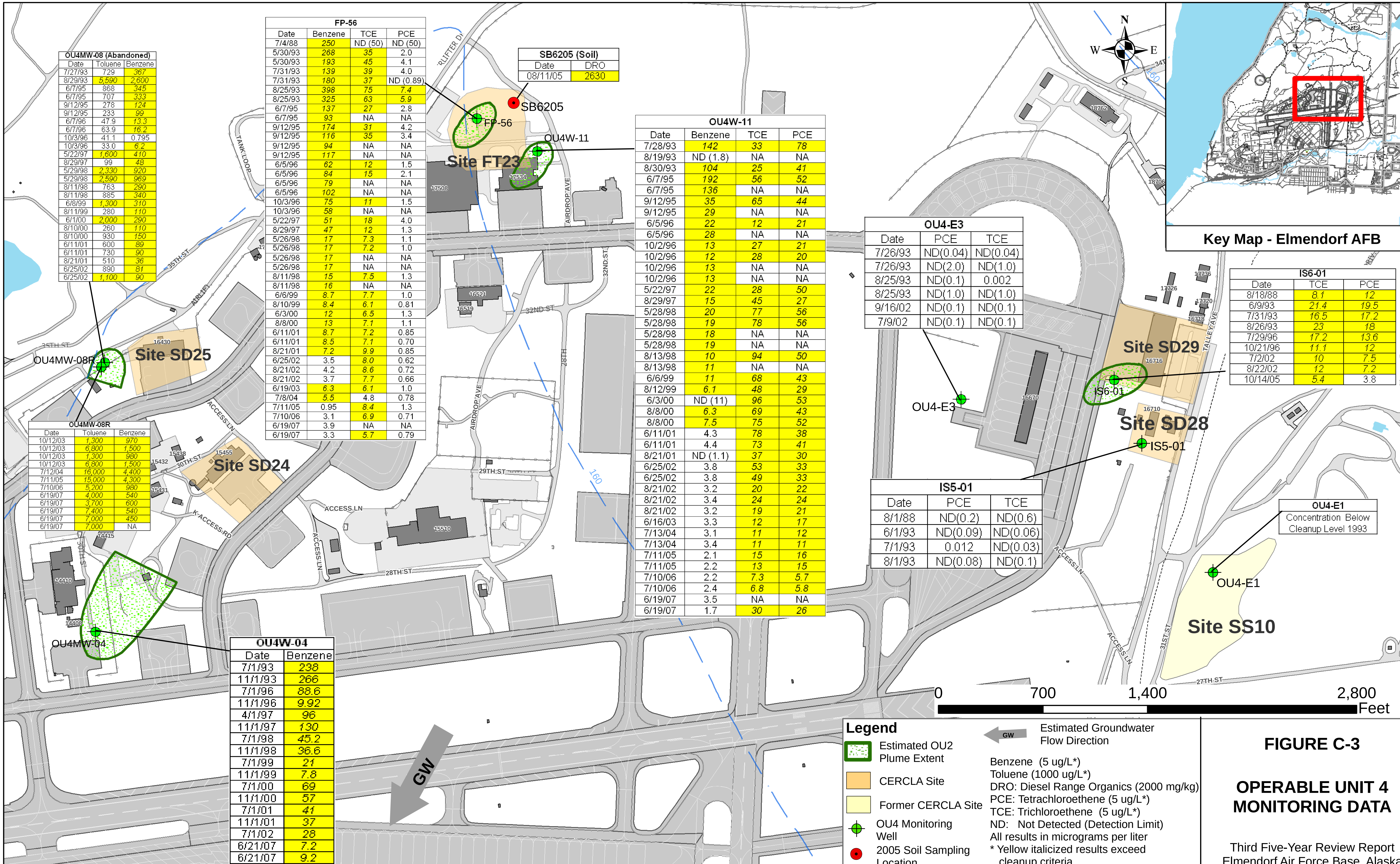
Benzene (5 ug/L*)
ND: Not Detected (Detection Limit)
All results in micrograms per liter
* Yellow italicized results exceed cleanup criteria

FIGURE C-2

OPERABLE UNIT 2 MONITORING DATA

Third Five-Year Review Report
Elmendorf Air Force Base, Alaska

S:\ES\Remed\Elmendorf RPO\GIS\Five Year Review\OU2.mxd cmr 11/7/08



OU4MW-08 (Abandoned)		
Date	Toluene	Benzene
7/27/93	729	*367*
8/29/93	*5,590*	*2,600*
6/7/95	868	*345*
6/7/95	707	*333*
9/12/95	278	*124*
9/12/95	233	*99*
6/7/96	47.9	*13.3*
6/7/96	63.9	*16.2*
10/3/96	41.1	0.795
10/3/96	33.0	*6.2*
5/22/97	*1,600*	*410*
8/29/97	99	*48*
5/29/98	*2,330*	*920*
5/29/98	*2,590*	*969*
8/11/98	763	*290*
8/11/98	885	*340*
6/8/99	*1,300*	*310*
8/11/99	280	*110*
6/1/00	*2,000*	*290*
8/10/00	260	*110*
8/10/00	930	*150*
6/11/01	600	*89*
6/11/01	730	*90*
8/21/01	510	*36*
6/25/02	890	*81*
6/25/02	*1,100*	*90*

OU4MW-08R		
Date	Toluene	Benzene
10/12/03	*1,300*	*970*
10/12/03	*6,800*	*1,500*
10/12/03	*1,300*	*980*
10/12/03	*6,800*	*1,500*
7/12/04	*16,000*	*4,400*
7/11/05	*15,000*	*4,300*
7/10/06	*5,200*	*980*
6/19/07	*4,000*	*540*
6/19/07	*3,700*	*600*
6/19/07	*7,400*	*540*
6/19/07	*7,000*	*450*
6/19/07	*7,000*	NA

FP-56			
Date	Benzene	TCE	PCE
7/4/88	*250*	ND (50)	ND (50)
5/30/93	*268*	*35*	2.0
5/30/93	*193*	*45*	4.1
7/31/93	*139*	*39*	4.0
7/31/93	*180*	*37*	ND (0.89)
8/25/93	*398*	*75*	*7.4*
8/25/93	*325*	*63*	*5.9*
6/7/95	*137*	*27*	2.8
6/7/95	*93*	NA	NA
9/12/95	*174*	*31*	4.2
9/12/95	*116*	*35*	3.4
9/12/95	*94*	NA	NA
9/12/95	*117*	NA	NA
6/5/96	*62*	*12*	1.5
6/5/96	*84*	*15*	2.1
6/5/96	*79*	NA	NA
6/5/96	*102*	NA	NA
10/3/96	*75*	*11*	1.5
10/3/96	*58*	NA	NA
5/22/97	*51*	*18*	4.0
8/29/97	*47*	*12*	1.3
5/26/98	*17*	*7.3*	1.1
5/26/98	*17*	*7.2*	1.0
5/26/98	*17*	NA	NA
5/26/98	*17*	NA	NA
8/11/98	*15*	*7.5*	1.3
8/11/98	*16*	NA	NA
6/6/99	*8.7*	*7.7*	1.0
8/10/99	*8.4*	*6.1*	0.81
6/3/00	*12*	*6.5*	1.3
8/8/00	*13*	*7.1*	1.1
6/11/01	*8.7*	*7.2*	0.85
6/11/01	*8.5*	*7.1*	0.70
8/21/01	*7.2*	*9.9*	0.85
6/25/02	3.5	*8.0*	0.62
8/21/02	4.2	*8.6*	0.72
8/21/02	3.7	*7.7*	0.66
6/19/03	*6.3*	*6.1*	1.0
7/8/04	*5.5*	4.8	0.78
7/11/05	0.95	*8.4*	1.3
7/10/06	3.1	*6.9*	0.71
6/19/07	3.9	NA	NA
6/19/07	3.3	*5.7*	0.79

SB6205 (Soil)	
Date	DRO
08/11/05	*2630*

OU4W-11			
Date	Benzene	TCE	PCE
7/28/93	*142*	*33*	*78*
8/19/93	ND (1.8)	NA	NA
8/30/93	*104*	*25*	*41*
6/7/95	*192*	*56*	*52*
6/7/95	*136*	NA	NA
9/12/95	*35*	*65*	*44*
9/12/95	*29*	NA	NA
6/5/96	*22*	*12*	*21*
6/5/96	*28*	NA	NA
10/2/96	*13*	*27*	*21*
10/2/96	*12*	*28*	*20*
10/2/96	*13*	NA	NA
10/2/96	*13*	NA	NA
5/22/97	*22*	*28*	*50*
8/29/97	*15*	*45*	*27*
5/28/98	*20*	*77*	*56*
5/28/98	*19*	*78*	*56*
5/28/98	*18*	NA	NA
5/28/98	*19*	NA	NA
8/13/98	*10*	*94*	*50*
8/13/98	*11*	NA	NA
6/6/99	*11*	*68*	*43*
8/12/99	*6.1*	*48*	*29*
6/3/00	ND (11)	*96*	*53*
8/8/00	*6.3*	*69*	*43*
8/8/00	*7.5*	*75*	*52*
6/11/01	4.3	*78*	*38*
6/11/01	4.4	*73*	*41*
8/21/01	ND (1.1)	*37*	*30*
6/25/02	3.8	*53*	*33*
6/25/02	3.8	*49*	*33*
8/21/02	3.2	*20*	*22*
8/21/02	3.4	*24*	*24*
8/21/02	3.2	*19*	*21*
6/16/03	3.3	*12*	*17*
7/13/04	3.1	*11*	*12*
7/13/04	3.4	*11*	*11*
7/11/05	2.1	*15*	*16*
7/11/05	2.2	*13*	*15*
7/10/06	2.2	*7.3*	*5.7*
7/10/06	2.4	*6.8*	*5.8*
6/19/07	3.5	NA	NA
6/19/07	1.7	*30*	*26*

OU4-E3		
Date	PCE	TCE
7/26/93	ND(0.04)	ND(0.04)
7/26/93	ND(2.0)	ND(1.0)
8/25/93	ND(0.1)	0.002
8/25/93	ND(1.0)	ND(1.0)
9/16/02	ND(0.1)	ND(0.1)
7/9/02	ND(0.1)	ND(0.1)

IS6-01		
Date	TCE	PCE
8/18/88	*8.1*	*12*
6/9/93	*21.4*	*19.5*
7/31/93	*16.5*	*17.2*
8/26/93	*23*	*18*
7/29/96	*17.2*	*13.6*
10/21/96	*11.1*	*12*
7/2/02	*10*	*7.5*
8/22/02	*12*	*7.2*
10/14/05	*5.4*	3.8

IS5-01		
Date	PCE	TCE
8/1/88	ND(0.2)	ND(0.6)
6/1/93	ND(0.09)	ND(0.06)
7/1/93	0.012	ND(0.03)
8/1/93	ND(0.08)	ND(0.1)

OU4-E1
Concentration Below Cleanup Level 1993

OU4W-04	
Date	Benzene
7/1/93	*238*
11/1/93	*266*
7/1/96	*88.6*
11/1/96	*9.92*
4/1/97	*96*
11/1/97	*130*
7/1/98	*45.2*
11/1/98	*36.6*
7/1/99	*21*
11/1/99	*7.8*
7/1/00	*69*
11/1/00	*57*
7/1/01	*41*
11/1/01	*37*
7/1/02	*28*
6/21/07	*7.2*
6/21/07	*9.2*

Legend

- Estimated OU2 Plume Extent
- CERCLA Site
- Former CERCLA Site
- OU4 Monitoring Well
- 2005 Soil Sampling Location
- Estimated Groundwater Flow Direction

Benzene (5 ug/L*)
Toluene (1000 ug/L*)
DRO: Diesel Range Organics (2000 mg/kg)
PCE: Tetrachloroethene (5 ug/L*)
TCE: Trichloroethene (5 ug/L*)
ND: Not Detected (Detection Limit)
All results in micrograms per liter
* Yellow italicized results exceed cleanup criteria

FIGURE C-3

OPERABLE UNIT 4 MONITORING DATA

Third Five-Year Review Report
Elmendorf Air Force Base, Alaska

S:\ES\Remed\Elmendorf RPO\GIS\Five Year Review/OU4.mxd cmr 9/12/08

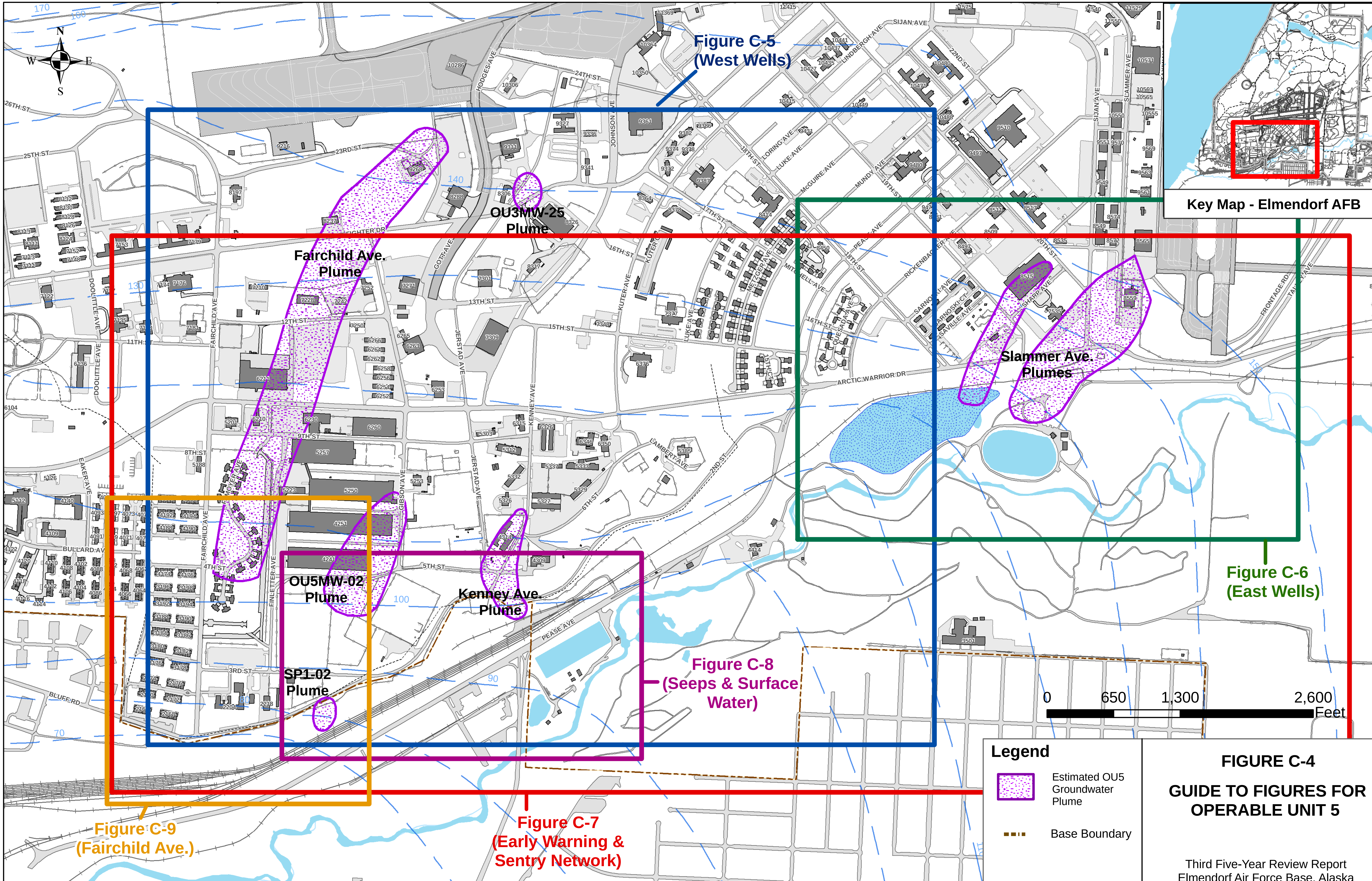
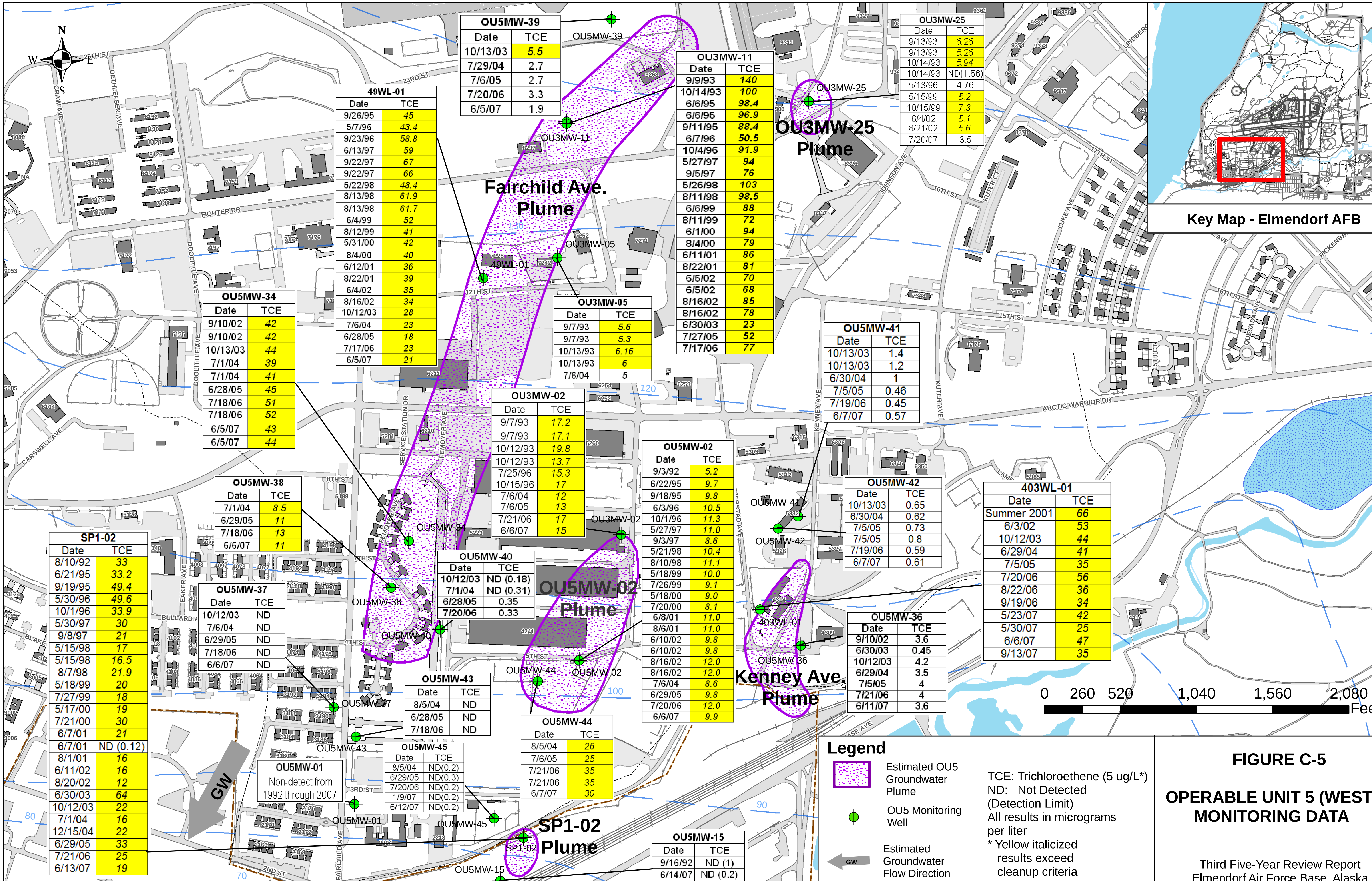


FIGURE C-4

GUIDE TO FIGURES FOR OPERABLE UNIT 5

Third Five-Year Review Report
Elmendorf Air Force Base, Alaska

S:\ES\Remed\Elmendorf RPO\GIS\Five Year Review\OU5Master.mxd cmr 9/12/08



OU5MW-39	
Date	TCE
10/13/03	*5.5*
7/29/04	2.7
7/6/05	2.7
7/20/06	3.3
6/5/07	1.9

49WL-01	
Date	TCE
9/26/95	*45*
5/7/96	*43.4*
9/23/96	*58.8*
6/13/97	*59*
9/22/97	*67*
9/22/97	*66*
5/22/98	*48.4*
8/13/98	*61.9*
8/13/98	*61.7*
6/4/99	*52*
8/12/99	*41*
5/31/00	*42*
8/4/00	*40*
6/12/01	*36*
8/22/01	*39*
6/4/02	*35*
8/16/02	*34*
10/12/03	*28*
7/6/04	*23*
6/28/05	*18*
7/17/06	*23*
6/5/07	*21*

OU3MW-11	
Date	TCE
9/9/93	*140*
10/14/93	*100*
6/6/95	*98.4*
6/6/95	*96.9*
9/11/95	*88.4*
6/7/96	*50.5*
10/4/96	*91.9*
5/27/97	*94*
9/5/97	*76*
5/26/98	*103*
8/11/98	*98.5*
6/6/99	*88*
8/11/99	*72*
6/1/00	*94*
8/4/00	*79*
6/11/01	*86*
8/22/01	*81*
6/5/02	*70*
6/5/02	*68*
8/16/02	*85*
8/16/02	*78*
6/30/03	*23*
7/27/05	*52*
7/17/06	*77*

OU3MW-25	
Date	TCE
9/13/93	*6.26*
9/13/93	*5.26*
10/14/93	*5.94*
10/14/93	ND(1.56)
5/13/96	4.76
5/15/99	*5.2*
10/15/99	*7.3*
6/4/02	*5.1*
8/21/02	*5.6*
7/20/07	3.5

OU5MW-34	
Date	TCE
9/10/02	*42*
9/10/02	*42*
10/13/03	*44*
7/1/04	*39*
7/1/04	*41*
6/28/05	*45*
7/18/06	*51*
7/18/06	*52*
6/5/07	*43*
6/5/07	*44*

OU3MW-05	
Date	TCE
9/7/93	*5.6*
9/7/93	*5.3*
10/13/93	*6.16*
10/13/93	*6*
7/6/04	5

OU5MW-41	
Date	TCE
10/13/03	1.4
10/13/03	1.2
6/30/04	1
7/5/05	0.46
7/19/06	0.45
6/7/07	0.57

OU3MW-02	
Date	TCE
9/7/93	*17.2*
9/7/93	*17.1*
10/12/93	*19.8*
10/12/93	*13.7*
7/25/96	*15.3*
10/15/96	*17*
7/6/04	*12*
7/6/05	*13*
7/21/06	*17*
6/6/07	*15*

OU5MW-02	
Date	TCE
9/3/92	*5.2*
6/22/95	*9.7*
9/18/95	*9.8*
6/3/96	*10.5*
10/1/96	*11.3*
5/27/97	*11.0*
9/3/97	*8.6*
5/21/98	*10.4*
8/10/98	*11.1*
5/18/99	*10.0*
7/26/99	*9.1*
5/18/00	*9.0*
7/20/00	*8.1*
6/8/01	*11.0*
8/6/01	*11.0*
6/10/02	*9.8*
6/10/02	*9.8*
8/16/02	*12.0*
8/16/02	*12.0*
7/6/04	*8.6*
6/29/05	*9.8*
7/20/06	*12.0*
6/6/07	*9.9*

OU5MW-42	
Date	TCE
10/13/03	0.65
6/30/04	0.62
7/5/05	0.73
7/5/05	0.8
7/19/06	0.59
6/7/07	0.61

403WL-01	
Date	TCE
Summer 2001	*66*
6/3/02	*53*
10/12/03	*44*
6/29/04	*41*
7/5/05	*35*
7/20/06	*56*
8/22/06	*36*
9/19/06	*34*
5/23/07	*42*
5/30/07	*25*
6/6/07	*47*
9/13/07	*35*

OU5MW-38	
Date	TCE
7/1/04	*8.5*
6/29/05	*11*
7/18/06	*13*
6/6/07	*11*

OU5MW-40	
Date	TCE
10/12/03	ND (0.18)
7/1/04	ND (0.31)
6/28/05	0.35
7/20/06	0.33

SP1-02	
Date	TCE
8/10/92	*33*
6/21/95	*33.2*
9/19/95	*49.4*
5/30/96	*49.6*
10/1/96	*33.9*
5/30/97	*30*
9/8/97	*21*
5/15/98	*17*
5/15/98	*16.5*
8/7/98	*21.9*
5/18/99	*20*
7/27/99	*18*
5/17/00	*19*
7/21/00	*30*
6/7/01	*21*
6/7/01	ND (0.12)
8/1/01	*16*
6/11/02	*16*
8/20/02	*12*
6/30/03	*64*
10/12/03	*22*
7/1/04	*16*
12/15/04	*22*
6/29/05	*33*
7/21/06	*25*
6/13/07	*19*

OU5MW-37	
Date	TCE
10/12/03	ND
7/6/04	ND
6/29/05	ND
7/18/06	ND
6/6/07	ND

OU5MW-36	
Date	TCE
9/10/02	3.6
6/30/03	0.45
10/12/03	4.2
6/29/04	3.5
7/5/05	4
7/21/06	4
6/11/07	3.6

OU5MW-43	
Date	TCE
8/5/04	ND
6/28/05	ND
7/18/06	ND

OU5MW-44	
Date	TCE
8/5/04	*26*
7/6/05	*25*
7/21/06	*35*
7/21/06	*35*
6/7/07	*30*

OU5MW-01
Non-detect from 1992 through 2007

OU5MW-45	
Date	TCE
8/5/04	ND(0.2)
6/29/05	ND(0.3)
7/20/06	ND(0.2)
1/9/07	ND(0.2)
6/12/07	ND(0.2)

OU5MW-15	
Date	TCE
9/16/92	ND (1)
6/14/07	ND (0.2)

Legend

Estimated OU5 Groundwater Plume

OU5 Monitoring Well

Estimated Groundwater Flow Direction

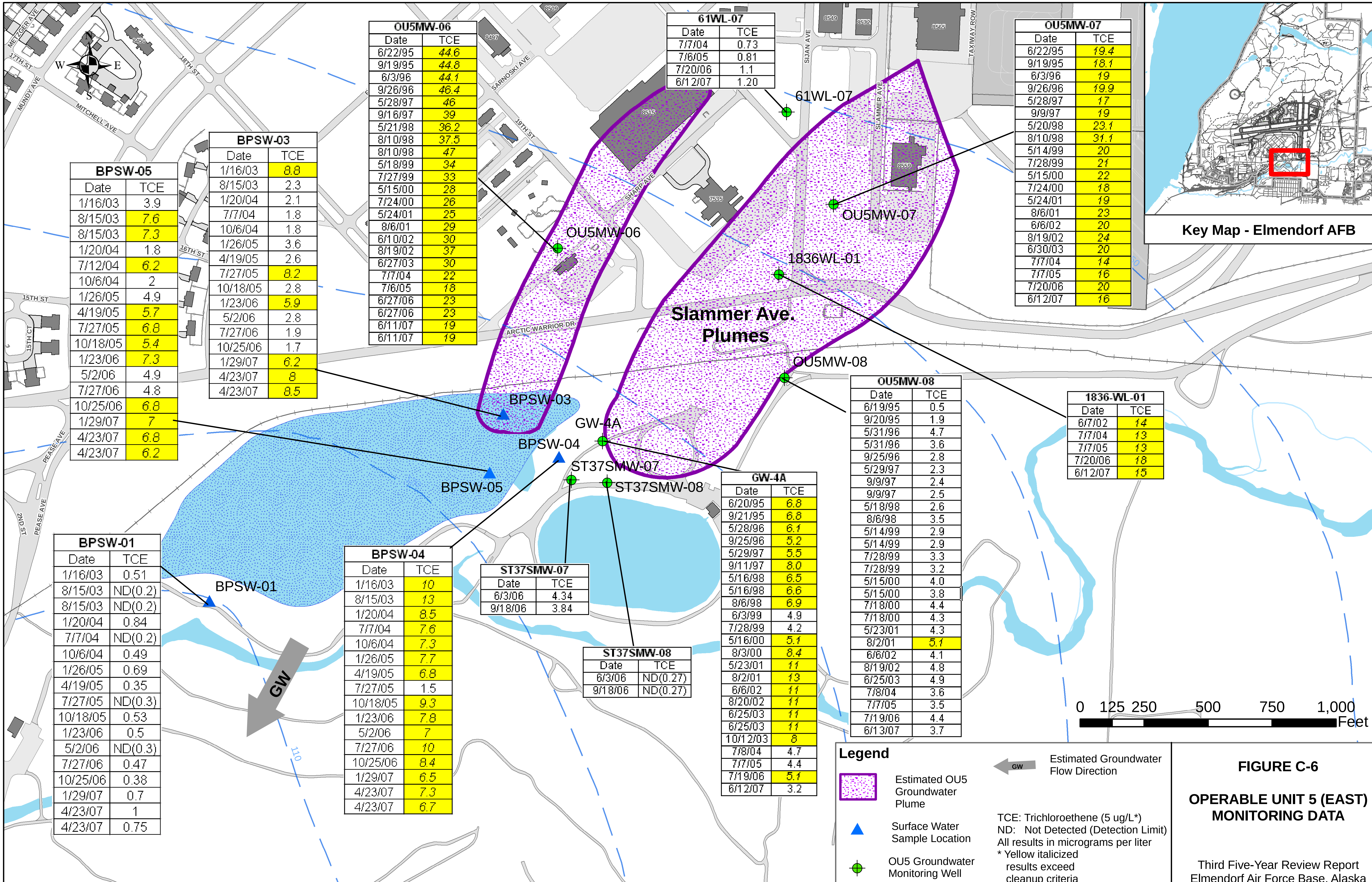
TCE: Trichloroethene (5 ug/L*)
ND: Not Detected
(Detection Limit)
All results in micrograms per liter
* Yellow italicized results exceed cleanup criteria

FIGURE C-5

OPERABLE UNIT 5 (WEST) MONITORING DATA

Third Five-Year Review Report
Elmendorf Air Force Base, Alaska

S:\ES\Remed\Elmendorf RPO\GIS\Five Year Review\OU5.mxd cmr 9/12/08



BPSW-05	
Date	TCE
1/16/03	3.9
8/15/03	7.6
8/15/03	7.3
1/20/04	1.8
7/12/04	6.2
10/6/04	2
1/26/05	4.9
4/19/05	5.7
7/27/05	6.8
10/18/05	5.4
1/23/06	7.3
5/2/06	4.9
7/27/06	4.8
10/25/06	6.8
1/29/07	7
4/23/07	6.8
4/23/07	6.2

BPSW-03	
Date	TCE
1/16/03	8.8
8/15/03	2.3
1/20/04	2.1
7/7/04	1.8
10/6/04	1.8
1/26/05	3.6
4/19/05	2.6
7/27/05	8.2
10/18/05	2.8
1/23/06	5.9
5/2/06	2.8
7/27/06	1.9
10/25/06	1.7
1/29/07	6.2
4/23/07	8
4/23/07	8.5

OU5MW-06	
Date	TCE
6/22/95	44.6
9/19/95	44.8
6/3/96	44.1
9/26/96	46.4
5/28/97	46
9/16/97	39
5/21/98	36.2
8/10/98	37.5
8/10/98	47
5/18/99	34
7/27/99	33
5/15/00	28
7/24/00	26
5/24/01	25
8/6/01	29
6/10/02	30
8/19/02	37
6/27/03	30
7/7/04	22
7/6/05	18
6/27/06	23
6/27/06	23
6/11/07	19
6/11/07	19

61WL-07	
Date	TCE
7/7/04	0.73
7/6/05	0.81
7/20/06	1.1
6/12/07	1.20

OU5MW-07	
Date	TCE
6/22/95	19.4
9/19/95	18.1
6/3/96	19
9/26/96	19.9
5/28/97	17
9/9/97	19
5/20/98	23.1
8/10/98	31.1
5/14/99	20
7/28/99	21
5/15/00	22
7/24/00	18
5/24/01	19
8/6/01	23
6/6/02	20
8/19/02	24
6/30/03	20
7/7/04	14
7/7/05	16
7/20/06	20
6/12/07	16

OU5MW-08	
Date	TCE
6/19/95	0.5
9/20/95	1.9
5/31/96	4.7
5/31/96	3.6
9/25/96	2.8
5/29/97	2.3
9/9/97	2.4
9/9/97	2.5
5/18/98	2.6
8/6/98	3.5
5/14/99	2.9
5/14/99	2.9
7/28/99	3.3
7/28/99	3.2
5/15/00	4.0
5/15/00	3.8
7/18/00	4.4
7/18/00	4.3
5/23/01	4.3
8/2/01	5.1
6/6/02	4.1
8/19/02	4.8
6/25/03	4.9
7/8/04	3.6
7/7/05	3.5
7/19/06	4.4
6/13/07	3.7

1836-WL-01	
Date	TCE
6/7/02	14
7/7/04	13
7/7/05	13
7/20/06	18
6/12/07	15

GW-4A	
Date	TCE
6/20/95	6.8
9/21/95	6.8
5/28/96	6.1
9/25/96	5.2
5/29/97	5.5
9/11/97	8.0
5/16/98	6.5
5/16/98	6.6
8/6/98	6.9
6/3/99	4.9
7/28/99	4.2
5/16/00	5.1
8/3/00	8.4
5/23/01	11
8/2/01	13
6/6/02	11
8/20/02	11
6/25/03	11
6/25/03	11
10/12/03	8
7/8/04	4.7
7/7/05	4.4
7/19/06	5.1
6/12/07	3.2

ST37SMW-07	
Date	TCE
6/3/06	4.34
9/18/06	3.84

ST37SMW-08	
Date	TCE
6/3/06	ND(0.27)
9/18/06	ND(0.27)

BPSW-01	
Date	TCE
1/16/03	0.51
8/15/03	ND(0.2)
8/15/03	ND(0.2)
1/20/04	0.84
7/7/04	ND(0.2)
10/6/04	0.49
1/26/05	0.69
4/19/05	0.35
7/27/05	ND(0.3)
10/18/05	0.53
1/23/06	0.5
5/2/06	ND(0.3)
7/27/06	0.47
10/25/06	0.38
1/29/07	0.7
4/23/07	1
4/23/07	0.75

BPSW-04	
Date	TCE
1/16/03	10
8/15/03	13
1/20/04	8.5
7/7/04	7.6
10/6/04	7.3
1/26/05	7.7
4/19/05	6.8
7/27/05	1.5
10/18/05	9.3
1/23/06	7.8
5/2/06	7
7/27/06	10
10/25/06	8.4
1/29/07	6.5
4/23/07	7.3
4/23/07	6.7

Legend

Estimated OU5 Groundwater Plume

Surface Water Sample Location

OU5 Groundwater Monitoring Well

GW Estimated Groundwater Flow Direction

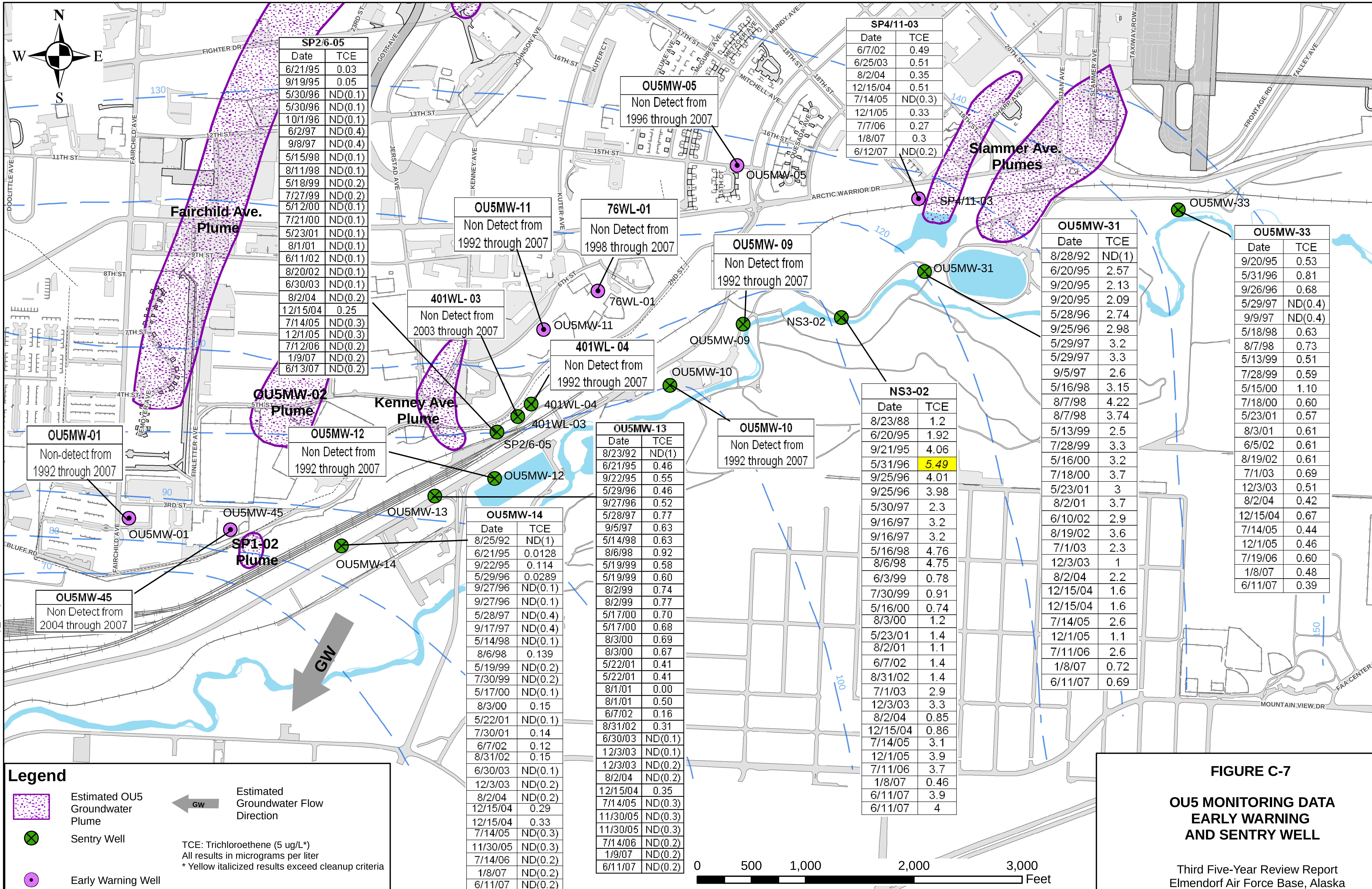
TCE: Trichloroethene (5 ug/L*)
ND: Not Detected (Detection Limit)
All results in micrograms per liter
* Yellow italicized results exceed cleanup criteria

FIGURE C-6

OPERABLE UNIT 5 (EAST) MONITORING DATA

Third Five-Year Review Report
Elmendorf Air Force Base, Alaska

S:\ES\Remed\Elmendorf RPO\GIS\Five Year Review\OU5east.mxd cmr 5/13/08



OU5MW-05
Non Detect from 1996 through 2007

OU5MW-11
Non Detect from 1992 through 2007

76WL-01
Non Detect from 1998 through 2007

OU5MW-09
Non Detect from 1992 through 2007

401WL-03
Non Detect from 2003 through 2007

401WL-04
Non Detect from 1992 through 2007

OU5MW-01
Non-detect from 1992 through 2007

OU5MW-12
Non Detect from 1992 through 2007

OU5MW-10
Non Detect from 1992 through 2007

OU5MW-45
Non Detect from 2004 through 2007

SP2/6-05

Date	TCE
6/21/95	0.03
9/19/95	0.05
5/30/96	ND(0.1)
5/30/96	ND(0.1)
10/1/96	ND(0.1)
6/2/97	ND(0.4)
9/8/97	ND(0.4)
5/15/98	ND(0.1)
8/11/98	ND(0.1)
5/18/99	ND(0.2)
7/27/99	ND(0.2)
5/12/00	ND(0.1)
7/21/00	ND(0.1)
5/23/01	ND(0.1)
8/1/01	ND(0.1)
6/11/02	ND(0.1)
8/20/02	ND(0.1)
6/30/03	ND(0.1)
8/2/04	ND(0.2)
12/15/04	0.25
7/14/05	ND(0.3)
12/1/05	ND(0.3)
7/12/06	ND(0.2)
1/9/07	ND(0.2)
6/13/07	ND(0.2)

SP4/11-03

Date	TCE
6/7/02	0.49
6/25/03	0.51
8/2/04	0.35
12/15/04	0.51
7/14/05	ND(0.3)
12/1/05	0.33
7/7/06	0.27
1/8/07	0.3
6/12/07	ND(0.2)

OU5MW-31

Date	TCE
8/28/92	ND(1)
6/20/95	2.57
9/20/95	2.13
9/20/95	2.09
5/28/96	2.74
9/25/96	2.98
5/29/97	3.2
5/29/97	3.3
9/5/97	2.6
5/16/98	3.15
8/7/98	4.22
8/7/98	3.74
5/13/99	2.5
7/28/99	3.3
5/16/00	3.2
7/18/00	3.7
5/23/01	3
8/2/01	3.7
6/10/02	2.9
8/19/02	3.6
7/1/03	2.3
12/3/03	1
8/2/04	2.2
12/15/04	1.6
12/15/04	1.6
7/14/05	2.6
12/1/05	1.1
7/11/06	2.6
1/8/07	0.72
6/11/07	0.69

OU5MW-33

Date	TCE
9/20/95	0.53
5/31/96	0.81
9/26/96	0.68
5/29/97	ND(0.4)
9/9/97	ND(0.4)
5/18/98	0.63
8/7/98	0.73
5/13/99	0.51
7/28/99	0.59
5/15/00	1.10
7/18/00	0.60
5/23/01	0.57
8/3/01	0.61
6/5/02	0.61
8/19/02	0.61
7/1/03	0.69
12/3/03	0.51
8/2/04	0.42
12/15/04	0.67
7/14/05	0.44
12/1/05	0.46
7/19/06	0.60
1/8/07	0.48
6/11/07	0.39

NS3-02

Date	TCE
8/23/88	1.2
6/20/95	1.92
9/21/95	4.06
5/31/96	*5.49*
9/25/96	4.01
9/25/96	3.98
5/30/97	2.3
9/16/97	3.2
9/16/97	3.2
5/16/98	4.76
8/6/98	4.75
6/3/99	0.78
7/30/99	0.91
5/16/00	0.74
8/3/00	1.2
5/23/01	1.4
8/2/01	1.1
6/7/02	1.4
8/31/02	1.4
7/1/03	2.9
12/3/03	3.3
8/2/04	0.85
12/15/04	0.86
7/14/05	3.1
12/1/05	3.9
7/11/06	3.7
1/8/07	0.46
6/11/07	3.9
6/11/07	4

OU5MW-13

Date	TCE
8/23/92	ND(1)
6/21/95	0.46
9/22/95	0.55
5/29/96	0.46
9/27/96	0.52
5/28/97	0.77
9/5/97	0.63
5/14/98	0.63
8/6/98	0.92
5/19/99	0.58
5/19/99	0.60
8/2/99	0.74
8/2/99	0.77
5/17/00	0.70
5/17/00	0.68
8/3/00	0.69
8/3/00	0.67
5/22/01	0.41
5/22/01	0.41
8/1/01	0.00
8/1/01	0.50
6/7/02	0.16
8/31/02	0.31
6/30/03	ND(0.1)
12/3/03	ND(0.1)
12/3/03	ND(0.2)
8/2/04	ND(0.2)
12/15/04	0.35
7/14/05	ND(0.3)
11/30/05	ND(0.3)
11/30/05	ND(0.3)
7/14/06	ND(0.2)
1/9/07	ND(0.2)
6/11/07	ND(0.2)

OU5MW-14

Date	TCE
8/25/92	ND(1)
6/21/95	0.0128
9/22/95	0.114
5/29/96	0.0289
9/27/96	ND(0.1)
9/27/96	ND(0.1)
5/28/97	ND(0.4)
9/17/97	ND(0.4)
5/14/98	ND(0.1)
8/6/98	0.139
5/19/99	ND(0.2)
7/30/99	ND(0.2)
5/17/00	ND(0.1)
8/3/00	0.15
5/22/01	ND(0.1)
7/30/01	0.14
6/7/02	0.12
8/31/02	0.15
6/30/03	ND(0.1)
12/3/03	ND(0.2)
8/2/04	ND(0.2)
12/15/04	0.29
12/15/04	0.33
7/14/05	ND(0.3)
11/30/05	ND(0.3)
7/14/06	ND(0.2)
1/8/07	ND(0.2)
6/11/07	ND(0.2)

Legend

Estimated OU5 Groundwater Plume

GW Estimated Groundwater Flow Direction

Sentry Well

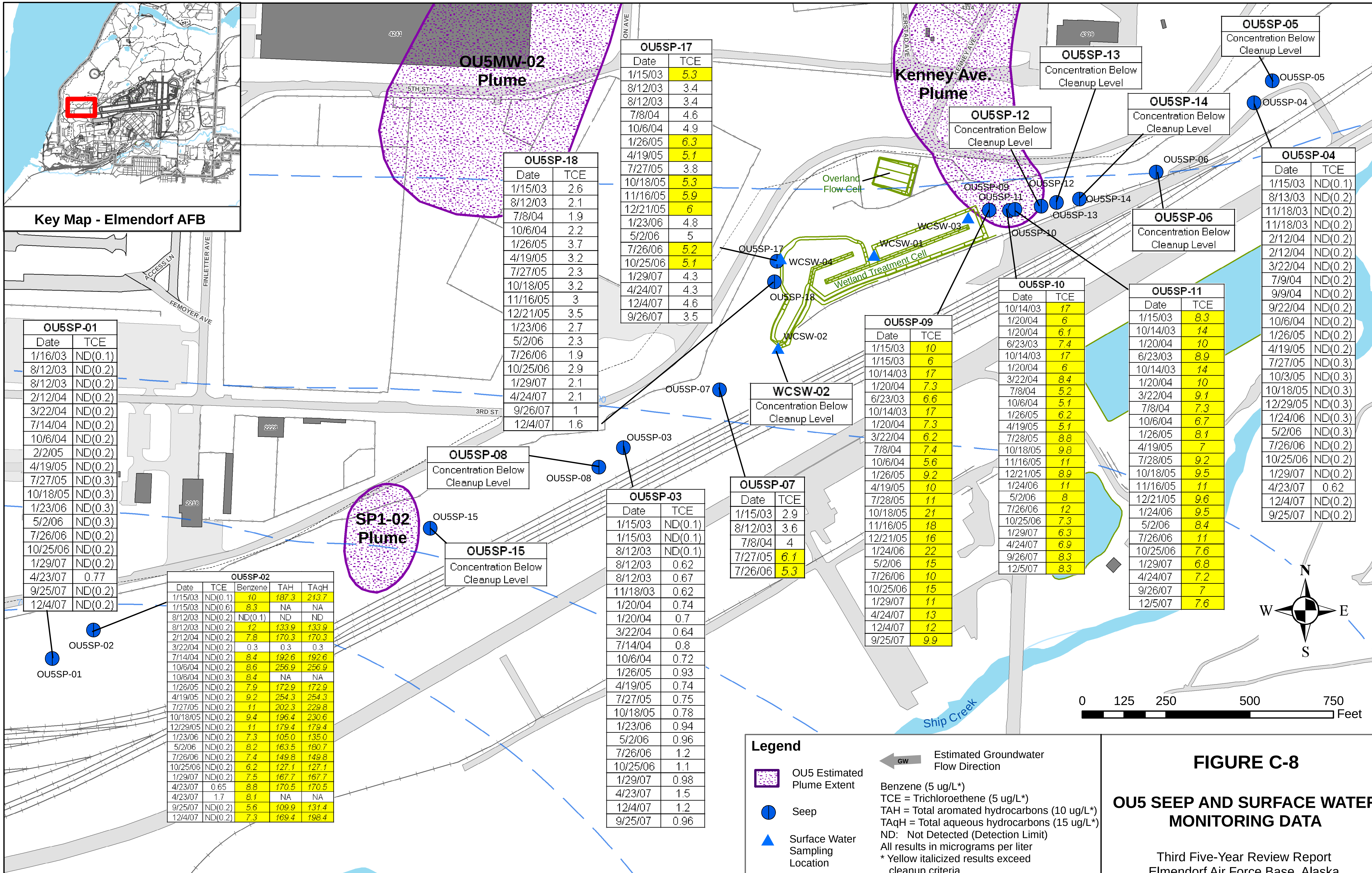
Early Warning Well

TCE: Trichloroethene (5 ug/L*)
All results in micrograms per liter
* Yellow italicized results exceed cleanup criteria

FIGURE C-7

OU5 MONITORING DATA EARLY WARNING AND SENTRY WELL

Third Five-Year Review Report
Elmendorf Air Force Base, Alaska



OU5SP-17

Date	TCE
1/15/03	*5.3*
8/12/03	3.4
8/12/03	3.4
7/8/04	4.6
10/6/04	4.9
1/26/05	*6.3*
4/19/05	*5.1*
7/27/05	3.8
10/18/05	*5.3*
11/16/05	*5.9*
12/21/05	*6*
1/23/06	4.8
5/2/06	5
7/26/06	*5.2*
10/25/06	*5.1*
1/29/07	4.3
4/24/07	4.3
12/4/07	4.6
9/26/07	3.5

OU5SP-18

Date	TCE
1/15/03	2.6
8/12/03	2.1
7/8/04	1.9
10/6/04	2.2
1/26/05	3.7
4/19/05	3.2
7/27/05	2.3
10/18/05	3.2
11/16/05	3
12/21/05	3.5
1/23/06	2.7
5/2/06	2.3
7/26/06	1.9
10/25/06	2.9
1/29/07	2.1
4/24/07	2.1
9/26/07	1
12/4/07	1.6

OU5SP-01

Date	TCE
1/16/03	ND(0.1)
8/12/03	ND(0.2)
8/12/03	ND(0.2)
2/12/04	ND(0.2)
3/22/04	ND(0.2)
7/14/04	ND(0.2)
10/6/04	ND(0.2)
2/2/05	ND(0.2)
4/19/05	ND(0.2)
7/27/05	ND(0.3)
10/18/05	ND(0.3)
1/23/06	ND(0.3)
5/2/06	ND(0.3)
7/26/06	ND(0.2)
10/25/06	ND(0.2)
1/29/07	ND(0.2)
4/23/07	0.77
9/25/07	ND(0.2)
12/4/07	ND(0.2)

OU5SP-02

Date	TCE	Benzene	TAH	TAqH
1/15/03	ND(0.1)	*10*	*187.3*	*213.7*
1/15/03	ND(0.6)	*8.3*	NA	NA
8/12/03	ND(0.2)	ND(0.1)	ND	ND
8/12/03	ND(0.2)	*12*	*133.9*	*133.9*
2/12/04	ND(0.2)	*7.8*	*170.3*	*170.3*
3/22/04	ND(0.2)	0.3	0.3	0.3
7/14/04	ND(0.2)	*8.4*	*192.6*	*192.6*
10/6/04	ND(0.2)	*8.6*	*256.9*	*256.9*
10/6/04	ND(0.3)	*8.4*	NA	NA
1/26/05	ND(0.2)	*7.9*	*172.9*	*172.9*
4/19/05	ND(0.2)	*9.2*	*254.3*	*254.3*
7/27/05	ND(0.2)	*11*	*202.3*	*229.8*
10/18/05	ND(0.2)	*9.4*	*196.4*	*230.6*
12/29/05	ND(0.2)	*11*	*179.4*	*179.4*
1/23/06	ND(0.2)	*7.3*	*105.0*	*135.0*
5/2/06	ND(0.2)	*8.2*	*163.5*	*180.7*
7/26/06	ND(0.2)	*7.4*	*149.8*	*149.8*
10/25/06	ND(0.2)	*6.2*	*127.1*	*127.1*
1/29/07	ND(0.2)	*7.5*	*167.7*	*167.7*
4/23/07	0.65	*8.8*	*170.5*	*170.5*
4/23/07	1.7	*8.1*	NA	NA
9/25/07	ND(0.2)	*5.6*	*109.9*	*131.4*
12/4/07	ND(0.2)	*7.3*	*169.4*	*198.4*

OU5SP-03

Date	TCE
1/15/03	ND(0.1)
1/15/03	ND(0.1)
8/12/03	ND(0.1)
8/12/03	0.62
8/12/03	0.67
11/18/03	0.62
1/20/04	0.74
1/20/04	0.7
3/22/04	0.64
7/14/04	0.8
10/6/04	0.72
1/26/05	0.93
4/19/05	0.74
7/27/05	0.75
10/18/05	0.78
1/23/06	0.94
5/2/06	0.96
7/26/06	1.2
10/25/06	1.1
1/29/07	0.98
4/23/07	1.5
12/4/07	1.2
9/25/07	0.96

OU5SP-07

Date	TCE
1/15/03	2.9
8/12/03	3.6
7/8/04	4
7/27/05	*6.1*
7/26/06	*5.3*

OU5SP-09

Date	TCE
1/15/03	*10*
1/15/03	*6*
10/14/03	*17*
1/20/04	*7.3*
6/23/03	*6.6*
10/14/03	*17*
1/20/04	*7.3*
3/22/04	*6.2*
7/8/04	*7.4*
10/6/04	*5.6*
1/26/05	*9.2*
4/19/05	*10*
7/28/05	*11*
10/18/05	*21*
11/16/05	*18*
12/21/05	*16*
1/24/06	*22*
5/2/06	*15*
7/26/06	*10*
10/25/06	*15*
1/29/07	*11*
4/24/07	*13*
12/4/07	*12*
9/25/07	*9.9*

OU5SP-10

Date	TCE
10/14/03	*17*
1/20/04	*6*
1/20/04	*6.1*
6/23/03	*7.4*
10/14/03	*17*
1/20/04	*6*
3/22/04	*8.4*
7/8/04	*5.2*
10/6/04	*5.1*
1/26/05	*6.2*
4/19/05	*5.1*
7/28/05	*8.8*
10/18/05	*9.8*
11/16/05	*11*
12/21/05	*8.9*
1/24/06	*11*
5/2/06	*8*
7/26/06	*12*
10/25/06	*7.3*
1/29/07	*6.3*
4/24/07	*6.9*
9/26/07	*8.3*
12/5/07	*8.3*

OU5SP-11

Date	TCE
1/15/03	*8.3*
10/14/03	*14*
1/20/04	*10*
6/23/03	*8.9*
10/14/03	*14*
1/20/04	*10*
3/22/04	*9.1*
7/8/04	*7.3*
10/6/04	*6.7*
1/26/05	*8.1*
4/19/05	*7*
7/28/05	*9.2*
10/18/05	*9.5*
11/16/05	*11*
12/21/05	*9.6*
1/24/06	*9.5*
5/2/06	*8.4*
7/26/06	*11*
10/25/06	*7.6*
1/29/07	*6.8*
4/24/07	*7.2*
9/26/07	*7*
12/5/07	*7.6*

OU5SP-04

Date	TCE
1/15/03	ND(0.1)
8/13/03	ND(0.2)
11/18/03	ND(0.2)
11/18/03	ND(0.2)
2/12/04	ND(0.2)
2/12/04	ND(0.2)
3/22/04	ND(0.2)
7/9/04	ND(0.2)
9/9/04	ND(0.2)
9/22/04	ND(0.2)
10/6/04	ND(0.2)
1/26/05	ND(0.2)
4/19/05	ND(0.2)
7/27/05	ND(0.3)
10/3/05	ND(0.3)
10/18/05	ND(0.3)
12/29/05	ND(0.3)
1/24/06	ND(0.3)
5/2/06	ND(0.3)
7/26/06	ND(0.2)
10/25/06	ND(0.2)
1/29/07	ND(0.2)
4/23/07	0.62
12/4/07	ND(0.2)
9/25/07	ND(0.2)

Legend

- OU5 Estimated Plume Extent
- Seep
- Surface Water Sampling Location
- Estimated Groundwater Flow Direction

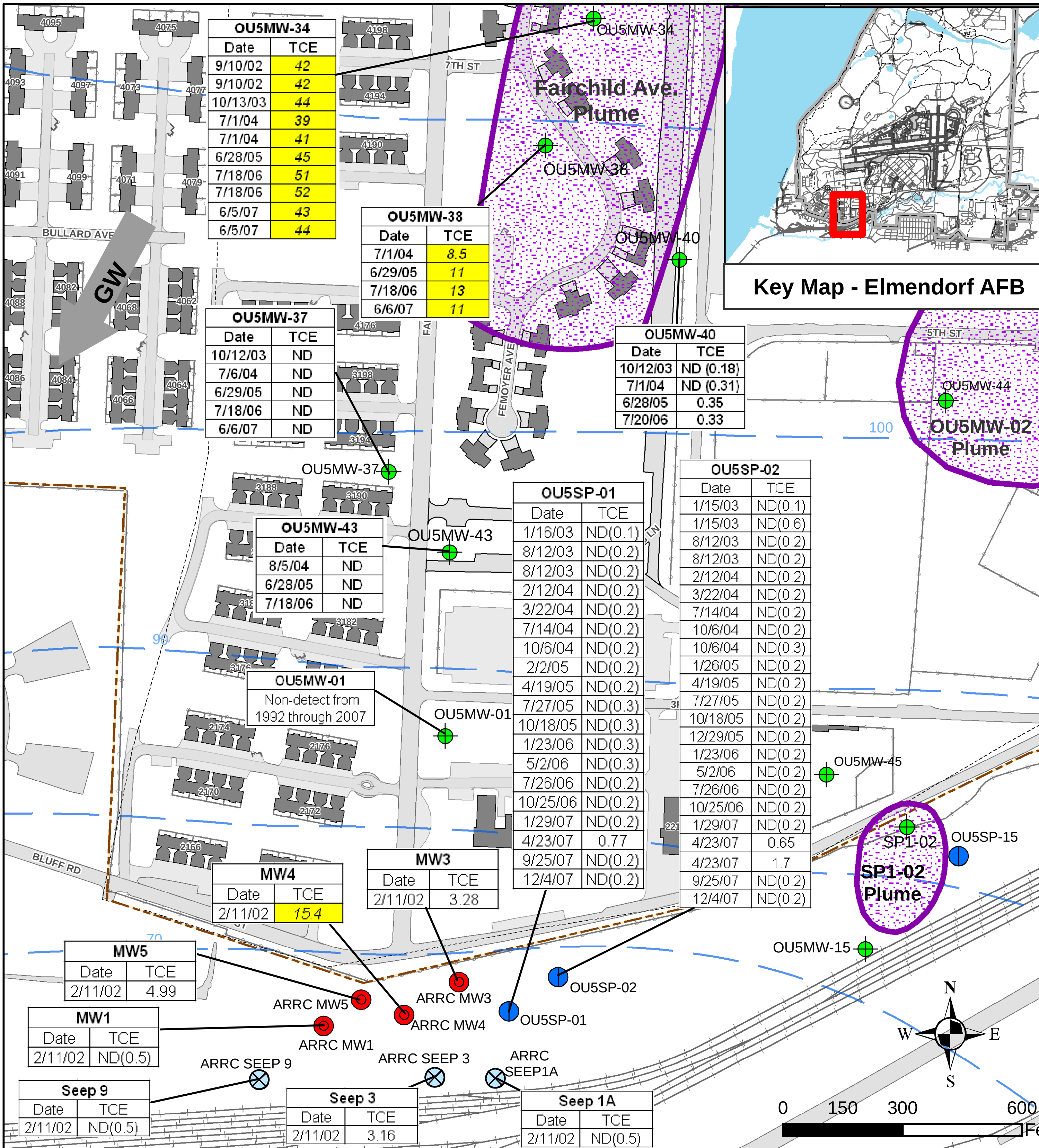
Benzene (5 ug/L*)
TCE = Trichloroethene (5 ug/L*)
TAH = Total aromated hydrocarbons (10 ug/L*)
TAqH = Total aqueous hydrocarbons (15 ug/L*)
ND: Not Detected (Detection Limit)
All results in micrograms per liter
* Yellow italicized results exceed cleanup criteria

FIGURE C-8

OU5 SEEP AND SURFACE WATER MONITORING DATA

Third Five-Year Review Report
Elmendorf Air Force Base, Alaska

S:\ES\Remed\Elmendorf RPO\GIS\Five Year Review\OU5surfacewater.mxd cmr 7/7/08



OU5MW-34

Date	TCE
9/10/02	*42*
9/10/02	*42*
10/13/03	*44*
7/1/04	*39*
7/1/04	*41*
6/28/05	*45*
7/18/06	*51*
7/18/06	*52*
6/5/07	*43*
6/5/07	*44*

OU5MW-38

Date	TCE
7/1/04	*8.5*
6/29/05	*11*
7/18/06	*13*
6/6/07	*11*

OU5MW-37

Date	TCE
10/12/03	ND
7/6/04	ND
6/29/05	ND
7/18/06	ND
6/6/07	ND

OU5MW-40

Date	TCE
10/12/03	ND (0.18)
7/1/04	ND (0.31)
6/28/05	0.35
7/20/06	0.33

OU5MW-43

Date	TCE
8/5/04	ND
6/28/05	ND
7/18/06	ND

OU5MW-01

Non-detect from 1992 through 2007

OU5SP-01

Date	TCE
1/16/03	ND(0.1)
8/12/03	ND(0.2)
8/12/03	ND(0.2)
2/12/04	ND(0.2)
3/22/04	ND(0.2)
7/14/04	ND(0.2)
10/6/04	ND(0.2)
2/2/05	ND(0.2)
4/19/05	ND(0.2)
7/27/05	ND(0.3)
10/18/05	ND(0.3)
1/23/06	ND(0.3)
5/2/06	ND(0.3)
7/26/06	ND(0.2)
10/25/06	ND(0.2)
1/29/07	ND(0.2)
4/23/07	0.77
9/25/07	ND(0.2)
12/4/07	ND(0.2)

OU5SP-02

Date	TCE
1/15/03	ND(0.1)
1/15/03	ND(0.6)
8/12/03	ND(0.2)
8/12/03	ND(0.2)
2/12/04	ND(0.2)
3/22/04	ND(0.2)
7/14/04	ND(0.2)
10/6/04	ND(0.2)
10/6/04	ND(0.3)
1/26/05	ND(0.2)
4/19/05	ND(0.2)
7/27/05	ND(0.2)
10/18/05	ND(0.2)
12/29/05	ND(0.2)
1/23/06	ND(0.2)
5/2/06	ND(0.2)
7/26/06	ND(0.2)
10/25/06	ND(0.2)
1/29/07	ND(0.2)
4/23/07	0.65
4/23/07	1.7
9/25/07	ND(0.2)
12/4/07	ND(0.2)

MW4

Date	TCE
2/11/02	*15.4*

MW3

Date	TCE
2/11/02	3.28

MW5

Date	TCE
2/11/02	4.99

MW1

Date	TCE
2/11/02	ND(0.5)

Seep 9

Date	TCE
2/11/02	ND(0.5)

Seep 3

Date	TCE
2/11/02	3.16

Seep 1A

Date	TCE
2/11/02	ND(0.5)

Legend

- Estimated OU5 Groundwater Plume
- USAF Monitoring Well
- USAF Seep
- Railroad Monitoring Well
- Railroad Seep
- GW Estimated Groundwater Flow Direction

TCE: Trichloroethene (5 ug/L*)
ND: Not Detected (Detection Limit)
All results in micrograms per liter
* Yellow italicized results exceed cleanup criteria

FIGURE C-9

OPERABLE UNIT 5 FAIRCHILD AVE. MONITORING DATA

Third Five-Year Review Report
Elmendorf Air Force Base, Alaska

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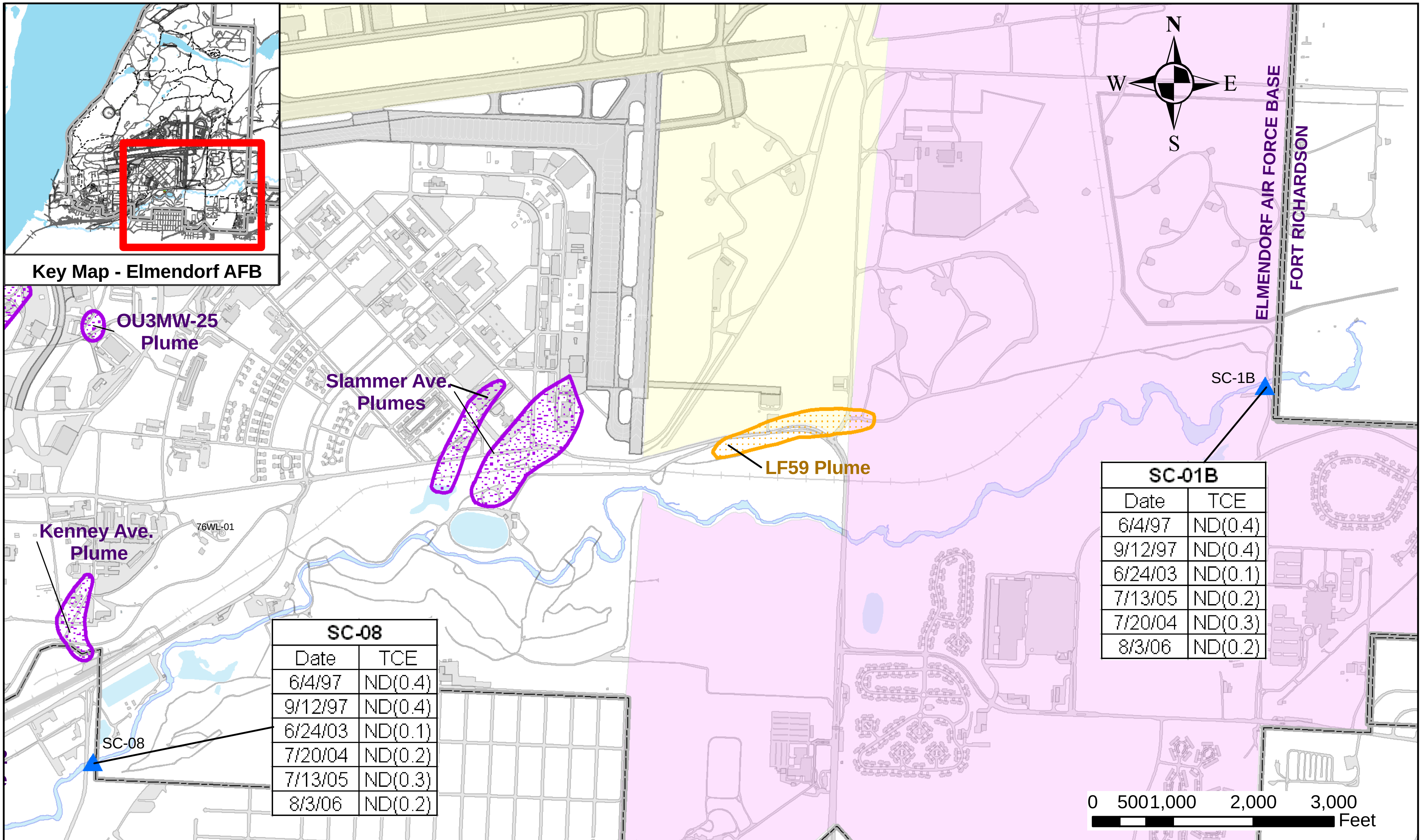


SC-08

Date	TCE
6/4/97	ND(0.4)
9/12/97	ND(0.4)
6/24/03	ND(0.1)
7/20/04	ND(0.2)
7/13/05	ND(0.3)
8/3/06	ND(0.2)

SC-01B

Date	TCE
6/4/97	ND(0.4)
9/12/97	ND(0.4)
6/24/03	ND(0.1)
7/13/05	ND(0.2)
7/20/04	ND(0.3)
8/3/06	ND(0.2)

Legend

- Surface Water Sampling Point
- OU5 Estimated Plume Extent
- OU1 Estimated Plume Extent

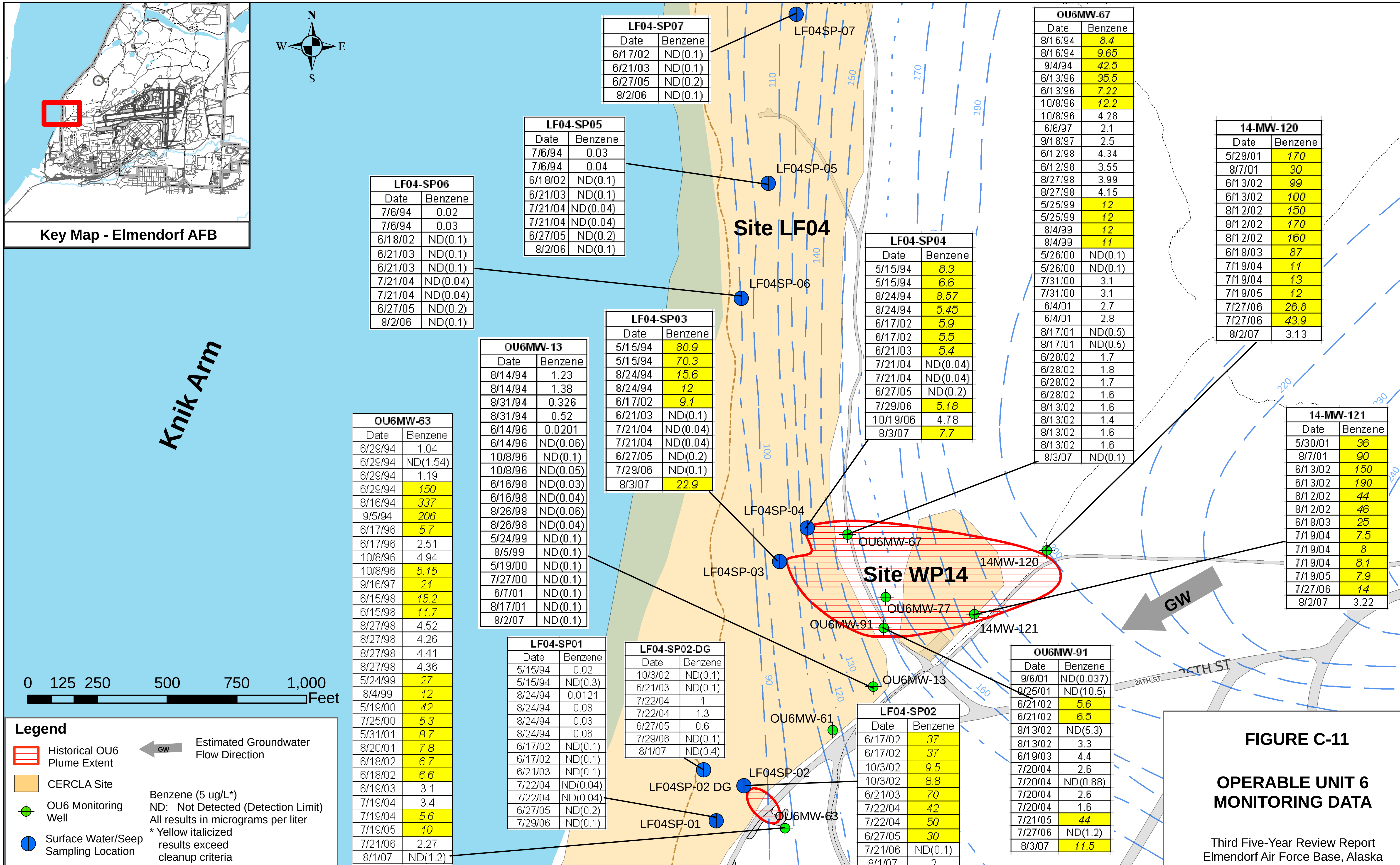
TCE: Trichloroethene (5 ug/L)
ND: Not Detected (Detection Limit)
All results in micrograms per liter

FIGURE C-10

OU5 SHIP CREEK MONITORING DATA

Third Five-Year Review Report
Elmendorf Air Force Base, Alaska

S:\ES\Remed\Elmendorf RPO\GIS\Five Year Review\ShipCreek.mxd cmr 9/12/08



LF04-SP07

Date	Benzene
6/17/02	ND(0.1)
6/21/03	ND(0.1)
6/27/05	ND(0.2)
8/2/06	ND(0.1)

LF04-SP05

Date	Benzene
7/6/94	0.03
7/6/94	0.04
6/18/02	ND(0.1)
6/21/03	ND(0.1)
7/21/04	ND(0.04)
7/21/04	ND(0.04)
6/27/05	ND(0.2)
8/2/06	ND(0.1)

LF04-SP06

Date	Benzene
7/6/94	0.02
7/6/94	0.03
6/18/02	ND(0.1)
6/21/03	ND(0.1)
6/21/03	ND(0.1)
7/21/04	ND(0.04)
7/21/04	ND(0.04)
6/27/05	ND(0.2)
8/2/06	ND(0.1)

LF04-SP03

Date	Benzene
5/15/94	*80.9*
5/15/94	*70.3*
8/24/94	*15.6*
8/24/94	*12*
6/17/02	*9.1*
6/21/03	ND(0.1)
7/21/04	ND(0.04)
7/21/04	ND(0.04)
6/27/05	ND(0.2)
7/29/06	ND(0.1)
8/3/07	*22.9*

OU6MW-13

Date	Benzene
8/14/94	1.23
8/14/94	1.38
8/31/94	0.326
8/31/94	0.52
6/14/96	0.0201
6/14/96	ND(0.06)
10/8/96	ND(0.1)
10/8/96	ND(0.05)
6/16/98	ND(0.03)
6/16/98	ND(0.04)
8/26/98	ND(0.06)
8/26/98	ND(0.04)
5/24/99	ND(0.1)
8/5/99	ND(0.1)
5/19/00	ND(0.1)
7/27/00	ND(0.1)
6/7/01	ND(0.1)
8/17/01	ND(0.1)
8/2/07	ND(0.1)

OU6MW-63

Date	Benzene
6/29/94	1.04
6/29/94	ND(1.54)
6/29/94	1.19
6/29/94	*150*
8/16/94	*337*
9/5/94	*206*
6/17/96	*5.7*
6/17/96	2.51
10/8/96	4.94
10/8/96	*5.15*
9/16/97	*21*
6/15/98	*15.2*
6/15/98	*11.7*
8/27/98	4.52
8/27/98	4.26
8/27/98	4.41
8/27/98	4.36
5/24/99	*27*
8/4/99	*12*
5/19/00	*42*
7/25/00	*5.3*
5/31/01	*8.7*
8/20/01	*7.8*
6/18/02	*6.7*
6/18/02	*6.6*
6/19/03	3.1
7/19/04	3.4
7/19/04	*5.6*
7/19/05	*10*
7/21/06	2.27
8/1/07	ND(1.2)

LF04-SP01

Date	Benzene
5/15/94	0.02
5/15/94	ND(0.3)
8/24/94	0.0121
8/24/94	0.08
8/24/94	0.03
8/24/94	0.06
6/17/02	ND(0.1)
6/17/02	ND(0.1)
6/21/03	ND(0.1)
7/22/04	ND(0.04)
7/22/04	ND(0.04)
6/27/05	ND(0.2)
7/29/06	ND(0.1)

LF04-SP02-DG

Date	Benzene
10/3/02	ND(0.1)
6/21/03	ND(0.1)
7/22/04	1
7/22/04	1.3
6/27/05	0.6
7/29/06	ND(0.1)
8/1/07	ND(0.4)

LF04-SP04

Date	Benzene
5/15/94	*8.3*
5/15/94	*6.6*
8/24/94	*8.57*
8/24/94	*5.45*
6/17/02	*5.9*
6/17/02	*5.5*
6/21/03	*5.4*
7/21/04	ND(0.04)
7/21/04	ND(0.04)
6/27/05	ND(0.2)
7/29/06	*5.18*
10/19/06	4.78
8/3/07	*7.7*

OU6MW-67

Date	Benzene
8/16/94	*8.4*
8/16/94	*9.65*
9/4/94	*42.5*
6/13/96	*35.5*
6/13/96	*7.22*
10/8/96	*12.2*
10/8/96	4.28
6/6/97	2.1
9/18/97	2.5
6/12/98	4.34
6/12/98	3.55
8/27/98	3.99
8/27/98	4.15
5/25/99	*12*
5/25/99	*12*
8/4/99	*12*
8/4/99	*11*
5/26/00	ND(0.1)
5/26/00	ND(0.1)
7/31/00	3.1
7/31/00	3.1
6/4/01	2.7
6/4/01	2.8
8/17/01	ND(0.5)
8/17/01	ND(0.5)
6/28/02	1.7
6/28/02	1.8
6/28/02	1.7
6/28/02	1.6
8/13/02	1.6
8/13/02	1.4
8/13/02	1.6
8/13/02	1.6
8/3/07	ND(0.1)

14-MW-120

Date	Benzene
5/29/01	*170*
8/7/01	*30*
6/13/02	*99*
6/13/02	*100*
8/12/02	*150*
8/12/02	*170*
8/12/02	*160*
6/18/03	*87*
7/19/04	*11*
7/19/04	*13*
7/19/05	*12*
7/27/06	*26.8*
7/27/06	*43.9*
8/2/07	3.13

14-MW-121

Date	Benzene
5/30/01	*36*
8/7/01	*90*
6/13/02	*150*
6/13/02	*190*
8/12/02	*44*
8/12/02	*46*
6/18/03	*25*
7/19/04	*7.5*
7/19/04	*8*
7/19/04	*8.1*
7/19/05	*7.9*
7/27/06	*14*
8/2/07	3.22

OU6MW-91

Date	Benzene
9/6/01	ND(0.037)
9/25/01	ND(10.5)
6/21/02	*5.6*
6/21/02	*6.5*
8/13/02	ND(5.3)
8/13/02	3.3
6/19/03	4.4
7/20/04	2.6
7/20/04	ND(0.88)
7/20/04	2.6
7/20/04	1.6
7/21/05	*44*
7/27/06	ND(1.2)
8/3/07	*11.5*

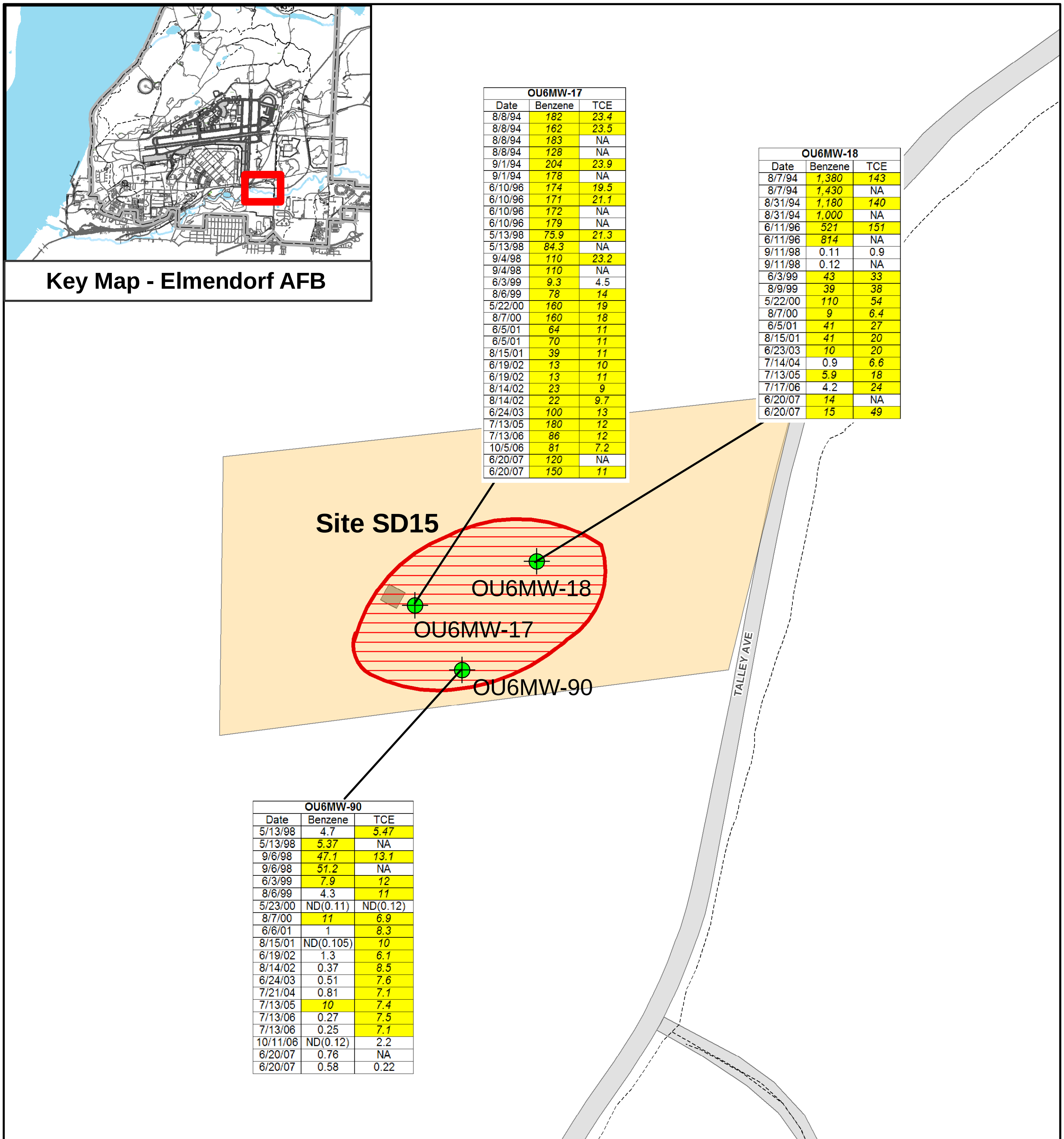
LF04-SP02

Date	Benzene
6/17/02	*37*
6/17/02	*37*
10/3/02	*9.5*
10/3/02	*8.8*
6/21/03	*70*
7/22/04	*42*
7/22/04	*50*
6/27/05	*30*
7/21/06	ND(0.1)
8/1/07	2

FIGURE C-11

OPERABLE UNIT 6 MONITORING DATA

Third Five-Year Review Report
Elmendorf Air Force Base, Alaska



OU6MW-17		
Date	Benzene	TCE
8/8/94	*182*	*23.4*
8/8/94	*162*	*23.5*
8/8/94	*183*	NA
8/8/94	*128*	NA
9/1/94	*204*	*23.9*
9/1/94	*178*	NA
6/10/96	*174*	*19.5*
6/10/96	*171*	*21.1*
6/10/96	*172*	NA
6/10/96	*179*	NA
5/13/98	*75.9*	*21.3*
5/13/98	*84.3*	NA
9/4/98	*110*	*23.2*
9/4/98	*110*	NA
6/3/99	*9.3*	4.5
8/6/99	*78*	*14*
5/22/00	*160*	*19*
8/7/00	*160*	*18*
6/5/01	*64*	*11*
6/5/01	*70*	*11*
8/15/01	*39*	*11*
6/19/02	*13*	*10*
6/19/02	*13*	*11*
8/14/02	*23*	*9*
8/14/02	*22*	*9.7*
6/24/03	*100*	*13*
7/13/05	*180*	*12*
7/13/06	*86*	*12*
10/5/06	*81*	*7.2*
6/20/07	*120*	NA
6/20/07	*150*	*11*

OU6MW-18		
Date	Benzene	TCE
8/7/94	*1,380*	*143*
8/7/94	*1,430*	NA
8/31/94	*1,180*	*140*
8/31/94	*1,000*	NA
6/11/96	*521*	*151*
6/11/96	*814*	NA
9/11/98	0.11	0.9
9/11/98	0.12	NA
6/3/99	*43*	*33*
8/9/99	*39*	*38*
5/22/00	*110*	*54*
8/7/00	*9*	*6.4*
6/5/01	*41*	*27*
8/15/01	*41*	*20*
6/23/03	*10*	*20*
7/14/04	0.9	*6.6*
7/13/05	*5.9*	*18*
7/17/06	4.2	*24*
6/20/07	*14*	NA
6/20/07	*15*	*49*

OU6MW-90		
Date	Benzene	TCE
5/13/98	4.7	*5.47*
5/13/98	*5.37*	NA
9/6/98	*47.1*	*13.1*
9/6/98	*51.2*	NA
6/3/99	*7.9*	*12*
8/6/99	4.3	*11*
5/23/00	ND(0.11)	ND(0.12)
8/7/00	*11*	*6.9*
6/6/01	1	*8.3*
8/15/01	ND(0.105)	*10*
6/19/02	1.3	*6.1*
8/14/02	0.37	*8.5*
6/24/03	0.51	*7.6*
7/21/04	0.81	*7.1*
7/13/05	*10*	*7.4*
7/13/06	0.27	*7.5*
7/13/06	0.25	*7.1*
10/11/06	ND(0.12)	2.2
6/20/07	0.76	NA
6/20/07	0.58	0.22

Legend

Estimated OU6 Groundwater Plume

CERCLA Site

Monitoring Well

Note: Groundwater Flow Direction varies dye to perched conditions

Benzene (5 ug/L*)
TCE: Trichloroethene (5 ug/L*)
ND: Not Detected (Detection Limit)
All results in micrograms per liter
* Yellow italicized results exceed cleanup criteria

FIGURE C-12

OPERABLE UNIT 6 (SD15) MONITORING DATA

Third Five-Year Review Report
Elmendorf Air Force Base, Alaska

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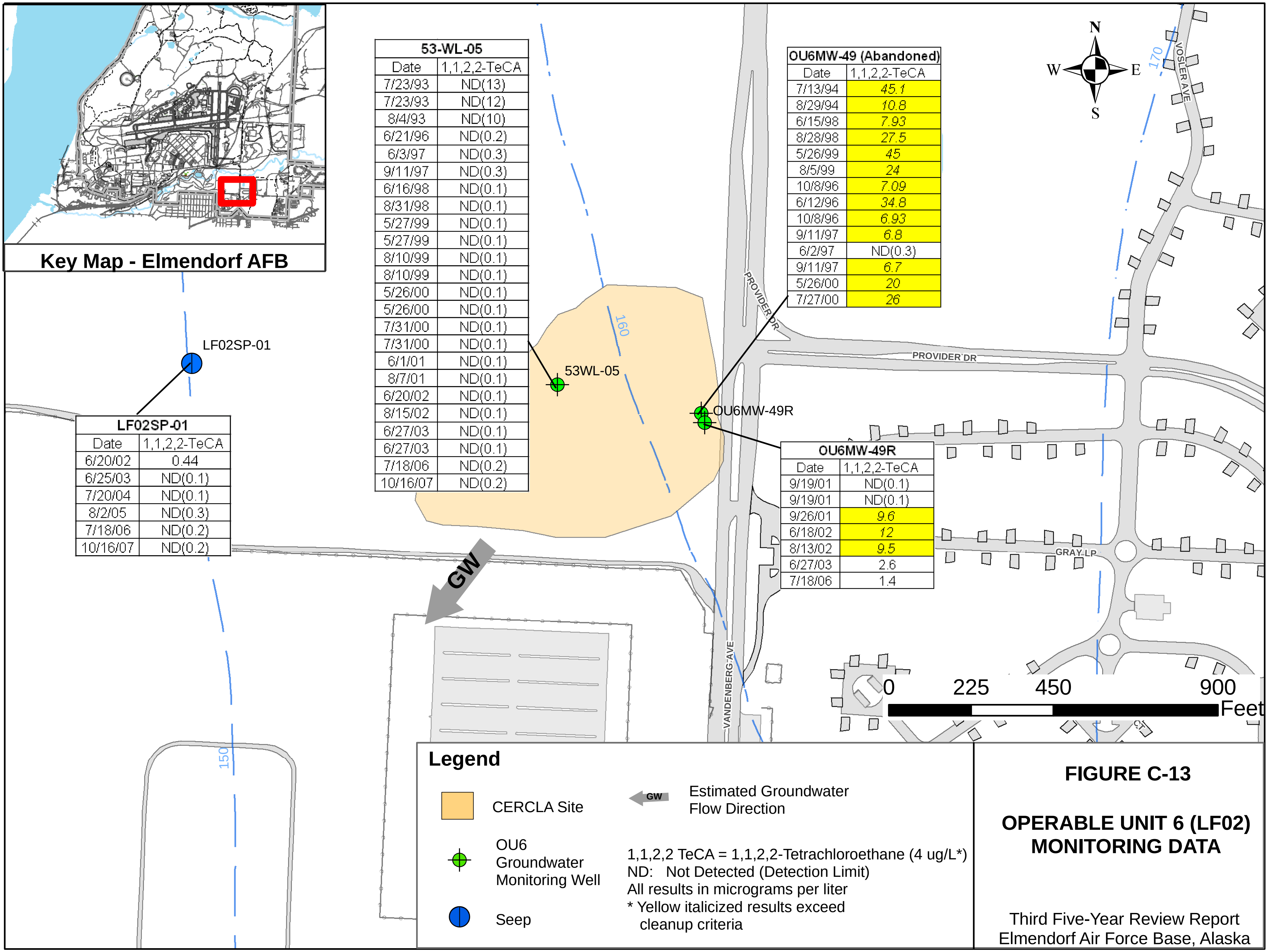

53-WL-05	
Date	1,1,2,2-TeCA
7/23/93	ND(13)
7/23/93	ND(12)
8/4/93	ND(10)
6/21/96	ND(0.2)
6/3/97	ND(0.3)
9/11/97	ND(0.3)
6/16/98	ND(0.1)
8/31/98	ND(0.1)
5/27/99	ND(0.1)
5/27/99	ND(0.1)
8/10/99	ND(0.1)
8/10/99	ND(0.1)
5/26/00	ND(0.1)
5/26/00	ND(0.1)
7/31/00	ND(0.1)
7/31/00	ND(0.1)
6/1/01	ND(0.1)
8/7/01	ND(0.1)
6/20/02	ND(0.1)
8/15/02	ND(0.1)
6/27/03	ND(0.1)
6/27/03	ND(0.1)
7/18/06	ND(0.2)
10/16/07	ND(0.2)

OU6MW-49 (Abandoned)	
Date	1,1,2,2-TeCA
7/13/94	*45.1*
8/29/94	*10.8*
6/15/98	*7.93*
8/28/98	*27.5*
5/26/99	*45*
8/5/99	*24*
10/8/96	*7.09*
6/12/96	*34.8*
10/8/96	*6.93*
9/11/97	*6.8*
6/2/97	ND(0.3)
9/11/97	*6.7*
5/26/00	*20*
7/27/00	*26*

LF02SP-01	
Date	1,1,2,2-TeCA
6/20/02	0.44
6/25/03	ND(0.1)
7/20/04	ND(0.1)
8/2/05	ND(0.3)
7/18/06	ND(0.2)
10/16/07	ND(0.2)

OU6MW-49R	
Date	1,1,2,2-TeCA
9/19/01	ND(0.1)
9/19/01	ND(0.1)
9/26/01	*9.6*
6/18/02	*12*
8/13/02	*9.5*
6/27/03	2.6
7/18/06	1.4

Legend

CERCLA Site

Estimated Groundwater Flow Direction

OU6 Groundwater Monitoring Well

Seep

1,1,2,2 TeCA = 1,1,2,2-Tetrachloroethane (4 ug/L*)
ND: Not Detected (Detection Limit)
All results in micrograms per liter
* Yellow italicized results exceed cleanup criteria

FIGURE C-13

OPERABLE UNIT 6 (LF02) MONITORING DATA

Third Five-Year Review Report
Elmendorf Air Force Base, Alaska

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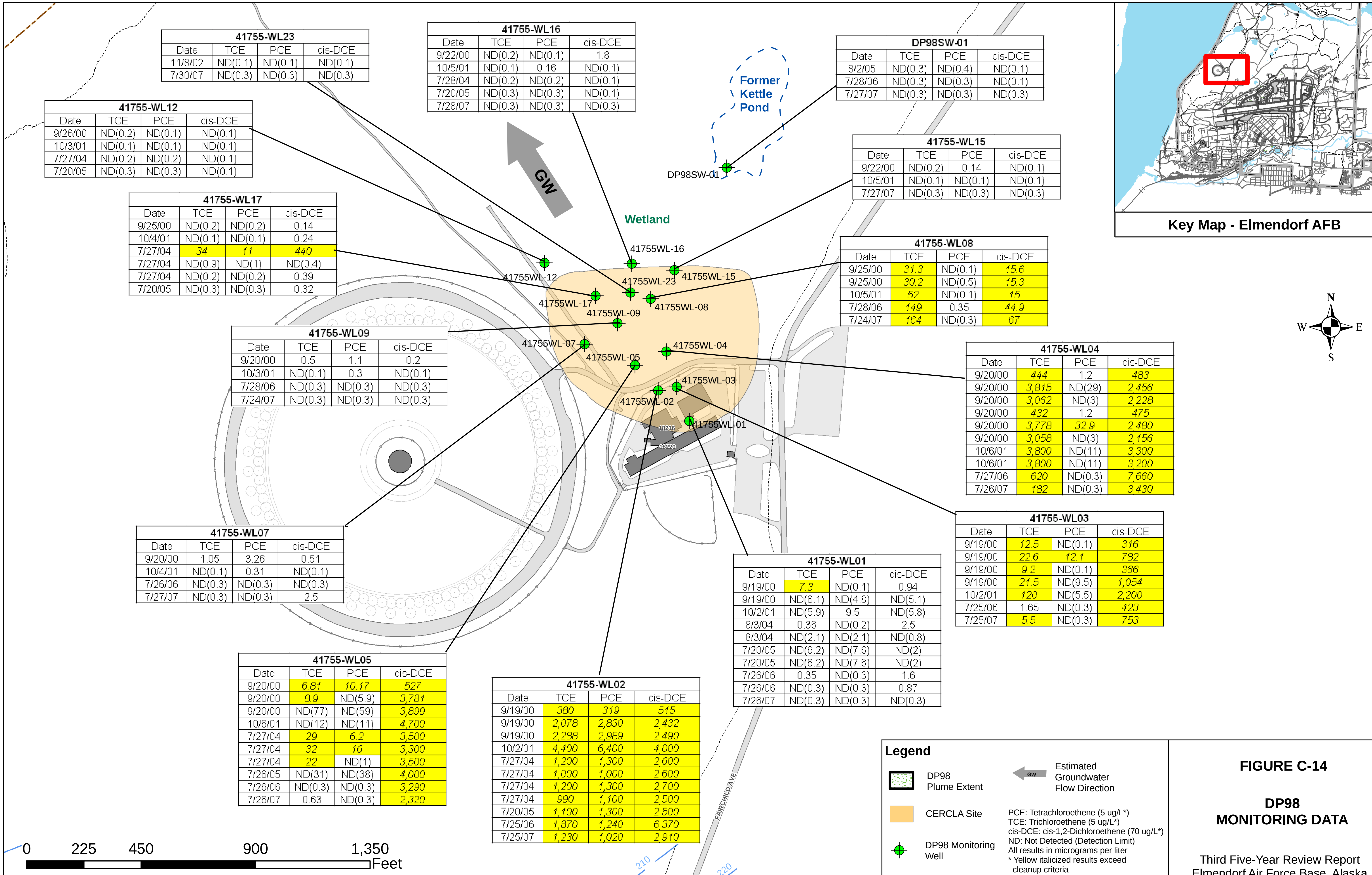

41755-WL23

Date	TCE	PCE	cis-DCE
11/8/02	ND(0.1)	ND(0.1)	ND(0.1)
7/30/07	ND(0.3)	ND(0.3)	ND(0.3)

41755-WL16

Date	TCE	PCE	cis-DCE
9/22/00	ND(0.2)	ND(0.1)	1.8
10/5/01	ND(0.1)	0.16	ND(0.1)
7/28/04	ND(0.2)	ND(0.2)	ND(0.1)
7/20/05	ND(0.3)	ND(0.3)	ND(0.1)
7/28/07	ND(0.3)	ND(0.3)	ND(0.3)

DP98SW-01

Date	TCE	PCE	cis-DCE
8/2/05	ND(0.3)	ND(0.4)	ND(0.1)
7/28/06	ND(0.3)	ND(0.3)	ND(0.1)
7/27/07	ND(0.3)	ND(0.3)	ND(0.3)

41755-WL12

Date	TCE	PCE	cis-DCE
9/26/00	ND(0.2)	ND(0.1)	ND(0.1)
10/3/01	ND(0.1)	ND(0.1)	ND(0.1)
7/27/04	ND(0.2)	ND(0.2)	ND(0.1)
7/20/05	ND(0.3)	ND(0.3)	ND(0.1)

41755-WL15

Date	TCE	PCE	cis-DCE
9/22/00	ND(0.2)	0.14	ND(0.1)
10/5/01	ND(0.1)	ND(0.1)	ND(0.1)
7/27/07	ND(0.3)	ND(0.3)	ND(0.3)

41755-WL17

Date	TCE	PCE	cis-DCE
9/25/00	ND(0.2)	ND(0.2)	0.14
10/4/01	ND(0.1)	ND(0.1)	0.24
7/27/04	*34*	*11*	*440*
7/27/04	ND(0.9)	ND(1)	ND(0.4)
7/27/04	ND(0.2)	ND(0.2)	0.39
7/20/05	ND(0.3)	ND(0.3)	0.32

41755-WL08

Date	TCE	PCE	cis-DCE
9/25/00	*31.3*	ND(0.1)	*15.6*
9/25/00	*30.2*	ND(0.5)	*15.3*
10/5/01	*52*	ND(0.1)	*15*
7/28/06	*149*	0.35	*44.9*
7/24/07	*164*	ND(0.3)	*67*

41755-WL09

Date	TCE	PCE	cis-DCE
9/20/00	0.5	1.1	0.2
10/3/01	ND(0.1)	0.3	ND(0.1)
7/28/06	ND(0.3)	ND(0.3)	ND(0.3)
7/24/07	ND(0.3)	ND(0.3)	ND(0.3)

41755-WL04

Date	TCE	PCE	cis-DCE
9/20/00	*444*	1.2	*483*
9/20/00	*3,815*	ND(29)	*2,456*
9/20/00	*3,062*	ND(3)	*2,228*
9/20/00	*432*	1.2	*475*
9/20/00	*3,778*	*32.9*	*2,480*
9/20/00	*3,058*	ND(3)	*2,156*
10/6/01	*3,800*	ND(11)	*3,300*
10/6/01	*3,800*	ND(11)	*3,200*
7/27/06	*620*	ND(0.3)	*7,660*
7/26/07	*182*	ND(0.3)	*3,430*

41755-WL07

Date	TCE	PCE	cis-DCE
9/20/00	1.05	3.26	0.51
10/4/01	ND(0.1)	0.31	ND(0.1)
7/26/06	ND(0.3)	ND(0.3)	ND(0.3)
7/27/07	ND(0.3)	ND(0.3)	2.5

41755-WL03

Date	TCE	PCE	cis-DCE
9/19/00	*12.5*	ND(0.1)	*316*
9/19/00	*22.6*	*12.1*	*782*
9/19/00	*9.2*	ND(0.1)	*366*
9/19/00	*21.5*	ND(9.5)	*1,054*
10/2/01	*120*	ND(5.5)	*2,200*
7/25/06	1.65	ND(0.3)	*423*
7/25/07	*5.5*	ND(0.3)	*753*

41755-WL01

Date	TCE	PCE	cis-DCE
9/19/00	*7.3*	ND(0.1)	0.94
9/19/00	ND(6.1)	ND(4.8)	ND(5.1)
10/2/01	ND(5.9)	9.5	ND(5.8)
8/3/04	0.36	ND(0.2)	2.5
8/3/04	ND(2.1)	ND(2.1)	ND(0.8)
7/20/05	ND(6.2)	ND(7.6)	ND(2)
7/20/05	ND(6.2)	ND(7.6)	ND(2)
7/26/06	0.35	ND(0.3)	1.6
7/26/06	ND(0.3)	ND(0.3)	0.87
7/26/07	ND(0.3)	ND(0.3)	ND(0.3)

41755-WL05

Date	TCE	PCE	cis-DCE
9/20/00	*6.81*	*10.17*	*527*
9/20/00	*8.9*	ND(5.9)	*3,781*
9/20/00	ND(77)	ND(59)	*3,899*
10/6/01	ND(12)	ND(11)	*4,700*
7/27/04	*29*	*6.2*	*3,500*
7/27/04	*32*	*16*	*3,300*
7/27/04	*22*	ND(1)	*3,500*
7/26/05	ND(31)	ND(38)	*4,000*
7/26/06	ND(0.3)	ND(0.3)	*3,290*
7/26/07	0.63	ND(0.3)	*2,320*

41755-WL02

Date	TCE	PCE	cis-DCE
9/19/00	*380*	*319*	*515*
9/19/00	*2,078*	*2,830*	*2,432*
9/19/00	*2,288*	*2,989*	*2,490*
10/2/01	*4,400*	*6,400*	*4,000*
7/27/04	*1,200*	*1,300*	*2,600*
7/27/04	*1,000*	*1,000*	*2,600*
7/27/04	*1,200*	*1,300*	*2,700*
7/27/04	*990*	*1,100*	*2,500*
7/20/05	*1,100*	*1,300*	*2,500*
7/25/06	*1,870*	*1,240*	*6,370*
7/25/07	*1,230*	*1,020*	*2,910*

Legend

- DP98 Plume Extent
- CERCLA Site
- DP98 Monitoring Well
- Estimated Groundwater Flow Direction

PCE: Tetrachloroethene (5 ug/L*)
TCE: Trichloroethene (5 ug/L*)
cis-DCE: cis-1,2-Dichloroethene (70 ug/L*)
ND: Not Detected (Detection Limit)
All results in micrograms per liter
* Yellow italicized results exceed cleanup criteria

FIGURE C-14

DP98 MONITORING DATA

Third Five-Year Review Report
Elmendorf Air Force Base, Alaska

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ATTACHMENT D

SITE INSPECTION CHECKLISTS

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Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: LF59	**Date of inspection:** 5/7/08
Location and Region: Elmendorf AFB, AK/ Reg 10	**EPA ID:** AK8570028649
Agency, office, or company leading the five-year review: Parsons	**Weather/temperature:** 50° Fair

Remedy Includes: (Check all that apply)

- G Landfill cover/containment
- G Access controls
- ✓ Institutional controls
- G Groundwater pump and treatment
- G Surface water collection and treatment
- G Other ______
- ✓ Monitored natural attenuation
- G Groundwater containment
- G Vertical barrier walls

Attachments: G Inspection team roster attached G Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Melissa Markell / Air Force RPM / 5/7/08
   Name / Title / Date
   Interviewed ✓ at site G at office G by phone Phone no. ______
   Problems, suggestions; G Report attached ______

2. **O&M staff** ______ / ______ / ______
   Name / Title / Date
   Interviewed G at site G at office G by phone Phone no. ______
   Problems, suggestions; G Report attached ______

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency ADEC
Contact Louis Howard — Enviro. Specialist — 8/14/07 — (907) 269-7552
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached See Note below and interview in Attachment E

Agency EPA Region 10
Contact Jacques Gusmano — Enviro. Specialist — 8/14/07 — (907) 271-1271
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

4. **Other interviews** (optional) G Report attached.

Notes from 8/14/07 meeting:
Concerns/Issues for 2008 Five Year Review
- Is MNA working
- Institutional controls working

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
   - ✓ O&M manual — ✓ Readily available — G Up to date — G N/A
   - G As-built drawings — G Readily available — G Up to date — ✓ N/A
   - ✓ Maintenance logs — ✓ Readily available — G Up to date — G N/A
   - Remarks: Monitoring plan / Annual Reports

2. **Site-Specific Health and Safety Plan** — ✓ Readily available — G Up to date — G N/A
   - G Contingency plan/emergency response plan — G Readily available — G Up to date — G N/A
   - Remarks: Parsons / Oasis

3. **O&M and OSHA Training Records** — ✓ Readily available — G Up to date — G N/A
   - Remarks: Parsons / Oasis

4. **Permits and Service Agreements**
   - G Air discharge permit — G Readily available — G Up to date — ✓ N/A
   - G Effluent discharge — G Readily available — G Up to date — ✓ N/A
   - G Waste disposal, POTW — G Readily available — G Up to date — ✓ N/A
   - G Other permits________ — G Readily available — G Up to date — G N/A
   - Remarks

5. **Gas Generation Records** — G Readily available — G Up to date — ✓ N/A
   - Remarks

6. **Settlement Monument Records** — G Readily available — G Up to date — ✓ N/A
   - Remarks

7. **Groundwater Monitoring Records** — ✓ Readily available — G Up to date — G N/A
   - Remarks: ERPIMS / Annual Reports

8. **Leachate Extraction Records** — G Readily available — G Up to date — ✓ N/A
   - Remarks

9. **Discharge Compliance Records**
   - G Air — G Readily available — G Up to date — ✓ N/A
   - G Water (effluent) — G Readily available — G Up to date — ✓ N/A
   - Remarks

10. **Daily Access/Security Logs** — G Readily available — G Up to date — ✓ N/A
    - Remarks: Area open to public

IV. O&M COSTS

1. **O&M Organization**
G State in-house — G Contractor for State
G PRP in-house — G Contractor for PRP
G Federal Facility in-house — ✓ Contractor for Federal Facility
G Other_______________

2. **O&M Cost Records** — Data from RIPs See tables in Section 4
✓ Readily available — ✓ Up to date
G Funding mechanism/agreement in place
Original O&M cost estimate in ROD — G Breakdown attached

Total annual cost by year for review period if available

From (Date)	To (Date)	Total cost	
			G Breakdown attached
			G Breakdown attached
			G Breakdown attached
			G Breakdown attached
			G Breakdown attached

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons: _______________

V. ACCESS AND INSTITUTIONAL CONTROLS G Applicable G N/A

A. Fencing

1. **Fencing damaged** — G Location shown on site map — G Gates secured — ✓ N/A
Remarks_______________

B. Other Access Restrictions

1. **Signs and other security measures** — G Location shown on site map — ✓ N/A
Remarks_______________

C. Institutional Controls (ICs)

1. **Implementation and enforcement** See Basewide IC Section 4.7

Site conditions imply ICs not properly implemented G Yes ✓No G N/A

Site conditions imply ICs not being fully enforced G Yes ✓No G N/A

Type of monitoring (*e.g.*, self-reporting, drive by) ________

Frequency ________

Responsible party/agency ________

Contact ________ Name ________ Title ________ Date Phone no.

Reporting is up-to-date G Yes G No G N/A

Reports are verified by the lead agency G Yes G No G N/A

Specific requirements in deed or decision documents have been met G Yes G No G N/A

Violations have been reported G Yes G No G N/A

Other problems or suggestions: G Report attached

2. **Adequacy** ✓ICs are adequate G ICs are inadequate G N/A

Remarks ________

D. General

1. **Vandalism/trespassing** G Location shown on site map ✓No vandalism evident

Remarks ________

2. **Land use changes on site** ✓N/A

Remarks ________

3. **Land use changes off site** ✓N/A

Remarks ________

VI. GENERAL SITE CONDITIONS

A. Roads ✓Applicable G N/A

1. **Roads damaged** G Location shown on site map G Roads adequate G N/A

Remarks Roads adequate

B. Other Site Conditions

Remarks ________

IX. GROUNDWATER/SURFACE WATER REMEDIES ✓ Applicable G N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines G Applicable ✓ N/A
1. **Pumps, Wellhead Plumbing, and Electrical** G Good condition G All required wells properly operating G Needs Maintenance G N/A Remarks
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks
3. **Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks
B. Surface Water Collection Structures, Pumps, and Pipelines G Applicable ✓ N/A
1. **Collection Structures, Pumps, and Electrical** G Good condition G Needs Maintenance Remarks
2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks
3. **Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks

C. Treatment System   G Applicable   ✓ N/A

1. **Treatment Train** (Check components that apply)
G Metals removal   G Oil/water separation   G Bioremediation
G Air stripping   G Carbon adsorbers
G Filters____
G Additive (*e.g.*, chelation agent, flocculent)________________________
G Others____
G Good condition   G Needs Maintenance
G Sampling ports properly marked and functional
G Sampling/maintenance log displayed and up to date
G Equipment properly identified
G Quantity of groundwater treated annually________________
G Quantity of surface water treated annually________________
Remarks____

2. **Electrical Enclosures and Panels** (properly rated and functional)
G N/A   G Good condition G Needs Maintenance
Remarks____

3. **Tanks, Vaults, Storage Vessels**
G N/A   G Good condition G Proper secondary containment   G Needs Maintenance
Remarks____

4. **Discharge Structure and Appurtenances**
G N/A   G Good condition G Needs Maintenance
Remarks____

5. **Treatment Building(s)**
G N/A   G Good condition (esp. roof and doorways)   G Needs repair
G Chemicals and equipment properly stored
Remarks____

6. **Monitoring Wells** (pump and treatment remedy)
G Properly secured/locked G Functioning   G Routinely sampled   G Good condition
G All required wells located   G Needs Maintenance   G N/A
Remarks____

D. Monitoring Data

1. Monitoring Data
✓ Is routinely submitted on time   ✓ Is of acceptable quality

2. Monitoring data suggests:
✓ Groundwater plume is effectively contained   ✓ Contaminant concentrations are declining

D. Monitored Natural Attenuation
1. **Monitoring Wells** (natural attenuation remedy) ✓ Properly secured/locked ✓ Functioning ✓ Routinely sampled ✓ Good condition ✓ All required wells located G Needs Maintenance G N/A Remarks

X. OTHER REMEDIES
If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS
A. Implementation of the Remedy
Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). Groundwater monitoring and LUCs - contaminants decreasing with time - contaminants appear to be coming from LF07
B. Adequacy of O&M
Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. Adequate

C.	Early Indicators of Potential Remedy Problems
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. None
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. None

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Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: ST41	**Date of inspection:** 5/7/08
Location and Region: Elmendorf AFB, AK Region 10	**EPA ID:** AK8570028649
Agency, office, or company leading the five-year review: Parsons	**Weather/temperature:** 50° Fair

Remedy Includes: (Check all that apply)

- G Landfill cover/containment
- G Access controls
- ✓ Institutional controls
- G Groundwater pump and treatment
- G Surface water collection and treatment
- G Other Free product recovery - complete
- ✓ Monitored natural attenuation
- G Groundwater containment
- G Vertical barrier walls

Attachments: G Inspection team roster attached G Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Donna Baumler (Name) Air Force RPM (Title) 5/7/08 (Date)
   Interviewed ✓ at site G at office G by phone Phone no. ________
   Problems, suggestions; G Report attached ________

2. **O&M staff** Dave Ward (Name) Jacobs (Title) 5/7/08 (Date)
   Interviewed ✓ at site G at office G by phone Phone no. ________
   Problems, suggestions; G Report attached ________

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency ADEC
Contact Louis Howard — Enviro. Specialist — 8/14/07 — (907) 269-7552
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached See Note below and interview in Attachment E

Agency EPA Region 10
Contact Jacques Gusmano — Enviro. Specialist — 8/14/07 — (907) 271-1271
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

4. **Other interviews** (optional) G Report attached.

Notes from 8/14/07 meeting:
Concerns/Issues for 2008 Five Year Review
- Is MNA working
- Institutional controls working

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1.	**O&M Documents**			
	✓ O&M manual	✓ Readily available	G Up to date	G N/A
	G As-built drawings	G Readily available	G Up to date	✓ N/A
	G Maintenance logs	G Readily available	G Up to date	✓ N/A
	Remarks Sampling Plan/Work Plan - Annual Report			
2.	**Site-Specific Health and Safety Plan**	G Readily available	✓ Up to date	G N/A
	G Contingency plan/emergency response plan	G Readily available	G Up to date	✓ N/A
	Remarks Work Plan			
3.	**O&M and OSHA Training Records**	G Readily available	✓ Up to date	G N/A
	Remarks At Jacobs			
4.	**Permits and Service Agreements**			
	G Air discharge permit	G Readily available	G Up to date	✓ N/A
	G Effluent discharge	G Readily available	G Up to date	✓ N/A
	G Waste disposal, POTW	G Readily available	G Up to date	✓ N/A
	G Other permits______	G Readily available	G Up to date	✓ N/A
	Remarks			
5.	**Gas Generation Records**	G Readily available	G Up to date	✓ N/A
	Remarks			
6.	**Settlement Monument Records**	G Readily available	G Up to date	✓ N/A
	Remarks			
7.	**Groundwater Monitoring Records**	✓ Readily available	G Up to date	G N/A
	Remarks ERPIMS/Annual reports			
8.	**Leachate Extraction Records**	G Readily available	G Up to date	✓ N/A
	Remarks			
9.	**Discharge Compliance Records**			
	G Air	G Readily available	G Up to date	✓ N/A
	G Water (effluent)	G Readily available	G Up to date	✓ N/A
	Remarks			
10.	**Daily Access/Security Logs**	G Readily available	G Up to date	✓ N/A
	Remarks			

IV. O&M COSTS

1. **O&M Organization**
G State in-house
G PRP in-house
G Federal Facility in-house
G Other____
G Contractor for State
G Contractor for PRP
G Contractor for Federal Facility

2. **O&M Cost Records**
G Readily available
G Up to date
G Funding mechanism/agreement in place
Original O&M cost estimate in ROD
G Breakdown attached

Data from RIPs
see tables in section 4

Total annual cost by year for review period if available

From ______ (Date)	To ______ (Date)	______ (Total cost)	G Breakdown attached
From ______ (Date)	To ______ (Date)	______ (Total cost)	G Breakdown attached
From ______ (Date)	To ______ (Date)	______ (Total cost)	G Breakdown attached
From ______ (Date)	To ______ (Date)	______ (Total cost)	G Breakdown attached
From ______ (Date)	To ______ (Date)	______ (Total cost)	G Breakdown attached

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons: ______________________________

V. ACCESS AND INSTITUTIONAL CONTROLS G Applicable G N/A

A. Fencing

1. **Fencing damaged** G Location shown on site map G Gates secured G N/A
Remarks____

B. Other Access Restrictions

1. **Signs and other security measures** G Location shown on site map G N/A
Remarks____

C. Institutional Controls (ICs)			
1.	**Implementation and enforcement**	See Basewide IC section 4.7	
	Site conditions imply ICs not properly implemented	G Yes ✓No G N/A	
	Site conditions imply ICs not being fully enforced	G Yes ✓No G N/A	
	Type of monitoring (*e.g.*, self-reporting, drive by) ___		
	Frequency ___		
	Responsible party/agency ___		
	Contact ___ Name ___ Title ___ Date ___ Phone no.		
	Reporting is up-to-date	G Yes G No G N/A	
	Reports are verified by the lead agency	G Yes G No G N/A	
	Specific requirements in deed or decision documents have been met	G Yes G No G N/A	
	Violations have been reported	G Yes G No G N/A	
	Other problems or suggestions: G Report attached		
2.	**Adequacy** ✓ICs are adequate G ICs are inadequate G N/A		
	Remarks ___		

D. General		
1.	**Vandalism/trespassing** G Location shown on site map ✓No vandalism evident	
	Remarks ___	
2.	**Land use changes on site** ✓N/A	
	Remarks ___	
3.	**Land use changes off site** ✓N/A	
	Remarks ___	

VI. GENERAL SITE CONDITIONS

A. Roads G Applicable ✓N/A	
1. **Roads damaged** G Location shown on site map G Roads adequate G N/A	
Remarks ___	

B. Other Site Conditions

Remarks ___

IX. GROUNDWATER/SURFACE WATER REMEDIES G Applicable ✓N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines G Applicable G N/A
1. **Pumps, Wellhead Plumbing, and Electrical** G Good condition G All required wells properly operating G Needs Maintenance G N/A Remarks
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks
3. **Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks
B. Surface Water Collection Structures, Pumps, and Pipelines G Applicable ✓N/A
1. **Collection Structures, Pumps, and Electrical** G Good condition G Needs Maintenance Remarks
2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks
3. **Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks

C. Treatment System G Applicable ✓N/A
1. **Treatment Train** (Check components that apply) G Metals removal G Oil/water separation G Bioremediation G Air stripping G Carbon adsorbers G Filters___ G Additive (*e.g.*, chelation agent, flocculent)___ G Others___ G Good condition G Needs Maintenance G Sampling ports properly marked and functional G Sampling/maintenance log displayed and up to date G Equipment properly identified G Quantity of groundwater treated annually___ G Quantity of surface water treated annually___ Remarks___
2. **Electrical Enclosures and Panels** (properly rated and functional) G N/A G Good condition G Needs Maintenance Remarks___
3. **Tanks, Vaults, Storage Vessels** G N/A G Good condition G Proper secondary containment G Needs Maintenance Remarks___
4. **Discharge Structure and Appurtenances** G N/A G Good condition G Needs Maintenance Remarks___
5. **Treatment Building(s)** G N/A G Good condition (esp. roof and doorways) G Needs repair G Chemicals and equipment properly stored Remarks___
6. **Monitoring Wells** (pump and treatment remedy) G Properly secured/locked G Functioning G Routinely sampled G Good condition G All required wells located G Needs Maintenance G N/A Remarks___

D. Monitoring Data
1. Monitoring Data ✓Is routinely submitted on time ✓Is of acceptable quality
2. Monitoring data suggests: ✓Groundwater plume is effectively contained ✓Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)

☑ Properly secured/locked ☑ Functioning ☑ Routinely sampled G Good condition
☑ All required wells located ☑ Needs Maintenance G N/A

Remarks ST41-25, ST41-07, ST41-28 and ST41-20 have heaved

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

Mark, record GPS coordinates and sample north POC for surface water

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

O+M is adequate and the remedy is protective

C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. N/A
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. N/A

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Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: SD24, SD25, SD28, SD29	**Date of inspection:** 5/7/08
Location and Region: Elmendorf AFB, AK Reg 10	**EPA ID:** AK8570028649
Agency, office, or company leading the five-year review: Parsons	**Weather/temperature:** 50° Fair

Remedy Includes: (Check all that apply)

- G Landfill cover/containment
- G Access controls
- ✓ Institutional controls
- G Groundwater pump and treatment
- G Surface water collection and treatment
- G Other
- ✓ Monitored natural attenuation
- G Groundwater containment
- G Vertical barrier walls

Attachments: G Inspection team roster attached   G Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Claude Mayer (Name)   Air Force RPM (Title)   5/7/08 (Date)
   Interviewed ✓ at site G at office G by phone Phone no. ______
   Problems, suggestions; G Report attached ______

2. **O&M staff** Marty Hannah (Name)   Oasis (Title)   5/7/08 (Date)
   Interviewed ✓ at site G at office G by phone Phone no. ______
   Problems, suggestions; G Report attached ______

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency ADEC
Contact Louis Howard (Name) — Enviro. Specialist (Title) — 8/14/07 (Date) — (907) 269-7552 (Phone no.)
Problems; suggestions; G Report attached See Note below and interview in Attachment E

Agency EPA Region 10
Contact Jacques Gusmano (Name) — Enviro. Specialist (Title) — 8/14/07 (Date) — (907) 271-1271 (Phone no.)
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

4. **Other interviews** (optional) G Report attached.

Notes from 8/14/07 meeting:
Concerns/Issues for 2008 Five Year Review
- Is MNA working
- Institutional controls working

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
   G O&M manual ✓Readily available G Up to date G N/A
   G As-built drawings G Readily available G Up to date ✓N/A
   G Maintenance logs G Readily available G Up to date ✓N/A
   Remarks Sampling Plans / Sampling logs

2. **Site-Specific Health and Safety Plan** ✓Readily available ✓Up to date G N/A
   G Contingency plan/emergency response plan G Readily available G Up to date ✓N/A
   Remarks Parsons / Oasis

3. **O&M and OSHA Training Records** ✓Readily available G Up to date G N/A
   Remarks At Oasis

4. **Permits and Service Agreements**
   G Air discharge permit G Readily available G Up to date ✓N/A
   G Effluent discharge G Readily available G Up to date ✓N/A
   G Waste disposal, POTW G Readily available G Up to date ✓N/A
   G Other permits__________ G Readily available G Up to date ✓N/A
   Remarks

5. **Gas Generation Records** G Readily available G Up to date ✓N/A
   Remarks

6. **Settlement Monument Records** G Readily available G Up to date ✓N/A
   Remarks

7. **Groundwater Monitoring Records** ✓Readily available G Up to date G N/A
   Remarks ERPIMS / Annual Rpts
   SD29 well monitored every 5 yrs

8. **Leachate Extraction Records** G Readily available G Up to date ✓N/A
   Remarks

9. **Discharge Compliance Records**
   G Air G Readily available G Up to date ✓N/A
   G Water (effluent) G Readily available G Up to date ✓N/A
   Remarks

10. **Daily Access/Security Logs** G Readily available G Up to date ✓N/A
    Remarks Wells located within security area

IV. O&M COSTS

1. **O&M Organization**
G State in-house G Contractor for State
G PRP in-house G Contractor for PRP
G Federal Facility in-house ✓ Contractor for Federal Facility
G Other

2. **O&M Cost Records** Data from RIPS see tables in Section 4
✓ Readily available ✓ Up to date
G Funding mechanism/agreement in place
Original O&M cost estimate in ROD G Breakdown attached

Total annual cost by year for review period if available

From ______ To ______	______	G Breakdown attached
Date Date	Total cost	
From ______ To ______	______	G Breakdown attached
Date Date	Total cost	
From ______ To ______	______	G Breakdown attached
Date Date	Total cost	
From ______ To ______	______	G Breakdown attached
Date Date	Total cost	
From ______ To ______	______	G Breakdown attached
Date Date	Total cost	

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons:

V. ACCESS AND INSTITUTIONAL CONTROLS ✓ Applicable G N/A

A. Fencing

1. **Fencing damaged** G Location shown on site map ✓ Gates secured ✓ N/A
Remarks SD29, SD24 + SD25 wells located inside secured fenced area

B. Other Access Restrictions

1. **Signs and other security measures** G Location shown on site map ✓ N/A
Remarks

C. Institutional Controls (ICs)

1. **Implementation and enforcement** See Basewide IC section 4.7

Site conditions imply ICs not properly implemented G Yes G No G N/A

Site conditions imply ICs not being fully enforced G Yes G No G N/A

Type of monitoring (*e.g.*, self-reporting, drive by) ____________

Frequency ____________

Responsible party/agency ____________

Contact ____________

Name Title Date Phone no.

Reporting is up-to-date G Yes G No G N/A

Reports are verified by the lead agency G Yes G No G N/A

Specific requirements in deed or decision documents have been met G Yes G No G N/A

Violations have been reported G Yes G No G N/A

Other problems or suggestions: G Report attached

____

2. **Adequacy** G ICs are adequate G ICs are inadequate G N/A

Remarks ____________

D. General

1. **Vandalism/trespassing** G Location shown on site map G No vandalism evident

Remarks ____________

2. **Land use changes on site** G N/A

Remarks ____________

3. **Land use changes off site** G N/A

Remarks ____________

VI. GENERAL SITE CONDITIONS

A. Roads G Applicable G N/A

1. **Roads damaged** G Location shown on site map G Roads adequate G N/A

Remarks ____________

B. Other Site Conditions

Remarks ____________

IX. GROUNDWATER/SURFACE WATER REMEDIES G Applicable ✓N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines G Applicable ✓N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
G Good condition G All required wells properly operating G Needs Maintenance G N/A
Remarks____

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
G Good condition G Needs Maintenance
Remarks____

3. **Spare Parts and Equipment**
G Readily available G Good condition G Requires upgrade G Needs to be provided
Remarks____

B. Surface Water Collection Structures, Pumps, and Pipelines G Applicable ✓N/A

1. **Collection Structures, Pumps, and Electrical**
G Good condition G Needs Maintenance
Remarks____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
G Good condition G Needs Maintenance
Remarks____

3. **Spare Parts and Equipment**
G Readily available G Good condition G Requires upgrade G Needs to be provided
Remarks____

C. Treatment System	G Applicable	G N/A

1. **Treatment Train** (Check components that apply)
G Metals removal G Oil/water separation G Bioremediation
G Air stripping G Carbon adsorbers
G Filters_______
G Additive (*e.g.*, chelation agent, flocculent)_______
G Others_______
G Good condition G Needs Maintenance
G Sampling ports properly marked and functional
G Sampling/maintenance log displayed and up to date
G Equipment properly identified
G Quantity of groundwater treated annually_______
G Quantity of surface water treated annually_______
Remarks_______

2. **Electrical Enclosures and Panels** (properly rated and functional)
G N/A G Good condition G Needs Maintenance
Remarks_______

3. **Tanks, Vaults, Storage Vessels**
G N/A G Good condition G Proper secondary containment G Needs Maintenance
Remarks_______

4. **Discharge Structure and Appurtenances**
G N/A G Good condition G Needs Maintenance
Remarks_______

5. **Treatment Building(s)**
G N/A G Good condition (esp. roof and doorways) G Needs repair
G Chemicals and equipment properly stored
Remarks_______

6. **Monitoring Wells** (pump and treatment remedy)
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G All required wells located G Needs Maintenance G N/A
Remarks_______

D. Monitoring Data

1. Monitoring Data – None for SD28 since ROD
G Is routinely submitted on time G Is of acceptable quality

2. Monitoring data suggests:
G Groundwater plume is effectively contained G Contaminant concentrations are declining Not at SD25

D. Monitored Natural Attenuation	
1.	**Monitoring Wells** (natural attenuation remedy) ✓ Properly secured/locked ✓ Functioning ✓ Routinely sampled ✓ Good condition ✓ All required wells located G Needs Maintenance G N/A Remarks SD24 well located in secure area - viewed through fence SD28 - no well + no gw contamination

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

SD24 - Contamination concentration decreasing
sampled every 5 years
SD25 - Replacement well installed in 2003
which may be the cause of concentration
increase
SD28 - No monitoring at this site

SD29 - Decreasing concentrations

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Adequate

C.	Early Indicators of Potential Remedy Problems
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. None
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. None

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Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: FT23	Date of inspection: 5/7/08
Location and Region: Elmendorf AFB AK/Reg 10	EPA ID: AK8570028649
Agency, office, or company leading the five-year review: Parsons	Weather/temperature: 50° Fair
Remedy Includes: (Check all that apply) G Landfill cover/containment G Access controls ✓ Institutional controls G Groundwater pump and treatment G Surface water collection and treatment ✓ Other Bioventing	✓ Monitored natural attenuation G Groundwater containment G Vertical barrier walls
Attachments: G Inspection team roster attached	G Site map attached

II. INTERVIEWS (Check all that apply)
1. O&M site manager Claude Mayer (Name) Air Force RPM (Title) 5/7/08 (Date) Interviewed ✓ at site G at office G by phone Phone no. ______ Problems, suggestions; G Report attached ______
2. O&M staff Marty Hannah (Name) Oasis (Title) 5/7/08 (Date) Interviewed ✓ at site G at office G by phone Phone no. ______ Problems, suggestions; G Report attached ______

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency ADEC
Contact Louis Howard — Enviro. Specialist — 8/14/07 — (907) 269-7552
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached See Note below and interview in Attachment E

Agency EPA Region 10
Contact Jacques Gusmano — Enviro. Specialist — 8/14/07 — (907) 271-1271
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

4. **Other interviews** (optional) G Report attached.

Notes from 8/14/07 meeting:
Concerns/Issues for 2008 Five Year Review
- Is MNA working
- Institutional controls working

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
   - ✓ O&M manual — ✓ Readily available — ✓ Up to date — G N/A
   - ✓ As-built drawings — ✓ Readily available — ✓ Up to date — G N/A
   - ✓ Maintenance logs — ✓ Readily available — ✓ Up to date — G N/A
   - Remarks____

2. **Site-Specific Health and Safety Plan** — ✓ Readily available — G Up to date — G N/A
   - G Contingency plan/emergency response plan — G Readily available — G Up to date — G N/A
   - Remarks Parsons | Oasis

3. **O&M and OSHA Training Records** — ✓ Readily available — G Up to date — G N/A
   - Remarks at Oasis

4. **Permits and Service Agreements**
   - G Air discharge permit — G Readily available — G Up to date — ✓ N/A
   - G Effluent discharge — G Readily available — G Up to date — ✓ N/A
   - G Waste disposal, POTW — G Readily available — G Up to date — ✓ N/A
   - G Other permits______________ — G Readily available — G Up to date — ✓ N/A
   - Remarks____

5. **Gas Generation Records** — G Readily available — G Up to date — ✓ N/A
   - Remarks____

6. **Settlement Monument Records** — G Readily available — G Up to date — ✓ N/A
   - Remarks____

7. **Groundwater Monitoring Records** — ✓ Readily available — ✓ Up to date — G N/A
   - Remarks ERPIMS + Annual Report

8. **Leachate Extraction Records** — G Readily available — G Up to date — ✓ N/A
   - Remarks____

9. **Discharge Compliance Records**
   - G Air — G Readily available — G Up to date — ✓ N/A
   - G Water (effluent) — G Readily available — G Up to date — ✓ N/A
   - Remarks____

10. **Daily Access/Security Logs** — G Readily available — G Up to date — ✓ N/A
    - Remarks____

IV. O&M COSTS

1. **O&M Organization**

G State in-house — G Contractor for State
G PRP in-house — G Contractor for PRP
G Federal Facility in-house — ✓ Contractor for Federal Facility
G Other________________________________

2. **O&M Cost Records** — Data from RIPS see tables in Section 4

✓ Readily available — ✓ Up to date
G Funding mechanism/agreement in place
Original O&M cost estimate in ROD — G Breakdown attached

Total annual cost by year for review period if available

From________ To________ ________ G Breakdown attached
Date — Date — Total cost
From________ To________ ________ G Breakdown attached
Date — Date — Total cost
From________ To________ ________ G Breakdown attached
Date — Date — Total cost
From________ To________ ________ G Breakdown attached
Date — Date — Total cost
From________ To________ ________ G Breakdown attached
Date — Date — Total cost

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons: ________________________________

V. ACCESS AND INSTITUTIONAL CONTROLS G Applicable G N/A

A. Fencing

1. **Fencing damaged** G Location shown on site map G Gates secured ✓ N/A
Remarks________________________________

B. Other Access Restrictions

1. **Signs and other security measures** G Location shown on site map ✓ N/A
Remarks________________________________

C. Institutional Controls (ICs)

1. **Implementation and enforcement** See Basewide IC Section 4.7

Site conditions imply ICs not properly implemented G Yes ✓No G N/A

Site conditions imply ICs not being fully enforced G Yes ✓No G N/A

Type of monitoring (*e.g.*, self-reporting, drive by) ______

Frequency ______

Responsible party/agency ______

Contact ______ Name ______ Title ______ Date ______ Phone no.

Reporting is up-to-date G Yes G No G N/A

Reports are verified by the lead agency G Yes G No G N/A

Specific requirements in deed or decision documents have been met G Yes G No G N/A

Violations have been reported G Yes G No G N/A

Other problems or suggestions: G Report attached

2. **Adequacy** ✓ICs are adequate G ICs are inadequate G N/A

Remarks ______

D. General

1. **Vandalism/trespassing** G Location shown on site map ✓No vandalism evident

Remarks ______

2. **Land use changes on site** G N/A

Remarks New hangars built recently - vapor intrusion barrier built into design

3. **Land use changes off site** ✓N/A

Remarks ______

VI. GENERAL SITE CONDITIONS

A. Roads ✓Applicable G N/A

1. **Roads damaged** G Location shown on site map ✓Roads adequate G N/A

Remarks No damage

B. Other Site Conditions

Remarks Part of site inside security fence

IX. GROUNDWATER/SURFACE WATER REMEDIES ✓ Applicable G N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines G Applicable ✓ N/A
1. **Pumps, Wellhead Plumbing, and Electrical** G Good condition G All required wells properly operating G Needs Maintenance G N/A Remarks________________
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks________________
3. **Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks________________
B. Surface Water Collection Structures, Pumps, and Pipelines G Applicable ✓ N/A
1. **Collection Structures, Pumps, and Electrical** G Good condition G Needs Maintenance Remarks________________
2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks________________
3. **Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks________________

C. Treatment System	☑ Applicable G N/A

1. **Treatment Train** (Check components that apply)
   G Metals removal   G Oil/water separation   ☑ Bioremediation / Bioventing
   G Air stripping   G Carbon adsorbers
   G Filters
   G Additive (*e.g.*, chelation agent, flocculent)
   G Others
   ☑ Good condition   G Needs Maintenance
   ☑ Sampling ports properly marked and functional
   ☑ Sampling/maintenance log displayed and up to date
   ☑ Equipment properly identified
   G Quantity of groundwater treated annually Ø
   G Quantity of surface water treated annually Ø
   Remarks One vent had problems with airflow due to ice blockage in lines

2. **Electrical Enclosures and Panels** (properly rated and functional)
   G N/A   ☑ Good condition G Needs Maintenance
   Remarks Experienced problem in Dec/Jan 08 - VFD replaced

3. **Tanks, Vaults, Storage Vessels**
   ☑ N/A   G Good condition G Proper secondary containment   G Needs Maintenance
   Remarks

4. **Discharge Structure and Appurtenances**
   ☑ N/A   G Good condition G Needs Maintenance
   Remarks

5. **Treatment Building(s)**
   ☑ N/A   G Good condition (esp. roof and doorways)   G Needs repair
   G Chemicals and equipment properly stored
   Remarks

6. **Monitoring Wells** (pump and treatment remedy)
   ☑ Properly secured/locked ☑ Functioning   ☑ Routinely sampled   ☑ Good condition
   ☑ All required wells located   ☑ Needs Maintenance   G N/A
   Remarks Cap on well FP56

D. Monitoring Data

1. Monitoring Data
   ☑ Is routinely submitted on time   ☑ Is of acceptable quality

2. Monitoring data suggests:
   ☑ Groundwater plume is effectively contained   ☑ Contaminant concentrations are declining

D. Monitored Natural Attenuation
1. **Monitoring Wells** (natural attenuation remedy) ✓ Properly secured/locked ✓ Functioning ✓ Routinely sampled ✓ Good condition ✓ All required wells located G Needs Maintenance G N/A Remarks

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

Only one portion of site remains with soil above cleanup level, but 4-5 vents are still operating.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Adequate

C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. None
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. None

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Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: ST37	**Date of inspection:** 5/6/08
Location and Region: Elmendorf AFB AK/Reg 10	**EPA ID:** AK 8570028649
Agency, office, or company leading the five-year review: Parsons	**Weather/temperature:** 50° Fair
Remedy Includes: (Check all that apply) G Landfill cover/containment G Access controls G ✓ Institutional controls G Groundwater pump and treatment G ✓ Surface water collection and treatment G Other ______	G ✓ Monitored natural attenuation G Groundwater containment G Vertical barrier walls
Attachments: G Inspection team roster attached	G Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Melissa Markell (Name) Air Force RPM (Title) 5/6/08 (Date)
Interviewed G at site G ✓ at office G by phone Phone no. ______
Problems, suggestions; G Report attached ______

2. **O&M staff** Marty Hannah (Name) Oasis (Title) 5/6/08 (Date)
Interviewed G ✓ at site G at office G by phone Phone no. 907-264-4442
Problems, suggestions; G Report attached Problems with pumps/controllers noted in this checklist

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency ADEC
Contact Louis Howard — Enviro. Specialist — 8/14/07 — (907) 269-7552
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached See Note below and interview in Attachment E

Agency EPA Region 10
Contact Jacques Gusmano — Enviro. Specialist — 8/14/07 — (907) 271-1271
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

4. **Other interviews** (optional) G Report attached.

Notes from 8/14/07 meeting:
Concerns/Issues for 2008 Five Year Review
- Is MNA working
- Institutional controls working

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)			
1. **O&M Documents**			
✓ O&M manual updated - June 06	✓ Readily available	✓ Up to date	G N/A
✓ As-built drawings	✓ Readily available	✓ Up to date	G N/A
✓ Maintenance logs	✓ Readily available	✓ Up to date	G N/A
Remarks These documents were with the contracted O+M personnel - Mr. Hannah			
2. **Site-Specific Health and Safety Plan**	✓ Readily available	✓ Up to date	G N/A
G Contingency plan/emergency response plan	G Readily available	G Up to date	G N/A
Remarks Tailgate safety meeting notes in binder			
3. **O&M and OSHA Training Records**	G Readily available	G Up to date	G N/A
Remarks At Oasis - Shawna Bragg - records			
4. **Permits and Service Agreements**			
G Air discharge permit	G Readily available	G Up to date	✓ N/A
G Effluent discharge	G Readily available	G Up to date	✓ N/A
G Waste disposal, POTW	G Readily available	G Up to date	✓ N/A
G Other permits____	G Readily available	G Up to date	G N/A
Remarks			
5. **Gas Generation Records**	G Readily available	G Up to date	✓ N/A
Remarks			
6. **Settlement Monument Records**	G Readily available	G Up to date	✓ N/A
Remarks			
7. **Groundwater Monitoring Records**	✓ Readily available	G Up to date	G N/A
Remarks ERPIMS + Annual Reports			
8. **Leachate Extraction Records**	G Readily available	G Up to date	✓ N/A
Remarks			
9. **Discharge Compliance Records**			
G Air	G Readily available	G Up to date	✓ N/A
✓ Water (effluent)	✓ Readily available	✓ Up to date	G N/A
Remarks Iron effluent only			
10. **Daily Access/Security Logs**	G Readily available	G Up to date	✓ N/A
Remarks			

IV. O&M COSTS

1. **O&M Organization**

G State in-house
G PRP in-house
G Federal Facility in-house
G Other______________________________

G Contractor for State
G Contractor for PRP
✓ Contractor for Federal Facility

2. **O&M Cost Records**

✓ Readily available ✓ Up to date
G Funding mechanism/agreement in place
Original O&M cost estimate in ROD G Breakdown attached

Data from RIPS
see tables in Section 4

Total annual cost by year for review period if available

From______ Date	To______ Date	______ Total cost	G Breakdown attached
From______ Date	To______ Date	______ Total cost	G Breakdown attached
From______ Date	To______ Date	______ Total cost	G Breakdown attached
From______ Date	To______ Date	______ Total cost	G Breakdown attached
From______ Date	To______ Date	______ Total cost	G Breakdown attached

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: ______________________________

V. ACCESS AND INSTITUTIONAL CONTROLS ✓ Applicable G N/A

A. Fencing

1. **Fencing damaged** G Location shown on site map ✓ Gates secured G N/A

Remarks ARRC controlled area
fences for overland flow cell, pump stations - all locked

B. Other Access Restrictions

1. **Signs and other security measures** G Location shown on site map ✓ N/A

Remarks______________________________

C. Institutional Controls (ICs)			
1. **Implementation and enforcement** See Basewide IC section 4.7			
Site conditions imply ICs not properly implemented	G Yes	✓No	G N/A
Site conditions imply ICs not being fully enforced	G Yes	✓No	G N/A

Type of monitoring (*e.g.*, self-reporting, drive by) ______
Frequency ______
Responsible party/agency ______
Contact ______
Name   Title   Date   Phone no.

Reporting is up-to-date	G Yes	G No	G N/A
Reports are verified by the lead agency	G Yes	G No	G N/A
Specific requirements in deed or decision documents have been met	G Yes	G No	G N/A
Violations have been reported	G Yes	G No	G N/A

Other problems or suggestions: G Report attached
This site has off base contamination - currently controlled through easement - valid through 2026

2. **Adequacy** ✓ICs are adequate G ICs are inadequate G N/A
Remarks ______

D. General

1. **Vandalism/trespassing** G Location shown on site map ✓No vandalism evident
Remarks ______

2. **Land use changes on site** ✓N/A
Remarks ______

3. **Land use changes off site** ✓N/A
Remarks ______

VI. GENERAL SITE CONDITIONS

A. Roads G Applicable G N/A

1. **Roads damaged** G Location shown on site map ✓Roads adequate G N/A
Remarks ______

B. Other Site Conditions

Remarks WRS and pumpstations on ARRC property

IX. GROUNDWATER/SURFACE WATER REMEDIES ✓ Applicable G N/A	
A. Groundwater Extraction Wells, Pumps, and Pipelines G Applicable ✓ N/A	
1.	**Pumps, Wellhead Plumbing, and Electrical** G Good condition G All required wells properly operating G Needs Maintenance G N/A Remarks
2.	**Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks
3.	**Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks
B. Surface Water Collection Structures, Pumps, and Pipelines ✓ Applicable G N/A	
1.	**Collection Structures, Pumps, and Electrical** ✓ Good condition G Needs Maintenance Remarks Gravel collection structures work fine. 3 pumps needed replacing last winter (seals). Replaced VFD in PS2 in Feb 08
2.	**Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ✓ Good condition G Needs Maintenance Remarks Gravel drains
3.	**Spare Parts and Equipment** ✓ Readily available ✓ Good condition G Requires upgrade G Needs to be provided Remarks Rebuilt pumps (3 this winter). Rebuilt pumps stored - ready to replace

C. Treatment System	✓ Applicable G N/A
1.	**Treatment Train** (Check components that apply) ✓ Metals removal - iron precip. G Oil/water separation ✓ Bioremediation G Air stripping G Carbon adsorbers G Filters G Additive (*e.g.*, chelation agent, flocculent) G Others ✓ Good condition G Needs Maintenance ✓ Sampling ports properly marked and functional ✓ Sampling/maintenance log displayed and up to date G Equipment properly identified G Quantity of groundwater treated annually G Quantity of surface water treated annually 20-25 gpm - pumped Remarks Valves replaced in overland cell Seeps 9,10+11 white pipe - 5gpm black pipe - 10gpm
2.	**Electrical Enclosures and Panels** (properly rated and functional) G N/A ✓ Good condition G Needs Maintenance Remarks Programmable logic control getting corrupted
3.	**Tanks, Vaults, Storage Vessels** ✓ N/A G Good condition G Proper secondary containment G Needs Maintenance Remarks
4.	**Discharge Structure and Appurtenances** G N/A ✓ Good condition G Needs Maintenance Remarks
5.	**Treatment Building(s)** ✓ N/A G Good condition (esp. roof and doorways) G Needs repair G Chemicals and equipment properly stored Remarks
6.	**Monitoring Wells** (pump and treatment remedy) G Properly secured/locked G Functioning G Routinely sampled G Good condition G All required wells located G Needs Maintenance ✓ N/A Remarks
D. Monitoring Data	
1.	Monitoring Data ✓ Is routinely submitted on time ✓ Is of acceptable quality
2.	Monitoring data suggests: See detailed description in Section 6.4.4 ✓ Groundwater plume is effectively contained ✓ Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)

- [x] Properly secured/locked
- [x] Functioning
- [x] Routinely sampled
- [x] Good condition
- [x] All required wells located
- [x] Needs Maintenance
- [ ] N/A

Remarks 49WL-01 - broken cap OUSMW-06 cracked concrete OUSMW-10 + NS3-02 casing slightly high / frost heave

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

Natural attenuation of groundwater
Wetland remediation system / Beaver Pond wetland treatment for contaminated seeps
- Ship Creek (POC) appears to be protected
- Determine if Seep 7 needs to be captured + treated

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Pumps are a maintenance problem
controller gives false alarms

C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. Seep 7 - determine if it needs to be captured/treated Fairchild Ave Plume - is it properly defined?
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. System designed for fuel - expensive - overland cell - serves only for iron removal Pump Stations 1+2 appear to be pumping clean water - if these seeps could be taken offline, O+M costs would be substantially reduced

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Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: LF02	Date of inspection: 5/7/08
Location and Region: Elmendorf AFB, AK/Reg 10	EPA ID: AK8570028649
Agency, office, or company leading the five-year review: Parsons	Weather/temperature: 50° Fair

Remedy Includes: (Check all that apply)

- ✓ Landfill cover/containment
- G Access controls
- ✓ Institutional controls
- G Groundwater pump and treatment
- G Surface water collection and treatment
- G Other
- ✓ Monitored natural attenuation
- G Groundwater containment
- G Vertical barrier walls

Attachments: G Inspection team roster attached G Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Donna Baumler (Name) Air Force RPM (Title) 5/7/08 (Date)
   Interviewed ✓ at site G at office G by phone Phone no. ______
   Problems, suggestions; G Report attached ______

2. **O&M staff** Dave Ward (Name) Jacobs (Title) 5/7/08 (Date)
   Interviewed ✓ at site G at office G by phone Phone no. ______
   Problems, suggestions; G Report attached ______

3.	**Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply. Agency ADEC Contact Louis Howard — Enviro. Specialist — 8/14/07 — (907) 269-7552 Name — Title — Date — Phone no. Problems; suggestions; G Report attached See Note below and interview in Attachment E Agency EPA Region 10 Contact Jacques Gusmano — Enviro. Specialist — 8/14/07 — (907) 271-1271 Name — Title — Date — Phone no. Problems; suggestions; G Report attached Agency Contact Name — Title — Date — Phone no. Problems; suggestions; G Report attached Agency Contact Name — Title — Date — Phone no. Problems; suggestions; G Report attached
4.	**Other interviews** (optional) G Report attached. Notes from 8/14/07 meeting: Concerns/Issues for 2008 Five Year Review - Is MNA working - Institutional controls working

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	**O&M Documents**			
	✓ O&M manual	✓ Readily available	✓ Up to date	G N/A
	G As-built drawings	G Readily available	G Up to date	✓ N/A
	✓ Maintenance logs	✓ Readily available	✓ Up to date	G N/A
	Remarks Sampling plans / Annual Reports			
2.	**Site-Specific Health and Safety Plan**	✓ Readily available	✓ Up to date	G N/A
	G Contingency plan/emergency response plan	G Readily available	G Up to date	G N/A
	Remarks Work Plan			
3.	**O&M and OSHA Training Records**	✓ Readily available	✓ Up to date	G N/A
	Remarks At Jacobs			
4.	**Permits and Service Agreements**			
	G Air discharge permit	G Readily available	G Up to date	✓ N/A
	G Effluent discharge	G Readily available	G Up to date	✓ N/A
	G Waste disposal, POTW	G Readily available	G Up to date	✓ N/A
	G Other permits________	G Readily available	G Up to date	✓ N/A
	Remarks________			
5.	**Gas Generation Records**	G Readily available	G Up to date	✓ N/A
	Remarks________			
6.	**Settlement Monument Records**	G Readily available	G Up to date	✓ N/A
	Remarks________			
7.	**Groundwater Monitoring Records**	✓ Readily available	✓ Up to date	G N/A
	Remarks ERPIMS / Annual Reports			
8.	**Leachate Extraction Records**	G Readily available	G Up to date	✓ N/A
	Remarks________			
9.	**Discharge Compliance Records**			
	G Air	G Readily available	G Up to date	✓ N/A
	G Water (effluent)	G Readily available	G Up to date	✓ N/A
	Remarks________			
10.	**Daily Access/Security Logs**	G Readily available	G Up to date	✓ N/A
	Remarks________			

IV. O&M COSTS

1. **O&M Organization**

G State in-house — G Contractor for State
G PRP in-house — G Contractor for PRP
G Federal Facility in-house — ✓ Contractor for Federal Facility
G Other___________________

2. **O&M Cost Records** — Data from RIPs see tables in Section 4

✓ Readily available — ✓ Up to date
G Funding mechanism/agreement in place
Original O&M cost estimate in ROD — G Breakdown attached

Total annual cost by year for review period if available

From (Date)	To (Date)	Total cost	
			G Breakdown attached
			G Breakdown attached
			G Breakdown attached
			G Breakdown attached
			G Breakdown attached

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: ___________________

V. ACCESS AND INSTITUTIONAL CONTROLS ✓ Applicable G N/A

A. Fencing

1. **Fencing damaged** — G Location shown on site map — G Gates secured — ✓ N/A

Remarks___________________

B. Other Access Restrictions

1. **Signs and other security measures** — G Location shown on site map — ✓ N/A

Remarks___________________

C. Institutional Controls (ICs)

1. **Implementation and enforcement** See Basewide IC Section 4.7

Site conditions imply ICs not properly implemented G Yes ✓No G N/A

Site conditions imply ICs not being fully enforced G Yes ✓No G N/A

Type of monitoring (*e.g.*, self-reporting, drive by) ____________

Frequency ____________

Responsible party/agency ____________

Contact ____________ ____________ ____________ ____________

Name Title Date Phone no.

Reporting is up-to-date G Yes G No G N/A

Reports are verified by the lead agency G Yes G No G N/A

Specific requirements in deed or decision documents have been met G Yes G No G N/A

Violations have been reported G Yes G No G N/A

Other problems or suggestions: G Report attached

____

2. **Adequacy** G ICs are adequate G ICs are inadequate G N/A

Remarks ____________

D. General

1. **Vandalism/trespassing** G Location shown on site map ✓No vandalism evident

Remarks ____________

2. **Land use changes on site** ✓N/A

Remarks ____________

3. **Land use changes off site** ✓N/A

Remarks ____________

VI. GENERAL SITE CONDITIONS

A. Roads G Applicable ✓N/A

1. **Roads damaged** G Location shown on site map G Roads adequateG N/A

Remarks ____________

B. Other Site Conditions

Remarks Heavily wooded

VII. LANDFILL COVERS ☑ Applicable G N/A

A. Landfill Surface

1. **Settlement** (Low spots) G Location shown on site map G Settlement not evident
   Areal extent______ Depth______
   Remarks Site heavily wooded - not obvious as landfill or former covered area

2. **Cracks** G Location shown on site map G Cracking not evident
   Lengths______ Widths______ Depths______
   Remarks______

3. **Erosion** G Location shown on site map G Erosion not evident
   Areal extent______ Depth______
   Remarks______

4. **Holes** G Location shown on site map G Holes not evident
   Areal extent______ Depth______
   Remarks______

5. **Vegetative Cover** G Grass G Cover properly established G No signs of stress
   ☑ Trees/Shrubs (indicate size and locations on a diagram)
   Remarks Heavily wooded

6. **Alternative Cover (armored rock, concrete, etc.)** G N/A
   Remarks______

7. **Bulges** G Location shown on site map G Bulges not evident
   Areal extent______ Height______
   Remarks______

8.	**Wet Areas/Water Damage**	G Wet areas/water damage not evident	
	G Wet areas	G Location shown on site map	Areal extent______
	G Ponding	G Location shown on site map	Areal extent______
	G Seeps	G Location shown on site map	Areal extent______
	G Soft subgrade	G Location shown on site map	Areal extent______
	Remarks______		
9.	**Slope Instability** G Slides	G Location shown on site map	G No evidence of slope instability
	Areal extent______		
	Remarks______		
B. Benches	G Applicable ✓N/A		
	(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)		
1.	**Flows Bypass Bench**	G Location shown on site map	G N/A or okay
	Remarks______		
2.	**Bench Breached**	G Location shown on site map	G N/A or okay
	Remarks______		
3.	**Bench Overtopped**	G Location shown on site map	G N/A or okay
	Remarks______		
C. Letdown Channels	G Applicable ✓N/A		
	(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)		
1.	**Settlement**	G Location shown on site map	G No evidence of settlement
	Areal extent______	Depth______	
	Remarks______		
2.	**Material Degradation**	G Location shown on site map	G No evidence of degradation
	Material type______	Areal extent______	
	Remarks______		
3.	**Erosion**	G Location shown on site map	G No evidence of erosion
	Areal extent______	Depth______	
	Remarks______		

4.	**Undercutting** G Location shown on site map G No evidence of undercutting Areal extent______ Depth______ Remarks______
5.	**Obstructions** Type______ G No obstructions G Location shown on site map Areal extent______ Size______ Remarks______
6.	**Excessive Vegetative Growth** Type______ G No evidence of excessive growth G Vegetation in channels does not obstruct flow G Location shown on site map Areal extent______ Remarks______
D. Cover Penetrations G Applicable ✓N/A	
1.	**Gas Vents** G Active G Passive G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks______
2.	**Gas Monitoring Probes** G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks______
3.	**Monitoring Wells** (within surface area of landfill) G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks______
4.	**Leachate Extraction Wells** G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks______
5.	**Settlement Monuments** G Located G Routinely surveyed G N/A Remarks______

E. Gas Collection and Treatment	G Applicable ✓N/A
1. **Gas Treatment Facilities** G Flaring G Thermal destruction G Collection for reuse G Good condition G Needs Maintenance Remarks_______________	
2. **Gas Collection Wells, Manifolds and Piping** G Good condition G Needs Maintenance Remarks_______________	
3. **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings) G Good condition G Needs Maintenance G N/A Remarks_______________	
F. Cover Drainage Layer	G Applicable ✓N/A
1. **Outlet Pipes Inspected** G Functioning G N/A Remarks_______________	
2. **Outlet Rock Inspected** G Functioning G N/A Remarks_______________	
G. Detention/Sedimentation Ponds	G Applicable ✓N/A
1. **Siltation** Areal extent__________ Depth__________ G N/A G Siltation not evident Remarks_______________	
2. **Erosion** Areal extent__________ Depth__________ G Erosion not evident Remarks_______________	
3. **Outlet Works** G Functioning G N/A Remarks_______________	
4. **Dam** G Functioning G N/A Remarks_______________	

H. Retaining Walls G Applicable ✓N/A	
1.	**Deformations** G Location shown on site map G Deformation not evident Horizontal displacement________ Vertical displacement________ Rotational displacement________ Remarks________
2.	**Degradation** G Location shown on site map G Degradation not evident Remarks________
I. Perimeter Ditches/Off-Site Discharge G Applicable ✓N/A	
1.	**Siltation** G Location shown on site map G Siltation not evident Areal extent________ Depth________ Remarks________
2.	**Vegetative Growth** G Location shown on site map G N/A G Vegetation does not impede flow Areal extent________ Type________ Remarks________
3.	**Erosion** G Location shown on site map G Erosion not evident Areal extent________ Depth________ Remarks________
4.	**Discharge Structure** G Functioning G N/A Remarks________
VIII. VERTICAL BARRIER WALLS G Applicable ✓N/A	
1.	**Settlement** G Location shown on site map G Settlement not evident Areal extent________ Depth________ Remarks________
2.	**Performance Monitoring** Type of monitoring________ G Performance not monitored Frequency________ G Evidence of breaching Head differential________ Remarks________

IX. GROUNDWATER/SURFACE WATER REMEDIES G Applicable G N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines G Applicable G N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
G Good condition G All required wells properly operating G Needs Maintenance G N/A
Remarks______________________________

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
G Good condition G Needs Maintenance
Remarks______________________________

3. **Spare Parts and Equipment**
G Readily available G Good condition G Requires upgrade G Needs to be provided
Remarks______________________________

B. Surface Water Collection Structures, Pumps, and Pipelines G Applicable G N/A

1. **Collection Structures, Pumps, and Electrical**
G Good condition G Needs Maintenance
Remarks______________________________

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
G Good condition G Needs Maintenance
Remarks______________________________

3. **Spare Parts and Equipment**
G Readily available G Good condition G Requires upgrade G Needs to be provided
Remarks______________________________

C. Treatment System	G Applicable ✓ N/A
1.	**Treatment Train** (Check components that apply) G Metals removal G Oil/water separation G Bioremediation G Air stripping G Carbon adsorbers G Filters________________ G Additive (*e.g.*, chelation agent, flocculent)________________ G Others________________ G Good condition G Needs Maintenance G Sampling ports properly marked and functional G Sampling/maintenance log displayed and up to date G Equipment properly identified G Quantity of groundwater treated annually________ G Quantity of surface water treated annually________ Remarks________________
2.	**Electrical Enclosures and Panels** (properly rated and functional) G N/A G Good condition G Needs Maintenance Remarks________________
3.	**Tanks, Vaults, Storage Vessels** G N/A G Good condition G Proper secondary containment G Needs Maintenance Remarks________________
4.	**Discharge Structure and Appurtenances** G N/A G Good condition G Needs Maintenance Remarks________________
5.	**Treatment Building(s)** G N/A G Good condition (esp. roof and doorways) G Needs repair G Chemicals and equipment properly stored Remarks________________
6.	**Monitoring Wells** (pump and treatment remedy) G Properly secured/locked G Functioning G Routinely sampled G Good condition G All required wells located G Needs Maintenance G N/A Remarks________________
D. Monitoring Data	
1.	Monitoring Data ✓ Is routinely submitted on time ✓ Is of acceptable quality
2.	Monitoring data suggests: ✓ Groundwater plume is effectively contained ✓ Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)

G Properly secured/locked G Functioning G Routinely sampled G Good condition
G All required wells located G Needs Maintenance G N/A

Remarks MW-05/02 frost heaved

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

Heavily wooded area - not obvious a landfill. No evidence of human traffic

Some areas had limited soil cover - these areas are not identifable today

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Adequate

C.	Early Indicators of Potential Remedy Problems
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. None
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. None

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: LF03	Date of inspection: 5/7/08
Location and Region: Elmendorf AFB, AK/R10	EPA ID: AK8570028649
Agency, office, or company leading the five-year review: Parsons	Weather/temperature: 50° Fair

Remedy Includes: (Check all that apply)

- G Landfill cover/containment
- G Access controls
- ✓ Institutional controls
- G Groundwater pump and treatment
- G Surface water collection and treatment
- G Other
- G Monitored natural attenuation
- G Groundwater containment
- G Vertical barrier walls

Attachments: G Inspection team roster attached G Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Donna Baumler (Name) Air Force RPM (Title) 5/7/08 (Date)
   Interviewed ✓ at site G at office G by phone Phone no. ______
   Problems, suggestions; G Report attached ______

2. **O&M staff** Dave Ward (Name) Jacobs (Title) 5/7/08 (Date)
   Interviewed ✓ at site G at office G by phone Phone no. ______
   Problems, suggestions; G Report attached ______

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency ADEC
Contact Louis Howard — Enviro. Specialist — 8/14/07 — (907) 269-7552
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached See Note below and interview in Attachment E

Agency EPA Region 10
Contact Jacques Gusmano — Enviro. Specialist — 8/14/07 — (907) 271-1271
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

4. **Other interviews** (optional) G Report attached.

Notes from 8/14/07 meeting:
Concerns/Issues for 2008 Five Year Review
- Is MNA working
- Institutional controls working

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	**O&M Documents**			
	G O&M manual	G Readily available	G Up to date	✓ N/A
	G As-built drawings	G Readily available	G Up to date	✓ N/A
	G Maintenance logs	G Readily available	G Up to date	✓ N/A
	Remarks			
2.	**Site-Specific Health and Safety Plan**	✓ Readily available	✓ Up to date	G N/A
	G Contingency plan/emergency response plan	G Readily available	G Up to date	✓ N/A
	Remarks Work Plan			
3.	**O&M and OSHA Training Records**	G Readily available	✓ Up to date	G N/A
	Remarks At Jacobs			
4.	**Permits and Service Agreements**			
	G Air discharge permit	G Readily available	G Up to date	✓ N/A
	G Effluent discharge	G Readily available	G Up to date	✓ N/A
	G Waste disposal, POTW	G Readily available	G Up to date	✓ N/A
	G Other permits______	G Readily available	G Up to date	✓ N/A
	Remarks			
5.	**Gas Generation Records**	G Readily available	G Up to date	✓ N/A
	Remarks			
6.	**Settlement Monument Records**	G Readily available	G Up to date	✓ N/A
	Remarks			
7.	**Groundwater Monitoring Records**	G Readily available	G Up to date	✓ N/A
	Remarks			
8.	**Leachate Extraction Records**	G Readily available	G Up to date	✓ N/A
	Remarks			
9.	**Discharge Compliance Records**			
	G Air	G Readily available	G Up to date	✓ N/A
	G Water (effluent)	G Readily available	G Up to date	✓ N/A
	Remarks			
10.	**Daily Access/Security Logs**	G Readily available	G Up to date	✓ N/A
	Remarks			

IV. O&M COSTS

1. **O&M Organization**

G State in-house | G Contractor for State
G PRP in-house | G Contractor for PRP
G Federal Facility in-house | ✓ Contractor for Federal Facility
G Other____

2. **O&M Cost Records** — Data from RIPs see tables in Section 4

✓ Readily available ✓ Up to date
G Funding mechanism/agreement in place
Original O&M cost estimate in ROD G Breakdown attached

Total annual cost by year for review period if available

From________ To________ __________ G Breakdown attached
Date Date Total cost

From________ To________ __________ G Breakdown attached
Date Date Total cost

From________ To________ __________ G Breakdown attached
Date Date Total cost

From________ To________ __________ G Breakdown attached
Date Date Total cost

From________ To________ __________ G Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: ________________________________

V. ACCESS AND INSTITUTIONAL CONTROLS ✓ Applicable G N/A

A. Fencing

1. **Fencing damaged** G Location shown on site map G Gates secured ✓ N/A
Remarks____

B. Other Access Restrictions

1. **Signs and other security measures** G Location shown on site map ✓ N/A
Remarks____

C. Institutional Controls (ICs)		
1.	**Implementation and enforcement** See Basewide IC section 4.7 Site conditions imply ICs not properly implemented G Yes ✓No G N/A Site conditions imply ICs not being fully enforced G Yes ✓No G N/A Type of monitoring (*e.g.*, self-reporting, drive by) ______ Frequency ______ Responsible party/agency ______ Contact ______ Name ______ Title ______ Date ______ Phone no. Reporting is up-to-date G Yes G No G N/A Reports are verified by the lead agency G Yes G No G N/A Specific requirements in deed or decision documents have been met G Yes G No G N/A Violations have been reported G Yes G No G N/A Other problems or suggestions: G Report attached	
2.	**Adequacy** ✓ICs are adequate G ICs are inadequate G N/A Remarks______	

D. General	
1.	**Vandalism/trespassing** G Location shown on site map ✓No vandalism evident Remarks Some Littering
2.	**Land use changes on site** ✓N/A Remarks______
3.	**Land use changes off site** ✓N/A Remarks______

VI. GENERAL SITE CONDITIONS

A. Roads G Applicable ✓N/A	
1.	**Roads damaged** G Location shown on site map G Roads adequate G N/A Remarks______

B. Other Site Conditions
Remarks______

IX. GROUNDWATER/SURFACE WATER REMEDIES G Applicable X N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines G Applicable ✓ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
G Good condition G All required wells properly operating G Needs Maintenance G N/A
Remarks____

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
G Good condition G Needs Maintenance
Remarks____

3. **Spare Parts and Equipment**
G Readily available G Good condition G Requires upgrade G Needs to be provided
Remarks____

B. Surface Water Collection Structures, Pumps, and Pipelines G Applicable ✓ N/A

1. **Collection Structures, Pumps, and Electrical**
G Good condition G Needs Maintenance
Remarks____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
G Good condition G Needs Maintenance
Remarks____

3. **Spare Parts and Equipment**
G Readily available G Good condition G Requires upgrade G Needs to be provided
Remarks____

C. Treatment System	G Applicable ✓N/A
1.	**Treatment Train** (Check components that apply) G Metals removal G Oil/water separation G Bioremediation G Air stripping G Carbon adsorbers G Filters___ G Additive (*e.g.*, chelation agent, flocculent)___ G Others___ G Good condition G Needs Maintenance G Sampling ports properly marked and functional G Sampling/maintenance log displayed and up to date G Equipment properly identified G Quantity of groundwater treated annually___ G Quantity of surface water treated annually___ Remarks___
2.	**Electrical Enclosures and Panels** (properly rated and functional) G N/A G Good condition G Needs Maintenance Remarks___
3.	**Tanks, Vaults, Storage Vessels** G N/A G Good condition G Proper secondary containment G Needs Maintenance Remarks___
4.	**Discharge Structure and Appurtenances** G N/A G Good condition G Needs Maintenance Remarks___
5.	**Treatment Building(s)** G N/A G Good condition (esp. roof and doorways) G Needs repair G Chemicals and equipment properly stored Remarks___
6.	**Monitoring Wells** (pump and treatment remedy) G Properly secured/locked G Functioning G Routinely sampled G Good condition G All required wells located G Needs Maintenance G N/A Remarks___

D. Monitoring Data	
1.	Monitoring Data G Is routinely submitted on time G Is of acceptable quality
2.	Monitoring data suggests: G Groundwater plume is effectively contained G Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G All required wells located G Needs Maintenance ~~G~~ N/A
Remarks

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

- Wooded/vegetated site - adjacent to housing area
- no visible evidence of waste material extruding on surface
- Recreation trails somewhat overgrown

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Adequate

C.	Early Indicators of Potential Remedy Problems
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. None
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. None

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Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: LF04	Date of inspection: 5/6/08
Location and Region: Elmendorf AFB, AK/Reg 10	EPA ID: AK8570028649
Agency, office, or company leading the five-year review: Parsons	Weather/temperature: 50° Fair

Remedy Includes: (Check all that apply)

- G Landfill cover/containment
- ✓ Access controls
- ✓ Institutional controls
- G Groundwater pump and treatment
- G Surface water collection and treatment
- G Other Debris Collection
- ✓ Monitored natural attenuation
- G Groundwater containment
- G Vertical barrier walls

Attachments: G Inspection team roster attached G Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Donna Baumler (Name) Air Force RPM (Title) 5/6/08 (Date)
   Interviewed ✓ at site G at office G by phone Phone no. ______
   Problems, suggestions; G Report attached ______

2. **O&M staff** Kelly McGovern/Dave Ward (Name) Jacobs (Title) 5/6/08 (Date)
   Interviewed G at site G at office G by phone Phone no.
   Problems, suggestions; G Report attached Slope stabilizing - debris decreasing. Port expansion will further stop debris

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency ADEC
Contact Louis Howard — Enviro. Specialist — 8/14/07 — (907) 269-7552
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached See Note below and interview in Attachment E

Agency EPA Region 10
Contact Jacques Gusmano — Enviro. Specialist — 8/14/07 — (907) 271-1271
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

4. **Other interviews** (optional) G Report attached.

Notes from 8/14/07 meeting:
Concerns/Issues for 2008 Five Year Review
- Is MNA working
- Institutional controls working

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. O&M Documents

- G O&M manual — ✓ Readily available — G Up to date — G N/A
- G As-built drawings — G Readily available — G Up to date — ✓ N/A
- G Maintenance logs — ✓ Readily available — G Up to date — G N/A

Remarks: In IR/Annual Reports

2. Site-Specific Health and Safety Plan — ✓ Readily available — ✓ Up to date — G N/A

- G Contingency plan/emergency response plan — G Readily available — G Up to date — G N/A

Remarks: Project H&S plan

3. O&M and OSHA Training Records — ✓ Readily available — ✓ Up to date — G N/A

Remarks: At Jacobs - Hazwoper training cert.

4. Permits and Service Agreements

- G Air discharge permit — G Readily available — G Up to date — ✓ N/A
- G Effluent discharge — G Readily available — G Up to date — ✓ N/A
- G Waste disposal, POTW — G Readily available — G Up to date — ✓ N/A
- G Other permits ______ — G Readily available — G Up to date — ✓ N/A

Remarks

5. Gas Generation Records — G Readily available — G Up to date — ✓ N/A

Remarks

6. Settlement Monument Records — G Readily available — G Up to date — ✓ N/A

Remarks

7. Groundwater Monitoring Records — ✓ Readily available — ✓ Up to date — G N/A

Remarks: ERPIMS/Annual Report

8. Leachate Extraction Records — G Readily available — G Up to date — ✓ N/A

Remarks

9. Discharge Compliance Records

- G Air — G Readily available — G Up to date — ✓ N/A
- G Water (effluent) — G Readily available — G Up to date — ✓ N/A

Remarks

10. Daily Access/Security Logs — ✓ Readily available — ✓ Up to date — G N/A

Remarks: Sign in sheet for LF04 entry

IV. O&M COSTS

1. **O&M Organization**
G State in-house G Contractor for State
G PRP in-house G Contractor for PRP
G Federal Facility in-house ✓ Contractor for Federal Facility
G Other

2. **O&M Cost Records** Data from RIPS
✓ Readily available ✓ Up to date See tables in Section 4
G Funding mechanism/agreement in place
Original O&M cost estimate In ROD G Breakdown attached

Total annual cost by year for review period if available

From ________ To ________ ________ G Breakdown attached
Date Date Total cost
From ________ To ________ ________ G Breakdown attached
Date Date Total cost
From ________ To ________ ________ G Breakdown attached
Date Date Total cost
From ________ To ________ ________ G Breakdown attached
Date Date Total cost
From ________ To ________ ________ G Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons:

V. ACCESS AND INSTITUTIONAL CONTROLS ✓ Applicable G N/A

A. Fencing

1. **Fencing damaged** G Location shown on site map ✓ Gates secured G N/A
Remarks Gate prevents vehicle access to LF04 North. One vehicle barrier broken

B. Other Access Restrictions

1. **Signs and other security measures** G Location shown on site map G N/A
Remarks Sign on gate - warns of landslides, mud flats, landfill waste
Beach - Port of Anchorage construction site - fenced

C. Institutional Controls (ICs)

1. **Implementation and enforcement** See Basewide IC Section 4.7

Site conditions imply ICs not properly implemented G Yes G No G N/A
Site conditions imply ICs not being fully enforced G Yes G No G N/A

Type of monitoring (*e.g.*, self-reporting, drive by) ______
Frequency ______
Responsible party/agency ______
Contact ______

Name Title Date Phone no.

Reporting is up-to-date G Yes G No G N/A
Reports are verified by the lead agency G Yes G No G N/A

Specific requirements in deed or decision documents have been met G Yes G No G N/A
Violations have been reported G Yes G No G N/A
Other problems or suggestions: G Report attached

2. **Adequacy** ✓ ICs are adequate G ICs are inadequate G N/A
Remarks ______

D. General

1. **Vandalism/trespassing** G Location shown on site map ✓ No vandalism evident
Remarks ______

2. **Land use changes on site** ✓ N/A
Remarks ______

3. **Land use changes off site** G N/A
Remarks Port expansion

VI. GENERAL SITE CONDITIONS

A. Roads G Applicable G N/A

1. **Roads damaged** G Location shown on site map G Roads adequate G N/A
Remarks Roads passable - some construction due to port expansion

B. Other Site Conditions

Remarks Land southeast of LF04 + WP14 used for borrow material for Port Construction - sites untouched

IX. GROUNDWATER/SURFACE WATER REMEDIES G Applicable G N/A	
A. Groundwater Extraction Wells, Pumps, and Pipelines G Applicable G N/A	
1.	**Pumps, Wellhead Plumbing, and Electrical** G Good condition G All required wells properly operating G Needs Maintenance G N/A Remarks_______________
2.	**Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks_______________
3.	**Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks_______________
B. Surface Water Collection Structures, Pumps, and Pipelines G Applicable G N/A	
1.	**Collection Structures, Pumps, and Electrical** G Good condition G Needs Maintenance Remarks_______________
2.	**Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks_______________
3.	**Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks_______________

C. Treatment System G Applicable ✓ N/A

1. **Treatment Train** (Check components that apply)
G Metals removal G Oil/water separation G Bioremediation
G Air stripping G Carbon adsorbers
G Filters______
G Additive (*e.g.*, chelation agent, flocculent)______
G Others______
G Good condition G Needs Maintenance
G Sampling ports properly marked and functional
G Sampling/maintenance log displayed and up to date
G Equipment properly identified
G Quantity of groundwater treated annually______
G Quantity of surface water treated annually______
Remarks______

2. **Electrical Enclosures and Panels** (properly rated and functional)
G N/A G Good condition G Needs Maintenance
Remarks______

3. **Tanks, Vaults, Storage Vessels**
G N/A G Good condition G Proper secondary containment G Needs Maintenance
Remarks______

4. **Discharge Structure and Appurtenances**
G N/A G Good condition G Needs Maintenance
Remarks______

5. **Treatment Building(s)**
G N/A G Good condition (esp. roof and doorways) G Needs repair
G Chemicals and equipment properly stored
Remarks______

6. **Monitoring Wells** (pump and treatment remedy)
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G All required wells located G Needs Maintenance G N/A
Remarks______

D. Monitoring Data

1. Monitoring Data
✓ Is routinely submitted on time G Is of acceptable quality Some wells MW-61/MW-77 should be incorporated into monitoring program

2. Monitoring data suggests:
✓ Groundwater plume is effectively contained ✓ Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
✓ Properly secured/locked   ✓ Functioning   G Routinely sampled   ✓ Good condition
✓ All required wells located   G Needs Maintenance   G N/A
Remarks Some wells (MW-61 + MW-77) not sampled recently

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction. Debris removal

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

MNA for groundwater in LF04 South
- Debris removal LF04 North (reduced quantity over time as slope stabilizes)
- Port expansion will protect bluff from wave action - reduce debris
- Some debris/barrels visible from former beach

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Generate adaquate monitoring
- changed location of seep monitoring (esp seep 3)
  - shows contentrations reduced downstream
- Some wells should be monitored (MW-61 + MW-77)

C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. Debris removal effectively done May want to remove obvious debris on slope if it can be done safely. Or could simply wait until it drops down. -Slope heavily wooded - stabilizing
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. None

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Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: WP14	**Date of inspection:** 5/6/08
Location and Region: Elmendorf AFB AK/Reg	**EPA ID:** AK8570028649
Agency, office, or company leading the five-year review: Parsons	**Weather/temperature:** 50° P/C → fair

Remedy Includes: (Check all that apply)

- G Landfill cover/containment
- G Access controls
- ✓ Institutional controls
- G Groundwater pump and treatment
- G Surface water collection and treatment
- G Other Free product removal when present
- ✓ Monitored natural attenuation
- G Groundwater containment
- G Vertical barrier walls

Attachments: G Inspection team roster attached G Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Donna Baumler (Name) Air Force RPM (Title) 5/6/08 (Date)
   Interviewed ✓ at site G at office G by phone Phone no. ______
   Problems, suggestions; G Report attached ______

2. **O&M staff** Dave Ward (Name) Jacobs (Title) 5/6/08 (Date)
   Interviewed ✓ at site G at office G by phone Phone no. ______
   Problems, suggestions; G Report attached ______

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency ADEC
Contact Louis Howard — Enviro. Specialist — 8/14/07 — (907)269-7552
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached See Note below and interview in Attachment E

Agency EPA Region 10
Contact Jacques Gusmano — Enviro. Specialist — 8/14/07 — (907)271-1271
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

4. **Other interviews** (optional) G Report attached.

Notes from 8/14/07 meeting:
Concerns/Issues for 2008 Five Year Review
Is MNA working?
Institutional controls - including on land that Air Force Base does not control
Cleanup level for TCE
Incorporate RPO work

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents** In Information Repository
   G O&M manual — G Readily available — G Up to date — G N/A
   G As-built drawings — G Readily available — G Up to date — G N/A
   G Maintenance logs — G Readily available — G Up to date — G N/A
   Remarks Annual Report

2. **Site-Specific Health and Safety Plan** — G Readily available — G Up to date — G N/A
   G Contingency plan/emergency response plan — G Readily available — G Up to date — G N/A
   Remarks At Jacobs Office / Part of project WP

3. **O&M and OSHA Training Records** — G Readily available — G Up to date — G N/A
   Remarks At Jacobs Office

4. **Permits and Service Agreements**
   G Air discharge permit — G Readily available — G Up to date — G N/A
   G Effluent discharge — G Readily available — G Up to date — G N/A
   G Waste disposal, POTW — G Readily available — G Up to date — G N/A
   G Other permits________ — G Readily available — G Up to date — G N/A
   Remarks

5. **Gas Generation Records** — G Readily available — G Up to date — G N/A
   Remarks

6. **Settlement Monument Records** — G Readily available — G Up to date — G N/A
   Remarks

7. **Groundwater Monitoring Records** — G Readily available — G Up to date — G N/A
   Remarks ERPIMS/annual reports

8. **Leachate Extraction Records** — G Readily available — G Up to date — G N/A
   Remarks

9. **Discharge Compliance Records**
   G Air — G Readily available — G Up to date — G N/A
   G Water (effluent) — G Readily available — G Up to date — G N/A
   Remarks

10. **Daily Access/Security Logs** — G Readily available — G Up to date — G N/A
    Remarks annual reports

IV. O&M COSTS

1. **O&M Organization**
G State in-house — G Contractor for State
G PRP in-house — G Contractor for PRP
G Federal Facility in-house — ✓ Contractor for Federal Facility
G Other______________________________

2. **O&M Cost Records**
✓ Readily available ✓ Up to date
G Funding mechanism/agreement in place
Original O&M cost estimate in ROD G Breakdown attached

Data from RIPs see tables in section 4

Total annual cost by year for review period if available

From__________ To__________ __________ G Breakdown attached
Date Date Total cost
From__________ To__________ __________ G Breakdown attached
Date Date Total cost
From__________ To__________ __________ G Breakdown attached
Date Date Total cost
From__________ To__________ __________ G Breakdown attached
Date Date Total cost
From__________ To__________ __________ G Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons: ______________________________

V. ACCESS AND INSTITUTIONAL CONTROLS ✓ Applicable G N/A

A. Fencing

1. **Fencing damaged** G Location shown on site map G Gates secured ✓ N/A
Remarks______________________________

B. Other Access Restrictions

1. **Signs and other security measures** G Location shown on site map ✓ N/A
Remarks______________________________

C. Institutional Controls (ICs)

1. **Implementation and enforcement** See Basewide IC section 4.7

Site conditions imply ICs not properly implemented G Yes ✓No G N/A

Site conditions imply ICs not being fully enforced G Yes ✓No G N/A

Type of monitoring (*e.g.*, self-reporting, drive by) ______

Frequency ______

Responsible party/agency ______

Contact ______ ______ ______ ______

Name Title Date Phone no.

Reporting is up-to-date G Yes G No G N/A

Reports are verified by the lead agency G Yes G No G N/A

Specific requirements in deed or decision documents have been met G Yes G No G N/A

Violations have been reported G Yes G No G N/A

Other problems or suggestions: G Report attached

______

2. **Adequacy** ✓ICs are adequate G ICs are inadequate G N/A

Remarks Extensive excavation for fill material to support port expansion conducted south of WP14. WP14 was not impacted.

D. General

1. **Vandalism/trespassing** G Location shown on site map ✓No vandalism evident

Remarks ______

2. **Land use changes on site** ✓N/A

Remarks ______

3. **Land use changes off site** ✓N/A

Remarks ______

VI. GENERAL SITE CONDITIONS

A. Roads ✓Applicable G N/A

1. **Roads damaged** G Location shown on site map ✓Roads adequate G N/A

Remarks ______

B. Other Site Conditions

Remarks Borrow for port expansion extends south of WP14

IX. GROUNDWATER/SURFACE WATER REMEDIES ✓ Applicable G N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines G Applicable ✓ N/A
1. **Pumps, Wellhead Plumbing, and Electrical** G Good condition G All required wells properly operating G Needs Maintenance G N/A Remarks______________________________
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks______________________________
3. **Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks______________________________
B. Surface Water Collection Structures, Pumps, and Pipelines G Applicable ✓ N/A
1. **Collection Structures, Pumps, and Electrical** G Good condition G Needs Maintenance Remarks______________________________
2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks______________________________
3. **Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks______________________________

C. Treatment System	G Applicable ✓ N/A
1.	**Treatment Train** (Check components that apply) G Metals removal G Oil/water separation G Bioremediation G Air stripping G Carbon adsorbers G Filters___ G Additive (*e.g.*, chelation agent, flocculent)___ G Others___ G Good condition G Needs Maintenance G Sampling ports properly marked and functional G Sampling/maintenance log displayed and up to date G Equipment properly identified G Quantity of groundwater treated annually___ G Quantity of surface water treated annually___ Remarks___
2.	**Electrical Enclosures and Panels** (properly rated and functional) G N/A G Good condition G Needs Maintenance Remarks___
3.	**Tanks, Vaults, Storage Vessels** G N/A G Good condition G Proper secondary containment G Needs Maintenance Remarks___
4.	**Discharge Structure and Appurtenances** G N/A G Good condition G Needs Maintenance Remarks___
5.	**Treatment Building(s)** G N/A G Good condition (esp. roof and doorways) G Needs repair G Chemicals and equipment properly stored Remarks___
6.	**Monitoring Wells** (pump and treatment remedy) G Properly secured/locked G Functioning G Routinely sampled G Good condition G All required wells located G Needs Maintenance G N/A Remarks___
D. Monitoring Data	
1.	Monitoring Data ✓ Is routinely submitted on time ✓ Is of acceptable quality
2.	Monitoring data suggests: ✓ Groundwater plume is effectively contained ✓ Contaminant concentrations are declining

D. Monitored Natural Attenuation			
1. **Monitoring Wells** (natural attenuation remedy)			
✓ Properly secured/locked	✓ Functioning	✓ Routinely sampled	✓ Good condition
✓ All required wells located	G Needs Maintenance		G N/A
Remarks			

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction. Free product recovery - effectively completed

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

natural attenuation remedy working
- no more recoverable free product
- benzene concentrations decreasing
- LF04 SP-03/04 → sporatic hits
ND has to do with monitoring location
wrong location sampled = ND (downgradient)
Show concentration degrades quickly
downgradient from seep

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Good

C.	Early Indicators of Potential Remedy Problems
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. None
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. None

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Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: SD15	**Date of inspection:** 5/7/08
Location and Region: Elmendorf AFB AK / Reg 10	**EPA ID:** AK8570028649
Agency, office, or company leading the five-year review: Parsons	**Weather/temperature:** 50° Fair

Remedy Includes: (Check all that apply)

- G Landfill cover/containment
- G Access controls
- ✓ Institutional controls
- G Groundwater pump and treatment
- G Surface water collection and treatment
- G Other HVE/SVE system shut down
- ✓ Monitored natural attenuation
- G Groundwater containment
- G Vertical barrier walls

Attachments: G Inspection team roster attached G Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Claude Mayer (Name) Air Force RPM (Title) 5/7/08 (Date)
   Interviewed ✓ at site G at office G by phone Phone no. ______
   Problems, suggestions; G Report attached ______

2. **O&M staff** Marty Hannah (Name) Oasis (Title) 5/7/08 (Date)
   Interviewed ✓ at site G at office G by phone Phone no. ______
   Problems, suggestions; G Report attached ______

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency ADEC
Contact Louis Howard — Enviro. Specialist — 8/14/07 — (907) 269-7552
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached See Note below and interview in Attachment E

Agency EPA Region 10
Contact Jacques Gusmano — Enviro. Specialist — 8/14/07 — (907) 271-1271
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

4. **Other interviews** (optional) G Report attached.

Notes from 8/14/07 meeting:
Concerns/Issues for 2008 Five Year Review
- Is MNA working
- Institutional controls working

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	**O&M Documents**			
	G O&M manual	✓ Readily available	G Up to date	G N/A
	G As-built drawings	✓ Readily available	G Up to date	G N/A
	G Maintenance logs	✓ Readily available	G Up to date	G N/A
	Remarks			
2.	**Site-Specific Health and Safety Plan**	✓ Readily available	✓ Up to date	G N/A
	G Contingency plan/emergency response plan	G Readily available	G Up to date	G N/A
	Remarks Parsons / Oasis			
3.	**O&M and OSHA Training Records**	✓ Readily available	G Up to date	G N/A
	Remarks At Oasis			
4.	**Permits and Service Agreements**			
	G Air discharge permit	G Readily available	G Up to date	✓ N/A
	G Effluent discharge	G Readily available	G Up to date	✓ N/A
	G Waste disposal, POTW	G Readily available	G Up to date	✓ N/A
	G Other permits ______	G Readily available	G Up to date	✓ N/A
	Remarks			
5.	**Gas Generation Records**	G Readily available	G Up to date	✓ N/A
	Remarks			
6.	**Settlement Monument Records**	G Readily available	G Up to date	✓ N/A
	Remarks			
7.	**Groundwater Monitoring Records**	✓ Readily available	✓ Up to date	G N/A
	Remarks ERPIMS / Annual Report			
8.	**Leachate Extraction Records**	G Readily available	G Up to date	✓ N/A
	Remarks			
9.	**Discharge Compliance Records**			
	G Air	G Readily available	G Up to date	✓ N/A
	G Water (effluent)	G Readily available	G Up to date	✓ N/A
	Remarks HVE shut down			
10.	**Daily Access/Security Logs**	G Readily available	G Up to date	✓ N/A
	Remarks			

IV. O&M COSTS

1. **O&M Organization**
G State in-house | G Contractor for State
G PRP in-house | G Contractor for PRP
G Federal Facility in-house | ✓ Contractor for Federal Facility
G Other____________________

2. **O&M Cost Records** Data from RIPS see tables in Section 4
G Readily available ✓ Up to date
G Funding mechanism/agreement in place
Original O&M cost estimate in ROD G Breakdown attached

Total annual cost by year for review period if available

From________ To________ ________ G Breakdown attached
Date Date Total cost
From________ To________ ________ G Breakdown attached
Date Date Total cost
From________ To________ ________ G Breakdown attached
Date Date Total cost
From________ To________ ________ G Breakdown attached
Date Date Total cost
From________ To________ ________ G Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons: ____________________

V. ACCESS AND INSTITUTIONAL CONTROLS ✓ Applicable G N/A

A. Fencing

1. **Fencing damaged** G Location shown on site map ✓ Gates secured G N/A
Remarks fence | gate for area

B. Other Access Restrictions

1. **Signs and other security measures** G Location shown on site map G N/A
Remarks Sign with contact information posted on entrance gate

C. Institutional Controls (ICs)

1. **Implementation and enforcement** See Basewide IC Section 4.7
Site conditions imply ICs not properly implemented G Yes ✓No G N/A
Site conditions imply ICs not being fully enforced G Yes ✓No G N/A

Type of monitoring (*e.g.*, self-reporting, drive by) ______________________
Frequency ______________________
Responsible party/agency ______________________
Contact ______________________
Name Title Date Phone no.

Reporting is up-to-date G Yes G No G N/A
Reports are verified by the lead agency G Yes G No G N/A

Specific requirements in deed or decision documents have been met G Yes G No G N/A
Violations have been reported G Yes G No G N/A
Other problems or suggestions: G Report attached

____

2. **Adequacy** ✓ICs are adequate G ICs are inadequate G N/A
Remarks ______________________

D. General

1. **Vandalism/trespassing** G Location shown on site map ✓No vandalism evident
Remarks ______________________

2. **Land use changes on site** ✓N/A
Remarks ______________________

3. **Land use changes off site** ✓N/A
Remarks ______________________

VI. GENERAL SITE CONDITIONS

A. Roads G Applicable ✓N/A

1. **Roads damaged** G Location shown on site map G Roads adequate G N/A
Remarks ______________________

B. Other Site Conditions

Remarks ______________________

IX. GROUNDWATER/SURFACE WATER REMEDIES G Applicable ✓N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines ✓Applicable G N/A
1. **Pumps, Wellhead Plumbing, and Electrical** G Good condition G All required wells properly operating G Needs Maintenance G N/A Remarks HVE System Shut down
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks
3. **Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks
B. Surface Water Collection Structures, Pumps, and Pipelines G Applicable ✓N/A
1. **Collection Structures, Pumps, and Electrical** G Good condition G Needs Maintenance Remarks
2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks
3. **Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks

C. Treatment System	☑ Applicable G N/A

1. **Treatment Train** (Check components that apply)
G Metals removal G Oil/water separation G Bioremediation
G Air stripping G Carbon adsorbers
G Filters
G Additive (*e.g.*, chelation agent, flocculent)
☑ Others HVE|SVE
G Good condition G Needs Maintenance
G Sampling ports properly marked and functional
G Sampling/maintenance log displayed and up to date
G Equipment properly identified
G Quantity of groundwater treated annually
G Quantity of surface water treated annually
Remarks

2. **Electrical Enclosures and Panels** (properly rated and functional)
☑ N/A G Good condition G Needs Maintenance
Remarks Shut down

3. **Tanks, Vaults, Storage Vessels**
☑ N/A G Good condition G Proper secondary containment G Needs Maintenance
Remarks

4. **Discharge Structure and Appurtenances**
☑ N/A G Good condition G Needs Maintenance
Remarks

5. **Treatment Building(s)**
☑ N/A G Good condition (esp. roof and doorways) G Needs repair
G Chemicals and equipment properly stored
Remarks To be excavated

6. **Monitoring Wells** (pump and treatment remedy)
☑ Properly secured/locked ☑ Functioning ☑ Routinely sampled ☑ Good condition
☑ All required wells located G Needs Maintenance G N/A
Remarks Two monitoring wells also served as HVE injection wells

D. Monitoring Data

1. Monitoring Data
☑ Is routinely submitted on time ☑ Is of acceptable quality

2. Monitoring data suggests:
☑ Groundwater plume is effectively contained ☑ Contaminant concentrations are declining

D. Monitored Natural Attenuation	
1.	**Monitoring Wells** (natural attenuation remedy) ☑ Properly secured/locked ☑ Functioning ☑ Routinely sampled ☑ Good condition ☑ All required wells located G Needs Maintenance G N/A Remarks MW-17 & MW-90 are also HVE wells need to remove all HVE piping

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

Contaminant concentration decreasing

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Adequate

C.	Early Indicators of Potential Remedy Problems
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. None
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. None

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Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: DP98	**Date of inspection:** 5/6/08
Location and Region: Elmendorf AFB AK / Reg. 10	**EPA ID:** AK 8570028649
Agency, office, or company leading the five-year review: Parsons	**Weather/temperature:** 50°F P/C -> fair

Remedy Includes: (Check all that apply)

- G Landfill cover/containment
- G Access controls
- ✓ Institutional controls
- G Groundwater pump and treatment
- G Surface water collection and treatment
- G Other Excavation (complete) and enhanced bio treatability study
- ✓ Monitored natural attenuation
- G Groundwater containment
- G Vertical barrier walls

Attachments: G Inspection team roster attached G Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Donna Baumler | Air Force RPM | 5/6/08
   Name | Title | Date
   Interviewed G at site G at office G by phone Phone no. ________
   Problems, suggestions; G Report attached ________

2. **O&M staff** Dave Ward | Jacobs | 5/6/08
   Name | Title | Date
   Interviewed G at site G at office G by phone Phone no. ________
   Problems, suggestions; G Report attached Well heaving - MW-08 MW-08 increasing TCE trend

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency ADEC
Contact Louis Howard — Enviro. Specialist — 8/14/07 — (907) 269-7552
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached See Note below and interview in Attachment E

Agency EPA Region 10
Contact Jacques Gusmano — Enviro. Specialist — 8/14/07 — (907) 271-1271
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; G Report attached

4. **Other interviews** (optional) G Report attached.

Notes from 8/14/07 meeting:
Concerns/Issues for 2008 Five Year Review
- Is MNA working
- Institutional controls working

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	**O&M Documents**			
	✓O&M manual	✓Readily available	G Up to date	G N/A
	G As-built drawings	G Readily available	G Up to date	✓N/A
	G Maintenance logs	✓Readily available	G Up to date	G N/A
	Remarks Information Repository and annual Reports			
2.	**Site-Specific Health and Safety Plan**	G Readily available	✓Up to date	G N/A
	G Contingency plan/emergency response plan	G Readily available	G Up to date	G N/A
	Remarks At Jacobs Office / Part of Project WP			
3.	**O&M and OSHA Training Records**	G Readily available	✓Up to date	G N/A
	Remarks Jacobs OSHA training at office			
4.	**Permits and Service Agreements**			
	G Air discharge permit	G Readily available	G Up to date	✓N/A
	G Effluent discharge	G Readily available	G Up to date	✓N/A
	G Waste disposal, POTW	G Readily available	G Up to date	✓N/A
	G Other permits______	G Readily available	G Up to date	✓N/A
	Remarks			
5.	**Gas Generation Records**	G Readily available	G Up to date	✓N/A
	Remarks			
6.	**Settlement Monument Records**	G Readily available	G Up to date	✓N/A
	Remarks			
7.	**Groundwater Monitoring Records**	G Readily available	✓Up to date	G N/A
	Remarks ERPIMS / annual Reports			
8.	**Leachate Extraction Records**	G Readily available	G Up to date	✓N/A
	Remarks			
9.	**Discharge Compliance Records**			
	G Air	G Readily available	G Up to date	✓N/A
	G Water (effluent)	G Readily available	G Up to date	✓N/A
	Remarks			
10.	**Daily Access/Security Logs**	G Readily available	G Up to date	✓N/A
	Remarks			

IV. O&M COSTS

1. **O&M Organization**

G State in-house
G PRP in-house
G Federal Facility in-house
G Other______________________

G Contractor for State
G Contractor for PRP
✓ Contractor for Federal Facility

2. **O&M Cost Records**

✓ Readily available ✓ Up to date
G Funding mechanism/agreement in place
Original O&M cost estimate in ROD G Breakdown attached

Data from RIPS
See tables in Section 4

Total annual cost by year for review period if available

From______ Date	To______ Date	______ Total cost	G Breakdown attached
From______ Date	To______ Date	______ Total cost	G Breakdown attached
From______ Date	To______ Date	______ Total cost	G Breakdown attached
From______ Date	To______ Date	______ Total cost	G Breakdown attached
From______ Date	To______ Date	______ Total cost	G Breakdown attached

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: ______________________

V. ACCESS AND INSTITUTIONAL CONTROLS ✓ Applicable G N/A

A. Fencing

1. **Fencing damaged** G Location shown on site map G Gates secured ✓ N/A
Remarks______________________

B. Other Access Restrictions

1. **Signs and other security measures** G Location shown on site map ✓ N/A
Remarks______________________

C. Institutional Controls (ICs)		
1.	**Implementation and enforcement** See Basewide IC section 4.7	
	Site conditions imply ICs not properly implemented	G Yes ✓No G N/A
	Site conditions imply ICs not being fully enforced	G Yes ✓No G N/A
	Type of monitoring (*e.g.*, self-reporting, drive by) ______	
	Frequency ______	
	Responsible party/agency ______	
	Contact ______ Name ______ Title ______ Date ______ Phone no.	
	Reporting is up-to-date	G Yes G No G N/A
	Reports are verified by the lead agency	G Yes G No G N/A
	Specific requirements in deed or decision documents have been met	G Yes G No G N/A
	Violations have been reported	G Yes G No G N/A
	Other problems or suggestions: G Report attached	
2.	**Adequacy** ✓ICs are adequate G ICs are inadequate G N/A	
	Remarks ______	

D. General		
1.	**Vandalism/trespassing** G Location shown on site map ✓No vandalism evident	
	Remarks ______	
2.	**Land use changes on site** ✓N/A	
	Remarks ______	
3.	**Land use changes off site** ✓N/A	
	Remarks ______	

VI. GENERAL SITE CONDITIONS

A. Roads ✓Applicable G N/A		
1.	**Roads damaged** G Location shown on site map ✓Roads adequate G N/A	
	Remarks ______	

B. Other Site Conditions
Remarks Most site wells located within wetlands

D. Monitored Natural Attenuation
1. **Monitoring Wells** (natural attenuation remedy) ☑ Properly secured/locked ☑ Functioning ☑ Routinely sampled ☑ Good condition G All required wells located ☑ Needs Maintenance WL-8/7 heaving G N/A Remarks located all wells outside wetlands. Saw WL-4/7 wells in wetland + WL

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

Natural attenuation remedy and enhanced bioremediation remedy are relatively recent. Data to evaluate is only now becoming available

- Enhanced bio - appears to be stalling @ cis 12 DCE - could maybe benefit from bioaugmentation
- Increasing concentration in MW-8
- Site adjacent to military location - not much can be done here (no continuing vibrations etc.)

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Monitoring appears to be adequate

C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. Increasing concentration in MW-8 - MW-8 is representative of groundwater discharge to surface water. Need to determine long term trend.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. N/A

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ATTACHMENT E

INTERVIEW DOCUMENTATION

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INTERVIEW RECORD

Site Name: Elmendorf Air Force Base	**Subject: Five-Year Review**
Type: □ **Telephone** □ **Visit** □ **E-Mail**	**Date: 26 November 2007**

CONTACT MADE BY:

Name:	**Title:**	**Organization:**

INDIVIDUAL CONTACTED:

Name: Louis Howard	**Title: Project Manager**
Organization: ADEC	**E-Mail Address:louishoward@alaska.gov**
Street Address: SPAR/CS Program 555 Cordova St. 2nd Fl.	**Telephone No: (907) 269-7552**
City, State, Zip: Anchorage, AK 99501	**Fax No: (907) 269-7649**

Interview Questions

1. What is your overall impression of the restoration effort at Elmendorf AFB? (General sentiment)
Overall the IRP program at Elmendorf is a well run organization. The cleanup effort has been effective for historical spills and releases to the environment.

2. What effects do you think site operations have had on the surrounding community? The cleanup operations have eliminated or substantially reduced the original sources of contamination which prevents off-site migration to the surrounding community.

3. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.
I am not aware of any other community concerns regarding the environmental cleanup activities.

4. Do you feel well-informed about activities and progress at the site?
Yes, this is one of the most open federal facility program that I have the pleasure of working with.

5. *Do you have any comments, suggestions, or recommendations regarding the site's operation or management?* None, other than continue the good work.

Interview Questions (Continued)
Technical Questions

6*. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please give purpose and results.* Yes. These included inspections of investigations and cleanups during the field seasons, Base tours for the Elmendorf RAB, RPM meetings on site activities, review, comment and comment resolution meetings on technical documents.

7. Have there been complaints, violations or other incidents related to the site requiring a response by your office? If so, please give details of the events and results of the responses.
None.

8. *What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?* Yes. There are too many sites to go into into detail given the constraints of this questionnaire. The quarterly summaries and various groundwater RPO Zone reports provide good information and details on this information.

Interview Questions (Continued)

9*. Have there been any significant changes in the O&M requirements, maintenance, schedules or sampling routines since start-up or in the last five years? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.*

Again, the quarterly reports and groundwater RPO Zone reports provide detailed information on this question. O&M changes have been required for several reasons: completion of site cleanup for a site and dismantling of remedial action equipment, additional information requiring change in frequency of monitoring and treatability studies for enhancing monitored natural attenuation. All actions enhance the protectiveness of the remedy.

10. Have there been unexpected O&M difficulties or costs at the site since start-up or in the last five years? If so, please give details or reference reports.

Again, the quarterly reports and groundwater RPO Zone reports provide detailed information on this question.

11. *Have there been opportunities to optimize O&M, or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency, or reference RPO or other report.* Again, the quarterly reports and groundwater RPO Zone reports provide detailed information on this question.

INTERVIEW RECORD

Site Name: Elmendorf Air Force Base	**Subject: Five-Year Review**
Type: □ Telephone □ Visit X E-Mail	**Date: Nov 18, 2007**

CONTACT MADE BY:

Name: Erin Slaughter	**Title:**	**Organization:**

INDIVIDUAL CONTACTED:

Name: Gloria Beckman	**Title: Project Manager**
Organization: OASIS Environmental, Inc.	**E-Mail Address: g.beckman@oasisenviro.com**
Street Address:825 W 8th	**Telephone No:907-264-4478**
City, State, Zip: Anchorage, AK 99501	**Fax No:907-258-4033**

Interview Questions

1. What is your overall impression of the restoration effort at Elmendorf AFB? (General sentiment)

Need overall reevaluation of existing remediation systems (mechanical systems as well as original system objectives). Some systems seem to have served their purpose and should be removed. It appears that monitoring programs are similar to those seen on other bases and that contaminants have reached the point where monitored natural attenuation may need assistance (provide electron donors or receptors as needed) to speed up the process and not rely on institutional controls forever.

General lack of information on sources for plumes appears to be another problem contributing to the lack of timely cleanup. Perhaps more time should be contributed to identification of sources and less on monitoring greater than 10 year old plumes that are not cleaning up.

Overlapping programs operating independently should be combined/merged to save cost and provide comprehensive data set that can be used by each project and not separated by program.

2. What effects do you think site operations have had on the surrounding community?

Definite impact on ARRC as part of their land is tied up in remediation. Some impact to the golf course but should not be noticed by people using the course.

3*. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.*

NO

4. Do you feel well-informed about activities and progress at the site?

NO

5. *Do you have any comments, suggestions, or recommendations regarding the site's operation or management?*

Combining information collected by all programs into one easily searchable data base would be helpful. Data has been collected for more than 10 years at many sites but at some locations it appears limited information was collected because most reports focus on the program being supported.

Interview Questions (Continued)
Technical Questions

6*. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please give purpose and results.*

We are currently involved in monitoring and remediation at Zone 2 and Zone 3 sites on Elmendorf. This involves weekly site visits and weekly communication with Air Force personnel. We are also involved with sample collection and RPO reporting. The results show no significant changes since previous reports were generated.

We are involved with managing the contractor's yard. Communication improvements are improving. We will install signs so contractors will know who to contact before using the yard.

Working with Air Force and ARRC personnel has been a positive experience and all involved are dedicated and have been helpful in transitioning the projects ftom Weston to OASIS and Parsons.

7. Have there been complaints, violations or other incidents related to the site requiring a response by your office? If so, please give details of the events and results of the responses.

NO

8. *What does the monitoring data show? Are there any trends that show contaminant levels are decreasing? Please refer to the RPO reports for the zones. Some downward trends were noted but not all areas show trends.*

Interview Questions (Continued)

9*. Have there been any significant changes in the O&M requirements, maintenance, schedules or sampling routines since start-up or in the last five years? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.*

Sample collection frequency has been changed. I do not see any impact as critical areas such as monitoring off-site migration was not reduced.

10. Have there been unexpected O&M difficulties or costs at the site since start-up or in the last five years? If so, please give details or reference reports.

Yes. The bioventing systems and HVE system associated with Zone 2 and the Wetland Remediation System associated with Zone 3 required more repair than originally estimated. OASIS assumed Weston would transfer fully functional systems. All systems required considerable attention from OASIS, a subcontracted electrician and repair to make systems operational and still require additional pump repair and the replacement of a VFD to have systems that are fully operational and that have backup equipment.

The cost to rebuild the pumps is substantial. It may be a good time to look at systems to evaluate life expectancy and cost benefit of continuing repair and operation.

11. *Have there been opportunities to optimize O&M, or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency, or reference RPO or other report. Yes. One seep sample was eliminated as it was not providing information that could be used for its original purpose. Most attention has been directed at ensuring health and safety of the field personnel as some systems may not have been up to code (for example the space heaters placed inside the vaults at the Wetland Remediation System may be a hazard if vault contains flammable vapors).*

INTERVIEW RECORD

Site Name: Elmendorf Air Force Base **Subject: Five-Year Review**

Type: □ **Telephone** □ **Visit** □**X E-Mail** **Date:**

CONTACT MADE BY:

Name: **Title:** **Organization:**

INDIVIDUAL CONTACTED:

Name: Arthur D. Isham	**Title: Member CEB**
Organization: Alaska Aerospace Development Corporation	**E-Mail Address: isham@gci.net**
Street Address: 4300 B Street Ste 101	**Telephone No: 561-3338**
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Interview Questions

1. What is your overall impression of the restoration effort at Elmendorf AFB? (General sentiment)

EAFB is doing what it can with the funding available. Their focus is on cleaning up legacy problems. They have been successful in reducing their waste stream so that future generations will not be burdened with a restoration effort, other than for accidents that may occur in spite of the stringent rules and regulations that they currently operate under.

2. What effects do you think site operations have had on the surrounding community?

For those that are aware of what EAFB is doing, it has had a positive public relations effect, although some people think that they should have never polluted in the first place. Most people are not aware of what is going on.

Interview Questions (Continued)

3*. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.*

I am not aware of any community concerns.

4. Do you feel well-informed about activities and progress at the site?

Only because I am a member of the CEB.

5. *Do you have any comments, suggestions, or recommendations regarding the site's operation or management?*

Do as much publicity as you can on the positive things. Be responsive to the negative things.

Port of Anchorage
Draft Response to
Elmendorf Air Force Base, Five Year Review
Interview Record

1. What is your overall impression of the restoration effort at Elmendorf AFB? (General Sentiment)

Generally, restoration efforts appear to be comprehensive and well managed and the overall risk to offsite properties appears to be well controlled. However, there seems to be a lack of a specific funding allocated to addressing identifiable elements. This lack of funding for specific issues increases the potential for off-site impacts to down gradient neighbors.

2. What effects do you think site operations have had on the surrounding community?

Restoration efforts have decreased the potential for off-site impacts and current controls appear to be adequate to control the remaining risk, as long as the controls are maintained and are modified as necessary to respond to any changes in current conditions. Down-gradient neighbors are likely to continue to be cautious and have some concern until remediation is fully successful.

3. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

As a down-gradient neighbor, the Port of Anchorage has concerns related to existing conditions at Gaylor Gulch, Elmendorf Air Force Base (EAFB) run-off and groundwater, and potential conflicts related to the Port Intermodal Expansion Project. Silt laden Drainage from Gaylor Gulch enters the Port of Anchorage (Port) storm sewer system resulting in significant maintenance issues. In addition, surface and groundwater flow from EAFB also enters Port drainage systems and will also pass through expanded operational areas currently under construction as part of the Port of Anchorage Intermodal Expansion Project. The potential for this flow to carry contaminates of concern, even in small quantities, has the potential to lead to compliance issues for the Port. Coordination efforts between EAFB and the Port need to continue to segregate EAFB run off and ground water discharge from port systems. Separate and distinct compliance points should be established for EAFB related drainage and Port related drainage to minimize the potential for future conflicts.

4. Do you feel well-informed about activities and progress at the site?

Generally, communication from EAFB is timely and effective. Increased communication and coordination need to be maintained during the Port of Anchorage Intermodal Expansion work.

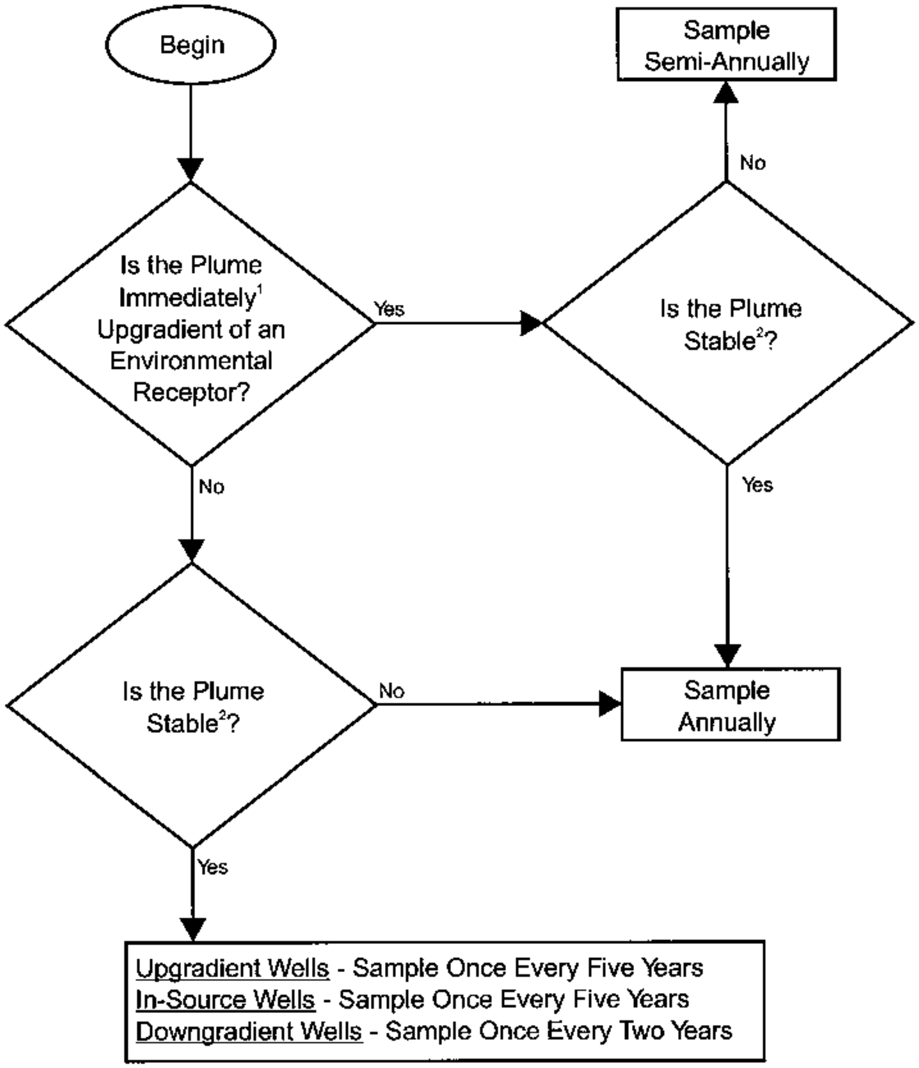
5. *Do you have any comments, suggestions, or recommendations regarding the site's operation or management?*

Generally, remediation efforts appear to be adequate. The specific issues addressed above should be taken into consideration.

ATTACHMENT F

DECISION GUIDES

FIGURE F-1
Basewide Monitoring Program
Well Sampling Frequency Decision Guide as Adapted for OU 4, 5, and 6



Definitions:

[1] Immediately Upgradient: **Means within a two-year warning line, similar to that generated for OU 5.**

[2] **Stable Plume:** A stable plume has defined boundaries with stable or decreasing contaminant concentrations.

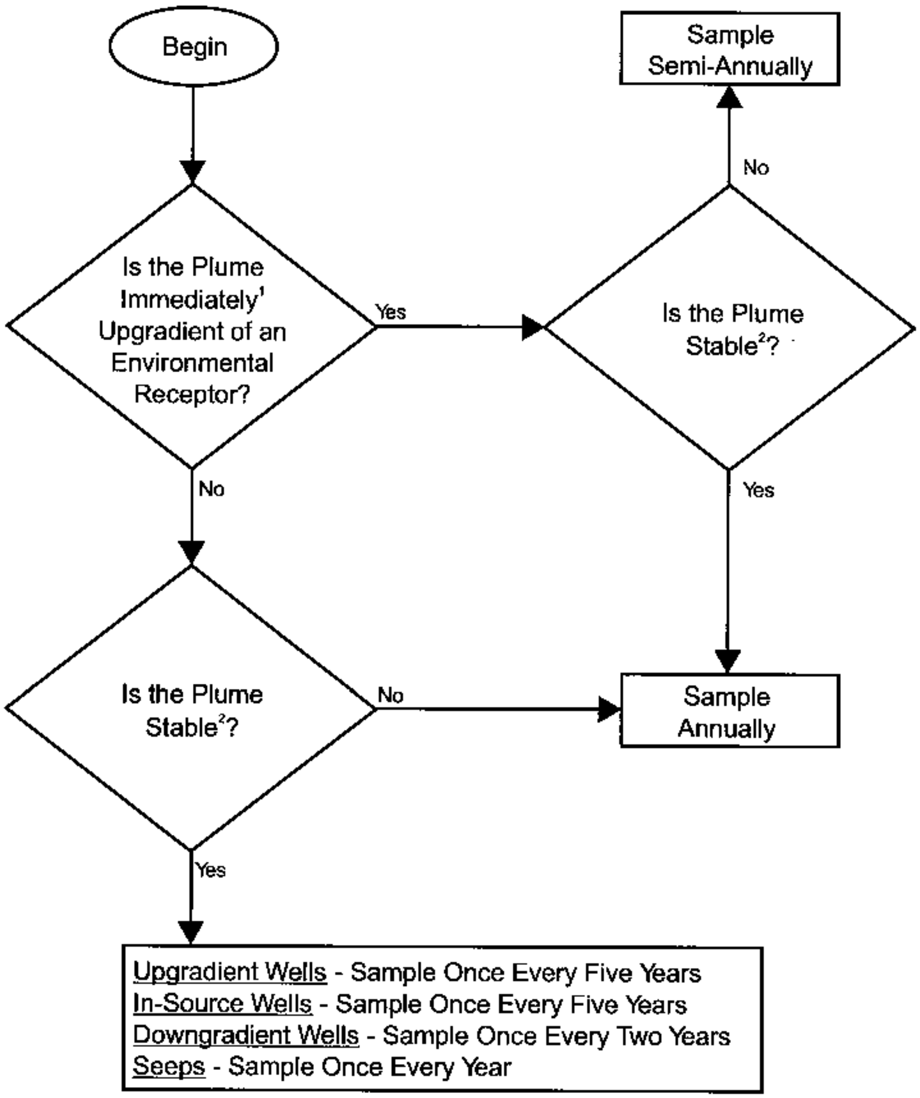
In 2003, the following plumes were not considered stable:

- Slammer/Arctic Warrior Plume
- Fairchild/Arctic Warrior Plume
- Kenney Avenue Plume
- SP1-02 Plume

Notes:

1. Seep are sampled annually, unless they exceed cleanup levels in which case they are sampled quarterly.
2. Wells with historical free product will be monitored annually for free product occurrence. Active product recovery will continue in wells with recoverable free product.
3. Sampling frequencies can be modified as needed to support site closure or modeling results.
4. Surface water sampling at OU 5 (Ship Creek) will be performed annually.

FIGURE F-2
Basewide Monitoring Program
Well Sampling Frequency Decision Guide as Adapted for DP98



[1] **Immediately Upgradient:** Within a two-year warning line. The warning line is defined as the distance groundwater travels in two years, ignoring retardation processes, and measure from a receptor (i.e. the kettle pond).

[2] **Stable Plume:** A stable plume has defined boundaries with stable or decreasing contaminant concentrations.

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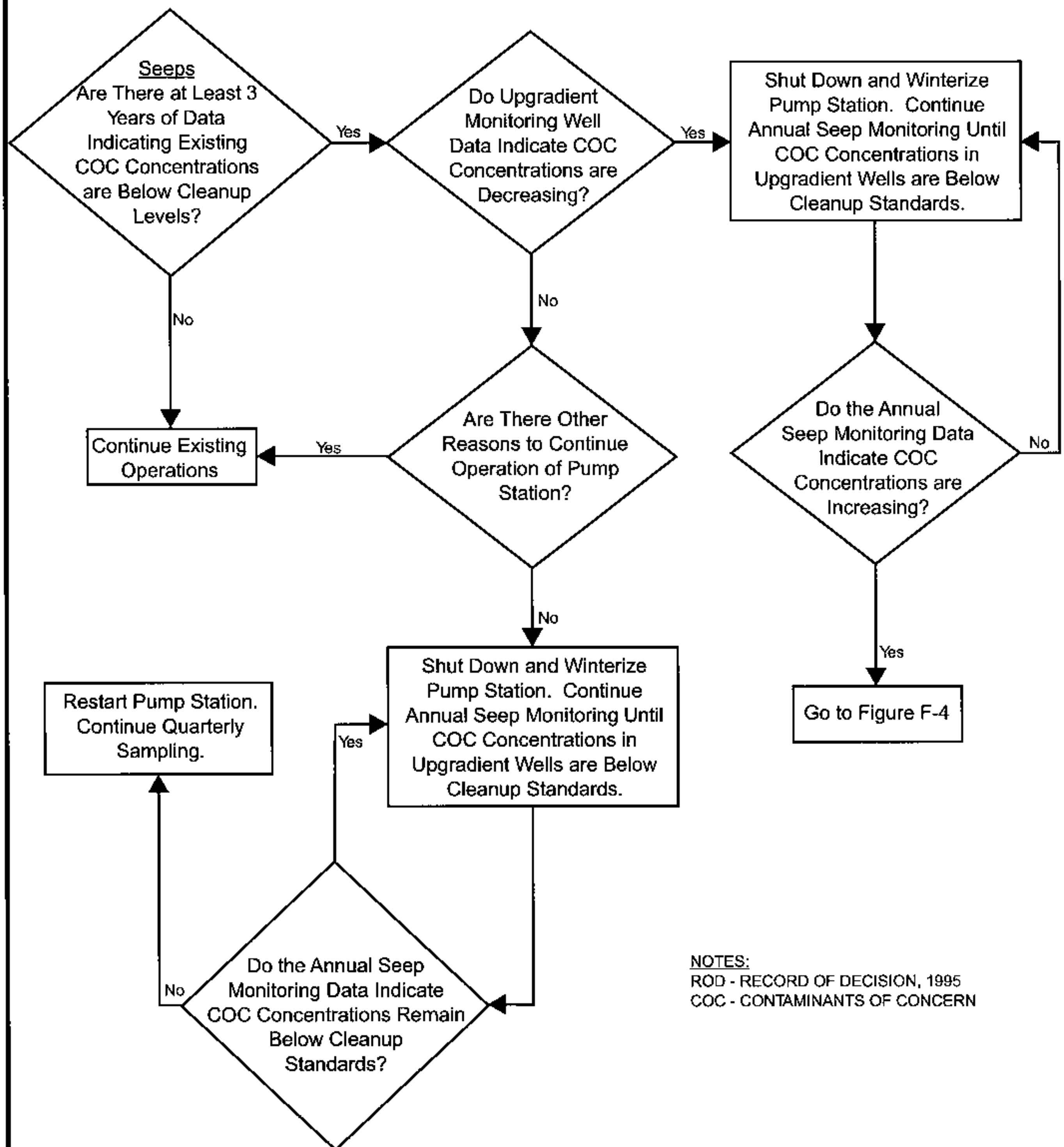
FIGURE F-3
Decision Guide for Shutting Down Pump Stations at OU5



NOTES:
ROD - RECORD OF DECISION, 1995
COC - CONTAMINANTS OF CONCERN

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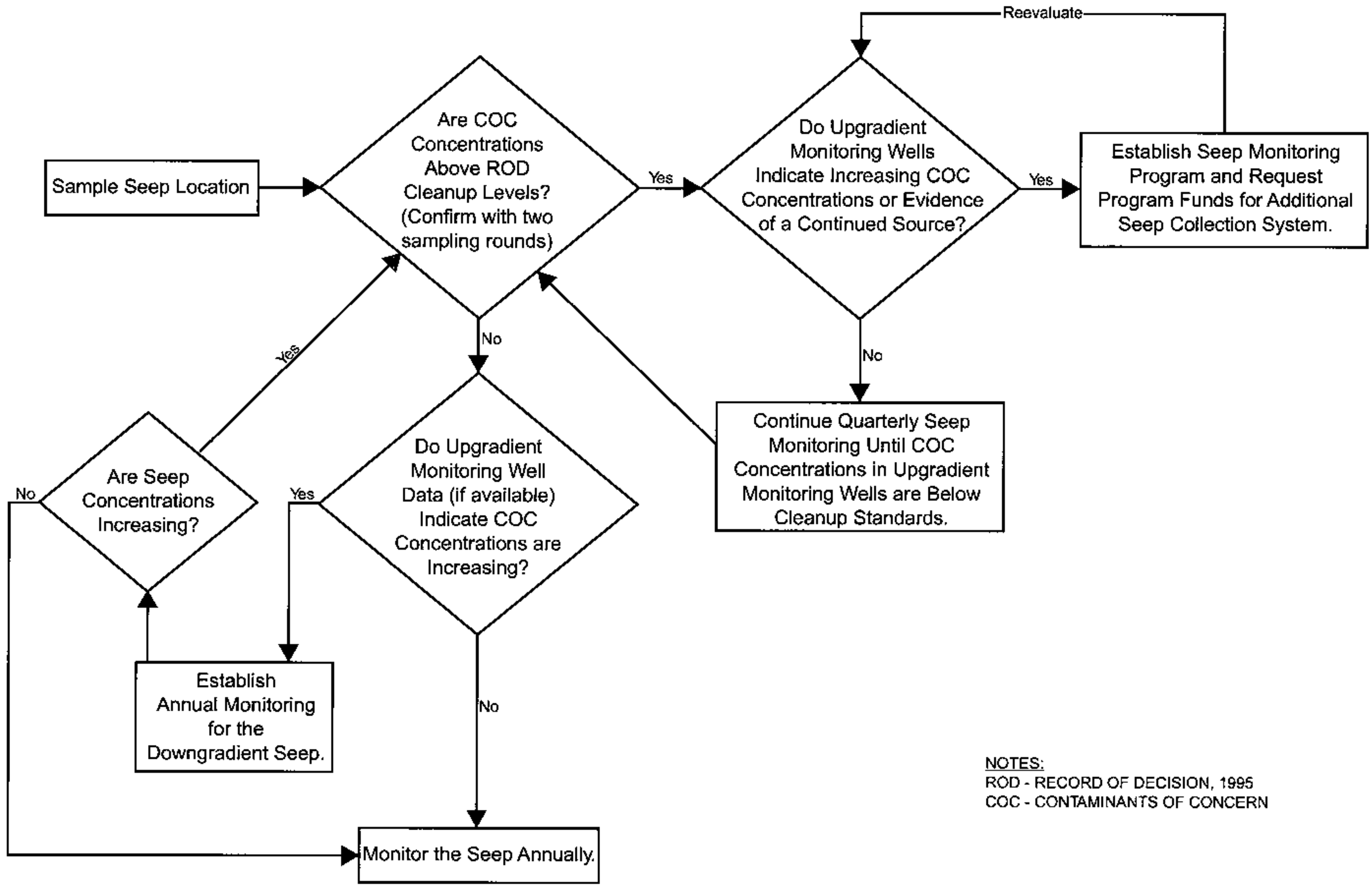
FIGURE F-4
Decision Guide for Restarting an Existing Seep Collection Area or Adding a New Seep Collection Area for Treatment at OU5



NOTES:
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